Comprehensive Stormwater Management Plan

Master Plan Update Improvements Seattle-Tacoma International Airport

Port of Seattle

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COMPREHENSIVE STORMWATER MANAGEMENT PLAN

FOR AGENCY REVIEW

SEATTLE-TACOMA INTERNATIONAL AIRPORT
MASTER PLAN UPDATE IMPROVEMENTS

Prepared for

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PREFACE

Comprehensive Stormwater Management Plan
Seattle-Tacoma International Airport
Master Plan Update Improvements

July 2001

This document contains replacement pages developed in response to comments received from the Washington State Department of Ecology (Ecology) on Volumes 1 through 4 of the December 2000 Comprehensive Stormwater Management Plan (SMP) for the Seattle-Tacoma International Airport Master Plan Update Improvements. A facilitated process was used to document specific revisions required by Ecology to the December 2000 SMP. Each SMP volume contains an itemized list of replacement pages, and the replacement pages are identified by a July 2001 footer.

SMP VOLUME 1
<u>JULY 2001 REPLACEMENT PAGES</u>

CERTIFICATE OF ENGINEER

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

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ACRONYMS

AKART	All known available and reasonable treatment
AMA	Aircraft Movement Area
AOA	Aircraft Operations Area
ARFF	Airport Rescue and Firefighting
ATCT	Air Traffic Control Tower
ASDE	Airport Surface Detection Equipment
ASR	Airport Surveillance Radar
BCT	Best Conventional Control Technology
BMPs	Best Management Practices
BOD	Biochemical Oxygen Demand
BPJ	Best Professional Judgement
cf	Cubic feet
cfs	Cubic feet per second
CIP	Capital Improvement Project
CMA	Calcium Magnesium Acetate
CMP	Corrugated metal pipe
CN	Curve number
CWA	Clean Water Act
DAF	Dissolved Air Flotation
DO	Dissolved Oxygen
DMRs	Discharge Monitoring Reports
DNR	Department of Natural Resources
Ecology	Washington State Department of Ecology
EDRPR	East Division Reclamation Plant at Renton
EIA	Effective impervious area
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ET	Evapotranspiration
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FSEIS	Final Supplemental Environmental Impact Statement
ft	Feet
GIS	Geographic Information System
HELP	Hydrologic Evaluation of Landfill Performance
HFAM	Hydrocomp Forecast and Analysis Model
hr	Hour
HSPF	Hydrologic Simulation Program – FORTRAN
IDF	Inflow design flow
in	Inches

ACRONYMS (Continued)

IWS	Industrial Wastewater System
IWTP	Industrial Wastewater Treatment Plant
KCRTS	King County Runoff Time Series
L	Liter
MCDF	Miller Creek Detention Facility
mg	Milligrams
mgd	Million gallons per day
mi	Miles
MPU	Master Plan Update
NAVAIDS	Navigational aids
NEAT	North End Air Terminal
NEPL	North Employees Parking Lot
NPDES	National Pollutant Discharge Elimination System
NWRC	U.S. Department of Agriculture National Wildlife Research Center
NWS	National Weather Service
PGIS	Pollution-generating impervious surfaces
PGPS	Pollution-generating pervious surfaces
Port	Port of Seattle
RDF	Regional Detention Facility
ROFA	Runway Object Free Area
RPE	Relative percent error
RPZ	Runway Protection Zone
RSA	Runway Safety Area
SASA	South Aviation Support Area
SBUH	Santa Barbara Urban Hydrograph
SCS	Soil Conservation Service
SDS	Storm Drain System
SMP	Preliminary Comprehensive Stormwater Management Plan
SPU	Seattle Public Utilities
STEP	South Terminal Expansion Project
STIA	Seattle-Tacoma International Airport
SWMD	Solid Waste Management Division
SWPPP	Stormwater Pollution Prevention Plan
TESC	Temporary Erosion and Sedimentation Control
TSS	Total suspended solids
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WDM	Watershed data management
WET	Whole Effluent Toxicity
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

The purpose of the Comprehensive Stormwater Management Plan (SMP) is to provide for the management of stormwater quantity and quality required as mitigation for the Master Plan Update (MPU) improvements for the Seattle-Tacoma International Airport (STIA). The plan identifies stormwater management standards that are administered through the Clean Water Act, Section 401 Water Quality Certification, and Section 402 National Pollutant Discharge Elimination System (NPDES) Permit.

In the interest of stormwater quantity management, the SMP includes recommendations that:

1. Identify new and existing stormwater detention facilities that will provide stormwater detention for proposed MPU projects and, in some cases, retrofit the airport to developed conditions existing prior to airport construction;
2. Identify locations for detention facilities that avoid aircraft movement areas;
3. Propose design guidelines that minimize waterfowl attraction to detention facilities; and
4. Propose a schedule for implementation of new stormwater facilities that is synchronized with projects contained in the MPU.

In addition to the new facilities that are proposed for stormwater management, policies are proposed in this plan that:

1. Provide stormwater detention facilities to retrofit existing drainage systems;
2. Improve flow regimes in the receiving waters, namely Miller and Des Moines Creeks;
3. Provide supplemental flow to the creeks during low stream flow;
4. Provide opportunities, where appropriate, to incorporate infiltration into detention project design; and
5. Provide administrative support to King County and local jurisdictions engaged in the basin planning process.

Stormwater quality recommendations in this plan include:

1. Using appropriate best management practices (BMPs) to meet or exceed stormwater quality treatment standards;
2. Retrofitting existing portions of the stormwater drainage system with BMPs;
3. Removing existing sources of stormwater pollutants from drainage areas where BMPs are not proposed; and
4. Implementing projects that enhance water quality such as wetland restoration, stream restoration, and enhancement of riparian buffer zones within the Miller and Des Moines Creek basins.

Ongoing compliance of the stormwater management system with state water quality standards is administered through the NPDES Permit and demonstrated by monitoring performed as part of the NPDES Permit.

The SMP was prepared by following a logical planning process that included:

1. Establishing the stormwater management goals, design standards, and design guidelines and constraints to guide stormwater planning activities;
2. Analyzing the existing hydrologic conditions, facilities, and stormwater quantity and quality conditions;
3. Reviewing the proposed STIA MPU improvements, particularly to identify their potential impacts upon stormwater management systems;
4. Evaluating future conditions in terms of flood flow and water quality impacts; and
5. Identifying new detention facility construction, BMPs, and stormwater quality treatment options, and evaluating the proposed stormwater management plan elements in terms of achieving standards and complying with regulations.

1. INTRODUCTION

1.1 PURPOSE

The Comprehensive Stormwater Management Plan (SMP) was prepared for the Port of Seattle (Port) to guide the development of stormwater facilities for projects associated with the Seattle-Tacoma International Airport (STIA) Master Plan Update (MPU). Technical analyses for this plan evaluated the feasibility of various stormwater management options, identified the potential issues associated with stormwater detention at the airport (such as waterfowl attraction), and recommended a comprehensive plan for managing stormwater for STIA as a whole, after integration of the MPU improvements.

The plan addresses construction for full build-out of the MPU program over the period from 1998 to around 2006 (and possibly later). These projects encompass several major revisions to the airport, including:

- New third runway and parallel taxiway;
- Expansion of the parking garage;
- New remote parking lots;
- New north terminal;
- Reconstruction of Concourse A (south terminal expansion project, or STEP);
- Development of the South Aviation Support Area (SASA);
- New air cargo facilities;
- New air traffic control tower; and
- Other minor projects.

Initial stormwater management planning for the MPU improvements was performed during the Final Supplemental Environmental Impact Statement (FSEIS) (Port of Seattle 1997). The FSEIS described the proposed MPU improvements and their potential impacts on streamflows in Miller[1] and Des Moines Creeks—the receiving waters for airport stormwater drainage—and the measures proposed to mitigate the impacts. This plan updates and refines those analyses by incorporating revised stormwater management standards for water quantity and quality into the mitigation analysis. A review draft of this plan was initially issued in June 1998. It was updated in November 1999 and August 2000 with additional analyses of revised flow control standards, water quality treatment, and updated MPU preliminary designs and schedules.[2] This current draft responds to written and oral review comments received from King County and other reviewers from November 1999 through November 2000.

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[1] Walker Creek is a tributary to Miller Creek. General discussions of Miller Creek include Walker Creek.

[2] Note: This Comprehensive Stormwater Management Plan contains the results of current hydrologic and hydraulic analyses of stormwater facilities for Master Plan Update improvements. Further refinement of this plan will occur as the Master Plan Update schedule is updated and final designs of MPU improvements and stormwater facilities are prepared.

1.2 GOALS AND OBJECTIVES

The overall goal of the SMP is to provide a design basis for all MPU improvements to meet or exceed applicable local and state stormwater regulatory requirements for stormwater management. The King County Surface Water Design Manual (the King County Manual; King County Department of Natural Resources 1998) and the Washington Department of Ecology's (Ecology) Stormwater Management Manual for the Puget Sound Basin (the Ecology Manual; Ecology 1992) provide the foundation for these requirements. Additional stormwater management activities were identified to protect Miller and Des Moines Creeks from increased stormwater runoff. To achieve these goals, the following specific objectives have been identified:

- Design the MPU improvements in accordance with applicable stormwater regulations and the conditions of approval for the MPU FSEIS (Port of Seattle 1997), and the Governor's Certification of Compliance with Applicable Air and Water Quality Standards (the Governor's Certification; Locke 1997);
- Meet Level 2 stormwater discharge criteria (as described in the King County Manual) for all airport runoff, as measured downstream of proposed or existing detention facilities, to mitigate impacts of stormwater discharge;
- Enhance stream low flows by ceasing the exercise of existing surface water rights (obtained by the Port through property acquisitions) on Miller Creek, supporting and participating in the Des Moines Creek Basin Committee's flow augmentation project on Des Moines Creek, incorporating infiltration into stormwater detention facilities where feasible, and if necessary, supplementing low flow with stored stormwater;
- Mitigate the potential impacts of stormwater discharge on water quality in Miller and Des Moines Creeks, thereby maintaining or improving the beneficial uses of the surface waters in the Miller Creek and Des Moines Creek drainage basins; and
- Reduce potential waterfowl attraction to stormwater facilities through appropriate design.

In addition to providing stormwater management for all new MPU improvements, the Port is actively working with King County and local jurisdictions to implement the recommendations of the Des Moines Creek Basin Plan (Des Moines Creek Basin Committee 1997), and is supporting a similar planning process for the Miller Creek basin. The Port is committed to supporting the recommendations of these studies to (1) improve the management of stormwater runoff in Miller and Des Moines Creeks, (2) help implement those recommendations that are found to be feasible, and (3) explore opportunities to increase the performance of existing facilities, if the proposed enhancement does not create a safety hazard to air traffic.

1.3 DOCUMENT ORGANIZATION

The SMP is organized into eight sections. Section 2 describes the stormwater management standards for water quantity and quality. Airport-specific stormwater design guidelines and hydrologic analysis methodology are discussed in Section 3. Section 4 provides information on the existing conditions at STIA, including drainage basins, conveyance systems, stormwater detention facilities, water quality, best management practices (BMPs), and hydrologic modeling of the existing conditions. Proposed MPU improvements are summarized in Section 5, which also includes information on 1994 and future (2006) land use. Section 6 describes hydrologic modeling of future conditions, and the associated stormwater quantity management options. Future stormwater quality is discussed in Section 7, which provides information on measures to mitigate potential water quality impacts associated with the proposed MPU improvements, including source control and treatment BMPs and receiving stream enhancement projects. References are listed in Section 8.

Twenty-six appendices containing technical support data are included with this document under separate cover (Volumes 2 through 4). Appendix A (Volume 2) contains data on hydrologic modeling for individual MPU improvements. Calibration of the hydrologic model is summarized in Appendix B (Volume 3). Appendices C through Z are contained in Volume 4. Existing detention facility data and proposed detention facility drawings are provided in Appendices C and D. BMP sizing estimations per unit area and water quality treatment BMP sizing calculations are included in Appendices E and H. Appendix F discusses the feasibility of stormwater infiltration and Appendix G discusses the benefits of acquiring water rights on Miller Creek. Appendices I through Z include the Landscape Management Plan, flooding analysis, water quality BMP cost estimates, industrial wastewater system monthly discharge monitoring reports, downstream analyses for Miller , Walker, and Des Moines Creeks, proposed stormwater conveyance drawings and information, construction erosion control information, Spill Prevention Plan, energy dissipation design, NEPL soil information, stormwater analysis of the ASR Site, and IWS lagoon storage capacity modeling results.

2. STORMWATER MANAGEMENT STANDARDS

The Port has established stormwater management procedures for MPU improvements to ensure that regulatory requirements for stormwater control and treatment are met, and that potential downstream impacts from the improvements are mitigated in accordance with the approved FSEIS for the MPU (Port of Seattle 1997), the Governor's Certification (Locke 1997), and the Clean Water Act.

2.1 WATER QUANTITY MANAGEMENT STANDARDS

The flow control standards adopted by the Port are in the King County and Ecology Manuals, which do not have identical requirements. The Port's objective is to integrate these requirements to reduce the impacts from peak stormwater runoff on Miller and Des Moines Creeks. First, however, the base year and the target watershed flow regimes needed to be determined since they define the pre-developed conditions and establish the goal for the flow control standards. Subsequently, the flow control standards were evaluated to achieve the goal.

2.1.1 <u>Definition of Level 1 and Level 2 Flow Control Standards</u>

Stormwater standards for the City of SeaTac and other local jurisdictions are based on the King County Manual. Level 1 and Level 2 flow control standards defined in the King County Manual are provided below:

- The **Level 1** flow control standard calls for detaining the post-developed 2- and 10-year peak flow rates to existing conditions.
- The **Level 2** flow control standard requires the flow duration of post-developed runoff to match the pre-developed flow duration for all flow magnitudes between 50 percent of the 2-year flow event and the 50-year flow event.

The flow control standard defined in the Ecology Manual is provided below.

- The Ecology standards call for detaining the 10- and 100-year post-developed peak flows and the 2-year post development peak flow to 50 percent of its existing rates.[3]

The King County Manual's basic requirement for stormwater detention is the Level 1 standard, which is intended to achieve the basic goals for stormwater management in urban areas. However, the Level 1 standard may not prevent increased streambed and bank erosion or increased flooding.

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[3] The intent of the 50 percent flow reduction is to account for the inadequacy of hydrologic modeling using event models, and failure to account for peak flow duration. The Level 2 standard is generally more restrictive than the Ecology standard. In fact, Ecology proposes adopting the Level 2 standard to replace the existing standard (Ecology 2000b).

In response to these differences, the Port has combined the standards of the two manuals to create an "Enhanced Level 1:"[4] flow control standard:

- Enhanced Level 1 standard requires detaining the 2-, 10-, and 100-year post-developed peak flows to their pre-developed magnitudes.

Proposed regional detention facilities would provide the storage needed to control streamflows to meet the Level 2 flow control goal, as discussed below.

2.1.2 Base Year

A common element of the different flow control standards is the need to define the existing (pre-developed) conditions. The selection of a base year defines the degree of basin development (i.e., impervious area and land cover) against which future development conditions will be compared. As described below, current regulations specify different base year conditions. However, STIA implementation of this SMP will involve retrofitting all of the STIA basins to pre-developed conditions (as described in Section 2.1.3), which is more restrictive (less developed) than the proposed base years. Therefore, the base year comparison is used only to determine the degree of development that existed prior to application of the retrofitting standard.

Several base year alternatives were considered for defining the existing condition for the MPU:

- 1974 was used as the base year for the *1997 Seattle-Tacoma International Airport Storm Drainage System Comprehensive Plan* (HDR 1997). This base year was required by Ecology in the August 1995 amendment to the Port's National Pollutant Discharge Elimination System (NPDES) permit since 1974 was the first full year in which flow controls were in effect in compliance with the Kludt (1972) stipulated agreement.

- The King County Manual requires the base year to be either (1) the year since 1979 in which a project was permitted and constructed in compliance with the Manual, or (2) the year 1979, when King County first required flow controls (King County 1998). With the exception of NEPL (see below), no significant drainage plans were implemented by the Port between 1979 and the present; therefore, 1979 is generally the base year required by the King County Manual.

- 1994 was used as the base year for the MPU EIS, with the assumption that all changes made to airport land use since 1994 were the result of MPU activities or NPDES requirements.

1994 conditions were used to define existing conditions for purposes of retrofitting the airport, with the exception of NEPL.[5]

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[4] "Enhanced" refers to the addition of the 100-year peak for MPU improvements.

[5] NEPL was permitted in 1997 and constructed in 1997-1998, in compliance with the 1992 King County Manual. Therefore, NEPL's existing site conditions are those created by the site improvements and drainage facilities constructed per the approved permits and engineering plans. If applicable, the retrofitting standard applied to NEPL assumes that the existing constructed parking lot will be retrofitted.

2.1.3 Target Watershed Flow Regime

To reduce stormwater peak flows and flow volume impacts from existing airport areas, the Port has committed to adopting a flow control goal for streamflows in Miller, Walker, and Des Moines Creeks that will protect the creeks from frequent, high velocity flows. The flow control goal, or target flow regime, was determined based on flow duration analyses.[6] Development of the target flow regime is described below.

Streamflow is expressed as a flow duration curve, which is calculated from a continuous streamflow time series (or hydrograph). The flow duration curve shows the amount of time that streamflow is exceeded at different flow magnitudes. Greater imperviousness in a watershed typically increases the duration and magnitude of high flows in a stream if these impacts have not been mitigated through detention.

The Miller and Des Moines Creek watersheds have been altered by human activities such as farming and logging for more than 100 years (Des Moines Creek Basin Committee 1997). Urbanization over the last 50 years (since the airport has been in existence) has resulted in total impervious surface area within the watersheds of about 24 percent in Miller Creek and 30 percent in Des Moines Creek.

While it was recognized that the level of imperviousness in Miller and Des Moines Creek watersheds has resulted in considerable degradation of the natural stream ecosystem, to a certain degree the stream morphology has stabilized and adapted to the more recent flow regimes. By re-introducing streams to pre-developed (i.e., forested) flow regimes that existed prior to development, unstable channel conditions may again result, and the stream could require years to adapt to this change. For example, a large reduction in peak flow magnitudes and sediment transport capability could cause increased sedimentation in a channel.

In watersheds experiencing low levels of urban development, it has been shown that streams can handle a certain amount of urbanization before signs of stream degradation are observed. The relationship between watershed imperviousness and resulting stream channel changes has been discussed in several comprehensive reviews (e.g., Scheuler 1994; Booth and Jackson 1997). Research models and data developed in the Pacific Northwest suggest that a threshold for urban stream stability exists at about 10 percent imperviousness (expressed as effective impervious area). Impervious area above this level results in unstable and eroding stream channels. Booth and Jackson (1997) measured habitat quality variables such as pool and riffle sequence, overhead cover, and wetted perimeter. They found decreases in these indices at 10 to 15 percent imperviousness. Therefore, 10 percent imperviousness was identified as a threshold for degraded channel conditions.

There is currently no policy by local jurisdictions to retrofit the Miller and Des Moines Creek watersheds through the site development permitting process. During the Des Moines Creek watershed basin planning process, the Des Moines Creek Basin Committee chose to rely on regional detention facilities to mitigate existing impacts for development constructed prior to adoption of stormwater detention standards (first enacted by King County in 1979 and then upgraded in 1990

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[6] A flow duration analysis depicts the percent of time that a range of flows are exceeded over the hydrologic period of record.

and 1998). In the Miller Creek basin, the MCDF was constructed in 1992 by King County to reduce downstream flooding and reduce the impacts of future development.

Therefore, for the purposes of establishing a target flow regime, a uniform watershed[7] land cover of 10 percent impervious was assumed, with 15 percent pervious grass and 75 percent pervious forest.[8,9] Basing target flows on theoretical basin development of 10 percent is expected to reduce existing peak flows and durations and be beneficial in maintaining stable stream channels (Ecology 2000a).

The above assumptions and goals are compatible with the goals of the Des Moines Creek Basin Committee for stabilizing the Des Moines Creek channel. The Draft Preliminary Design Report for the Des Moines Creek Regional Detention Facility (RDF) notes that the critical erosive flow rate under current conditions is higher than would exist under forested conditions (King County CIP Design Team 1999). With the proposed reduction in assumed impervious area, the resulting assumed pre-development flow duration curve will be lower than the actual existing conditions flow duration curve.

2.1.4 <u>Updated Detention Requirements</u>

During Section 401 Water Quality Certification discussions with Ecology in 1998, additional mitigation to reduce stormwater discharge rates was identified. To provide additional protection to Miller, Walker, and Des Moines Creeks, the following standards were added to the mitigation requirements for MPU improvements:

- In the Miller and Walker Creek basins (draining airport areas), the stormwater detention facilities will be designed to Level 2 (using a theoretical basin development of 10 percent impervious area as described above). For sub-watersheds draining to the Miller Creek Detention Facility (MCDF), additional future analysis by the Port or the Miller Creek Basin Committee may show that the target flow and Level 2 standards can be met at the outlet of the MCDF (with or without expansion or modification of the facility). Stormwater detention facilities shown by the Port may be modified, with approval by Ecology, to reflect using available detention in the MCDF and a new point of compliance. In either case, the objective to meet the target flow using the Level 2 standard in Miller Creek will be met.
- The Level 2 detention storage will be provided in on-site stormwater detention vaults in the Des Moines Creek basin (using a theoretical basin development of 10 percent impervious area). However, if the proposed Des Moines Creek RDF is constructed, the detention standard will be Enhanced Level 1, and 1994 land cover will be used.

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[7] For application of this standard a "watershed" means the area that drains to a detention pond and/or has a unique point of compliance.

[8] This target flow regime of 10 percent impervious area, 15 percent grass, and 75 percent forest is more restrictive than the flow regime used in the November 1999 SMP. The previous retrofitting target flow also assumed 10 percent impervious area, but existing impervious was converted to grass, and the remaining pervious area was unchanged.

[9] In watersheds when existing imperious area is less than 10 percent, the impervious area is not changed and the difference between actual percent impervious and 10 percent is assumed to be grass.

- 100-year peak flows will be matched to address potential downstream flooding.

The point of compliance for Level 2 analysis is the downstream future subbasin outlet (see Appendix A – Figure A-7 for node locations).[10]

2.2 WATER QUALITY MANAGEMENT STANDARDS

This section describes the regulatory and treatment standards required to retrofit existing developed areas and to provide water quality BMP guidance for MPU projects.

2.2.1 Regulatory Requirements

Water quality is regulated by the Federal Water Pollution Control Act (33 USC § 1251, et seq.), also known as the Clean Water Act, and the Washington Water Pollution Control Act (RCW 90.48).

The Clean Water Act was designed to protect the "chemical, physical, and biological integrity of the Nation's waters (U.S. Environmental Protection Agency [EPA] 1993)."

The portions of the Clean Water Act relevant to this project are implemented through Section 401 (water quality certification), Section 402 (NPDES) and Section 404 (addressing fill in waters of the United States). Issuance of a 401 Certification for the MPU improvement considers standards that are required at one point in time, whereas the NPDES Permit under Section 402 considers compliance with standards over time.

The Port's ongoing compliance with the Clean Water Act and, in turn, protection of STIA's receiving waters, are demonstrated through compliance with its Section 402 (NPDES) Permit, administered in Washington by Ecology (Ecology 1998). As stated in the associated Fact Sheet for the Permit, "compliance with the effluent limitations and other conditions in this permit constitutes compliance with the Federal Water Pollution Control Act... and the Washington Water Pollution Control Act (RCW 90.48)."

NPDES Permit Compliance is continually executed via an adaptive management process by which (1) BMPs are implemented, (2) monitoring and inspections demonstrate BMP effectiveness, (3) BMP improvements are made when necessary, and (4) follow-up sampling demonstrates that the improvements are effective. Ecology reviews and approves this process annually to ensure that the Port's discharges are in compliance with the Clean Water Act, and that the discharge conditions are protective of the receiving waters. Numerous BMP improvements have been implemented through this process and follow-up monitoring has confirmed their efficacy.

Specifically, the NPDES Permit requires the following measures for stormwater:

- A stormwater pollution prevention plan (SWPPP) that identifies and implements source control and treatment BMPs;

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[10] The downstream future subbasin outlet for the relocated 154th Street is the MCDF.

- Routine water quality and toxicity monitoring for STIA stormwater outfalls and IWS discharge, and reporting of these results to Ecology; and
- Evaluation of pollution sources and BMP effectiveness via self-inspection and monitoring results, to identify when and where additional BMPs are necessary to accomplish the SWPPP objectives.

Water quality BMP retrofitting would be performed over a number of years as needed. Where possible, retrofitting would be coordinated and scheduled to occur in conjunction with redevelopment actions in specific parts of STIA. As an ongoing action, an overall water quality BMP retrofitting implementation schedule would be most appropriately addressed by the Port's Section 402 Permit.

2.2.2 Water Quality Treatment Requirements for New, Redeveloped, and Retrofitted Surfaces

The Ecology Manual requires that water quality BMPs, to the maximum extent practicable, be implemented for the entire site (i.e., new and redeveloped surfaces, water quality treatment, and retrofitting for existing surfaces not otherwise to be redeveloped). The King County Manual requires that water quality treatment facilities be provided for all runoff from new and redeveloped or retrofitted Pollution-Generating Impervious Surface (PGIS) and Pollution-Generating Pervious Surface (PGPS); the King County Manual does not require water quality treatment for existing surfaces not to be redeveloped.

The standards for water quality treatment are described in the King County Manual (King County Department of Natural Resources [DNR] 1998) and the Ecology Manual (Ecology 1992). If these basins were in unincorporated King County, the King County Manual would require the Basic Water Quality Menu for all new development in the Miller and Walker Creek basins and redevelopment areas in the Miller and Des Moines Creek basins.

On-going water quality monitoring may indicate the need for future additional water quality BMPs. Technology in the field is continually improving the effectiveness and application of new water treatment systems. While the airport has unique operation requirements (i.e., wildlife control), the proposed drainage design would allow the application of future stormwater treatment technology to the proposed drainage system.

Water quality treatment BMPs are briefly described below.

2.2.2.1 Pollution-Generating Surfaces

The King County Manual requires stormwater treatment BMPs for land areas classified as PGIS and PGPS.

The King County Manual defines PGIS as follows:

> *Pollution-Generating Impervious Surface (PGIS): Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to vehicular use or storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the*

run-on or blow-in of rainfall. Metal roofs are also considered to be PGIS unless they are treated to prevent leaching.

The King County Manual defines PGPS as follows:

Any non-impervious surface with vegetative ground cover subject to use of pesticides and fertilizers. Such surfaces include, but are not limited to, the lawn and landscaped areas of residential or commercial sites, golf courses, parks and sports fields.

Infrequently used maintenance roads (such as those in the runway infields), sidewalks, non-metallic and coated metallic roof tops are not considered PGIS. Water quality treatment BMPs are not required and would not necessarily be provided for these impervious areas. However, per the King County Manual, where non-PGIS and PGPS runoff cannot be separated, BMPs will be sized for the total flow.

2.2.2.2 Best Management Practices

Water quality for the MPU improvements will be managed through use of treatment BMPs. The King County and the Ecology Manuals provide standards for application of BMPs to different land areas and their design. BMPs are briefly described below.

New development and redevelopment projects will use any one of the following BMPs from the Basic Water Quality Menu in the King County Manual:

- Filter strip;
- Bioswale;
- Wetpond;
- Wetvault;
- Stormwater wetland;
- Combined detention and wetpool facility; or
- Sand filter.

Stormwater wetlands and wetpool facility BMPs are not further evaluated below because they are inconsistent with the STIA waterfowl attraction guidelines. Additional BMPs, such as oil control, are used for high use areas (e.g., entry drives).

As described in Section 4.5.1, many of the facilities at STIA have BMPs in place that meet the required standards. For new development and redevelopment, BMPs will be added and/or retrofitted as described in Section 7.1 to ensure compliance with all applicable standards.

<u>Filter Strips</u>

The primary water quality BMP for impervious surfaces such as runways and taxiways would be filter strips. Runoff from these surfaces sheet flows over broad, shallow-sloped grassy areas. Flow velocity is slowed by grass, thereby enhancing the settling of particulates. Vegetation also mechanically traps particles. Some water infiltrates into the ground as it flows over the vegetated area, further filtering out particles. Removal of metals and organic compounds is also significant, as these pollutants typically bind to trapped particles and/or the organic material in the soil and vegetation.

Bioswales

Bioswales are grassy, flat-bottomed swales that receive runoff after it is collected and concentrated (in most cases, runoff passes through a detention facility before entering a bioswale). Although flow depth and flow path length are typically greater than for filter strips, the pollutant-removal mechanisms are the same. Where space permits, bioswales are generally the preferred treatment BMP for runoff that has already been concentrated in a collection system.

Wetvaults

Wetvaults provide a permanent pool (dead storage) to settle particulates. Metals and organic compounds that sorb to particulates are removed to some extent as well. Wetvaults are designed to enhance settling by using "plug flow," whereby inflowing stormwater displaces the treated water already in the vault as a unit. Vaults would be used in place of wetponds because the creation of additional open water within 10,000 ft of an active runway must be designed to minimize wildlife attraction (Federal Aviation Administration [FAA] 1997). Wetvaults are generally used to treat stormwater when space limitations do not allow for bioswales.

Oil Control

Per the King County Manual, sites with potential petroleum sources, such as high-vehicle-use sites or storage/transfer areas, must provide oil control in addition to other water quality BMPs. The upper and lower Terminal Drives have been identified as high vehicle use sites. In addition, the ramp areas near the terminals are aircraft fueling areas. Oil controls will be installed for the drives by retrofitting with appropriate treatment BMPs or diversion to the IWS. The ramp area drains to the IWS, which is a petroleum spill control BMP. The Port has a spill control plan for SDS areas, which is included in Appendix V. Additional spill control measures are included in the STIA SWPPP. The Port will continue to evaluate its spill control plan per its NPDES permit.

3. DESIGN CONSIDERATIONS AND HYDROLOGIC ANALYSIS METHODOLOGY

3.1 AIRPORT-SPECIFIC DESIGN GUIDELINES

Due to the unique nature of airport activities, stormwater facilities must be designed to be compatible with aircraft operations and not pose an unacceptable risk to air traffic safety. The facilities must also be designed to accommodate the hydrologic divide between two watersheds, which must be preserved (Locke 1997).

3.1.1 Overall Guidelines

The following summarizes the overall design guidelines and constraints that guide the development of stormwater facilities at STIA:

- The Port's stormwater management standards, described in Sections 2.1 and 2.2, shall be used in the design of all new stormwater facilities;
- The hydrologic divide separating Miller, Walker, and Des Moines Creeks shall maintain the same basin areas;
- Open stormwater detention ponds shall be designed to minimize the attractants of wildlife that pose a hazard to aircraft;
- Locations of potential stormwater management facilities shall avoid areas slated for MPU development or other future commercial development;
- Site geotechnical conditions must be favorable; and
- Consideration should be given to minimize potential impacts and permitting issues associated with stormwater facility construction within sensitive areas (e.g., wetlands).

3.1.2 Wildlife Proximity to Open Detention Ponds

The Port and FAA are very concerned about attracting wildlife at stormwater detention facilities. As is the case in most large airports, STIA contains large open tracts of unimproved land that are required for safety and noise mitigation. These areas, and in particular areas of open water and wetlands, can present potential hazards to air traffic because water bodies often attract wildlife. During the past century, wildlife-aircraft strikes have resulted in the loss of hundreds of lives worldwide and caused billions of dollars worth of aircraft damage (FAA 1997).

Although this issue at stormwater management facilities can be effectively avoided by constructing underground stormwater vaults, constructing facilities underground results in higher cost for stormwater detention. Other factors that weigh into whether open ponds or underground facilities are selected include land availability to site the facility, proximity of that land to flight lines, competing uses for the land, long-term maintenance, and confined space entry requirements.

3.1.2.1 FAA Guidance

FAA Advisory Circular 150/5200-33 (FAA 1997) describes FAA policy regarding wildlife attraction near airports. The circular states that any activity or land use on or near an airport that threatens aircraft safety by attracting or sustaining hazardous wildlife is an incompatible land use. Examples of wildlife species that pose a threat to aircraft safety include waterfowl, flocking birds (starlings, blackbirds, and pigeons), raptors (owls and hawks), and other common passerine birds (sparrows).

Land uses identified by FAA as being incompatible with safe airport operations include wastewater treatment facilities, wetlands, and landfills containing organic wastes. The advisory circular (FAA 1997) states that when siting land uses such as wetland mitigation projects, these projects can be no closer than 10,000 ft from turbine aircraft movement areas and 5 miles from approach or departure airspace if the wildlife attraction may cause hazardous wildlife movement into or across these zones.

FAA identifies stormwater detention and retention ponds as compatible land uses at or near an airport. FAA recognizes that stormwater runoff is a normal function at most airports and runoff control is necessary for safe aircraft operation. Detention and retention ponds provide benefits of controlling runoff and protecting water quality, but they can attract hazardous wildlife. The FAA and the Port are mandated to adhere to established guidelines that prevent creation of hazardous wildlife attractants on or near STIA.

3.1.2.2 Research into Wildlife Attraction to Stormwater Ponds

Several U.S. and Canadian agencies involved in wildlife management at airports were contacted to determine how the FAA policy is interpreted, whether more specific standards for wildlife control at stormwater ponds have been developed, and if research has been conducted that supports these policies. Current practices at STIA were also reviewed. Agencies and personnel contacted include:

- U.S. Department of Agriculture (USDA) Wildlife Services, Olympia (Mike Linnel);
- USDA National Wildlife Research Center (NWRC), Landusky, Ohio (Richard Doldeer);
- FAA Office of Airport Safety and Standards (Ed Cleary, Wildlife Specialist);
- Transport Canada Wildlife Control Manual (Transport Canada 1994); and
- STIA Wildlife Manager (Dennis Bulman).

These individuals and agencies recognized the risk due to attracting wildlife at open stormwater detention ponds, and agreed that measures should be implemented to minimize the occurrence of waterfowl at these locations. However, since conditions vary widely throughout the country (i.e., geographic, climate, wildlife of concern, etc.), no agency has proposed a universal quantitative standard that identifies how much open water is acceptable in terms of duration and frequency of occurrence. A literature search could not locate any research on attractants of wildlife to detention ponds, and persons contacted could not identify any. The STIA Wildlife Hazard Management Plan (Port of Seattle 2000a) and subsequent updates are expected to provide further guidance.

3.1.2.3 Maximum Duration of Open Water at Detention Ponds

Wildlife managers agree that stormwater management practices are necessary and mandated at airports, and identify permanent open water as the primary concern. Retention ponds having permanent water are considered to have moderate to high hazard to aircraft operations and are universally regarded as unacceptable. Temporary open-water surfaces are not as large an issue as permanent ponds, except under continuous runoff events that create extended periods of open water. The following comments were offered by the persons contacted:

- USDA Wildlife Services: The primary concern is with continuous storm events producing extended duration of water surface (a maximum acceptable duration was not specified);
- NWRC: Temporary open-water surfaces of 1 week or less should not be a problem;
- FAA: As a general guidance, the pond should be dry after 24 to 48 hours after end of storm event, but this can be enhanced for local conditions and concerns;
- Transport Canada: No suggestions on detention ponds (other than habitat modification) were offered except that under extreme problem areas (gulls and waterfowl causing major problems), physical barriers should be in place; and
- STIA: A maximum continuous open-water surface of 24 to 48 hours was considered acceptable.

These statements suggest that stormwater detention ponds that occasionally hold water for periods of up to several days may not present a wildlife attractant hazard. Also, many recognize that natural flooding of nearby streams, open ditches, and other areas would occur during storm events. Under such conditions, open water would be widespread throughout the region, making it difficult to justify a requirement for covering open detention ponds for extreme rainfall conditions.

Based on the information summarized above, it was concluded that the duration of open water in stormwater detention ponds should be minimized in all runoff events up to and including the 2-year design storm. The 2-year storm event is typically identified as the flooding event when significant overbank flooding starts to occur; therefore, control of open water in stormwater facilities should not be required during events exceeding the 2-year storm. Following FAA guidance, a conservative standard for the maximum duration of open water during the 2-year event is 24 hours. This duration is measured starting at the end of the precipitation event.[11] For the purposes of this analysis, the duration of open water is calculated as the time it takes for the pond to drain, starting at the maximum storage of the 2-year design storm event.

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[11] It is assumed that, during a design storm event, there would be numerous and widespread open water attractants until the precipitation event ends.

3.1.2.4 Detention Pond Design Requirements

Based on the above review, the following are design guidelines and considerations for new stormwater management facilities sited at or near STIA (within 10,000 ft of active runways), recommended by FAA Advisory Circular 150/5200-33 (FAA 1997). These measures are intended to minimize hazards associated with wildlife attractants to stormwater detention ponds.

- Cover or net all permanent open-water surfaces;
- To minimize the frequency and duration of open water to acceptable levels, water that is detained by the 2-year design storm should completely drain (or fall to a level that is covered by a net or solid cover) within 24 hours after the end of the storm event. That is, the pond should drain from the 2-year design storm depth to the bottom or covered depth in 24 hours or less;
- Use steep side slopes and deep pond depths to minimize shallow water areas and minimize the total water surface area;
- Slope the pond bottom to allow quick drainage and reduce the potential for standing water;
- Eliminate the potential for wetland vegetation growth on the pond bottom and side slopes by lining the pond with riprap or quarry spalls. Alternatively, use vegetation that provides no food or habitat for wildlife. For example, closely mowed grass, which is preferred by waterfowl, should be avoided;
- Break up possible avian flight lines by planting trees, setting up poles and/or fences which do not allow most waterfowl clear landing or takeoff room on the pond surface; and
- Designs of open stormwater facilities should be reviewed and approved by USDA Wildlife Services and the STIA Wildlife Manager to ensure that these objectives are met.

3.1.2.5 Maintenance

The maintenance and performance of the as-built pond should be closely monitored after construction. The maintenance program should control growth of unwanted vegetation. The performance of the facility, in terms of the type and frequency of occurrence of wildlife at the facility, should also be monitored. If performance does not meet expectations, it may be necessary to retrofit the facility with nets, wire grids, or similar deterrents. These activities should be integrated into an active airport bird avoidance program.

3.1.3 <u>Proximity to Aircraft Movement Areas</u>

FAA (1989) Advisory Circular 150/5300-13, *Airport Design*, identifies three zones that impact the siting of detention facilities:

- Runway Safety Area (RSA)–A defined surface surrounding the runway prepared or suitable for reducing the risk to airplane passengers if a plane leaves the runway;

- Runway Object Free Area (ROFA)–An area on the ground, centered on the runway, taxiway, or taxi lane centerline, that is provided to enhance the safety of aircraft operation by remaining free of objects, except for objects that need to be located in the ROFA for air navigation or aircraft ground maneuvering purposes; and
- Runway Protection Zone (RPZ)–A safeguarded area off the runway end created to enhance the protection of people and property on the ground.

The delineation of these zones under the future condition with the third runway is illustrated in Figure 3-1.

Stormwater detention facilities must be located outside runway and taxiway safety areas. The RSA extends a minimum of 250 ft from runway centerlines and 1,000 ft beyond the end of the runway. A similar zone for taxiways extends 117 ft from taxiway centerlines.

While the restrictions for the ROFA refer to aboveground objects, it is recommended that stormwater detention facilities not be located in this zone unless no other location is hydraulically feasible. The ROFA extends a minimum of 400 ft from runway centerlines and 1,000 ft beyond the end of the runway.

Objects may be located within the RPZ if they do not attract wildlife and are outside the ROFA. If detention facilities must be located in the RPZ due to hydraulic limitations, they should either be constructed underground or incorporate special design features to prevent the attraction of wildlife.

3.1.4 Feasibility of Creating Artificial Aquifer Storage in New Embankments

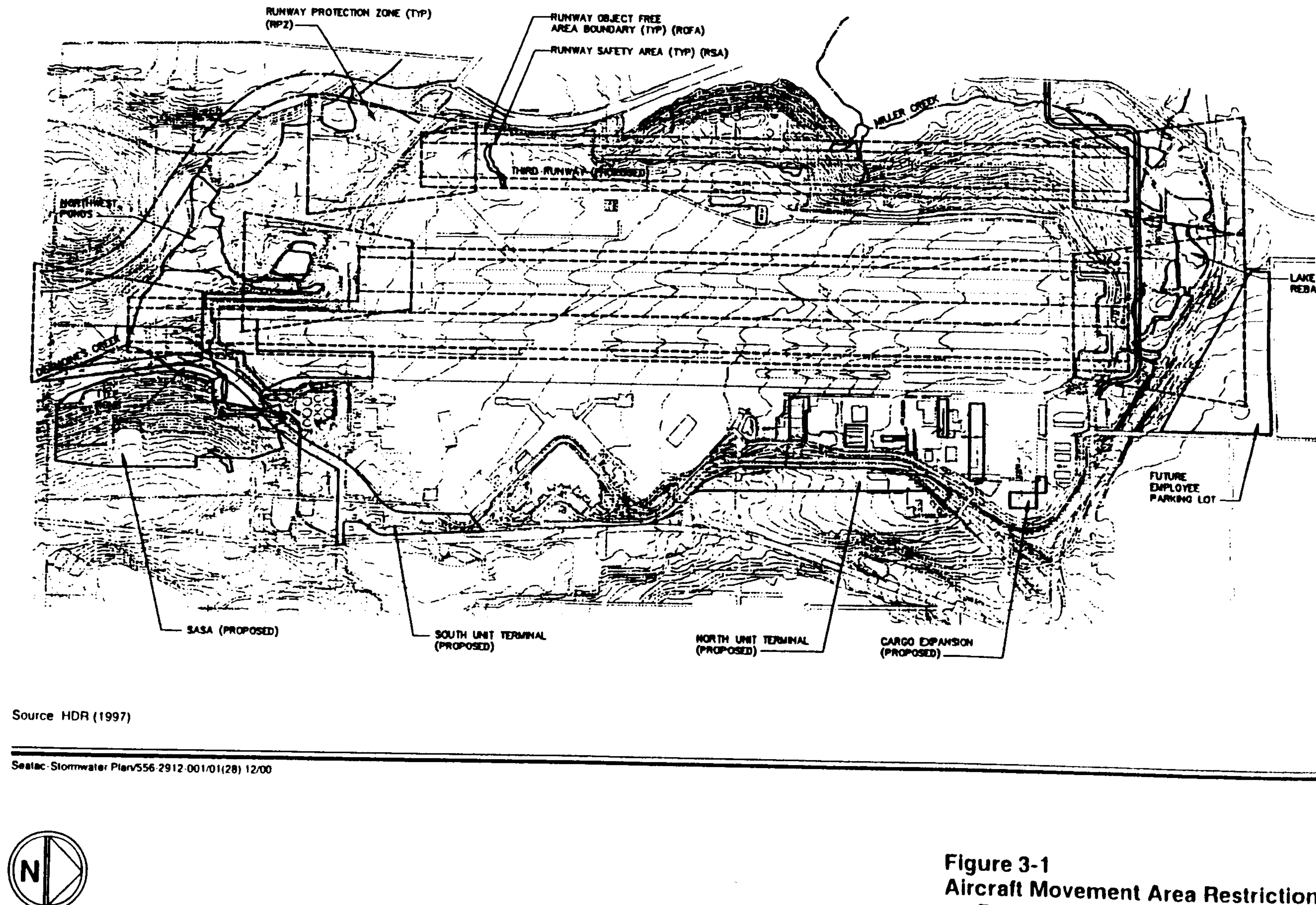
One of the conditions identified in the Governor's Certificate that provided state approval to the EIS is the possible use of a man-made aquifer within the new third runway embankment to detain runoff and enhance groundwater recharge (Locke 1997). In response, an engineering review was conducted to evaluate the potential of constructing such an aquifer (HNTB 1998) (Appendix K).

HNTB's review identified the following key issues regarding a constructed aquifer in the embankment:

- Overall embankment stability and long-term settlement parameters for the runway shall be primary factors for analysis and design;
- Long-term maintenance and reliability of the drainage system are critical to ensure viability of both the runway embankment and the constructed aquifer system; and
- Constructability, increased long-term performance risks, and project cost must also be evaluated.

While the concept of creating an aquifer within the embankment may be within the realm of theoretical feasibility, the specific application to a runway embankment introduces potential significant risks to the project. The primary risks identified by HNTB include:

- An aquifer located within an embankment would introduce water into potential failure planes within the embankment, reducing the factor of safety for the embankment;
- The added weight of a fully charged aquifer would substantially impact the seismic stability of the embankment, requiring additional buttress features or slope stabilization;



Source HDR (1997)

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Figure 3-1
Aircraft Movement Area Restrictions on Detention Pond Siting

- Water introduced into the aquifer and subsequently released for discharge may affect the fines content of the engineered fill material, potentially causing clogging of the aquifer system, transport of fines to surface discharge points, piping within the fill, and long-term settlement;
- The ability to maintain the embankment aquifer would be very limited because it is located deep within the embankment fill; and
- Constructing an aquifer would require extensive processing of aggregate materials to obtain the necessary performance characteristics to process and discharge water.

Several examples of water-induced slope failures have occurred recently, including one airport embankment project in Telluride, Colorado that resulted in airport closure for one year. The slope failure was primarily attributed to stormwater build-up within the embankment. HNTB has discussed the aquifer concept with FAA and several geotechnical engineers to determine whether any man-made aquifer embankments are in existence at major airports. No such projects have been identified.

After considering the issues, risks, and lack of practical application data, it was concluded by the Port that enhanced infiltration into the runway embankment is not a viable option for this project.

Conventional embankment design and construction techniques will, however, provide benefits to stormwater management without a constructed aquifer. These benefits include rainfall infiltration through the soil to the groundwater, which would reduce peak runoff discharge, promote groundwater recharge, and enhance baseflows in Miller Creek (Appendix L). Additional detailed analysis of the hydrology and hydrogeology of the embankment are included in the report *Low Streamflow Analyses for the Seattle-Tacoma International Airport Master Plan Update* (Earth Tech 2000).

3.2 DAM SAFETY

Washington Administrative Code (WAC) from *Washington State Department of Ecology, Water Resources Program, Dam Safety Section* (DSS) manual Part II, Chapter 173-175, "Dam Safety Regulations," was reviewed for the applicability of dam safety regulations. Two threshold criteria are defined in this manual:

> "The Dam Safety Regulations (Chapter 173-175 WAC) are applicable to dams which can impound a volume of 10 acre-ft or more of water above natural ground as measured at the dam crest elevation."
>
> "For a dam whose height is 6 feet or less and which meets the above conditions [and is not judged to pose a risk to life, and minimal property damage], the Dam Safety Section (DSS) may elect to exempt the dam from regulations."

The proposed detention pond facilities were reviewed and SDW1B "Pond D," SDW1A "Pond G," and the SASA pond were identified as ponds that qualify for the dam permit (Table 3-1).

Table 3-1. Summary of water impoundment behind earthen dams.

Pond	Bottom Elevation (ft)	Natural Ground Elevation (ft)	Crest Elevation (ft)	Impounded Volume to Crest Elevation	Volume Impounded above Natural Ground	Criteria	
						Vol. >10 AF	Height ≥6 ft
C	272.0	275.0	278.7	15.9 AF	9.3 AF	No	No
D	340.0	343.0	350.0	67.8 AF	41.5 AF	Yes	Yes
F	342.0	348.0	351.6	15.7 AF	5.7 AF	No	No
G	246.0	246.0	258.1	28.7 AF	28.7 AF	Yes	Yes
SASA	300.0	310.0	325.0	92.0 AF	66.0 AF	Yes	Yes

Source: HNTB Corporation, February 2001.

The Port has retained a geotechnical consultant to address the geotechnical or hydrogeological analyses required for the design of these facilities.

Both ponds D and G will exist by the end of the year 2001, but the designs impound less than the threshold volume of 10 acre-ft in their initial development.

The Port understands that the dam safety permit must be in place prior to excavating to impound a volume of 10 acre-ft or more of water above natural ground as measured at the dam crest elevation behind new or existing earthen dams.

3.3 HYDROLOGIC ANALYSIS METHODOLOGY

Two hydrologic model computer programs were used to simulate continuous watershed hydrology and design stormwater detention facilities for the MPU projects: Hydrologic Simulation Program-FORTRAN (HSPF; EPA 1997) and King County Runoff Times Series (KCRTS; King County Department of Natural Resources 1995)

HSPF allows continuous simulation (as opposed to an event-based model) of complex drainage networks. The model is especially appropriate for Western Washington, where hydrology is dominated by runoff from sequential storms, rather than single storm events. This model is recommended by local agencies for large modeling areas and is considered an appropriate method for evaluating effects of stormwater runoff on receiving streams. The model calculates stormwater runoff from the airport drainage basins to compare the effects of airport runoff downstream of the proposed MPU projects.

The HSPF model is currently supported and maintained by the EPA's Environmental Research Laboratory. Because the airport encompasses three watersheds, separate HSPF models for Miller, Walker, and Des Moines Creeks were developed. For each watershed, an existing condition model and a proposed condition model were developed. The difference between these two modeling scenarios quantifies the impact that MPU development has on subbasin runoff. The development and application of these models are further described in Sections 4.4 and 6.1 and Appendices A and B.

The HSPF model was used to:

- Develop runoff parameters for model input by calibrating the model to project watersheds (see Appendix B).
- Model the existing (pre-developed/target flow standards) and future (post-developed/2006) hydrologic conditions in the watersheds.
- Model low stream flow conditions in the watersheds.
- Verify the results and performance of the KCRTS stormwater detention designs.
- Model stream flow conditions at points downstream of STIA to demonstrate that there are no adverse stream impacts.

King County Department of Natural Resources (KCDNR) developed KCRTS software to estimate flows and design detention facilities using runoff file data. Runoff files are a database of 50 years of continuous flows for typical King County land cover and soil types. KCDNR provided basin-specific runoff files corresponding to the HSPF calibration for the three affected watersheds (see Appendix B).

KCRTS is most appropriate for modeling discrete drainage areas, rather than complex drainage areas or watersheds. KCRTS was used to:

- Provide initial estimates of pre-developed and develop flow rates from individual subbasins.
- Perform preliminary detention facility designs to meet Level 2 flow controls.
- Generate stage-storage-discharge tables for input into the HSPF model.

Model Calibration

Hydrological modeling using HSPF requires the calibration of many parameters that describe different hydrologic processes. These processes include:

- Rainfall runoff from pervious and impervious surfaces;
- Infiltration of rainfall to soils;
- Soil moisture accounting;
- Flow of groundwater from soils to streams; and
- Loss of groundwater to deep aquifers.

Each of these physical processes is controlled by several parameters. The calibration process adjusts model parameters to achieve a close match between recorded streamflows and simulated streamflows for a period when streamflow data are available. Calibration of the HSPF model is discussed in detail in Appendix B.

4. EXISTING CONDITIONS

This section describes the existing conditions for the drainage basins, conveyance systems, and detention of stormwater at STIA. Included is a long-term hydrologic simulation of current conditions for Miller, Walker, and Des Moines Creeks using the HSPF model as well as a summary of model calibration for each watershed and airport runoff. In addition, this section provides a summary of existing water quality BMPs at STIA and current water quality conditions based on several years of monitoring data.

4.1 DRAINAGE BASINS

Sea-Tac International Airport lies along the drainage divide between the Miller Creek and Des Moines Creek watersheds (Figure 4-1). Figure 4-2 illustrates the 1994 land use condition and future drainage subbasin boundaries. 1994 represents existing land use condition for purposes of retrofitting the airport, with the exception of NEPL (see Section 2.1.2).

The Miller Creek watershed covers approximately 8.1 mi^2 of predominantly urban area lying mostly within the cities of Burien and SeaTac, plus a small portion of Normandy Park and King County. Miller Creek drains a relatively small portion of STIA, including the north end of the runways and the air cargo areas north of the terminal. The upper reaches of Miller Creek, north of Highway 518, drain a gently rolling plateau between the Duwamish/Green River Valley and Puget Sound. In the lower reaches, the creek flows through a well-incised ravine cut through glacial material, and enters Puget Sound at the City of Normandy Park. Walker Creek is a tributary to Miller Creek.

The Des Moines Creek watershed covers 5.9 mi^2 of predominantly urban area lying mostly within the cities of SeaTac and Des Moines, plus a small area of King County. This creek drains most of STIA, the City of SeaTac commercial area along International Boulevard (Highway 99), and residential areas in the remainder of the basin. Des Moines Creek is approximately 3.5 miles long; it flows from an elevation of about 350 ft and drains into Puget Sound. Additional information on the Des Moines Creek watershed can be found in the 1997 Des Moines Creek Basin Plan (Des Moines Creek Basin Committee 1997).

Table 4-1 summarizes the Miller Creek and Des Moines Creek STIA drainage areas and percent impervious surface areas under existing and future conditions. The STIA stormwater drainage system will cover about 9 percent of the Miller Creek watershed and 23 percent of the Des Moines Creek watershed (including newly acquired property for the MPU). Currently, about 23 percent of the total surface area in the Miller Creek watershed and 32 percent in the Des Moines Creek watershed are impervious.

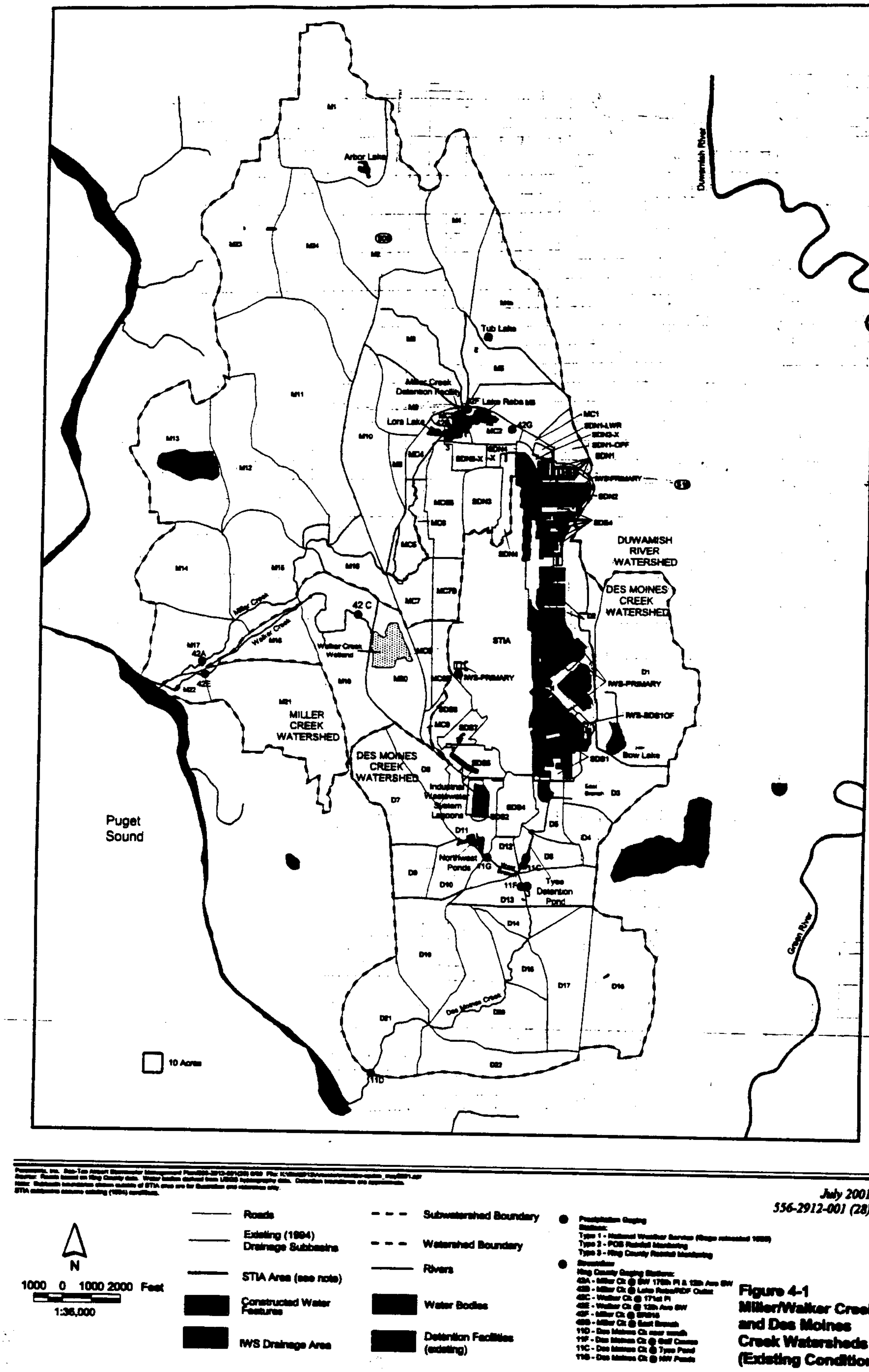
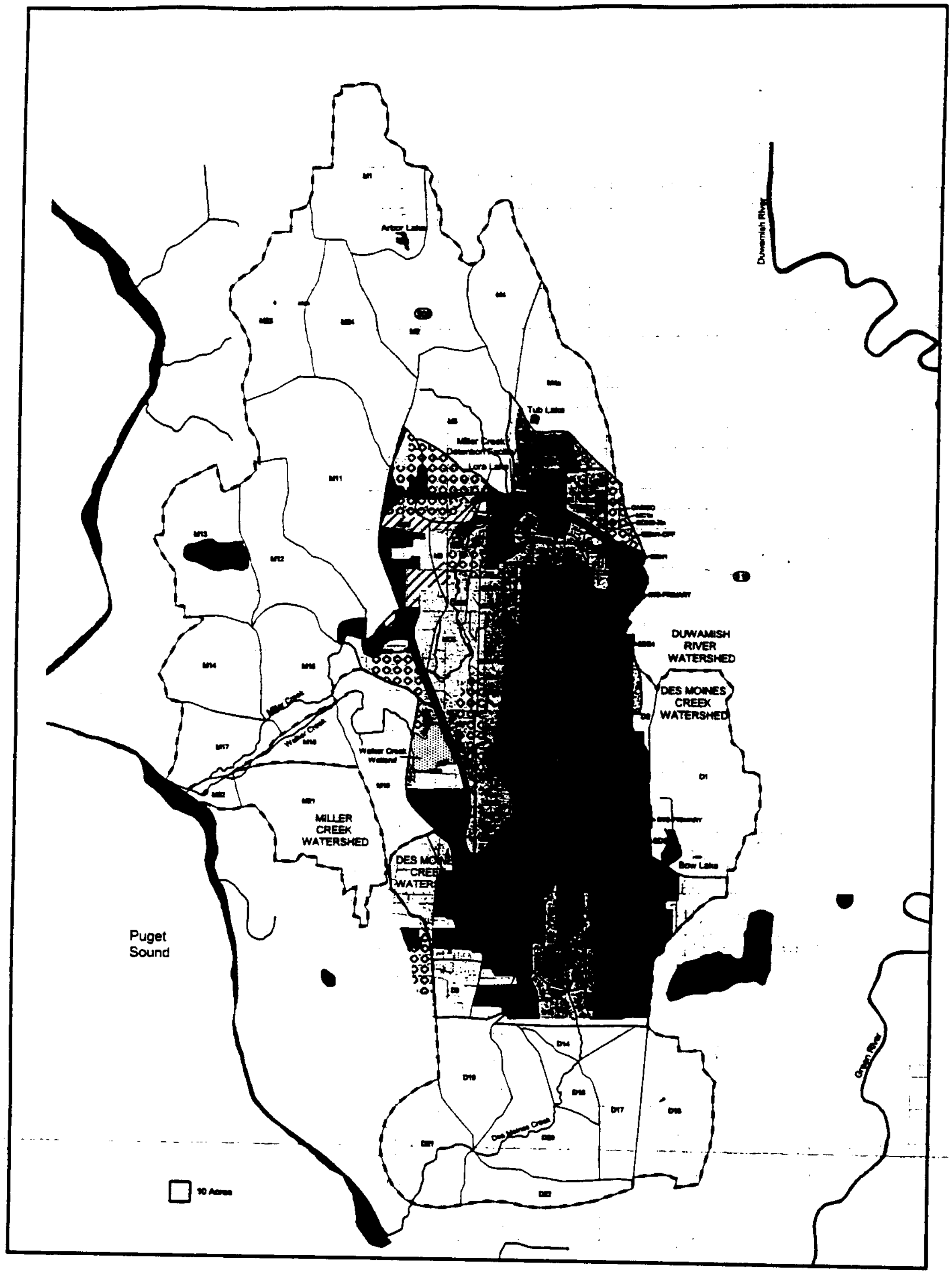


Figure 4-1
Miller/Walker Creek and Des Moines Creek Watersheds (Existing Conditions)



Parametrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 8/00 File: K:\Gis\2912\...
Source: Roads based on King County data. Water bodies derived from USGS topography data. Estimated wetland boundaries are based on field reconnaissance by Parametrix, Inc.
Land use data interpreted from 1995 STIA aerial photograph (Walker and Assoc. 1995).
Note: Subbasin boundaries shown outside of STIA area are for illustration and reference only.

July 2001
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N
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- Roads
- Future (2006) Drainage Subbasins
- STIA Area (see note)
- Watershed Boundary
- Subwatershed Boundary
- Rivers
- Water Bodies
- Constructed Water Features
- Detention Facilities (existing)
- Sea-Tac Airport
- Commercial
- Open/Grass
- Transportation
- Low Density Residential
- High Density Residential
- Multi-Family Residential
- Forest

Figure 4-2 Future STIA Drainage Subbasins and 1994 Land Use

Table 4-1. **Summary of Miller, Walker, and Des Moines Creek drainage areas at STIA and change in impervious area between 1994 baseline and 2006 future conditions (acres).**[a]

	1994 Baseline			2006 Future Condition			Increase in Impervious Area
	Pervious	Impervious[b]	Total	Pervious	Impervious[b]	Total	
Miller Creek							
SDN1	6.2	9.9	16.1	3.5	12.7	16.1	2.8
SDN1LWR	5.0	0.4	5.4	4.9	0.6	5.4	0.2
SDN1OFF	25.8	10.5	36.3	28.3	8.0	36.3	-2.5
SDN2Xn	4.3	0.0	4.3	3.9	0.3	4.3	0.3
SDN3	33.4	14.5	47.9	23.6	24.3	47.9	9.8
SDN3A	28.6	1.9	30.5	22.2	8.2	30.5	6.3
SDN3X	25.4	0.0	25.4	25.4	0.0	25.4	0.0
SDN4	27.7	2.6	30.3	18.1	12.3	30.3	9.7
SDN4X	14.1	1.1	15.2	11.0	4.2	15.2	3.1
SDW1A	52.0	0.9	52.8	37.4	15.4	52.8	14.5
SDW1B	92.5	4.3	96.9	69.9	27.0	96.9	22.7
NEPL	41.4	0.9	42.3	10.0	32.3	42.3	31.4
CARGO	7.0	1.1	8.1	0.0	8.1	8.1	7.0
Other STIA[c]	246.5	15.1	261.8	247.8	13.8	261.8	-1.3
Total							**103.7**
Walker Creek							
SDW2	41.3	3.3	44.6	35.1	9.5	44.6	6.2
M8	22.2	6.6	28.8	22.2	6.6	28.8	0.0
M9	76.1	22.5	98.6	76.1	22.5	98.6	0.0
Total							**6.2**
Des Moines Creek							
SDE4	50.7	115.5	166.2	40.1	126.1	166.2	10.6
SDS1	0.9	16.8	17.7	1.4	16.3	17.7	-0.5
SDS2	7.7	1.5	9.2	8.1	1.0	9.2	-0.5
SDS3	165.5	178.0	343.5	144.3	199.2	343.5	21.2
SDS3A	62.7	7.1	69.8	34.6	35.1	69.8	28.0
SDS4	45.4	19.2	64.6	32.1	32.5	64.6	13.3
SDS5	32.1	0.4	32.5	28.3	4.2	32.5	3.8
SDS6	12.5	4.3	16.7	13.5	3.2	16.7	-1.1
SDS7	83.2	8.0	91.3	55.1	36.2	91.3	28.2
SASA	25.3	8.9	34.3	0.0	34.3	34.3	25.4
Other STIA[d]	136.1	57.7	194.4	136.0	57.5	193.5	-0.2
Total							**128.2**
IWS							
NCPS	6.9	28.8	35.7	4.8	30.9	35.7	2.1
NSMPS	6.6	0.0	6.6	4.7	2.0	6.6	2.0
NSPS	0.3	13.5	13.8	0.3	13.4	13.8	-0.1
Primary	24.9	277.6	302.6	13.5	289.1	302.6	11.5
SASA	51.8	6.5	58.3	0.1	58.3	58.4	51.8
Total							**67.3**
TOTAL	**1462.1**	**839.4**	**2302.6**	**1156.3**	**1145.1**	**2301.7**	**305.7**

Note: Rows may not total exactly as shown due to rounding. Source: GIS coverage.

[a] The purpose of this table is to provide supporting data for comparing pervious areas; this data was not used for modeling purposes.

[b] Impervious area includes impervious area, lakes, and detention ponds.

[c] Includes subbasins M6, MC1, MC2, MC3, MC4, MC5, MC6, MC7.

[d] Includes subbasins D5, D6, D11, D13.

4.2 CONVEYANCE SYSTEMS

Stormwater runoff from the airport discharges to Miller Creek and the west and east branches of Des Moines Creek through a system of piped conveyances and outfalls referred to as the storm drain system (SDS). Stormwater runoff from areas around the airport terminal and apron areas is captured by the industrial wastewater system (IWS), which is a separate collection and treatment system. After treatment at the Industrial Wastewater Treatment Plant (IWTP) the IWS directly discharges to Puget Sound. Both of these conveyance systems are described below. The subbasin designations and drainage areas of the SDS and IWS under existing (1994) conditions are shown in Figure 4-1; impervious areas are depicted in Figure 4-3.

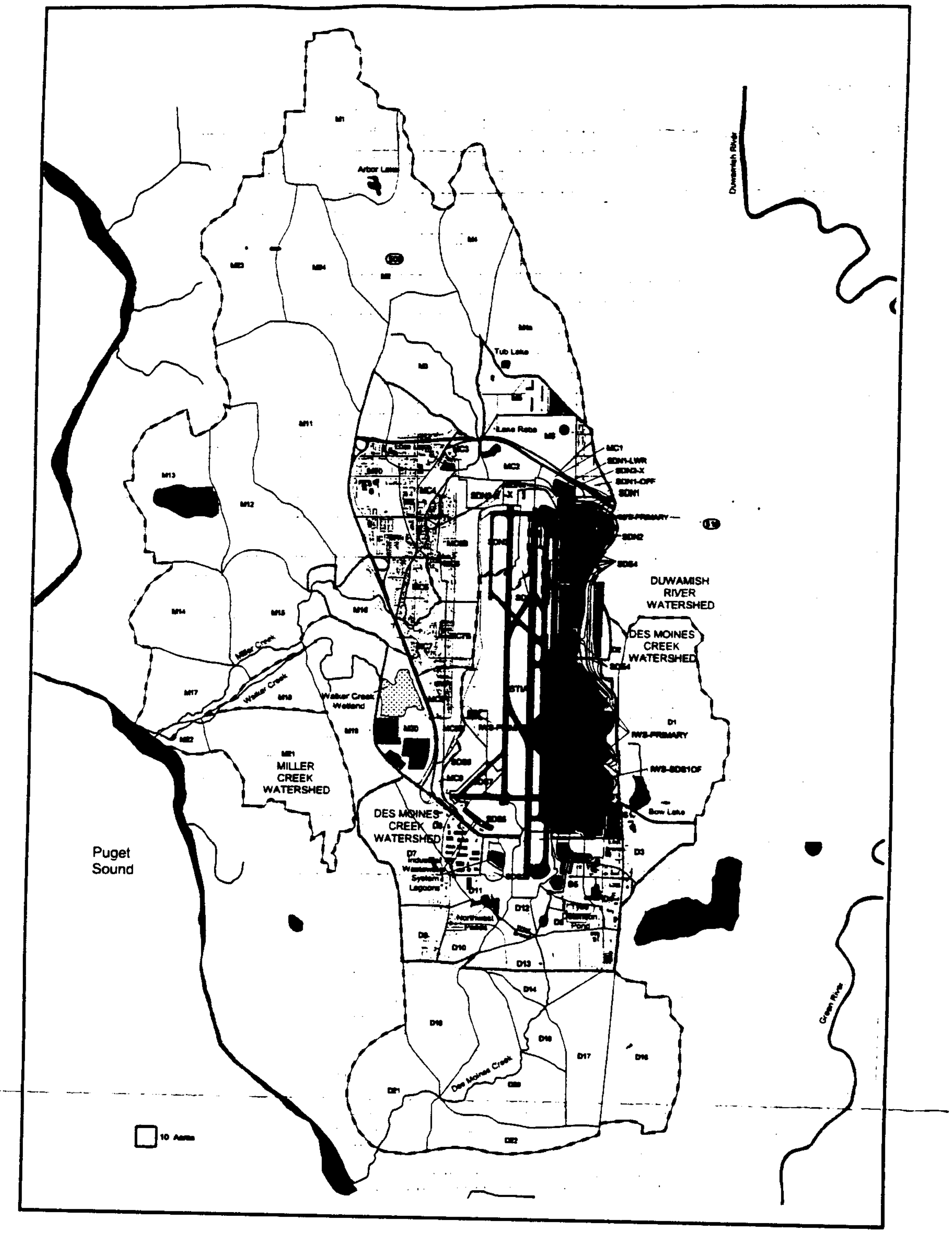
Some areas of the airport drain to the IWS via diversion and pump facilities. The diversion and pump facilities are discussed in Section 4.2.3. In the event of a large storm, excess runoff may be diverted back to the SDS. These diversions and overflows are accounted for in the HSPF model, as described in Section 4.2.3.

4.2.1 Storm Drainage System

The SDS has operated since the airport was commissioned in the 1940s. This stormwater system consists of pipes, manholes, catch basins, and pumping facilities that collect surface water runoff from pervious and impervious surfaces, including runways, taxiways, runway fields, most roof tops, and roadways.

The stormwater system discharges directly and indirectly (via City of SeaTac storm drains or constructed drainage ditches and stormwater facilities) to Miller and Des Moines Creeks at 12 outfalls that are authorized by the NPDES Permit issued by Ecology (Ecology 1998). In addition, portions of Port property drain from 2 permitted outfalls via City of SeaTac storm drains to Gilliam Creek. No new impervious areas or MPU projects are proposed in the area draining to Gilliam Creek. Therefore, stormwater management is not evaluated in this basin. Combined, the Port's SDS is comprised of more than 33 miles of pipeline covering over 800 acres.

The Port recently completed a Comprehensive Drainage Plan that evaluated the hydraulic capacity of the SDS (HDR 1997; the conveyance evaluation chapter of that plan is provided in Appendix S). The study concluded that the SDS is sized to convey the 10-year design storm event (the King County design standard for existing conveyance systems), and up to 98 percent of the system can convey the 25-year storm event. New conveyance will be designed to the 25-year capacity and will include spill containment (the King County standard for new conveyance systems).



July 2001
556-2912-001 (28)

Roads	Rivers
Watershed Boundary	STIA Area (see note)
Subwatershed Boundary	Existing (1994) Drainage Subbasins
Impervious Areas	
Constructed Water Features	
Water Bodies	

N

1000 0 1000 2000 Feet

1:36,000

Figure 4-3
STIA and Surrounding Development 1994

4.2.2 Industrial Wastewater System

The IWS collects and treats industrial wastewater;[12] the IWS serves as a spill-control BMP. The IWS was initially constructed in 1963 to collect runoff from terminal aprons, taxiways, hangars, portions of the terminal roof top,[13] the parking garage, the toll plaza, aircraft and vehicle maintenance areas, and some parking lots in the air cargo area. Runoff from these areas may be contaminated by accidental fuel spills, de-icing chemicals, and washwater from cleaning of aircraft and ground support vehicles. A comprehensive engineering evaluation of the IWS system was conducted in 1995 (Kennedy/Jenks 1995) and a program for upgrading the system is ongoing. The original IWS system has been gradually expanded over the years to include larger areas of terminal apron plus newly developed areas subject to industrial activities. Many parts of the current IWS system originally belonged to the SDS, but were later connected to the IWS.

Runoff from the IWS catchment areas is collected by the IWS conveyance system. The IWS is divided into two primary drainage areas: the air cargo/runway system and the terminal system. Runoff from these areas is conveyed to the IWTP via separate pipeline routes. With upcoming planned improvements, the IWS conveyance system will be sized to handle approximately the 25-year design storm. Because the IWS does not discharge to the streams, it is not included in the hydrologic modeling analysis for the SMP. However, five pump stations, which normally drain to the IWS, overflow to the SDS under high flow conditions (see Section 4.2.3 below). These overflows are included in the hydrologic model of the SDS and receiving streams.

Three lagoons (Lagoons 1, 2, and 3) in the southwest corner of STIA provide storage for the industrial wastewater prior to treatment in the IWTP. Treated discharge flows to an outfall pipeline that joins the Midway Wastewater Treatment Plant effluent pipe for discharge into Puget Sound via a marine outfall. The discharge is authorized by the Port's NPDES Permit. IWS treatment performance and the Port's determination of all known available and reasonable treatment (AKART) for the IWS are discussed in Sections 4.5.3 and 7.5, respectively.

4.2.2.1 IWS Storage Capacity

The 2006 configuration of the IWS (land use, lagoon storage capacity, treatment rate, and outfall discharge capacity) is summarized in Table 4-2. A continuous simulation of the IWS was performed using KCRTS (King County Regional Time Series) to demonstrate that overflows will

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[12] As defined in STIA's NPDES Permit WA-002465-1, "Industrial wastewater is water or liquid-carried waste from industrial or commercial processes, as distinct from domestic wastewater, non-contact cooling water, or stormwater associated with industrial activity. Industrial wastewater may result from any process or activity of industry, manufacturer, trade, or business, and includes, but is not limited to: water used for industrial processes such as pipe integrity pressure testing and vehicle and aircraft wash water; stormwater contaminated with fuel, oil, fire foam, cleaning agents, and aircraft deicing/anti-icing agents; contaminated construction dewatering waters; excess water from groundwater well construction and monitoring; and leachate from solid waste facilities. Industrial wastewater does not include stormwater runoff that contains deicing/anti-icing agents that shear or drip from aircraft in the stormwater system."

[13] Although the intent of the IWS is to treat areas subject to industrial pollution, most of the IWS was constructed by diverting existing drainage areas. In some areas that were diverted to the IWS, it was generally not practicable to separate non-industrial drainage areas from industrial drainage areas. The Port undertakes an ongoing effort to remove non-industrial drainage areas from the IWS, where such diversions become practicable.

not occur under proposed IWS conditions (see Appendix Z). This analysis confirmed that zero overflows occur when the 50-year KCRTS period of record is simulated for the conditions described in Table 4-2. If any future additional diversion to the IWS is proposed, then the performance of the IWS system will be evaluated prior to the diversion to verify that SMP performance standards are met.

Table 4-2. IWS configuration (land use, storage, treatment rate, discharge rate, number of overflows)

Parameter	Value
Land Use	
Till Grass	16.53 acres
Outwash Grass	8.16 acres
Airport Fill	0.01 acres
Wetland	0.01 acres
Impervious Area	410.00 acres
TOTAL	**434.71 acres[a]**
Storage Volume	
Lagoon 1	1.6 mg
Lagoon 2	3.3 mg
Lagoon 3	72.0 mg
TOTAL	**76.9 mg**
Outfall Discharge Capacity	**7.1 mgd**
Treatment Rate	**4.0 mgd**
Number of Overflows in 50-year Simulation	**0**
Treatment Rate at Which One Overflow Occurs	**3.1 mgd**
Treatment Rate at Which Two Overflows Occur	**2.4 mgd**

[a] Although all major planned additions to the IWS are included, this area conservatively includes approximately 16 acres of impervious area to account for future unplanned additions to the IWS.

To demonstrate IWS performance at reduced treatment rates, an analysis was also performed to determine the treatment rates at which one and two overflows would occur over the 50-year KCRTS period of record, with all other future conditions (Table 4-2) held constant (see Appendix Z). This analysis determined that one overflow would occur at a treatment rate of approximately 3.1 mgd, and two overflows would occur at a treatment rate of approximately 2.4 mgd.

If the safe storage capacity of IWS storage is exceeded during extreme precipitation events untreated water would have to be released to Des Moines Creek. This has occurred only once under the current configuration of the IWS, during an extreme rain-on-snow event in December 1996-January 1997. The release lasted only a few hours. No petroleum hydrocarbons were detected downstream of the release. As stated above, increased storage capacity and treatment rate will prevent overflows.

If a release becomes necessary, operational procedures will minimize the impact on Des Moines Creek. Initial runoff from each storm (which flushes most of the pollutant load from the ground surfaces) flows to Lagoons 1 and 2. Any release of untreated water would occur from Lagoon 3, in which pollutants would be more dilute, especially under the extreme events in which overflow would occur. Although an overflow spillway is provided to meet dam safety requirements, overflows from Lagoon 3 would be released from a bypass pipe at mid-depth to avoid discharge from the lagoon surface (preventing release of floating petroleum product) or from the lagoon bottom (preventing entrainment and discharge of accumulated sediment).

4.2.2.2 IWS Discharge Line Capacity

The hydraulic capacity of the existing 18-inch outfall has been evaluated and determined to be at least 6.3 MGD (Appendix O, Case 1). This is in excess of the current and proposed future maximum treatment rate of 4 MGD. Additionally, approximately 75 ft of the effluent line upstream of the effluent manhole was replaced in 1996 (Kennedy/Jenks 1998) and a portion of the 18-inch effluent line under Lagoon 3 is scheduled to be replaced in 2001. These improvements will increase the capacity of the outfall to 7.1 MGD (Appendix O, Case 2).

4.2.3 Pump Facilities

Five pump stations divert runoff from the SDS to the IWS. Table 4-3 summarizes the location, drainage area (1998), and capacity of these facilities.

Table 4-3. IWS pump stations.

Name	Location	Drainage Area (acres)	Pump Capacity (gpm)
North Snowmelt Pump Station (SDS to IWS)	SDN2	6.63	750
Central Snowmelt Pump Station (SDS to IWS)[1]	SDE4	0.75	750
South Snowmelt/Olympic Tank Farm Pump Station (SDS to IWS)[1]	Olympic Tank Farm	0.01	750
North Cargo Pump Station (SDS to IWS)	SDN2	35.60	2750
North Satellite Pump Station (SDS to IWS)	SDE4	13.75	2150

[1] No excess runoff is discharged to streams under the 100-year storm event (or smaller storm events).

The pump stations divert runoff up to at least the 6-month/24-hour event from these areas. Under high-flow conditions, excess runoff discharges to the SDS system. Detailed information on the above pump facilities is provided in Appendix C. The hydrologic models described in Section 3.2 incorporate the drainage areas and pump capacities shown in the Table 4-3 facilities.

Pump facilities are also located in the parking garage area to pump runoff to the IWS, along the utility tunnel under the arrival/departure drives and ramps to pump roadway drainage to SDE4, and at other miscellaneous sites where gravity drainage is not feasible. These small pump stations are not included in the hydrologic model because of their small size, or because they affect only the IWS, which was not analyzed in detail in the HSPF models.

4.2.4 Recent SDS to IWS Reroutes

Many projects have been constructed at the airport in recent years to reroute potentially polluted storm drainage from the terminal area to the IWS. The SDS Comprehensive Drainage Plan (HDR 1997) incorporated improvements that were recommended by the STIA SWPPP (Port of Seattle 1998a) to reduce the potential for anti- and de-icing chemicals to reach the SDS. Other projects were also identified and constructed. Table 4-4 summarizes airport projects that were constructed during the period 1994-1998 to reroute critical storm drainage areas to the IWS.

Table 4-4. SDS to IWS reroute projects implemented during 1994-1998.

		Change in Drainage Area		
SWPPP Project	Year	From[a]	To	Acres
North Cargo Area pump station	1997	SDN2	IWS	39.79
Cargo Area 4	1996	SDE4	IWS	4.40
North Satellite pump station	1995	SDE4	IWS	6.63
Gate C-8	1995	SDS3	IWS	0.27
South Satellite apron	1997	SDS1	IWS	1.75
Gate B5	1995	SDS1	IWS	0.25
Concourse A-D apron	1996	SDS1	IWS	16.82
D-gate flush gutter reroute	1994	SDE4	IWS	5.26
North snowmelt pump station	1998	SDN2	IWS	6.63
Central snowmelt pump station	1998	SDE4	IWS	0.75
South snowmelt pump station	1998	SDS4	IWS	0.34
South Satellite	2000	SDS1	IWS	1.91
TOTAL				**84.8**

[a] These drainage basins refer to basins defined in the STIA comprehensive storm drainage system plan technical information notebook (Symonds 1996).

As a result of these improvements, approximately 85 acres of impervious area have been transferred from the SDS to the IWS. These transfers included direct pipe reconnections from the SDS to the IWS, and for areas that could not be gravity-drained, pump stations sized for either the 6-month/24-hour storm or the 2-year/24-hour storm to divert flow from the SDS to the IWS. All projects recommended in the 1997 SWPPP have been completed.

4.3 STORMWATER DETENTION

Stormwater runoff at STIA is currently detained by approximately 351.1 acre-ft of detention storage (Table 4-5). This includes facilities that were built prior to 1994 and new facilities built at the airport for MPU improvements currently under development. Available facility descriptions, physical data, and operational data for the stormwater facilities are provided in Appendix C. Two existing regional facilities serve the airport and surrounding communities: Tyee Pond and the Miller Creek Detention Facility (see Figure 4-1). King County is currently designing a third facility, the Des Moines Creek RDF, which will be implemented as part of the Des Moines Creek Basin Plan (Des Moines Creek Basin Committee 1997). This facility is to be located at the head of the west branch of Des Moines Creek at the Northwest Ponds, and is anticipated to provide a total of

Table 4-5. **Existing stormwater detention facilities.**

Name	Location	Year Built	Drainage Areas Served[e]	Active Storage Capacity (acre-ft)
IWS Lagoons[a]	Southwest corner of airport	1960s-1980's	Airport IWS system (discharges directly to Puget Sound)	236.0[f]
Lake Reba	Miller Creek tributary	1973	SDN1, SDN1-OFF, SDN1-LWR, SDN2X, SDN3, SDN3X, SDN4, SDN4X, NEPL, CARGO, MC1, MC2, MC6, NCPS[c], NSMPS[c]	15.8 (at overflow crest)
Miller Creek Detention Facility	Miller Creek	1992	SDN1, SDN1-OFF, SDN1-LWR, SDN2X, SDN3, SDN3X, SDN4, SDN4X, NEPL, CARGO, MC1, MC2, M6, M1, M2, M3, M4, M5, MC3, NCPS[c], NSMPS[c]	68.0[d] (at emergency spillway)
Northwest Ponds	West Branch Des Moines Creek	Pre-1970	DM10, DM11, DM9, DM7, DM8, SDS2, SDS5, SDS6, SDS3A, SDS3, SDS7, IWS[c]	16.9 (at road crest)
Tyee Regional Detention Pond	East Branch Des Moines Creek	1988	DM6, SDS1, DM5, DM4, SASA, SDE4, DM2, DM1, DM3, IWS-Primary[c], NSPC[c]	18.5 (at overflow structure)
NEPL Vault[b]	Tributary to Miller Creek via Lake Reba	1997	NEPL	4.0 (at 100-year design level)
1998 Taxiway Vault[b]	SDS-3	1998	Airport (SDS-3, new taxiway for third runway)	5.5 (at 100-year design level)
South remote parking lot and expansion[g]	East Branch Des Moines Creek	1985-86	Parking lots	0.7 total
Doug Fox infiltration facility[g]	SDE-4	1989	Parking lot and flight kitchen	0.06 (plus 300' x 30' infiltration trench)
S. 160th St. Remote Parking Lot[h]	City of SeaTac storm system	1990	Parking lot	1.3
Starling Road detention pond[g]	West Branch Des Moines Creek	1993	Road	Not available
Flying Food detention vault[g]	Miller Creek tributary	1987	Roof and parking lot	0.05
Lufthansa detention pond[g]	Miller Creek tributary	1989	Roof and parking lot	0.06
TOTAL				**351.1 acre-ft**

[a] The IWS discharges to Puget Sound and does not impact Des Moines or Miller Creeks.
[b] These facilities were built as part of MPU improvements.
[c] Only during overflow conditions.
[d] The Miller Creek Detention Facility active storage capacity includes Lake Reba's active storage of 15.8 acre-ft; Lake Reba's storage was only counted once in the overall total.
[e] Refer to Figure 4-1.
[f] 236.0 acre-ft is the total storage capacity after expansion of Lagoon 3, currently under way. The existing storage is 90.5 acre-ft.
[g] These projects will be removed due to MPU projects.
[h] S. 160th Remote Parking Lot is in the Gilliam Creek basin and will not be changed.

NEPL = North Employee Parking Lot.

Table 4-6. **BMP inventory for existing STIA subbasins as they will be configured for Master Plan Update buildout, prior to additional treatment.**

Subbasin	Approx. Future PGIS[a] (ac)	Existing WQ Treatment[e]					Existing Source Control BMPs[c]
		Existing Treatment BMPs	Filter Strip (sf)	Bio-swale (sf)	Fully Treated PGIS[a] (ac)	PGIS Not Fully Treated (ac)	
SDN1	7.5	Bioswale	0	3,500	0.7	6.8	SPC, SWP, CBC, LND, SWE
SDN2	2.1	Diverted to IWS	0	0	2.1	0.0	SPC, SWP, CBC, SWE
SDN3	24.7	Filter Strips	782,000	0	24.7	0.0	SPC, SWP, CBC, SWE
SDN4	9.0	Filter Strips	96,000	0	9.0	0.0	SPC, SWP, CBC, SWE
SDN6 cargo area north of SR518	4.1	none	0	0	0.0	4.1	(none – no exist PGIS)
MC1-MC3 S 154th	3.9	none	0	0	0.0	3.9	SWE[d]
MC4-MC8 New west side buffer area subbasins	7.3	none	0	0	0.0	7.3	(not currently part of STIA)
NEPL	29.0	Bioswale	0	4,400	29.0	0.0	SPC, SWP, CBC, LND, SWE
SDW1, SDW2 new 3RW	55.1	none	0	0	0.0	55.1	(none – no exist PGIS)
SDE4-South south of 170th	32.0	none	0	0	0.0	32.0	SPC, SWP, CBC, LND, SWE
SDE4-Taxiways taxiway area	18.8	Filter Strips	50,000	0	4.6	14.2	SPC, SWP, CBC, SWE
SDE4-NEAT NEAT area north of 170th	35.0	Bioswale	0	2,160	2.9	32.1	SPC, SWP, CBC, SWE, LND
Delta Parking Lot	3.2	none	0	0	0.0	3.2	SPC, SWP, CBC, SWE
SDS1	11.7	none	0	0	0.0	11.7	SPC, SWP, CBC, SWE
SDS2	0.0	none (no PGIS)	0	0	0.0	0.0	none
SDS3	234.6	Filter Strips	1,680,000	0	190.0	44.6	SPC, SWP, CBC, SWE
SDS4	32.3	Filter Strips	360,000	0	32.3	0.0	SPC, SWP, CBC, SWE
SDS5 formerly subbasin D	0.0	none (no PGIS)	0	0	0.0	0.0	SPC, SWP, CBC
SDS6 formerly subbasin B	1.5	none	0	0	0.0	1.5	SPC, SWP, CBC
SDS7 (new 3RW includes former SDW-3)	40.2	none	0	0	0.0	40.2	SPC, SWP, CBC
SASA	27.4	Bioswale	0	13,000	17.6	9.8	SPC, SWP, CBC, LND, SWE
TOTAL SDS DRAINAGE AREA (acres)	579.4						

[a] PGIS = Pollution Generating Impervious Surface, the amount of area requiring water quality treatment BMPs. Includes existing and new surfaces

[b] Basins SDN1, SDN2, SDN3, SDN4, NEPL, SDN6 flow to Lake Reba, which has a permanent pool volume that provides additional wetpool treatment not included in these calculations

[c] SOURCE CONTROLS
SPC = Spill Control and Countermeasures Planning
SWP = Stormwater Pollution Prevention Planning (POS and Tenants)
SWE = Sweeping
CBC = Regular Catchbasin Cleanout
LND = Landscape Maintenance BMPs, including Integrated Pest Management

[d] These subbasins will be under the jurisdiction of the City of SeaTac. Source control operations would be performed by the City

[e] BMP	Approx. Required Treatment/Acre
Bioswale	960 sf
Filter Strips	5,000 sf
Wetvaults	4,610 cf

180 acre-ft of storage. The Port is actively working with the County and Basin Committee to implement the project as a plan participant. This facility would mitigate impacts of stormwater runoff from all past and future (beyond Level 1 of King County standards) development in the Des Moines Creek watershed.

Detention storage provided by the smaller facilities (those with less than 1 acre-ft of storage) is not currently considered in the hydrologic modeling of the SDS and IWS systems described in this report. Future model updates may include these facilities when design data are obtained and models are refined.

4.4 HYDROLOGIC MODELING/WATER QUANTITY

As described in Section 3.2, the HSPF model was used to evaluate the stormwater impacts, including flood frequency, flow duration, and baseflow maintenance under existing conditions. These analyses, when compared with those for proposed conditions, quantify the storage requirements for the proposed stormwater detention facilities.

This section describes the use of HSPF to model current hydrologic conditions at the airport. Details are presented in Appendices A and B and Section 6.1.

4.4.1 Model Development

The HSPF models of Miller Creek and Des Moines Creek have previously been prepared by several investigators (NHC 1990, Montgomery Water Group 1995, Des Moines Creek Basin Plan Committee 1997, and Parametrix 1999a). Each investigation contributed to the understanding of the hydrologic processes that quantify the amount of streamflow in each watershed.

The Miller Creek HSPF model developed for the FEIS (FAA 1996) was adapted from a previous version developed for the Miller Creek Regional Stormwater Facilities Design Hydrologic Modeling (NHC 1990). The NHC model was modified using updated watershed characteristics (land use and drainage area). Corrections to the stream network, and additional streamflow monitoring data for calibration, were included in the FEIS version of the model.

The HSPF models in the 1999 draft SMP (Parametrix 1999a) updated the FEIS versions (for Miller and Des Moines Creeks). The revisions consisted of updated watershed characteristics and SDS network information, additional information describing existing stormwater detention facilities, and MPU project effects (for future condition simulation). Additional streamflow monitoring data were obtained for SDS and Miller Creek flow and used for calibration of the model.

The HSPF models in this SMP were further updated with new land use and soils data from King County and further calibration of model input (see Appendix B). In addition, Walker Creek was separated from Miller Creek and calibrated independently.

4.4.1.1 Land Use Characterization

Characterization of land use is prerequisite to calibrating the HSPF models because land use data influence parameters that describe hydrologic processes. Data used to develop the previous FEIS and 1999 SMP Miller and Des Moines basin models were checked against available information.

Land use data for areas draining to the detention facilities were compiled using ArcView 3.2 Geographic Information Systems (GIS) coverage of airport land use, based on 1993 aerial photography (Walker and Associates 1993). Data included drainage basin boundaries, soil, vegetation, and impervious surfaces. Appendix B provides further detail of land use characterization.

4.4.1.2 Model Calibration

Appendix B presents the results of the calibration effort for modeling the Miller, Walker, and Des Moines Creek basins.

4.4.2 Long-term Simulation

Following calibration of the HSPF models, long-term hydrologic simulations of current conditions for Miller and Des Moines Creeks were performed. These simulations were run for the 1948-1996 (49-year) period using hourly STIA precipitation and daily Puyallup evaporation data as input.

The results of the simulations were summarized using flood frequency estimates and flow durations at selected locations shown on Figure A-7, Appendix A.

4.4.3 Flow Duration Analysis of Target Watershed Flow Regime

Section 2.1.3 describes how the target watershed flow regimes for Miller and Des Moines Creeks were derived and established. To derive the target watershed flow regime for the pre-developed condition, the HSPF models (incorporating 2006 basin boundaries) were modified by changing basin land cover to 10 percent impervious, 15 percent grass, and 75 percent forest. The physical characteristics of the stream reaches were unchanged.

4.5 EXISTING BMPs AND WATER QUALITY

An analysis of existing BMPs and a summary of NPDES monitoring water quality data are provided below.

4.5.1 Best Management Practices

Most of STIA's existing SDS and the current off-site areas to be incorporated into the SDS were developed before current water quality treatment BMP requirements were established. Therefore, these areas are not completely served by water quality BMPs. Nevertheless, approximately 68 percent of existing STIA SDS pollution-generating impervious surfaces are treated with water quality BMPs that meet current design standards.

Existing water quality BMPs were analyzed to help determine the treatment BMPs that would be required for future development and redevelopment. A subbasin-by-subbasin inventory was prepared for (1) PGIS, and (2) existing treatment BMPs. This analysis is described below, and summarized in Table 4-6. The analysis of existing BMP conditions was performed for subbasins as they are anticipated to be configured upon completion of the Master Plan Update. These are pre-design estimates, and may change as project design proceeds.

Table 4-6. BMP inventory for existing STIA subbasins as they will be configured for Master Plan Update buildout, prior to additional treatment.

Subbasin	Approx. Future PGIS[a] (ac)	Existing WQ Treatment[b]: Existing Treatment BMPs	Filter Strip (sf)	Bio-swale (sf)	Fully Treated PGIS[a] (ac)	PGIS Not Fully Treated (ac)	Existing Source Control BMPs[c]
SDN1	7.5	Bioswale	0	3,500	0.7	6.8	SPC, SWP, CBC, LND, SWE
SDN2	2.1	Diverted to IWS	0	0	2.1	0.0	SPC, SWP, CBC, SWE
SDN3	24.7	Filter Strips	782,000	0	24.7	0.0	SPC, SWP, CBC, SWE
SDN4	9.0	Filter Strips	96,000	0	9.0	0.0	SPC, SWP, CBC, SWE
SDN6 [illegible]	4.1	none	0	0	0.0	4.1	(none -- no exist. PGIS)
MC1-MC3 [illegible]	3.9	none	0	0	0.0	3.9	SWE[d]
MC4-MC8 [illegible]	7.3	none	0	0	0.0	7.3	(not currently part of STIA)
NEPL	29.0	Bioswale	0	4,400	29.0	0.0	SPC, SWP, CBC, LND, SWE
SDW1, SDW2 [illegible]	55.1	none	0	0	0.0	55.1	(none -- no exist. PGIS)
SDE4-South [illegible]	32.0	none	0	0	0.0	32.0	SPC, SWP, CBC, LND, SWE
SDE4-Taxiways [illegible]	18.8	Filter Strips	50,000	0	4.6	14.2	SPC, SWP, CBC, SWE
SDE4-NEAT [illegible]	35.0	Bioswale	0	2,160	2.9	32.1	SPC, SWP, CBC, SWE, LND
Delta Parking Lot	3.2	none	0	0	0.0	3.2	SPC, SWP, CBC, SWE
SDS1	2.6	none	0	0	0.0	2.6	SPC, SWP, CBC, SWE
SDS2	0.0	none (no PGIS)	0	0	0.0	0.0	none
SDS3	234.6	Filter Strips	1,680,000	0	190.0	44.6	SPC, SWP, CBC, SWE
SDS4	32.3	Filter Strips	360,000	0	32.3	0.0	SPC, SWP, CBC, SWE
SDS5 [illegible]	0.0	none (no PGIS)	0	0	0.0	0.0	SPC, SWP, CBC
SDS6 [illegible]	1.5	none	0	0	0.0	1.5	SPC, SWP, CBC
SDS7 [illegible]	40.2	none	0	0	0.0	40.2	SPC, SWP, CBC
SASA	27.4	Bioswale	0	13,000	17.6	9.8	SPC, SWP, CBC, LND, SWE
TOTAL SDS DRAINAGE AREA (acres)	570.3						

[a] PGIS = Pollution Generating Impervious Surface, the amount of area requiring water quality treatment BMPs. Includes existing and new surfaces.

[b] Basins SDN1, SDN2, SDN3, SDN4, NEPL, SDN6 flow to Lake Reba, which has a permanent pool volume that provides additional wetpool treatment not included in these calculations.

[c] SOURCE CONTROLS

SPC = Spill Control and Countermeasures Planning
SWP = Stormwater Pollution Prevention Planning (POS and Tenants)
SWE = Sweeping
CBC = Regular Catchbasin Cleanout
LND = Landscape Maintenance BMPs, including Integrated Pest Management

[d] These subbasins will be under the jurisdiction of the City of SeaTac. Source control operations would be performed by the City.

[e] BMP	Approx. Required Treatment/Acre
Bioswale	960 sf
Filter Strips	5,000 sf
Wetvaults	4,610 cf

4.5.1.1 Estimation of BMP Size Requirements Per Unit PGIS Area

For each type of BMP, size requirements were estimated for 1 acre of PGIS (Table 4-7) per the Basic Menu in the King County Manual. Runoff calculations and BMP sizing calculations for these estimates are described in Appendix E. Per the King County Manual, filter strips and bioswales were sized based on peak flows. For this analysis, they were sized for undetained runoff. When these BMPs follow a detention facility, their required size may be substantially smaller.

Table 4-7. Estimated BMP size per acre of PGIS.

BMP	Approximate Required Size Per Acre of PGIS
Filter Strip	5,000 ft^2 [a,b]
Bioswale	960 ft^2 [a,c]
Wetvault	4,610 ft^3

[a] For undetained runoff.

[b] Minimum filter strip length = 34.5 ft for 300-ft flow path; filter strip length and area changes with contributing flow path length.

[c] Area given is for bottom of bioswale. Including side slopes, bioswale area at 1.0 ft depth would be 1915 ft^2. However, where the unit size (960 ft^2) was used to evaluate existing bioswales, the bottom width of the existing bioswales was used, consistent with the area calculation used to estimate 960 ft^2. Where this area figure is used to estimate future bioswale area, planners should be aware that an additional 6 ft of width is necessary (assuming Z = 3, 3 ft needed on each side of bottom).

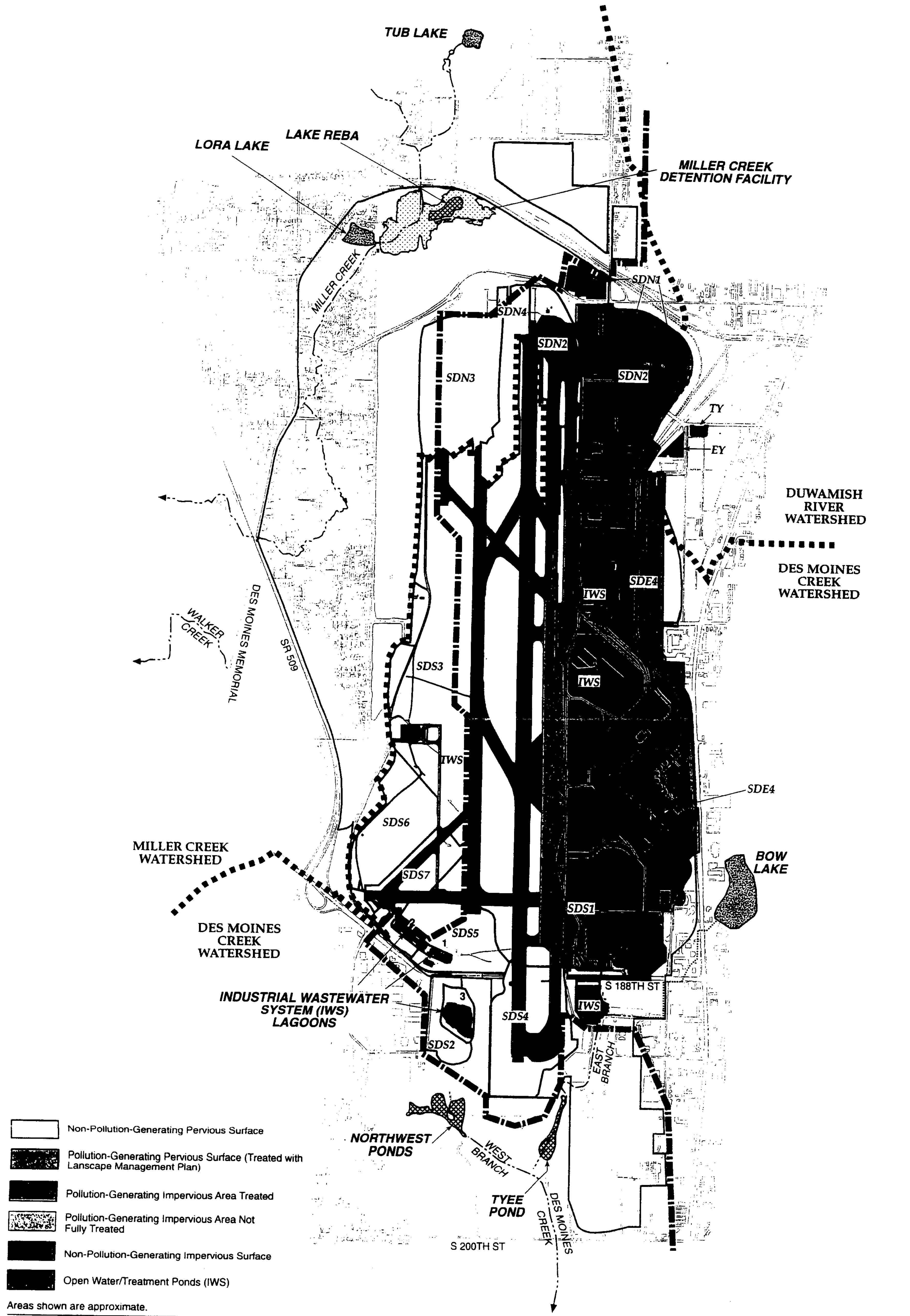
4.5.1.2 Subbasin PGIS Areas

Subbasin PGIS areas listed in Table 4-6 represent PGIS areas for subbasins as they will be configured upon completion of the Master Plan Update. PGIS areas were estimated for each subbasin by using a combination of GIS analysis and manual map and aerial photograph measurements to determine the amount of non-roof impervious area. For the purposes of this initial assessment, roof tops were assumed to be non-PGIS. However, as discussed in Section 7.4, roof tops will be inventoried and tested to determine their status as PGIS or non-PGIS.

4.5.1.3 BMP Inventory

The inventory of existing BMPs (Table 4-6) was developed using a combination of existing engineering plans, aerial photos, historical information, and direct observation and measurement. For example, for existing runway and taxiway drainage, cross-sections on original plans showed flowpaths passing over grassy strips before discharging to catchbasins in the grass infields. Although these original cross-sections were not available for all runways and taxiways, Port engineering staff (Rothnie 1999 personal communication) confirmed that all existing runways and taxiways are similarly configured.

Bioswales were conservatively assumed to be trapezoidal, 6-ft-wide at the base, 2-inch-deep flow (regularly mowed), with 3:1 side slopes. Upon completion of the inventory, consistency of BMP coverage with Ecology Manual requirements was assessed for each subbasin (Table 4-6 and Figure 4-4). In Table 4-6, if the "PGIS Treated" equals "PGIS" for a subbasin, that subbasin is compliant. If not compliant, the number of acres of PGIS requiring treatment is listed.



Sea-Tac Airport Stormwater Management Plan/55-2912-001/01(28) 6/01 (K)

Piped Stream

Approximate division between redevelopment area (east of line) and new development area (west of line)

Approximate Master Plan Projects Boundary

Drainage Basin Divide

Water Bodies

SCALE IN FEET
0 750 1,500

N

Sea-Tac Airport Drainage Basin Boundaries

Detention Facility (Existing)

SDS3 Sea-Tac Airport Drainage Basin Name

Constructed Water Feature

July 2001
556-2912-001 (28)

Figure 4-4
Water Quality Treatment for Existing Surfaces

4.5.2 SDS Water Quality

As required by its current NPDES Permit, the Port has monitored the stormwater quality from its SDS outfalls since 1995. Overall, the data show that the concentrations of various constituents in STIA stormwater are generally less than those in runoff from other residential, urban, and industrial areas in the region (Table 4-8). For example, the median concentrations for STIA constituents (column 3) are lower than those in urban stormwater (columns 5 and 6), with the exception of total recoverable copper. These data provide evidence for the efficacy of BMPs that have been implemented by the Port over a number of years. The following sections provide a brief description for each constituent category.

Table 4-8. Seattle-Tacoma International Airport runoff quality (1994-2000) compared to regional and national urban stormwater quality studies[a] (from Port of Seattle 2000b).

(1) Constituent	(2) Units	(3) STIA: RW/TW[b] (median)	(4) STIA: All Data (median)	(5) Bellevue: Sturtevant Creek[c] (log-normal median)	(6) Bellevue: BURP[e] (mean, median)	(7) King County: (Metro 1982) (mean)	(8) NURP[h]: (EPA 1983) (median)	(9) Portland NPDES[i] (median)	(10) Freeway Runoff (mean)
FOG	mg/L	0.5	1.0	3.7	2.5	7.8	–	–	30[f]
TPH	mg/L	0.08	0.3[j]	3.7	–	–	–	6.5	–
Fecal coliforms	mpn/ 100 ml	14	42	201	980	–	1000 to 21000	–	–
BOD	mg/L	5.0	6.0	–	6.6	–	9	20	–
TSS	mg/L	9	17	82.3	50	–	100	119	106[g]
Turbidity	mg/L	7	13	29.4	19	–	–	–	–
NH3[d]	mg/L	0.03	0.1	0.58	0.17	–	–	–	–
Cu (TR)	µg/L	26	25	10.4		20	34	40	43[g]
Pb (TR)	µg/L	1	4	26.3	170	210	144	25	466[g]
Zn (TR)	µg/L	34	69	161.4	120	110	160	376	638[g]

[a] "–" indicates no data available, reported, or applicable.

[b] RW/TW = runways/taxiways, represented by SDS3, SDS4, SDN3, and SDN4 subbasin data.

[c] From Bellevue (1996), Sturtevant Creek, downstream site.

[d] Ammonia values are expressed as total ammonia, not as ammonia-nitrogen. Data from 1998 Annual Report (Port of Seattle 1998b), the last year in which NH3 was reported.

[e] Bellevue Urban Runoff Program. From Pitt and Bissonnette (1984). For turbidity, Cu, Pb, and Zn, data reported as mean of grab samples; therefore, Bellevue (1996) data are better comparators because they represent median.

[f] Highway runoff in England (Booth and Homer 1995).

[g] Highway runoff from Interstate 5 freeway in Seattle with 57,000 automobiles per day, 43 to 54 storm samples in 1980-81 (Chui, et al. 1982).

[h] National Urban Runoff Program.

[i] City of Portland (1993).

[j] Results from NWTPH-Dx analyses since March 1998. NWTPH-Dx method replaced TPH (IR).

FOG = Fats, oil, grease

TPH = Total petroleum hydrocarbons

BOD = Biochemical oxygen demand

TSS = Total suspended solids

4.5.2.1 Metals and Hydrocarbons

Both Miller and Des Moines Creeks are affected by stormwater from the surrounding urban areas, including local streets and State Routes (SR) 518 and 509. Streets and highways are a source of heavy metals, such as lead and zinc, as well as hydrocarbons, such as gasoline and oil (EPA 1983). Metals sources also include tire wear, brake linings, exhaust fumes, and exterior metal products. Since there are few or no BMPs in place in the surrounding urban area to control runoff from these sources, SR 518, SR 509, and SR 99, and other roads and streets are expected to contribute significantly to the pollutant load of Miller and Des Moines Creeks.

Stormwater from STIA is also a potential contributor of hydrocarbons, oils and grease, and metals to both creeks. However, as Table 4-8 shows, concentrations of these pollutants in STIA's runoff are typically lower than those found in urban and highway runoff in Puget Sound. For example, the Port's 2000 Annual Stormwater Monitoring Report (Port of Seattle 2000b) indicated that more than 95 percent of the airport's petroleum-type pollutants in stormwater runoff were below levels found in urban runoff from other sources in the region. According to the report, 36 percent of samples collected since March 1998 have had TPH concentrations less than the detectable limit (Port of Seattle 2000b). Similarly, over 75 percent of the lead, copper, and zinc concentrations in airport runoff were below the median from the comparable regional data. In particular, it should be noted that copper and zinc concentrations have dropped significantly at outfall SDS1 since the rerouting of runoff from aircraft service areas from the SDS to the IWS in June 1997 (Port of Seattle 1999a).

4.5.2.2 Fecal Coliforms

Stormwater runoff from SDS subbasins typically contains fewer fecal coliforms than other urban stormwater. However, instream data collected by the City of Des Moines shows locally elevated levels of fecal coliforms under both storm and baseflow conditions. Although fecal coliforms are not a perfect indicator of contamination, they generally indicate the presence and magnitude of human and animal wastes. Microbial source tracing (MST; a genetic "fingerprint"-matching method) by King County found that bacteria from human sources dominated the identifiable strains of coliforms in the stream, especially downstream of residential areas serviced by septic systems (Des Moines Creek Basin Plan Committee 1997). However, source-tracing studies, including MST, performed by the Port since 1998 do not indicate sanitary sewage as a source of fecal contamination in storm or base flows (Port of Seattle 2000b).

4.5.2.3 Suspended Solids and Turbidity

During storm flow, turbidity and suspended solids in both creeks can increase as a result of runoff from surrounding urban areas and STIA, as well as from instream bank erosion and streambed scour. Median values of total suspended solids (TSS) and turbidity in STIA stormwater were less than values observed in comparable regional data in more than 80 percent of samples.

4.5.2.4 Nutrients

Data collected by the City of Des Moines indicate that septic systems are also a probable source of elevated nitrogen levels observed in Des Moines Creek after storm events (Des Moines Creek Basin

Plan Committee 1997). Other sources of elevated nutrients in the watersheds include fertilizers used on lawns, parks, and golf courses. Urea, a source of ammonia, was formerly used as a runway de-icer. The Port discontinued the use of urea by the end of 1996. Current data show that ammonia concentrations in STIA stormwater have decreased to background levels (Port of Seattle 1998b).

4.5.2.5 Temperature

During the summer months, water temperatures in Des Moines Creek can exceed the optimal upper temperature of 14°C for salmonid species and the water quality standard of 16°C (Des Moines Creek Basin Plan Committee 1997). The Des Moines Creek study also reported that water temperatures in Bow Lake and the Northwest Ponds exceeded the lethal limit for salmonids of 22°C, although these extreme temperatures were not observed farther downstream. More favorable downstream temperatures result from shading by riparian bank vegetation, inputs of cooler groundwater, and evaporative cooling. High temperatures have not been identified as a primary concern for Miller Creek (Parametrix 1996).

4.5.2.6 Dissolved Oxygen and Biochemical Oxygen Demand

In late summer, dissolved oxygen (DO) concentrations in the Northwest Ponds are periodically below the water quality standard of 9.5 mg/L for Class AA waters. These low DO levels are probably associated with a biochemical oxygen demand (BOD) caused by organic sediments and algae blooms combined with minimal wind and hydraulic mixing. Warm water temperatures and reduced baseflows during the summer months also contribute to low DO. However, DO does not appear to be a problem farther downstream because of re-aeration through weirs and riffled stream-bed areas (Des Moines Creek Basin Plan Committee 1997). During winter months, de-icing chemicals applied to runways and taxiways are a potential source of BOD and declines in DO to Lake Reba, Miller Creek, the Northwest Ponds, and Des Moines Creek. The Port has completed a study of the effects of runway de-icing on instream DO (Port of Seattle 2000c). The study documented fluctuating DO, with decreases in DO most directly related to the occurrence of dry periods. Changes in DO patterns attributable to de-icing chemicals were not distinguishable.

4.5.3 IWS Treatment Performance

As described in Section 4.2.2, the IWS collects, stores, treats, and discharges industrial wastewater. The IWTP is not a stormwater treatment facility. Treatment and discharge of industrial wastewater is permitted and regulated by the Port's NPDES Permit WA-002465-1 (Ecology 1998). The interim technology-based effluent limitations were set by Ecology using best professional judgement (BPJ), based on best conventional control technology (BCT) for stormwater runoff treatment in the Petroleum Refining Point Source category (40 CFR Part 419; the Port's treatment technology is the same as was used to develop the BCT limits for runoff treatment in this category).

The IWTP treats collected water by flash-mixing aluminum chloride into the influent water to flocculate particulates and oils, dissolved air flotation (DAF) to carry the floc to the surface, and a skimmer to remove the floated contaminants. IWTP effluent is monitored continuously for flow rate; weekly for pH, total suspended solids, and oil/grease; and monthly for BOD, glycols, and total petroleum hydrocarbons.

Since 1997, several improvements to the IWTP treatment process have been made, including (1) two new DAF units, (2) cleaning and lining Lagoons 1 and 2, (3) new DAF flow controls, (4) new aluminum chloride feed pumps, (5) a new effluent sampling system to allow "live" sampling, and (6) new pH monitoring and control equipment (Kennedy/Jenks 1998).

As demonstrated in the monthly Discharge Monitoring Reports (DMRs) submitted to Ecology, with the exception of one TSS excursion in summer 2000,[14] effluent water quality limitations have been met since November 1996 (for recent data, see Appendix N).

4.5.3.1 Oil and Grease Removal

King County's performance goal for treatment of runoff from high-use sites is 10 mg/L TPH (King County 1998). The Port of Seattle NPDES permit limitations for oil and grease are 8 mg/L (average monthly) and 15 mg/L (daily maximum). Based on NPDES monitoring data from April 1995 through January 1999 (reported in monthly discharge monitoring reports to Ecology), the average oil and grease concentration in IWTP effluent is 4.80 mg/L (less than the typical detection limit of 5.00 mg/L). Therefore, the IWTP exceeds the performance goal for treatment of runoff from high-use areas, and is compliant with NPDES permit limitations.

4.5.3.2 TSS Removal

The interim effluent limitations for TSS in IWS discharge are 21 mg/L (monthly average) and 33 mg/L (daily maximum). As with oil and grease, the IWTP was designed to remove TSS to meet these numerical criteria, as opposed to a criterion based on percent removal. As demonstrated in the monthly DMRs submitted to Ecology, these effluent water quality limits have been met since November 1996, with the exception of a TSS excursion due to atypical pumping and treatment necessary for Lagoon 3 construction activities (for recent data, see Appendix N). Current effluent data (January 1999-October 2000, representative of current treatment conditions after the above-described improvements were made) demonstrate an average IWTP effluent TSS concentration of approximately 12.7 mg/L.

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[14] A single TSS excursion occurred in Summer 2000, during an atypical event. Under current conditions, pumping Lagoon 3 completely empty would disturb sediment on the bottom of the Lagoon. Therefore, a small amount of water normally is allowed to remain in the bottom of the Lagoon. To allow for Lagoon 3 expansion construction, it was necessary to pump and treat this water. Algae concentrated in this small amount of water was sufficient to cause a TSS excursion. This excursion is a result of one-time operational conditions. Furthermore, cleaning and lining of the Lagoon will occur in 2001, inhibiting future algae growth.

5. PROPOSED MPU IMPROVEMENTS

5.1 SUMMARY OF PROPOSED IMPROVEMENTS

MPU improvements that would likely require stormwater management are summarized in Table A-3 (Appendix A). Also included in Table A-3 are the names of potential stormwater detention facilities that could serve the new MPU improvements. These facilities are described in more detail in Section 6.1.3.

The primary MPU improvements are shown in Figure 5-1. This figure shows the general extent of the major projects and proposed new impervious surfaces. Minor MPU improvements are not shown on this figure; these are primarily located in the terminal and air cargo redevelopment areas and generally do not create new impervious surface area draining to the SDS. Also, the SMP addresses only permanent projects.[15] These and other projects that may be developed to support needed infrastructure improvements will be evaluated for stormwater impacts based on criteria established herein to ensure that cumulative impacts are addressed. Updated information on all MPU improvements would be periodically incorporated into the SMP as necessary.

The Airport Surveillance Radar (ASR), which is being relocated as a result of other MPU improvements, was not evaluated with other MPU projects. It is located outside of the active STIA footprint on the west side acquisition area. Although total impervious area on the site will decrease from 1994 to 2006, effective impervious area (EIA) will increase. Level 2 flow controls will be provided to meet the target flow regime discussed in Section 2.1.3 (the predeveloped condition is adjusted to assume 75 percent forest; the 3 percent EIA is less than 10 percent and is unadjusted; the remainder is grass). The site will be accessed only for infrequent maintenance and repair (no more than four times per week), thus will not have PGIS. See Appendix Y for discussion of hydrologic analysis and flow controls and Section 7.1.2.5 for discussion of water quality.

MPU improvements in Table A-3 (Appendix A) are based on project scheduling developed in late 1998, and will likely change as project priorities change and schedules are further refined. In general, projects not assigned a construction start and end date have not been scheduled, other than being assigned to one of the four MPU phases (i.e., Phase I, II, III, and IV).

5.2 LAND USE CHANGES

To determine the future land use characteristics of the airport property, available data on current MPU improvements were compiled into a GIS database to allow the calculation of pervious and impervious areas. The GIS database was also used to calculate changes in soil types and vegetation cover. These data were then incorporated into the HSPF modeling analysis, as discussed in Section 4.4.1. Figure 4-2 illustrates the 1994 land use condition and Figure 4-3 depicts drainage subbasin boundaries prior to 1994.

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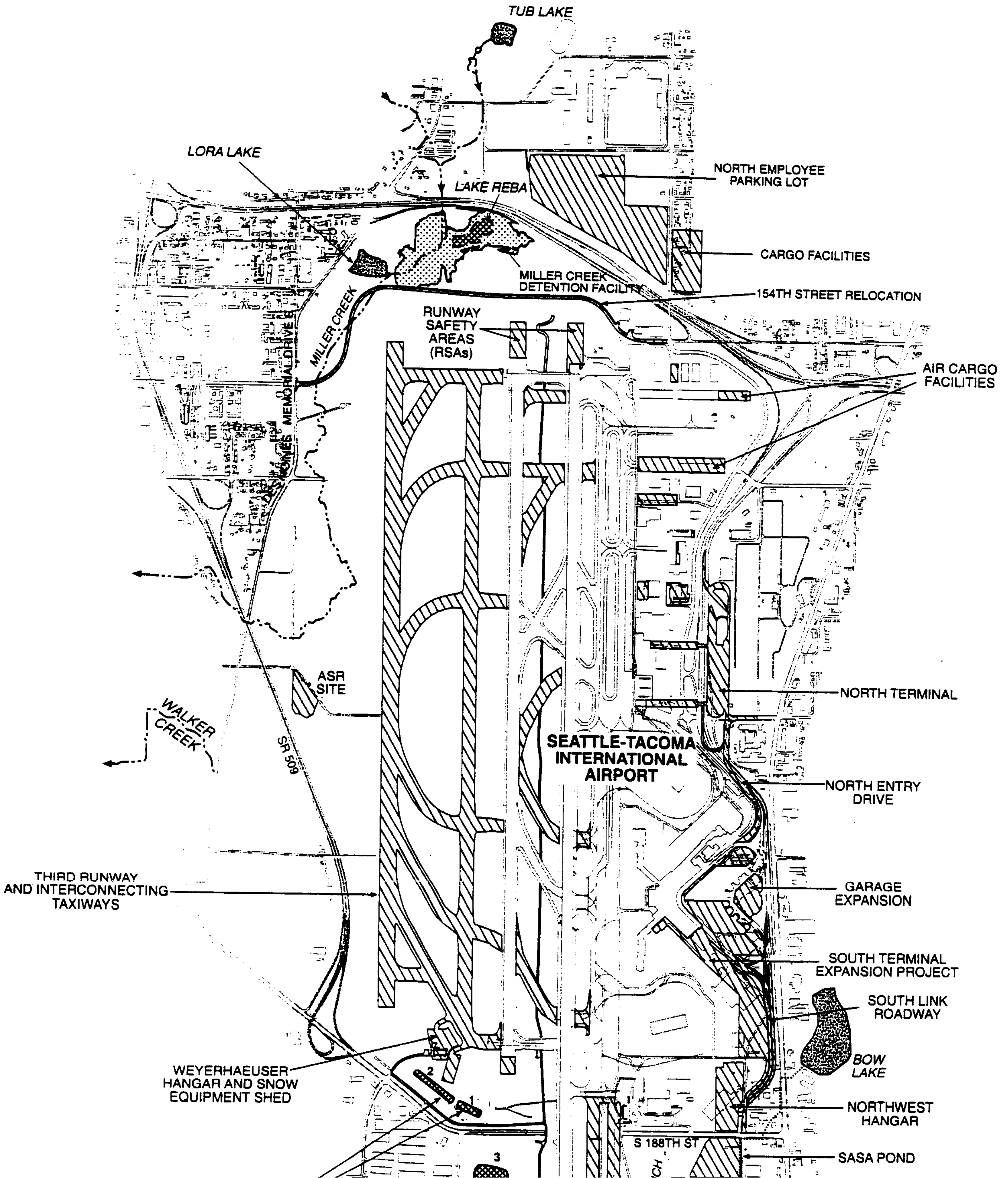
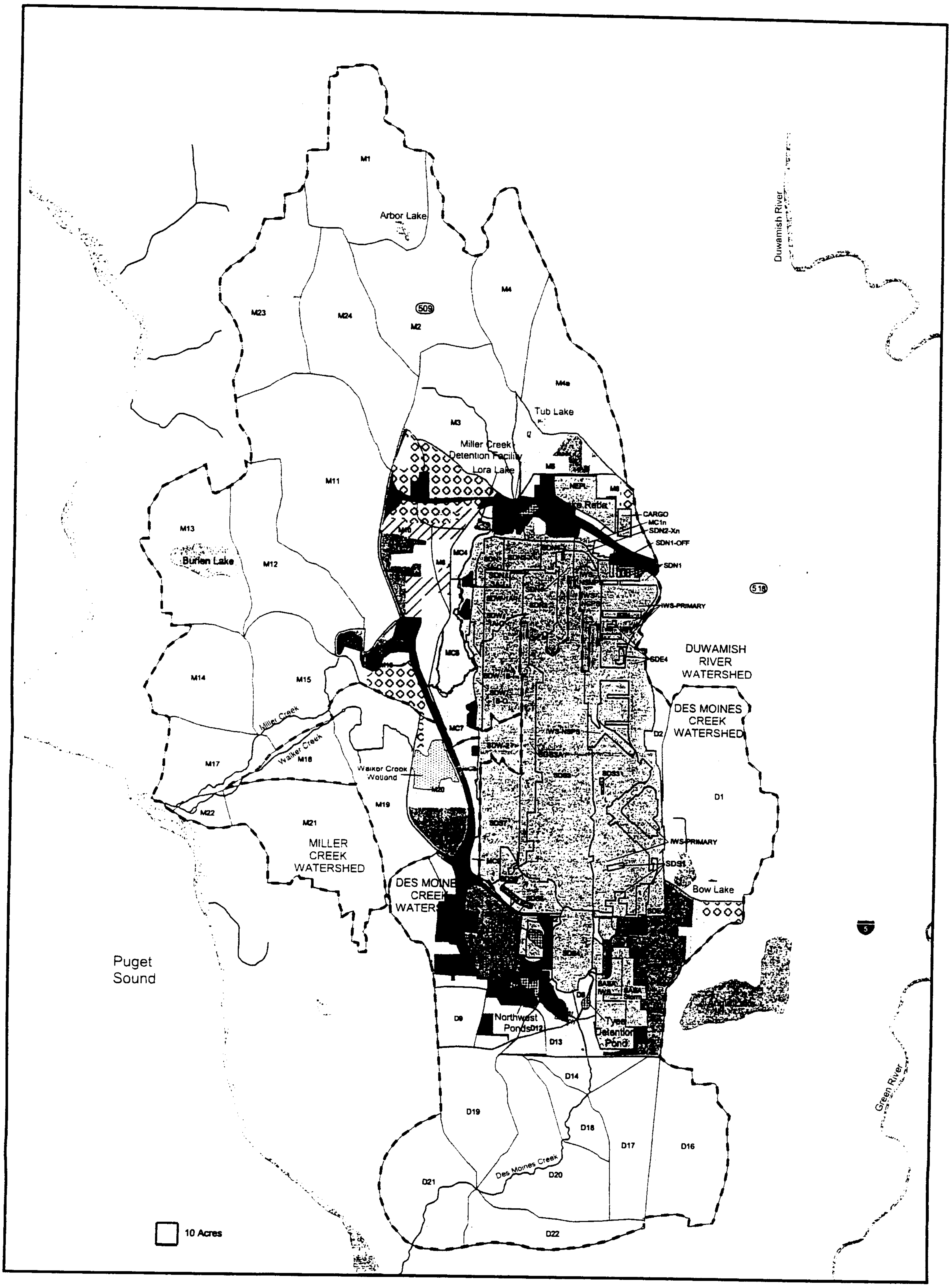
[15] The SMP addresses permanent projects. The SR 509 temporary interchange project was not evaluated as an MPU project in the SMP. However, temporary stormwater impacts from the SR 509 interchange are being evaluated by King County under separate cover (HNTB 2000).


TUB LAKE
LORA LAKE
LAKE REBA
NORTH EMPLOYEE PARKING LOT
CARGO FACILITIES
MILLER CREEK DETENTION FACILITY
154TH STREET RELOCATION
MILLER CREEK
DES MOINES MEMORIAL DRIVE S
RUNWAY SAFETY AREAS (RSAs)
AIR CARGO FACILITIES
ASR SITE
WALKER CREEK
SR 509
NORTH TERMINAL
SEATTLE-TACOMA INTERNATIONAL AIRPORT
NORTH ENTRY DRIVE
THIRD RUNWAY AND INTERCONNECTING TAXIWAYS
GARAGE EXPANSION
SOUTH TERMINAL EXPANSION PROJECT
SOUTH LINK ROADWAY
BOW LAKE
WEYERHAEUSER HANGAR AND SNOW EQUIPMENT SHED
NORTHWEST HANGAR
S 188TH ST
SASA POND
1
2
3



Parametrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File: K:\Gis\2912\Arcview\rseatac-apoxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Estimated wetland boundaries are based on field reconnaissance by Parametrix, Inc. Land use data interpreted from 1993 STIA aerial photograph (Walker and Assoc. 1993).
Note Subbasin boundaries shown outside of STIA area are for illustration and reference only.

July 2001
556-2912-001 (28)

N

1000 0 1000 2000 Feet

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Roads
Future (2006) Drainage Subbasins
STIA Area (see note)
Watershed Boundary
Subwatershed Boundary
Rivers
Water Bodies
Constructed Water Features
Detention Facilities (existing and proposed)
Sea-Tac Airport
Commercial
Open/Grass
Transportation
Low Density Residential
High Density Residential
Multi-Family Residential
Forest

Figure 5-2
STIA Drainage Subbasins and 2006 Land Use

AR 046424

5.2.1 Future Land Use

Figure 5-2 illustrates the land use condition and drainage subbasin boundaries after MPU improvement build-out, estimated at this time to occur in about 2006. Changes in land use are based on the available design layouts of those projects currently under design or construction (e.g., the Third Runway, associated taxiway, and the garage expansion). The layout for the remaining MPU improvements is based on preliminary design data and the Airport Layout Plan. This includes the SASA in the southeast corner of the airport, the north and south terminal expansions, new cargo facilities in the air cargo area and north of SR-518, the relocated Northwest Hangar, the South LINK roadway, and other miscellaneous projects.

The drainage basin boundaries under the build-out condition (Figure 5-2) will be similar to the baseline (1994) drainage boundaries (Figure 4-3). However, minor changes to the boundary resulting from newly constructed drainage systems for the Third Runway and parallel taxiway, and improvements to the existing system in the vicinity of redevelopment projects will occur. However, future development will not change the total amount of airport area draining to Miller, Walker, and Des Moines Creeks (i.e., the Miller, Walker, and Des Moines Creek basins gain or lose less than 1 acre of drainage area to each other).

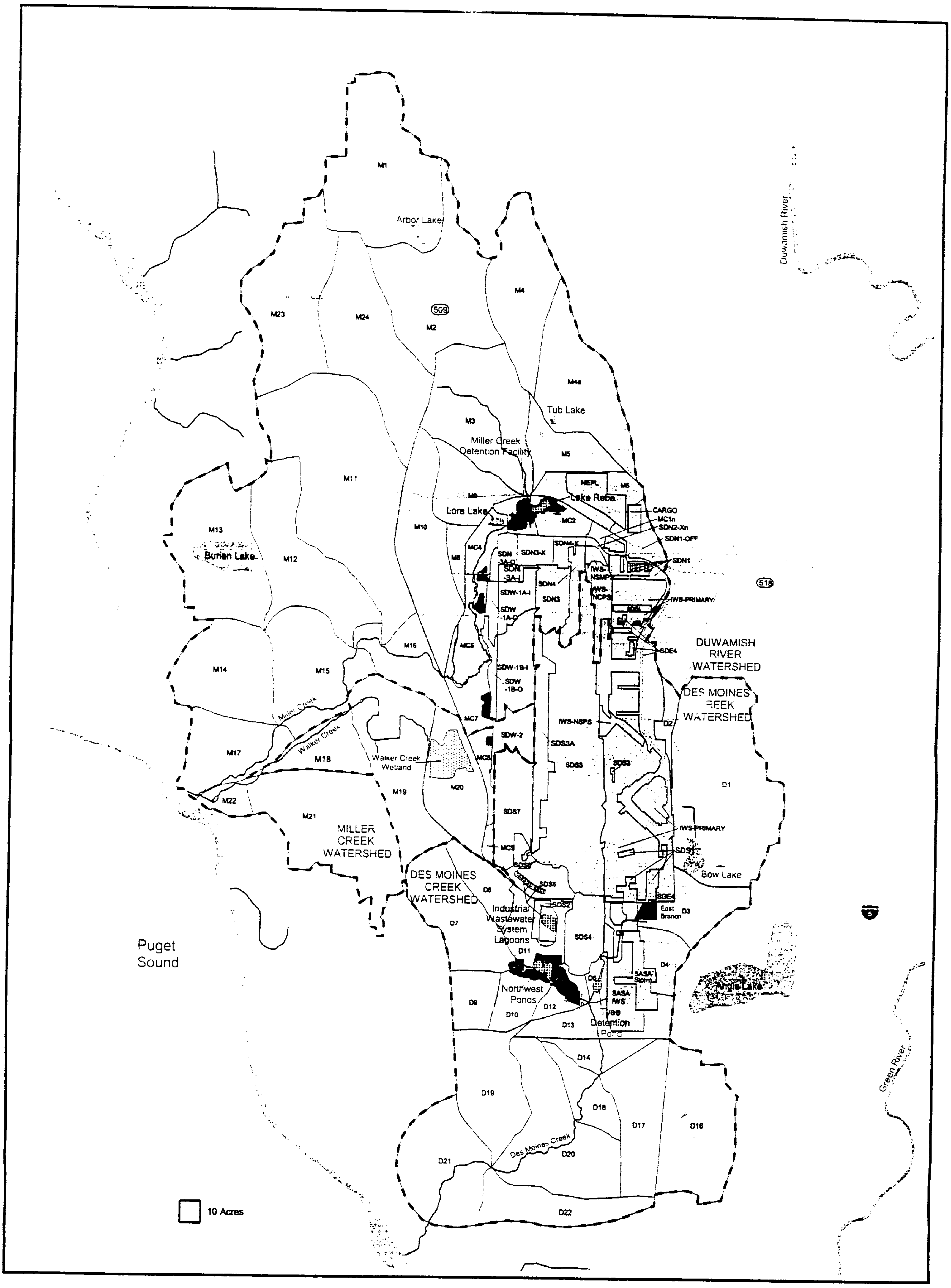
For the Third Runway acquisition area, located west of 12th Avenue South, it was assumed that houses would be removed and only the primary streets would remain (streets would be used only for emergency and maintenance access). With the exception of the ASR site, potential future commercial development of that area is not part of the MPU and therefore was not evaluated.

Under the future condition model, only the airport land use changes; the remainder of the watershed remains identical to the 1994 base year. (A review of the areas upstream shows little available land for development not controlled by the Port. In addition, existing stormwater management standards and proposed RDF should be adequate to address impacts.)

5.2.2 Changes in Impervious Area

Future impervious area is depicted in Figure 5-3 and enumerated in Table 4-1. Approximately 106 acres (net) of new impervious surface area will be created in the Miller Creek watershed, approximately 6 acres will be added in the Walker Creek watershed, and approximately 128 acres will be created in the Des Moines Creek watershed. In the Miller Creek watershed, most new impervious surface area will be from the Third Runway, associated taxiways, and the NEPL. In the Walker Creek watershed, new impervious area will be attributable to the Third Runway and associated taxiways. In the Des Moines Creek watershed, most new impervious surface area to Des Moines Creek will be from the Third Runway, associated taxiways, and the SASA parking and roof drainage.

An additional 111 acres of impervious area will be added to the IWS, either by rerouting existing impervious areas currently in the SDS (e.g., terminal areas) or by constructing new impervious areas (e.g., SASA).



Parametrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File:K:\GIS\2912\Arcview\rrseatac_apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Detention boundaries estimated by Parametrix, Inc.
Impervious surface data interpreted from 1993 STIA aerial photograph (Walker and Assoc. 1993).
Note: STIA Subbasin GIS coverage obtained where conditions may change between 2006 base conditions and other conditions; subbasin boundaries shown outside of STIA area are for illustration and reference only.

July 2001
556-2912-001 (28)

N

1000 0 1000 2000 Feet

1:36,000

Roads

Future (2006) Drainage Subbasins

STIA Area (see note)

Watershed Boundary

Subwatershed Boundary

Rivers

Water Bodies

Constructed Water Features

Detention Facilities (existing and proposed)

Impervious Areas

Figure 5-3
STIA Subbasins Future Impervious Areas

AR 046426

6. HYDROLOGIC MODELING OF FUTURE CONDITIONS AND STORMWATER QUANTITY MANAGEMENT

6.1 HYDROLOGIC MODELING

6.1.1 Model Development

For the hydrologic analysis of future conditions after completion of the MPU improvements, the Miller, Walker, and Des Moines Creek HSPF models were enhanced to reflect changes in impervious areas and drainage basin boundaries in the STIA subbasins. Existing and future impervious areas associated with the proposed MPU improvements are shown on Figure 5-3, and the revised drainage basin boundaries are shown in Figure 5-2.

6.1.2 Detention Options

The stormwater detention options for STIA MPU improvements are:

- New stormwater detention vaults;
- New stormwater detention ponds; and
- Expanded existing detention ponds.

6.1.2.1 New Stormwater Detention Vaults

A stormwater detention vault is a large, reinforced concrete containment structure. Normally, vaults are constructed underground. Vaults have advantages in that they can be constructed with only minimal conflicts with existing land uses; they do not create a wildlife attractant hazard; and they can be built concurrently with construction of the MPU improvement they intend to serve. The Port recently constructed a 4.0 acre-ft vault at the NEPL and a 5.9 acre-ft vault to serve the 1998-99 taxiway project.

The disadvantages of underground vaults are that they are expensive; they provide little economy of size when structures exceed a few acre-ft in volume; and maintenance is more difficult within the confined space of the vault.

6.1.2.2 New Stormwater Detention Ponds

A stormwater detention pond is created by excavating a depression or creating a berm (or a combination thereof). The pond outflow is controlled by an outlet structure with a series of vertically-arranged orifices.

Ponds have advantages in that they are relatively inexpensive to construct, with construction mostly consisting of earthwork and an outlet structure. With regard to construction, they are particularly economical for large-scale applications. Ponds are open, allowing for easy maintenance. The disadvantages of detention ponds is that they generally preclude other use of the land that they occupy. Also, near STIA they create a wildlife attractant, which must be controlled with netting and other deterrents.

6.1.2.3 Expanded Existing Detention Facilities

Several options exist for expanding the existing detention ponds serving STIA - the Miller Creek Detention Facility and Northwest Ponds. Table 6-1 summarizes the potential for expanding these facilities.

Table 6-1. Existing detention ponds serving Seattle-Tacoma International Airport with potential for expansion.

Facility	Current Active Storage Volume (acre-ft)	Maximum Expanded Storage (acre-ft)
Miller Creek Detention Facility		
Existing	68.0	68.0
Site 1	–	24.0
Site 2	–	16.4
TOTAL	**68.0**	**108.4**
Northwest Ponds		
Existing	16.9	–
Proposed RDF	–	180
TOTAL	**16.9**	**180**

6.1.2.4 Expanded Miller Creek Detention Facility

The expansion of the Miller Creek Detention Facility would require enlarging the existing live storage volume, and the existing gate opening area may need to be adjusted to gain the full detention benefits from the new storage. No expansion for MPU projects is proposed; future expansion alternatives may be evaluated that reduce the sizes of detention facilities proposed in the SMP.

Figure D-3 (Appendix D) illustrates where excavation would occur. Wetlands in the area would be avoided. To avoid increasing wildlife attraction to the area, the area of pond expansion would be designed as a free-draining (no standing water) facility.

6.1.2.5 Expanded Northwest Ponds

The Port is currently working with King County to design and construct a regional detention pond at the Northwest Ponds, located at the head of the west branch of Des Moines Creek (Des Moines Creek RDF). The Des Moines Creek Basin Plan determined that up to 180 acre-ft of detention storage can be developed at that site. The basin plan includes diverting water from the detention pond to an abandoned sewerline for direct discharge to Puget Sound. The Port is actively working with the County as a plan participant to implement that project (the Port has been responsible for funding 40 percent of the plan). The facility would reduce existing peak flood impacts in the Des Moines Creek basin.

Flooding in the Tyee golf course would be substantially reduced by the proposed regional pond because the West Branch of Des Moines Creek would be rebuilt to improve flow and reduce over-bank flooding. Areas of expanded detention storage within the facility would be planted with shrub-scrub vegetation intended to deter use by waterfowl.

6.1.3 Estimated Detention Storage

Proposed stormwater detention facilities for the MPU were designed based on the drainage area served by each facility, the detention standard, the detention storage volume required to meet the flow control standards, and potential for waterfowl attraction. As shown in the following sections, proposed storage volumes were designed to prevent increases in flood frequency and flow duration.

Approximately 344 acre-ft of new stormwater detention storage (see Table 6-2) will be needed to mitigate the impacts of increased stormwater runoff associated with MPU projects. The locations of new facilities are shown in Figure 6-1.

Further refinement of stormwater detention storage volumes will occur during the final design of the Stormwater Management Improvements for each MPU project. During this process the hydraulic design of the facilities will be reevaluated and detention volumes adjusted as appropriate to ensure that the Port's stormwater management standards are met as described in Section 2.1.4 (pg. 2-4) and Section 2.2.2 (pg. 2-6) of this document. Hydraulic design reports for each proposed facility will document these detailed modeling and design analyses.

6.1.4 Water Quality of Stormwater Stored in Vaults

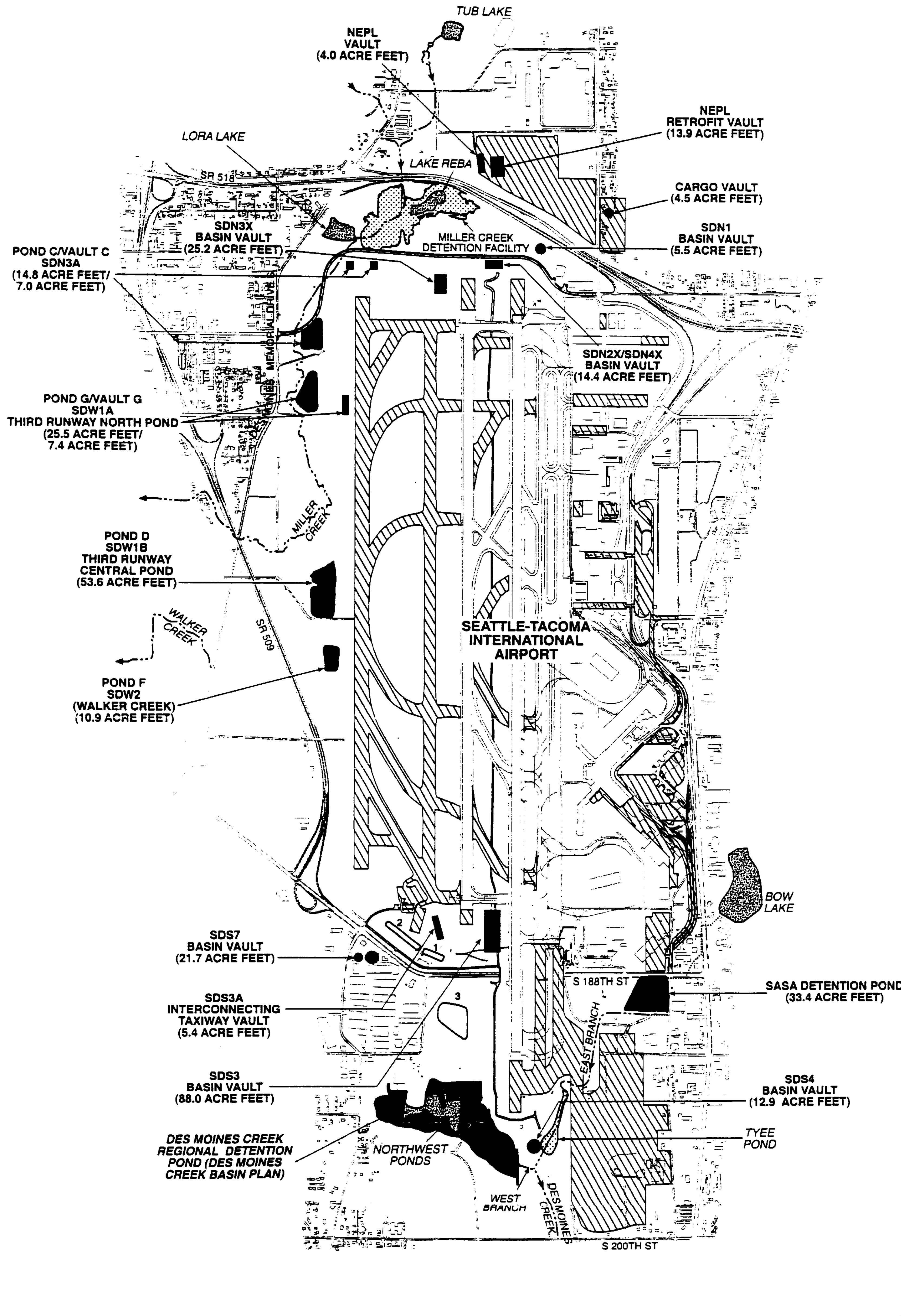
Stormwater may be stored in vaults for periods of weeks or months (this may apply to water detained for long periods due to low target release rates or to water retained during the winter for low stream flow support during the dry season). Storage for long periods may result in low dissolved oxygen (DO) concentrations. However, dissolved oxygen is not expected to be reduced to anoxic levels, because (1) median BOD in runway/taxiway runoff is only 5 mg/L (see Section 4.5.2), (2) vault storage would preclude the growth of algae, which would consume dissolved oxygen (however, microbial activity could consume oxygen), and (3) water stored in vaults will remain cool, allowing a higher saturation level and slowing microbial activity. Furthermore, stormwater will be released via small orifices, and in most cases, must flow in channels or pipes for a considerable distance before reaching the receiving water; these conditions which will induce turbulence and reaeration before water reaches the receiving waters. No additional design features are expected to be necessary to treat water stored or released from vaults.

6.2 STORMWATER QUANTITY MANAGEMENT

6.2.1 Low Stream Flow Impacts and Mitigation

6.2.1.1 Predicted Low Stream Flow Impacts

The hydrologic analysis of potential impacts of the STIA MPU improvements on Miller and Des Moines Creeks was originally presented in the MPU EIS. That EIS analysis was based on studies conducted in 1995.



Sea-Tac Airport Stormwater Management Plan/556-2912-001/01(28) 7/01 (K)

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Water Features

Proposed Stormwater Detention Facilities (With Simulated Maximum Storage Volume)

Master Plan Projects

Creek

Piped Creek

Detention Facility

SCALE IN FEET
0 750 1,500

N

Figure 6-1
Proposed Detention Facilities for Master Plan Projects

Table 6-2. Summary of required detention facility volumes.

Watershed	Hydrologic Evaluation Point	Volume Required (acre-ft)	Type of Facility[a]	Comments
Miller Creek	NEPL	13.9 [b]	Vault	In addition to existing 4 acre-ft
	CARGO	4.5	Vault	
	SDN2x + SDN4x	14.4	Vault	
	SDN3/3x	25.2	Vault	
	SDN1	5.5	Vault	
	SDN3A	Pond: 14.8 / Vault: 7.0	Pond/Vault	
	SDW1A	Pond: 25.5 / Vault: 7.4	Pond/Vault	Infiltration used
	SDW1B	53.6	Pond	Infiltration used
Total Miller Creek		**171.8**		
Walker Creek	**SDW2**	**10.9**	**Pond**	
Des Moines Creek	SASA Detention Facility	33.4 [c]	Pond	
	Interconnecting taxiway (SDS3A)	5.4	Vault	
	Third Runway South (SDS7 and 6)	21.7	Vault	
	SDS3	88.0	Vault	
	SDS4	12.9	Vault	
Total Des Moines Creek		**161.4**		

a Types of facilities: Vault – enclosure with multiple orifice outlets on vertical riser with overflow spillway; Pond – open earth construction with netting or other means to provide wildlife deterrent.

b Volume needed to retrofit existing facility.

c Retrofit STIA area only.

Modeling conducted in 2000 presented a more comprehensive evaluation of the potential low stream flow impacts in Miller, Des Moines, and Walker Creeks from the planned STIA improvements. The *Low Streamflow Analysis for Seattle-Tacoma Master Plan Update* (Earth Tech 2000) contains detailed information and references for this work. This analysis was revised in 2001; results of the update are provided in the revised *Low Streamflow Analysis* report and therefore are not included in the SMP.

6.2.1.2 Infiltration Facilities

Ecology has indicated that infiltration is the highest priority for stormwater control, provided that proper soil conditions exist and groundwater quality is protected. The Port has reviewed the feasibility of providing infiltration facilities for stormwater management to determine opportunities to minimize the potential effect of new impervious surfaces on low stream flows in Miller, Walker, and Des Moines Creeks.

The locations of stormwater management facilities discussed in the previous sections were selected based on hydrologic and hydraulic conditions (i.e., the sites are downstream of development to mitigate peak flows prior to discharge to surface water). These sites were further analyzed for their feasibility as infiltration sites (see Appendix F).

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The Ecology and King County Manuals provide design guidance for stormwater infiltration facilities. The Port's policy on wildlife attractant hazards at open-water facilities imposes additional constraints on the design and location of infiltration facilities. In general, the following conditions must exist for infiltration to be further considered:

- Site soils must have natural infiltration rates that meet the minimum requirements specified in the King County Surface Water Design Manual;
- No potential can exist for impacts caused by infiltrated stormwater, such as increased water to landslide areas or fill slopes, increased water effects in nearby closed depressions, and higher groundwater levels that may cause flooding;
- The water table must be sufficiently below the bottom of the infiltration facility (minimum 3 ft, verified by wet season monitoring) to provide adequate infiltration rates during prolonged storms; and
- Long periods of open standing water must not exceed the Port's policy on preventing wildlife attraction (see Section 3.1.2).

Site Investigations

Based on the location of detention ponds C, D, and G, three immediately adjacent sites (defined as Infiltration Areas 1, 2, and 3; see Appendix F) were identified as potential sites for infiltration of water discharged from the detention ponds and/or vaults on the airfield. The footprints of detention ponds C, D, and G were also considered for potential infiltration capacity (see Figure 6-1). In addition, infiltration testing was conducted at and adjacent to the site of Pond F (Walker Creek watershed). Infiltration testing was conducted along with collection of soils and groundwater data to establish the feasibility of infiltration in these areas. Again, infiltration facility requirements were established based on those contained in the King County Surface Water Design Manual.

Infiltration Areas 1 and 3 were found to be suitable for stormwater infiltration. Infiltration Area 2 and Pond G were deemed unacceptable due to low permeability soils and/or high groundwater levels. Ponds C and D were also deemed unacceptable based on the presence of groundwater seepage. The Pond F site and adjacent area north of Pond F was deemed unacceptable for stormwater infiltration due to saturated till conditions. Additional information on the site investigations is provided in Appendix F.

Infiltration Rates

The soils in both Infiltration Areas 1 and 3 were characterized as silty fine to medium sands. The locations tested exhibited moderate to high infiltration capacities. Specifically, Area 1 capacities ranged from 4.6 to 20.4 in/hr; Area 3 capacities ranged from 0.94 to 7.5 in/hr. Assuming a nominal 400 lineal ft of an 8-ft wide infiltration trench for both areas, and design infiltration rates of 4.2 in/hr and 2.7 in/hr respectively, Area 1 can be expected to infiltrate 0.30 cfs of stormwater, and Area 3 can be expected to infiltrate 0.20 cfs of stormwater. Additional information on site tests can be found in Appendix F.

Wildlife Attraction

As previously stated, the Port has established a policy restricting the duration of open water at stormwater detention facilities to 24 hours following a 2-year runoff event. Because infiltration facilities must retain water within the facility to allow water to infiltrate into the ground, the duration of water storage in an infiltration facility could be much greater than that in a detention pond. Therefore, infiltration facilities present a greater design challenge. To create an infiltration facility that meets the Port's policy on wildlife attractants, infiltration ponds would need to be covered with a permanent net or structural cover, or constructed in vaults or trenches.

6.2.1.3 Acquisition of Water Rights on Miller Creek

As a mitigation measure to offset potential baseflow impacts, the Port will cease the exercise of existing water rights along Miller Creek, thereby eliminating these withdrawals and improving baseflows. These surface water rights will be acquired during private property acquisition along Miller Creek for the Third Runway project. These surface water rights were originally issued to allow property owners to divert flow from Miller Creek for domestic use, lawn and yard watering, and irrigation. The detailed analysis of the benefits of ceasing withdrawals from the creek is provided in Appendix G.

Based on water rights records obtained from Ecology, at least 17 residential properties, and one farm property with recorded surface water right certificates or claims exist along Miller Creek. Properties with water right permits or certificates can legally divert water from Miller Creek. Five additional farm properties below Lake Reba were also identified that could potentially divert water from Miller Creek but for which a registered water right or claim could not be found. Nevertheless, it was initially assumed that all of these properties could actively divert surface water from Miller Creek, thereby creating an impact to baseflows. However, in an attempt to verify this assumption, individual property owners were contacted to ascertain their actual water withdrawal practices from Miller Creek. Nineteen of the 23 property owners responded. The majority of these did not withdraw any water from the creek, regardless of their right to do so. For the four non-respondents, water withdrawal rates were estimated based on property size and potential water use.

Using this information and the stated assumptions, the estimated total quantity of water withdrawn by the identified water rights holders and other users was estimated to be 0.042 cfs.

6.2.1.4 Baseflow Augmentation in Des Moines Creek

The 1997 Des Moines Creek Basin Plan recommended that a well and pump system be constructed near South 200th Street to mitigate existing low baseflow impacts in Des Moines Creek (Des Moines Creek Basin Committee 1997). The flow augmentation to the stream would help the existing poor water quality conditions in the stream during the late summer, when low flow rates contribute to elevated temperatures and lowered dissolved oxygen levels.

The water for this project will come from an existing Port-owned well located within the Tyee Valley Golf Course. Cool, high quality water from a deep aquifer will be drawn from the well and aerated by discharging it onto a rock pile before it enters the stream. This water should improve the current water quality conditions in the stream and may also improve downstream fish habitat conditions. The basin plan recommended that the augmentation system supply up to 400 gpm (about 0.8 cfs) of water from the well to the stream for several weeks during the normal summer low-flow period.

Streamflow data recorded in 1996 and 1997 (King County 1997) indicate that late summer flow rates in the stream below the confluence of the east and west branches drop to about 0.3 to 0.5 cfs. Based on a potential well supply of 0.8 cfs, flow augmentation should prevent streamflow levels from dropping below 1.0 cfs.

The baseflow augmentation system would probably be operated by an automated stream gage on Des Moines Creek at the location where King County currently operates a gage. The County gage is located at a concrete weir a short distance north of South 200th Street. Permanent instrumentation would be installed at that site to operate the flow augmentation system. The pump system would be turned on when the streamflow drops below 1.0 cfs. The system could also be set to pump cool groundwater to the stream when temperatures exceed a critical level. Initially, the critical water temperature would be set at 19°C, which was about the maximum water temperature in lower Des Moines Creek in 1996 (upper Des Moines Creek reached 20.5°C). The pumping rate would have different levels so that flow augmentation could be ramped up as the streamflow drops or as the temperature increases. Additional streamflow measurements should be conducted to confirm the late summer flow rates, and tests should be conducted after the facility is installed to evaluate the benefits of different pumping rates on instream temperature and dissolved oxygen levels.

The Des Moines Creek Basin Committee will be responsible for implementing the plan, as provided in the Des Moines Creek Basin Plan. However, the Port will work with the Des Moines Creek Basin Committee to ensure that the flow augmentation project is implemented once the Section 401 Water Quality Certification for the Third Runway is issued. Ecology has indicated its support of this project.

6.2.2 Retrofit of Stormwater Detention for Existing Airport Areas

As previously discussed, stormwater impacts from existing airport areas will be mitigated by proposed detention ponds and vaults. In addition, the entire airport will be retrofit to the theoretical basin development condition with the proposed detention facilities. However, the Port will continue participation in constructing regional stormwater detention facilities. Miller Creek Detention Facility expansion and the proposed Des Moines RDF would reduce peak flows and durations, and achieve stable and non-degrading flow regimes in Miller and Des Moines Creeks. If the facilities are expanded (MCDF) or constructed (RDF), the Port would reduce detention volumes to meet the Enhanced Level 1 or other applicable standard. Regional detention facilities provide stormwater detention storage needed to retrofit the airport to pre-developed conditions (as defined in Section 2.1).

6.3 CONSTRUCTION SCHEDULE

The MPU improvements would be constructed over a period of approximately 10 years. The goal of the scheduling analysis is to verify that stormwater detention requirements for the MPU improvements are met during the period of MPU development. Prior to build-out, some MPU improvement projects may be built before certain stormwater detention facilities are in place. Thus, MPU improvement project implementation must be tracked on a yearly basis to verify that individual projects do not cause peak flows to increase at the stormwater outfalls, and to approximately schedule the construction of stormwater detention as needed.

Table A-3 in Appendix A shows the schedule of required start and completion dates of the principal MPU improvements that will require stormwater detention, the stormwater detention facilities that will serve those projects, and estimated dates when detention facilities would be required to be on-line. This schedule identifies when the stormwater detention facilities should be constructed so that MPU improvements have the detention available at the appropriate time. Construction of these facilities must be phased such that they are on-line before construction commences on the new impervious areas they would serve. Since multiple MPU improvements could be served by a single detention facility, certain detention facilities may need to be constructed several years before construction begins on the principal MPU improvement slated to use that facility.

6.4 OTHER KING COUNTY MANUAL REQUIREMENTS

6.4.1 Flood Analysis

The MPU improvements encroach into the 100-year floodplain in two locations on Miller Creek: the Vacca Farm restoration site and the MSE Wall location. At the Vacca Farm, Miller Creek will be relocated and 8,455 cubic yards of floodplain storage will be displaced with fill for the relocated 154th Street. This lost storage will be mitigated by excavating 9,589 cubic yards of new floodplain. The effects on 100-year flood elevations are discussed in detail in Appendix J. No floodplain impacts have been identified at Vacca Farm or at the proposed MSE wall site (Appendix J).

6.4.2 Downstream Analysis Impacts

Evaluation of downstream analysis impacts for Miller, Walker, and Des Moines Creeks are discussed in Appendix P.

6.4.3 Conveyance System

Proposed stormwater conveyance figures are included in Appendix Q. These design drawings are subject to revision as the SMP if further refined and designs of MPU improvements and stormwater facilities are finalized. Energy dissipation design criteria and parameters are included in Appendix W.

6.4.4 Restricting Public Access to Ponds with Steep Slopes

The airport's perimeter security fence will restrict public access to stormwater ponds. Ponds not included in the airport's security area will have slopes less than 3:1 or will be fenced.

7. FUTURE STORMWATER QUALITY

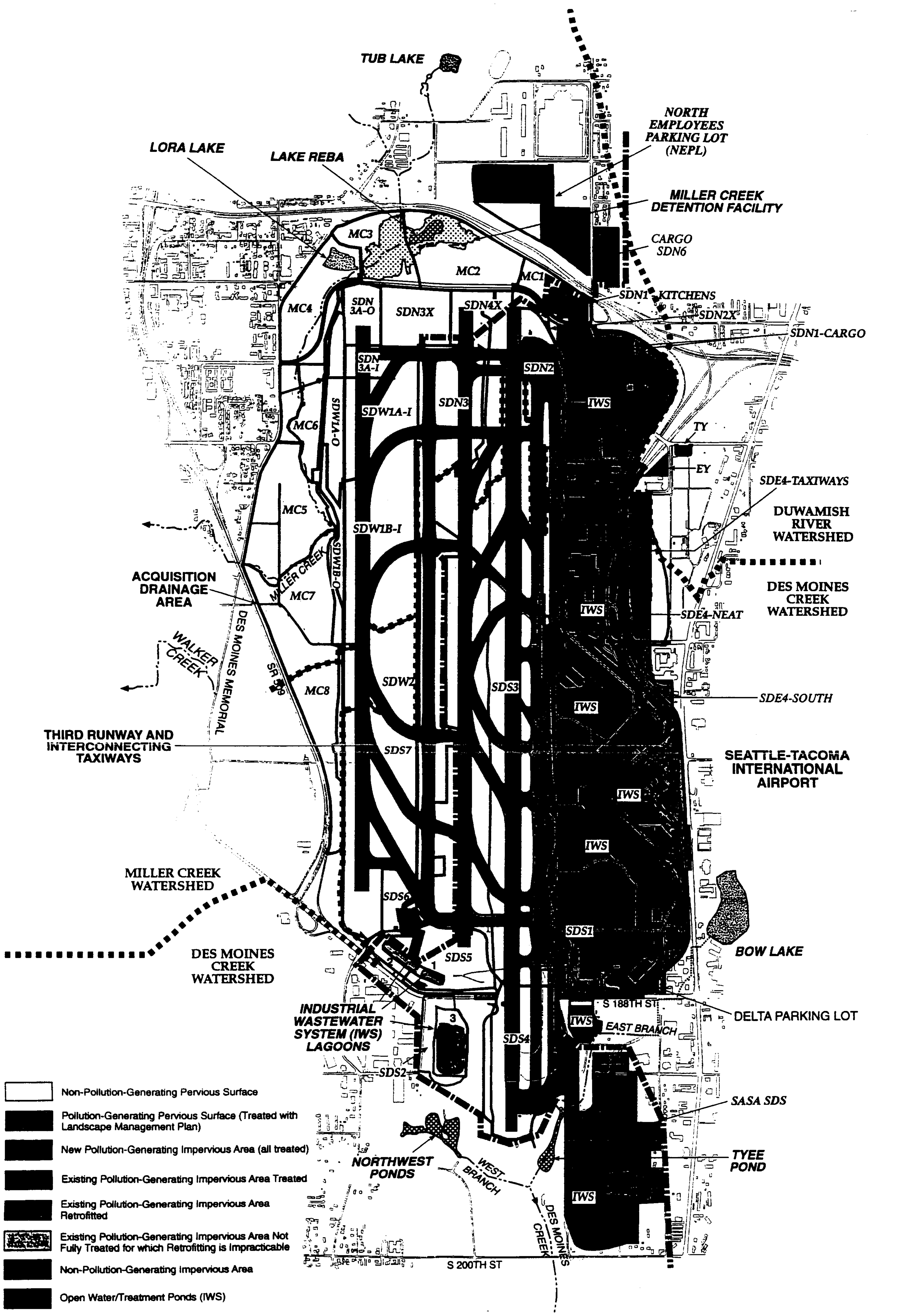
This section discusses structural and nonstructural treatment BMPs for pollution-generating surfaces as they will be configured under future conditions. For purposes of this discussion, the areas and BMPs are organized as follows:

- Structural BMPs for SDS pollution-generating impervious surfaces: Section 7.1;
  - New development impervious surfaces: Section 7.1.1
  - Redeveloped surfaces: Section 7.1.2
  - Existing areas in compliance: Section 7.1.3
  - Retrofitted surfaces: Section 7.1.4
  - Existing surfaces not practicable for retrofitting: Section 7.1.5
- Non-pollution-generating impervious surfaces: Section 7.3;
- Roof Tops: Section 7.4;
- Industrial Wastewater System: Section 7.5; and
- Pervious Surfaces: Section 7.6.

7.1 STORMWATER DRAINAGE SYSTEM WATER QUALITY TREATMENT BMPS

This section describes water quality treatment BMP implementation for new development, redevelopment, and retrofitted areas in the SDS. In keeping with the standards described in Section 2.2, the Port plans to implement BMPs according to the following schedule (see Figure 7-1 for BMP implementation):

1. In all new SDS subbasins (SDW1A, SDW1B, SDW2, and SDN3A) and existing subbasins that will be 100 percent redeveloped (e.g., SDS6 and SDS7) for MPU improvements, implement treatment BMPs in accordance with the King County Manual.
2. For all portions of existing SDS subbasins that will be partially redeveloped as part of MPU improvements, implement BMPs in those areas. BMPs shall comply with the King County Manual.
3. For portions of existing subbasins that are anticipated to be redeveloped as part of non-MPU improvements within the next 20 years (e.g., the North Air Terminal), implement BMPs during those redevelopment actions.
4. For portions of existing subbasins that are not anticipated to be redeveloped:
   a.) if already in compliance, nothing is proposed; or
   b.) if not in compliance and retrofitting is practicable, install BMPs; or
   c.) if not in compliance and retrofitting is not practicable and water quality monitoring has indicated actions may be needed, evaluate the application of new or experimental BMPs (see Section 7.1.5).
5. For non-Port PGIS draining to Port outfalls, nothing is proposed by the Port.



Areas shown are approximate.

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Approximate division between redevelopment area (east of line) and new development area (west of line)

Future (2006) Drainage Basin Divide

Sea-Tac Airport Drainage Basin Boundaries

SDS2 Sea-Tac Airport Drainage Basin Name

Water Bodies

Detention Facility (Existing)

Constructed Water Feature

SCALE IN FEET 0 750 1,500

N

July 2001
556-2912-001 (28)

Figure 7-1
Water Quality Treatment for New and Retrofitted Surfaces

AR 046440

Treatment BMPs for new development and redevelopment areas will be applied in accordance with the King County Basic Water Quality Menu.

Water quality treatment facility designs described in the following sections are conceptual, and are based on preliminary project information. They are intended to demonstrate the Port's capability to provide treatment BMPs for these areas. Other treatment options may be used at the Port's discretion. Final design will comply with the King County and Ecology Manuals.

7.1.1 <u>Treatment BMPs for New Development</u>

7.1.1.1 Third Runway and Connecting Taxiways

Construction of the new Third Runway and connecting taxiways (Figure 5-1) will add approximately 50 acres of pervious (grass infield) surface and 156 acres of impervious surface area to the STIA SDS. As shown in Figure 5-2, these areas will drain to Miller Creek via two new SDS outfalls (SDW1A and SDW1B), Walker Creek via a new outfall (SDW2), and to Des Moines Creek via an existing outfall (SDS7).

Water quality for the Third Runway drainage is expected to be similar to that measured in subbasin SDS3 in recent years. Subbasin SDS3 consists almost exclusively of runways, taxiways, and grass infields. As discussed in Section 4.5.2, stormwater from this subbasin is generally less polluted than regional and national urban stormwater.

Filter strips will treat stormwater runoff as it drains directly from new impervious areas of the runway and taxiways. After draining through filter strips, runway and taxiway drainage will be conveyed via pipes to the detention vaults or ponds prior to discharge to Miller or Des Moines Creeks.

Required filter strip length was conservatively calculated for the greatest width of pavement measured from the crown, which occurs at runway-taxiway intersections. At these locations, flow travels from the shoulder-pavement crown, diagonally across the runway, and partially along the taxiway before sloping off to the filter strips. The total flow path distance is approximately 300 ft (Appendix H). Relevant area and flow parameters for a 1-acre section of Taxiway are given in Table 7-1. Filter strip size calculations are provided in Appendix H.

Table 7-1. Water Quality BMP design parameters, Third Runway and connecting taxiways.

Parameter	Value
IWS Area (acres)	0
SDS PGIS (acres)	156
SDS Non-PGIS (acres)	0
PGIS Treatment BMPs	Filter strips
Water Quality Design Storm Flow	0.31 cfs per acre
BMP Size	Required filter strip length is 34 ft. Actual filter strip length is at least 75 ft on straightaways and 34 ft on connecting taxiway sections.

For the widest sections of taxiways, the minimum required filter strip length will be 34 ft (for filter strips, as with bioswales, *length* is the dimension parallel to the flow path). This size will provide the 9-minute hydraulic residence time required by the King County Manual. For other taxiway and runway sections, the flow path will be smaller, and therefore the minimum strip length will be less than 34 ft. As previously noted, the actual filter strip widths in most locations will be substantially greater than the minimum required width; average filter strip width for straight sections of the Third Runway and taxiways will typically be at least 75 ft on straightaways and 34 ft on connecting taxiway sections.

7.1.1.2 The South Aviation Support Area

The proposed SASA will be constructed in areas occupied by portions of the Tyee Valley Golf Course and the South Employee Parking Lot (see Figure 5-1). The SASA will create a total of approximately 93 acres of new impervious surface, including roof tops, apron, taxiways from runway 34R, and vehicle parking.

All apron areas at SASA (approximately 58 acres) will drain to the IWS. The hangar roof tops in the SASA (15 acres) will drain to Des Moines Creek via the new SASA detention pond;[16] as non-PGIS, the roof tops are not anticipated to have an adverse effect on stormwater quality (see Section 7.4). Parking areas would comprise the only PGIS draining to the SDS, and would be treated by bioswales before discharging to the new detention pond.

The SASA PGIS area was divided into subareas A through D (Appendix H). Relevant area and flow parameters for SASA are given in Table 7-2. Bioswale size calculations are provided in Appendix H.

Table 7-2. Water quality BMP design parameters, SASA.

Parameter	Value
IWS Area (acres)	58.4
SDS PGIS (acres)	17.8
SDS Non-PGIS (acres)	16.7
PGIS Treatment BMPs	Bioswales
Water Quality Design Storm Flow	5.03 cfs
BMP Size	Eight bioswales each approximately 255 ft long, width 7.0 ft to 8.4 ft

Each subarea would drain to a bioswale approximately 255 ft long (Appendix H). Bioswale widths would vary from 7.0 to 8.4 ft, depending on each subarea's drainage area. These swales would provide at least the 9-minute hydraulic residence time, per the King County Manual.

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[16] Stormwater runoff from SASA may be discharged directly to Des Moines Creek after water quality treatment. The SASA pond will then be designed to over detain stormwater upstream of the SASA discharge points, thereby mitigating flow impacts from SASA.

7.1.1.3 North Employee Parking Lot

The NEPL, completed in 1998, added 29 acres of new impervious surface to a previously undeveloped area north of SR 518. The NEPL drains to an 18-ft-wide (20-ft bottom width minus 2-ft earthen divider) by 200-ft-long bioswale, installed downstream of the NEPL detention vault (Appendix H). Sizing calculations for the bioswale are provided in Appendix H and summarized in Table 7-3. All PGIS will be treated per the requirements of the King County Manual.

Table 7-3. Water quality BMP design parameters, NEPL.

Parameter	Value
IWS Area (acres)	0
New SDS PGIS (acres)	29.0
SDS Non-PGIS (acres)	0
PGIS Treatment BMPs	Bioswale
Water Quality Design Storm Flow	2.96 cfs
BMP Size	Bioswale 200 ft long, width 18 ft

7.1.1.4 North Safety Zone

The north safety zone consists of an unpaved apron at the north end of the Third Runway. The embankment for the safety zone will be constructed on areas currently occupied by South 154th Street and open STIA property. This project area will have no new impervious surfaces (and no pollution-generating pervious surfaces); thus, water quality treatment is not necessary.

7.1.1.5 South 154th Street

South 154th Street will be relocated approximately 500 ft north to allow construction of the Third Runway and the safety areas for runways 16R and 16L. The existing road area will increase only slightly, from 5.8 acres to approximately 5.9 acres of impervious surface (the total impervious area draining to the new water quality facilities will be approximately 6.2 acres). The existing road surface is untreated.

The South 154th Street relocation will be constructed by the Port, and will be owned and maintained by the City of SeaTac. Preliminary designs call for drainage to four bioswales located along the new roadway (Appendix H). Preliminary BMP design for the project is presented in Appendix H and summarized in Table 7-4. All PGIS will be treated per the requirements of the King County Manual.

Table 7-4. Water quality BMP design parameters. South 154th Street.

Parameter	Value
IWS Area (acres)	0
SDS PGIS (acres)	6.2
SDS Non-PGIS (acres)	0
PGIS Treatment BMPs	Bioswales
Water Quality Design Storm Flow	0.11 cfs. 1.0 cfs. 1.40 cfs. 0.16 cfs
BMP Size	2 x 135 ft. 9 x 180 ft. 8 x 300 ft. 3 x 200 ft

7.1.1.6 North Cargo Area

Cargo handling facilities (freight terminal buildings, warehouses, and parking lots) will be constructed north of SR 518 and east of 24th Avenue South. The project will create approximately 8.1 acres of new impervious surface, approximately 4.3 acres of which will be PGIS. The area is currently undeveloped.

Although the footprint for the North Cargo Area is defined (Figures 5-1 and 6-1), no plans exist for the area layout. BMP design for the area is conceptual.

The North Cargo Area will drain to a detention vault that will serve both PGIS and non-PGIS. A bioswale was conservatively sized for pre-detained flows from PGIS areas only (pre-detained flow rates from PGIS areas will exceed combined detained flow rates).

Sizing calculations for the bioswale are provided in Appendix H and summarized in Table 7-5. All PGIS will be treated per the requirements of the King County Manual.

Table 7-5. Water quality BMP design parameters, North Cargo Area.

Parameter	Value
IWS Area (acres)	0
New SDS PGIS (acres)	4.3
SDS Non-PGIS (acres)	3.8
PGIS Treatment BMPs	Bioswale
Water Quality Design Storm Flow	1.29 cfs
BMP Size	2 bioswales 254 ft long, width 7.7 ft

7.1.2 <u>Treatment BMPs for Redevelopment Projects</u>

7.1.2.1 South Terminal Expansion Project

The South Terminal Expansion Project will consist of hangar relocation, pavement replacement, construction of temporary baggage handling facilities, expansion of Terminal A, and reconfiguration of service areas, parking lots, and the south end of Air Cargo Road (Figure 5-1).

The ramp area improvements will continue to drain to the IWS, which provides water quality controls for high use areas. New roof surfaces, constructed with non-leaching surfaces, will drain to the SDS, which will discharge to the east branch of Des Moines Creek.

The STEP PGIS runoff could be treated by a wetvault. Relevant area and flow parameters for STEP are summarized in Table 7-6. Wetvault size calculations are provided in Appendix H.

Table 7-6. Water quality BMP design parameters, STEP.

Parameter	Value
IWS Area (acres)	1.6
New SDS PGIS (acres)	9.1
SDS Non-PGIS (acres)	5.1
PGIS Treatment BMPs	Wetvault
Mean Annual Storm Runoff Volume	13,900 cf
BMP Size	41,700 cf

Based on the preliminary STEP layout, the wetvault volume will be 41,700 cf. The wetvault location and details are provided in Appendix H. The wetvault will be placed at the south end of the Air Cargo Road realignment. The wetvault will be located on the west side of the new roadway to avoid interference with the proposed South Access Freeway lanes. The proposed vault will be relatively long and narrow to allow placement parallel to the roadway and Aircraft Operating Area fence line. Use of a wetvault is conceptual. Other BMPs, such as bioswales, may be used instead of wetvaults in accordance with the King County and Ecology Manuals.

7.1.2.2 North End Air Terminal

The area north of South 170th Street (including the Doug Fox parking lot, north entry and exit freeways, and air cargo areas) is planned to undergo substantial redevelopment as part of the North End Air Terminal (NEAT) project. The NEAT will add new passenger terminal and ground transportation facilities. Although no schedule has been set for NEAT development, it is anticipated to commence near the completion of the Master Plan Update.

The NEAT project is not an MPU project. The project design and drainage network layout have not progressed to a stage where BMPs could be sized for specific areas. However, the projected footprint of the area (SDE4 north of South 170th Street, excluding SDE4 Taxiways) can be used to estimate the total size of BMPs needed to serve the area. For a conservative estimate, BMP size was estimated for the area without detention.

Based on the unit BMP size estimate (discussed in Section 4.5.1), the NEAT's 35 acres of PGIS will require approximately 14,400 square ft of bioswales (new and existing) and 92,200 cf of wetvault (new).

Most pervious surfaces within the NEAT area would likely be classified as PGPS. Treatment for these areas would be provided via a landscape management plan (Section 7.6 and Appendix I).

7.1.2.3 South Link Freeway

The South Link connector will be the northerly freeway section of the South Access Road constructed between the south end of the passenger terminal and South 188th Street. It will be built approximately along the existing alignment of Air Cargo Road south of the terminal.

Similar to NEAT, design for the South Link Freeway between South 188th Street and the south end of the terminal has not progressed to a stage where BMPs could be designed for specific areas of the project. BMP size was estimated for the project based on the unit BMP size estimate described in Section 4.5.1.

The South Link Freeway's 8.8 acres of PGIS could be treated by approximately 40,600 cf of wetvaults. Most pervious surfaces within the South Link Freeway area would likely be classified as PGPS. Treatment for these areas would be provided via a landscape management plan (see Section 7.6 and Appendix I).

7.1.2.4 Delta Parking Lot

The Delta Parking Lot currently discharges to undesignated storm drains. The parking lot is not currently served by treatment BMPs. All PGIS in this subbasin is anticipated to be diverted to the IWS as part of the South Terminal Expansion Project. If any PGIS remains in the subbasin, it will be treated by BMPs in compliance with King County and Ecology Manual requirements.

7.1.2.5 ASR Site

The ASR site will redevelop former residential property to construct a radar tower and control building. The rooftop will be constructed with non-pollution-generating materials (no bare metal). Equipment and vehicle access on both the gravel and paved surfaces will be only for infrequent maintenance and repair (no more than four times per week). Thus the surfaces are not PGIS, and no water quality treatment is required.

A 1000-gallon fuel tank will be installed on the ASR site for emergency power generation. Because the tank is double-walled, the Ecology Manual does not require separate containment. As required by the Ecology Manual, the tank's fill connection is fitted with overfill/spill control features (see detail drawings in Appendix Y). Leak detection features are also included. Less than 1000 gallons of fuel would be transferred within any year, therefore the site does not meet the King County Manual "high-use" threshold requiring oil controls.

7.1.3 Existing Areas in Compliance with Treatment Requirements

Several subbasins and portions of subbasins have BMPs in compliance with the King County Manual. The analysis of these areas, discussed in detail in Section 4.5.1, is summarized in Table 7-7.

Portions of these fully treated existing areas will be redeveloped. Any redevelopment of the above areas will be designed and constructed to result in full treatment of PGIS to the maximum extent practicable.

Additionally, the NEPL, a Master Plan project completed in 1998, has full treatment of all PGIS, as described in Section 7.1.1.3.

Table 7-7. **Summary of existing areas in compliance with water quality treatment BMP requirements.**

Area	Existing Treated Land Use	PGIS Treated	BMPs
SDN1-Kitchens[a]	Parking lot	0.7	Treatment wetland, bioswale
SDN3	Runway and taxiways	24.7	Filter strips
SDN4	Runway and taxiways	9.0	Filter strips
SDE4-Taxiways[a]	Taxiways	4.6	Filter strips
SDE4-NEAT[a]	Parking lot	2.9	Bioswale
SDS3[a]	Runway and taxiways	190.0	Filter strips
SDS4	Runway and taxiways	32.3	Filter strips
SASA area[a]	Construction staging area	17.6	Bioswale

[a] The areas reflected in this table represent the treated portion of the PGIS in these areas. Some existing PGIS in these areas is untreated. Treatment of untreated portions of these areas is discussed in Sections 7.1.1, 7.1.2, 7.1.4, and 7.1.5.

7.1.4 Treatment BMP Retrofitting

Additional BMPs were identified to provide runoff treatment to the maximum extent practicable for subbasins where existing BMP coverage is not consistent with the Ecology Manual (Table 7-8). The proposed additional BMPs were selected and sized based on best available information. These BMPs were identified to demonstrate the Port's ability and intent to provide treatment BMPs per the implementation plan described at the beginning of Section 7.1.

7.1.4.1 Subbasin SDN1

An existing bioswale provides full treatment for approximately 0.7 acre of the flight kitchen parking lots north of South 154th Street. Approximately 6.8 acres of PGIS in subbasin SDN1 are currently partially treated or untreated.

As shown in Appendix D, a detention vault will be constructed to detain runoff from subbasin SDN1, with a volume of approximately 5.6 acre-ft and a footprint of approximately 22,000 square ft. Subbasin SDN1 will be retrofitted for water quality treatment by constructing a wetvault combined with the detention vault. The approximate wetvault volume required to treat this area would be calculated as follows (formula given for land use types found in subbasin SDN1; note that 0.27 acre of airport fill was included in the till grass area):

$$\text{Volume} = 3 * [(0.9 * A_{impervious}) + (0.25 * A_{till\ grass}) + (0.01 * A_{outwash})] * (R/12)$$

Where:

R = rainfall from mean annual storm (inches)
All areas in square ft

$$\text{Volume} = 3 * [(0.9 * 576{,}700) + (0.25 * 97{,}600) + (0.01 * 267{,}500)] * (0.47/12)$$

Volume = 64,200 cubic ft

Four ft of dead storage plus 1 ft of sediment storage within the footprint of the detention vault would provide more than this volume and would meet minimum and maximum wetvault depth requirements (with baffle and other design requirements also included).

The Port will implement the above alternative, or another alternative that will provide treatment for all PGIS in subbasin (SDN1).

7.1.4.2 Terminal Drives

Based on the volume of vehicle traffic and the traffic use pattern (idling, stop-and-go traffic) on the Upper and Lower Terminal Drives (approximately 2.0 acres), the area meets the intent of the King County Manual definition of a high-use site. Therefore, oil control BMPs in compliance with the King County Manual will be applied to drainage from the Terminal Drives. The Terminal Drives will be diverted to the IWS. As discussed in Section 4.5.3, the IWS meets the oil-control treatment requirement for high-use sites. However, should diversion to the IWS be unfeasible, oil control facilities will be installed per the King County Manual (coalescing plate oil-water separator or equivalent).

7.1.4.3 South Satellite Canopy

Stormwater monitoring in subbasin SDS1 indicated that approximately 0.6 acre of area under the building overhang at the South Satellite Terminal may have been contributing types and quantities of pollutants more appropriate for drainage to the IWS. Therefore, the entire south Satellite SDS area was diverted to the IWS in 2000. The 0.6-acre SDS area under the overhang could not be effectively separated from the roof drainage; thus, the entire South Satellite SDS was diverted.

7.1.4.4 Alaska Airlines Parking

The Alaska Airlines Parking Lot (approximately 2.0 acres) is currently untreated. The area, which is part of subbasin SDS1, drains to South 188th Street. A bioswale (approximately 1,500 square ft) would be installed along the vegetated strip of South 188th Street.

7.1.5 Areas Not Practicable for Retrofitting

The Ecology Manual states that the minimum stormwater requirements (including water quality treatment) shall be implemented to the maximum extent practicable for the entire site.

As described in Sections 7.1.1 through 7.1.4 above, water quality treatment will be implemented for the majority of the SDS, via treatment BMPs installed concurrently with new development or redevelopment, or installed solely as a retrofit. However, as described below, retrofitting of approximately 35.4 acres of subbasin SDE4 and 44.6 acres of subbasin SDS3 with conventional treatment BMPs would be impracticable, requiring extensive disturbance of complex drainage areas not scheduled for redevelopment (Figure 7-1). Retrofitting these fully developed existing areas would require the use of wetvaults. The total cost to retrofit these areas would be approximately $15 million (Appendix M). The Port will continue to evaluate the need for and use of innovative

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treatment BMPs to treat portions of SDS3 and SDE4 taxiways. These BMPs would be used where practicable and cost-effective.

If future redevelopment in SDE4 or SDS3 takes place, BMPs will be installed for the redeveloped areas as required by the Ecology and King County Manuals. Source control BMPs will continue to be used for all subbasins, as described in Table 7-10 and the STIA SWPPP (Port of Seattle 1998a).

As described in Section 6.2, peak flow retrofitting will be implemented for 100 percent of STIA's stormwater drainage system.

7.1.5.1 SDE4-South

This area is a part of subbasin SDE4 containing portions of the airport entry and exit freeways and ramps, and a portion of Air Cargo Road. Within this basin, treatment for 8.8 acres of PGIS will be installed with the redevelopment of the South Access Freeway. The Upper and Lower Terminal Drives (approximately 2 acres), which lie within SDE4, are determined to be a high-use area, and will be diverted to the IWS (see Table 4.1 for IWS capacity). Approximately 21.2 acres are non-practicable for water quality treatment retrofitting, located between the north end of the South Access Freeway and South 170th Street.

The non-practicable treatment area within SDE4-South drains directly to the storm sewer trunk line that conveys runoff from approximately 123 acres of subbasin SDE4 upstream of this area. It would be difficult to isolate SDE4-South drainage from the runoff conveyed within the trunk line. Furthermore, most of the upstream area is in need of treatment through redevelopment (e.g., SDE4-NEAT) or retrofitting (e.g., SDE4-Taxiways). Therefore, for purposes of a planning-level cost estimate, if treatment were to be provided for this area, it was assumed that the treatment would also include capacity for the upstream areas.

Because the area is fully developed (exit freeway and parking lot), costs were estimated for an underground wetvault. As demonstrated in Appendix M, an approximately 550,000-cf vault would be required, at a cost of $7.2 million. Although this would defray costs of installing treatment for the upstream areas, the unit cost of treatment would be much higher to include this area. In particular, construction of the vault would be difficult due to the depth of the existing drainage pipes (approximately 16 to 18 ft below the surface) and the location of the trunk line under the exit freeway. The exit freeway would need to remain open, which would add substantial logistical constraints to construction, and a large premium on construction costs (included in "contingency" - Appendix M). Even if construction were conducted to allow the freeway to remain open, the impacts on local traffic would be severe.

7.1.5.2 Portion of SDE4-Taxiways

This is the area of subbasin SDE4 containing a portion of Taxiway A (Figure 7-1). Of this area, 4.6 acres drain to grassy filter strips adjacent to the taxiway, which provide adequate treatment. However, 14.2 acres of the taxiway in this area do not drain to grassy filter strips with sufficient width, or do not drain to grassy filter strips at all.

This area and the area downstream of its collected drainage are fully developed. To treat this area, a wetvault would be necessary. Because this area drains through SDE4-South described above, treatment costs would be included in the costs for that area. However if the SDE4-South wetvault were not constructed, and a wetvault was constructed for this area alone, the unit costs would be similar. This is because the wetvault would be installed in a cargo-handling area subject to high aircraft and ground vehicle use.

Although retrofitting with conventional BMPs is not practicable, new or alternative BMPs would be evaluated for this area as pavement panel replacement or other maintenance takes place. These BMPs could include catch basin filter inserts or similar devices that could be installed in targeted locations in the drainage system.

7.1.5.3 Portion of SDS3 Taxiways

Most of subbasin SDS3 receives adequate treatment with grassy filter strips adjacent to the runways and taxiways. However, no grassy infields exist for the SDS3 ramp and taxiways contiguous with the IWS ramp area surrounding the terminals. Approximately 44.6 acres are not practicable for treatment (see Figure 7-1).

Because the area drains to different branches of the subbasin SDS3 drainage system, treatment of this area would require four separate wetvaults (Appendix M). The estimated total cost of constructing these vaults would be $7.7 million.

Each of these vaults would be built nearly adjacent to Runway 16L/34R (the longest runway). Any work within 250 ft of a runway requires total closure of the runway during work. Due to operational requirements, this would place constraints on the hours when construction could occur. Construction of the vaults would require demolition and replacement of approximately 101,000 square ft of taxiway pavement. The above factors would add premiums to construction costs (included in "contingency" - Appendix M). Furthermore, construction would be occurring in the highest-traffic area within the entire airport, and would result in substantial impacts and delays to aircraft.

As indicated above for SDE4 taxiways, alternative BMPs will be evaluated for this area as pavement panel replacement or other maintenance takes place.

7.2 SUMMARY OF BMP COVERAGE

Upon completion of the MPU and other anticipated projects (e.g., north terminal expansion), an estimated 499.4 acres (86 percent) of the STIA SDS will have water quality treatment BMPs, out of a total SDS PGIS area of 579.4 acres (Table 7-8 and Figure 7-1). All areas except portions of subbasins SDE4 and SDS3 will be fully served by water quality treatment BMPs. Source control BMPs will be implemented for all PGIS, and regularly reviewed for additional or improved methods.

Table 7-8. Summary of proposed water quality treatment BMP coverage for STIA SDS subbasins.

Subbasin	Retrofit Category	Existing Treatment[b] (see Table 4-6): Fully Treated PGIS[a] (ac)	Existing Treatment[b]: PGIS Not Fully Treated (ac)	Land Use and Activities	New or Additional Source Controls[c]	Proposed Additional Treatment: Additional Treatment BMPs[e] or Conditions	Wetvault (cf)	Bio-swale (sf)	Filter Strip (sf)	Re-route to IWS (ac)	Fully Treated PGIS (ac)	PGIS Not Fully Treated (ac)
SDN1	4B	0.7	6.8	Air Cargo Road, cargo building rooftops, flight kitchen rooftops and parking lots. Some metal rooftops are uncoated	Roof coating	Approx 64,200 cf wetvault. Apply coating or install membrane on rooftops	64,200	0	0	0	7.5	0.0
SDN2	4A	2.1	3.0	Taxiways and aircraft operating area. All PGIS in this subbasin is diverted to the IWS (up to the water quality design storm)		No additional BMP's needed	0	0	0	0	2.1	0.0
SDN3	4A	24.7	0.0	Taxiways and runways		Existing filter strips exceed treatment BMP requirements. No additional BMPs needed	0	0	0	0	24.7	0.0
SDN4	4A	9.0	0.0	Taxiways		Existing filter strips exceed treatment BMP requirements. No additional BMP's needed	0	0	0	0	9.0	0.0
SDN6	3	0.0	4.1	New cargo facility. PGIS would be parking lots and loading areas	SPC, SWP, LND, CBC, SWE	Approx. 3,910 sf bioswale	0	3,910	0	0	4.1	0.0
MC1-MC3	2	0.0	3.9	Relocated S. 154th Street, constructed by the Port. After construction, will be under the jurisdiction of the City of SeaTac.	d	Approx. 4,890 sf bioswale for new S. 154th Street Alignment	0	4,890	0	0	3.9	0.0
MC4-MC8	2	0.0	7.3	West side residential area to become part of STIA. Most of the area would be demolished and undeveloped. Some new commercial development	SPC, SWP, LND, SWE	As part of future commercial development. Approx. 7,000 sf bioswale	0	7,000	0	0	7.3	0.0
NEPL	4A	29.0	0.0	North Employees' Parking Lot completed in 1998		Fully treated by bioswale constructed with NEPL. No additional BMP's needed	0	0	0	0	29.0	0.0
SDW1, SDW2	1	0.0	55.1	New Third Runway and taxiways	SPC, SWP, CBC, SWE	386,000 sf filter strips for runway and taxiway areas	0	0	385,700	0	55.1	0.0
SDE4-South	3, 4C	0.0	32.0	Area south of S. 170th Street, including entry/exit freeway, service roads, terminal drives, parking. New South Access Freeway and Light Rail Link will be constructed		Route Terminal drives (2 ac) to IWS. Install BMP's (likely ~40,600 cf wetvaults) for S. Access Fwy (8.8 ac) when constructed. 21.2 ac of Exit Fwy are impracticable for treatment	40,600	0	0	2	10.8	21.2
SDE4-Taxiways	4C	4.6	14.2	Taxiways		Existing filter strips exceed treatment BMP requirements for 4.6 acres. Investigate use of alternative BMP's for 14.2 acres of taxiway impracticable for conventional treatment	0	0	0	0	4.6	14.2
SDE4 NEAT	3	2.9	32.1	North End Air Terminal development north of S. 170th Street. New passenger terminal and ground transportation facilities		BMP's will be incorporated into NEAT development (likely 92,200 cf wetvaults and 14,400 sf bioswales)	92,200	14,400	0	0	35.0	0.0
Delta Parking Lot	2	0.0	3.2	Area to be redeveloped as part of STEP		All PGIS in this basin will be diverted to IWS as part of Master Plan ramp and hangar expansion	0	0	0	3.2	3.2	0.0
SDS1	4B	0.0	11.7	Alaska Airlines parking lot, a portion of aircraft movement area, and area under South Satellite building overhang. STEP parking		Aircraft movement area and area under S. Satellite canopy has been routed to IWS (0.6 ac). 1,920 sf bioswale for Alaska parking lot. 41,700 cf wetvault for STEP parking	41,700	1,920	0	0.6	11.7	0.0
SDS2	4A	0.0	0.0	Use of existing gravel parking area will be discontinued, leaving no PGIS		No STIA PGIS will remain in this basin	0	0	0	0	0.0	0.0
SDS3	4C	190.0	44.6	Runways and taxiways		Existing filter strips exceed treatment BMP requirements for 190 acres. Investigate use of alternative BMP's for 44.6 acres of taxiway impracticable for conventional treatment	0	0	0	0	190.0	44.6
SDS4	4A	32.3	0.0	Runways and taxiways		Existing filter strips exceed treatment BMP requirements. No additional BMPs needed	0	0	0	0	32.3	0.0
SDS5	4A	0.0	0.0	Perimeter Road (infrequently used)		No PGIS	0	0	0	0	0.0	0.0
SDS6	1	0.0	1.5	New Weyerhaeuser Hangar driveway and parking lot. Perimeter Road (infrequently used)		Convert Perimeter Road ditches to 1,440 sf bioswale or create new bioswale for roads	0	1,440	0	0	1.5	0.0
SDS7	1	0.0	40.2	Redeveloped area to become Third Runway and taxiways	SPC, SWP, CBC, SWE	Construct at least 201,000 sf filter strips for runway and taxiway areas	0	0	201,000	0	40.2	0.0
SASA	1	17.6	9.8	South Aviation Support Area. PGIS would be aircraft operation and service area and parking lots		Aircraft operation and service area to drain to IWS. Approx. 15,300 sf bioswales to serve parking lots	0	15,300	0	0	27.4	0.0
TOTAL SDS DRAINAGE AREA (acres)											499.4	80.0

[a] PGIS = Pollution Generating Impervious Surface, the amount of area requiring water quality treatment BMPs

[b] Basins SDN1, SDN2, SDN3, SDN4, NEPL, and SDN6 flow to Lake Reba, which has a permanent pool volume that provides additional wetpool treatment not included in these calculations

[c] SOURCE CONTROLS
SPC = Spill Control and Countermeasures Planning
SWP = Stormwater Pollution Prevention Planning (POS and Tenants)
SWE = Sweeping
CBC = Regular Catchbasin Cleanout
LND = Landscape Maintenance BMPs, including Integrated Pest Management

[d] These subbasins will be under the jurisdiction of the City of SeaTac. Source control operations would be performed by the City

[e] BMP	Approx. Required Treatment/Acre
Bioswale	960 sf
Filter Strips	5,000 sf
Wetvaults	4,610 cf

Ref: SWMP Dec. 2000

7.3 NON-POLLUTION-GENERATING IMPERVIOUS SURFACES

As described in the King County Manual, water quality treatment is not required for non-pollution-generating impervious surfaces, including, but not limited to: road shoulders used primarily for emergency parking, paved bicycle pathways, fenced firelanes, or infrequently used maintenance access roads. Most roof tops are also considered non-PGIS, as discussed in Section 7.4 below.

7.4 ROOF TOPS

The King County Manual states that metal roofs are considered pollution-generating unless they are treated to prevent leaching. Most existing roof tops at STIA are constructed of non-metallic materials. Therefore, these roof tops are considered non-PGIS, and will not require treatment. However, a limited number of existing roof tops have metal surfaces that drain to the SDS (see Figures T-1a through T-1c, Appendix T).

To be considered non-PGIS, at least one of the following practices will be implemented for each new roof top at STIA: (1) the roof top surface will be constructed with a non-metal or factory-coated metal surface to prevent leaching, or (2) runoff from the roof top will receive treatment as PGIS, with a BMP from the Basic Water Quality Menu.

The retrofitting of existing roof tops will be assessed and managed under the Port's SWPPP. This process will include the following steps:

1. Sampling and testing of stormwater will be performed at accessible locations in the SDS downstream of metal roof tops.[17] These monitoring locations will be selected to minimize runoff from other sources. At least two flow-weighted composite stormwater samples from representative storms will be analyzed for appropriate constituents and acute whole effluent toxicity (WET). Sampling and analysis will be consistent with the NPDES Permit and the *Procedure Manual for Stormwater Monitoring at Sea-Tac International Airport* (Port of Seattle, 1999c). Roof top assessments will begin prior to renewal of the Port's NPDES Permit in 2001.
2. Roof tops whose runoff does not meet Ecology's acute WET performance standards[18] will be considered PGIS. The Port will submit to Ecology a schedule for retrofitting the roof tops to eliminate or reduce the source. The Port will develop a retrofit schedule and submit it to Ecology for concurrence by the end of the next NPDES Permit cycle.[19]
3. Retrofitting will include at least one of the following:
    - Coatings or membranes: Use of a thermoplastic polyolefin or polyethylene heat-weldable membrane with characteristics similar to those described in Appendix T (data

[17] Exempt from this sampling and testing would be any roof tops constructed with a material or finish that has been designated by King County DNR or Ecology as non-PGIS.

[18] According to WAC 173-205, for acute WET tests, the average survival in 100% effluent shall be at least 80 percent, and no single sample shall have less than 65 percent survival.

[19] Based on a four-and-one-half-year permit cycle, the next cycle would be 2002-2007.

provided for a currently-available product). However, if other coating or paint methods are demonstrated to produce runoff meeting the WET performance standard, the Port may implement these methods, with appropriate monitoring to demonstrate effectiveness.

- Treatment BMPs: Routing of roof top runoff through a Basic Water Quality Menu treatment BMP.
- Roof replacement: Replacement of roof top with a non-metal or factory-coated surface to prevent leaching (e.g., non-PGIS roof top).

The above process identified two roof tops in subbasin SDN1 that act as PGIS (Port of Seattle 2000b). The Port is implementing the process described above to control pollutants generated by these roof tops. When corrective actions are implemented, the Port will perform follow-up monitoring to verify effective pollutant control.

As discussed in Section 2.1, stormwater detention will be provided for all new and existing impervious surfaces as part of the MPU SMP, regardless of status as PGIS or non-PGIS.

7.5 IWS AKART DETERMINATION

As required by its NPDES Permit, the Port has performed an analysis and determination of all known available and reasonable methods of treatment (AKART) for handling of IWS flows (Kennedy/Jenks 1998). The Port has determined that the recommended AKART alternative is to discharge treated effluent from the IWTP to the King County DNR East Division Reclamation Plant at Renton (EDRPR). This alternative will eliminate or reduce IWS discharge to Puget Sound. IWS flows will continue to be treated by the IWTP to remove oil and grease as well as TSS before flowing to the EDRPR. The Port is negotiating with DNR to determine pretreatment standards, flow limits and timing, conveyance from the IWTP to the EDRPR, permitting, monitoring, and fees (Feldman 1999). The Port's NPDES Permit requires that the AKART recommendation must be fully implemented by June 2004. It has been submitted to Ecology for concurrence.

7.6 PERVIOUS SURFACES

STIA has both *managed* and *unmanaged* landscapes (Figure 7-1). Unmanaged landscapes are those in which there is no physical (e.g., mowing) or chemical (e.g., fertilizers, herbicides, pesticides) management. All unmanaged landscapes are considered non-pollution-generating pervious surfaces (non-PGPS). Managed landscapes require a landscape management plan or water quality treatment.

7.6.1 <u>Managed Areas</u>

7.6.1.1 Runway/Taxiway Infields

The runway/taxiway infield consists of a uniform grass/legume/cover crop mixture. For safe operation of the Aircraft Operation Area (AOA), landscape management is limited to mowing. Typically, no fertilizers, pesticides, or herbicides are applied to the infields nor is application anticipated or planned. A landscape management plan for the infields is provided in Appendix U.

7.6.1.2 Landscaped Areas

The Port's SWPPP for Airport Operations (Port of Seattle 1998a) and Interim Landscape Design Standards (Port of Seattle 1999b) apply to management of the following areas:

- Landscaped areas along the east side of the AOA;
- AOA fence;
- Airport drives and Air Cargo Road;
- Areas around Port/tenant facilities on the airport perimeter; and
- Emergency and fire access roads.

The Interim Landscape Design Standards and applicable sections of the SWPPP are included in Appendix I.

The SWPPP for Airport Operations is required by Special Condition S 12 B of the Port's NPDES permit. Section 3.8 of the SWPPP covers landscape activities, including chemical use, container disposal, integrated pest management, fertilizer application, weeding, pruning, and a prohibition of herbicide application near water courses. The SWPPP for Airport Operations has been reviewed and approved by Ecology. The SWPPP has been incorporated into the Port's Interim Landscape Design Standards.

The Port's Interim Landscape Design Standards (Appendix I) are part of the Regulations for Airport Construction and are used to direct landscape development by the Port and its tenants. The goals of the plan include: "promote the retention and conservation of existing natural vegetation, and reduce the impacts of development on storm drainage systems and natural habitats." These goals are accomplished by "providing increased areas of permeable surfaces which allow infiltration of storm water, reduction in the quantity of stormwater discharge, improvement in the quality of stormwater discharge, and creating more sustainable landscapes through the use of 'water wise' irrigation techniques, drought-tolerant or native plants and other water management strategies."

7.6.2 <u>Unmanaged Areas</u>

Areas such as the west side of the airport and the areas surrounding Lake Reba and the Northwest Ponds are unmanaged PGPS[20] – little or no mowing or landscape maintenance occurs, and no fertilizers or pesticides are applied.

7.7 OTHER ACTIONS BENEFITING WATER QUALITY

This section describes Port actions being taken to mitigate potential impacts to water quality in Miller and Des Moines Creeks that result from implementation of the MPU improvements. Proposed actions to mitigate water quality impacts include treatment and source control BMPs,

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[20] Emergency and fire access roads and corridors in these areas (mostly consisting of abandoned residential streets) are managed as described in the Port's SWPPP and landscape design standards.

receiving stream enhancement projects. and elimination of impacts via removal of some existing watershed activities.

Several existing and proposed facilities, changes in land use, and BMPs will mitigate the potential impacts of stormwater discharge from MPU improvement projects. These activities will either maintain or improve upon the beneficial uses in the Miller Creek and Des Moines Creek drainage basins. Potential beneficial uses include water supply; stock watering; fish and shellfish migration, rearing, spawning, and harvesting; wildlife habitat; and recreation. All but stock watering are known to be current or recent uses.

Mitigation activities currently in place or planned for existing and new SDS subbasins, the IWS, and the receiving watersheds are summarized in Table 7-9.

Table 7-9. Summary of Master Plan Update improvements related to water quality mitigation activities and benefits.

Action	Water Quality Benefits
Elimination of existing pollutant sources in areas to be redeveloped	Remove pollution-generating activities and land uses generally not served by BMPs, and replace with activities served by BMPs
Source controls	Presented in Table 7-10
Existing and proposed conventional water quality treatment BMPs (bioswales, filter strips, wetvaults)	Remove particulates, metals, and other constituents that bind to particulates
Pollutant removal in Lake Reba	Remove particulates and metals that bind to particulates
Flow augmentation	Increase summer low flows, with the goal of reducing stream temperatures and increasing dissolved oxygen in Des Moines Creek
Construction erosion control	Reduce sediment load to receiving waters
Snowmelt facilities	Reduce BOD (in snowmelt runoff with de-icing chemicals) that reaches receiving waters
Enhancement of wetland water quality functions (Miller Creek and Tyee Valley Golf Course wetland restoration)	Convert farmland and golf course to vegetated wetlands, removing sources of pollutants; restored wetlands will remove and uptake particulates, nutrients, metals, and other toxics from stormwater
Miller Creek buffer enhancement	Increase biofiltration of runoff flowing into the creek from riparian areas, reduce erosion and sediment supply, shade the creek to reduce stream temperatures and increase DO carrying capacity
Miller Creek stream channel restoration and enhancement	Reduce scour, erosion, and sediment supply
Level 2 hydrologic controls	Reduce scour, erosion, and sediment supply

Overall, the quality of stormwater in the watersheds is expected to either stay the same or improve because:

- The areas to be developed for the Third Runway and taxiways, which will be constructed with water quality BMPs as described in Section 7.1.1, consist largely of medium-density residential neighborhoods, farms, roads, and a golf course. Impacts associated with these existing land uses will be removed and replaced with MPU improvements, the largest portion of which will be runways and taxiways. STIA's runways and taxiways produce runoff quality with characteristics similar to, or better than, residential runoff in the Seattle metropolitan area (Section 4.5.2) and the land use change should benefit water quality.
- Existing land uses in the acquisition area generally do not have BMPs that comply with the King County and Ecology Manuals, whereas the MPU improvements replacing these areas will be served by BMPs that do comply and should thus generate runoff with pollutant loading below existing levels.
- Existing SDS subbasins will be retrofitted with water quality BMPs to the maximum extent practicable, increasing the extent of treated drainage area.

Furthermore, stream channels, buffers, and riparian wetlands in both watersheds will be enhanced and restored, which will provide additional water quality benefits. Information on each specific mitigation action and water quality benefit is provided below. A complete discussion of mitigation goals and proposals is contained in the *Natural Resources Mitigation Plan* (Parametrix 2000).

7.7.1 Removal of PGIS from Subbasins

For certain limited areas (e.g., the Upper and Lower Terminal Drives), the most appropriate BMP for runoff treatment is diversion to the IWS. SDS diversions to the IWS would be included in the implementation plans.

Roof top coatings can also convert PGIS to non-PGIS, and are included as a potential BMP (see Appendix T).

7.7.2 Elimination of Existing Pollutant Sources in Areas to be Redeveloped

The MPU improvements will redevelop existing medium-density residential neighborhoods, golf course, arterial roads, cultivated farms, and some undeveloped properties. Most of these areas had been developed before water quality treatment BMPs were required. Redevelopment of these areas will remove past cumulative impacts that are untreated by BMPs and that currently degrade water quality in Miller and Des Moines Creeks, including:

- 380 septic tanks (removing sources of fecal coliforms and excess nutrients);
- 183 underground fuel storage tanks (eliminating potential sources of petroleum pollutants);
- 29.8 acres of streets and driveways, (reducing sources of particulates, oils and greases, and heavy metals);

- 13.6 acres of cultivated farmland to be restored to floodplain and vegetated buffer (eliminating sediment and other water quality impacts normally associated with farming);
- Lawns on over 400 residential properties (eliminating potential sources of fertilizers, herbicides, and pesticides);
- 80 acres of golf course (eliminating potential sources of fertilizers, herbicides, and pesticides); and
- Approximately 17 domestic and 6 commercial agricultural water withdrawals (Appendix G).

7.7.3 <u>Source Controls</u>

Source controls are used throughout STIA (Table 7-10). Source controls are nonstructural measures that are intended to prevent stormwater contact with pollutants. Source identification is also an important part of source control; if elevated pollution levels or aquatic toxicity are noted, the Port undertakes an effort to trace and eliminate the source.

7.7.4 <u>Pollutant Removal in Lake Reba</u>

Lake Reba, a Port constructed stormwater facility, has a permanent pool that functions as a wetpond. Wetponds are water quality treatment BMPs that settle particulates out of the water column. Pollutants such as heavy metals and nutrients that sorb to particulates are also removed. Although Lake Reba does not fully meet existing wetpond design standards, it provides water quality benefits to the downstream systems.

Table 7-10. Seattle-Tacoma International Airport source control BMPs.

Activity	BMPs
Aircraft servicing	Restrict to IWS areas or block drains
	Store glycol in IWS areas
	Confine parking of lavatory waste trucks to IWS
	Identify and connect problem SDS areas to IWS
	Restrictions for fueling on taxiway Alpha
	Monitor SDS outfalls during de-icing
Aircraft Movement Area (AMA) anti-icing/de-icing	Minimize de-icing chemical use
	Use calcium magnesium acetate (CMA)/sand mixture for roadways
Snow storage	Operate pump stations to divert snowmelt to IWS
Spill control	Implement spill plan
Vehicle washing and maintenance	Prohibit vehicle washing in SDS areas
	Place signs in key locations
	Clean sumps in Taxi Yard annually
	Sweep Taxi Yard and control litter
	Maintain catch basin inserts

Table 7-10. **Seattle-Tacoma International Airport source control BMPs (continued).**

Activity	BMPs
AMA maintenance	Sweep pavement frequently
	Inspect catch basin sumps annually and clean as needed
	Store and dispose of sediments properly
	Construct secondary containment for used engine fluids
Inappropriate connections and discharges	Inspect outfalls for evidence of illicit connections
Temporary storage of surplus and used materials	Store liquids in approved secondary containment or IWS areas only
	Control entry of surplus materials
Landscape management (see Section 7.6)	Strive to use environmentally benign chemicals
	If landscape chemicals are used:
	Follow proper cleaning/disposal procedures
	Apply during dry periods
	Restrict use near waterways
	Incorporate BMPs into contractor specifications
	Apply herbicides/pesticides according to instructions
	Avoid catch basin grates when applying fertilizer or pesticides
	Implement Integrated Pest Management Plan
	Give priority to biological methods of pest management
	Conduct regular weeding and pruning
	Follow Ecology guidelines for herbicide application
	Trim ivy-covered areas by hand
	Fertilize shrubs and trees by hand
	Do not use beauty bark in drainage ditches
Tenant activities in SDS areas	Monitor and educate tenants on source and spill control
	De-ice aircraft according to established procedures
	Encourage drip pans beneath fueling trucks if leakage is observed
	Sweep around dumpsters
	Store liquids in secondary containment
	Do not store used fluids or hazardous waste in SDS areas
	Do not maintain vehicles or equipment in SDS areas
	Inspect catch basin grates
	Require tenant water pollution control plans
	Ensure tenant compliance with Port SWPPP
	Require tenant spill control plans

Table 7-10. **Seattle-Tacoma International Airport source control BMPs (continued).**

Activity	BMPs
Other operational BMPs	Evaluate operations to determine potential pollution and revise SOPs to minimize pollution
	Designate an SWPPP implementation monitor
	Conduct regular inspections
	Assemble pollution prevention team
	Conduct SDS outfall monitoring
	Sign catch basins ("dump no waste – drains to salmon stream")
	Establish packing material source control

7.7.5 Low Streamflow Augmentation in Des Moines Creek

As discussed in Section 6.2.1, the Port will work with the Des Moines Creek Basin Committee to ensure that the flow augmentation project is implemented as soon as possible. Flow augmentation would aim to reduce temperatures and increase dissolved oxygen potential during the late summer low flows.

7.7.6 Construction Erosion Control

The Port applies construction temporary erosion and sedimentation control (TESC) measures in excess of Ecology Manual minimum requirements, by:

- Planning and implementing construction SWPPPs and monitoring plans[21] for every individual MPU improvement activity (Appendix R, Attachments 2 and 3);
- Applying and monitoring conventional TESC BMPs;
- Providing advanced stormwater treatment where necessary and appropriate;
- Supervising contractor erosion control compliance with an erosion control and stormwater specialist; and
- Funding independent third-party oversight of construction erosion control and stormwater management and compliance.[22]

Potential construction impacts and corresponding mitigation activities that will reduce or eliminate the potential impacts are summarized in Appendix R. This appendix contains design drawings subject to revision as the SMP is further refined and designs of MPU improvements and stormwater facilities are finalized.

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[21] The Port's NPDES Permit requires an Ecology-approved stormwater monitoring plan for each construction project to be performed by the Port.

[22] As required by the Governor's Certificate for this project, the Port is required to hire a third party to ensure that all TESC plans are properly implemented.

7.7.7 Snowmelt Facilities

The Port recently constructed three snowmelt facilities to store melting snow from runways and taxiways that may contain de-icing chemicals. These facilities include:

- North snowmelt pump station, located just south of South 154th Street (former SDN2 drainage basin which is now diverted to IWS);
- Central snowmelt pump station, located just south of the fire station at the edge of the aircraft apron, east of the North Satellite; and
- South snowmelt pump station, located immediately west of the Olympic Tank Farm, at the edge of the Runway 34R hardstand and taxiway.

A fourth snow storage area lies within the IWS area near the Delta hangar. Melt water from these facilities drains to the IWS. This BMP is designed to reduce a potential source of BOD in SDS runoff that reaches Miller and Des Moines Creeks.

7.7.8 Enhancement of Wetland Water Quality Functions

Existing degraded wetlands in the Miller Creek and Des Moines Creek basins will be enhanced to improve water quality functions. Restored wetlands will benefit water quality by:

- Eliminating existing agricultural pollution sources;
- Increasing settling and mechanical trapping of particulates;
- Removing dissolved metals and other toxics that bind to particulates;
- Reducing and binding metals in humic material; and
- Biologically removing and uptaking nutrients.

7.7.9 Miller Creek Buffer Enhancement

The riparian buffers along approximately 6,500 linear ft of Miller Creek will be enhanced (Parametrix 1999b). Native trees, understory plants, and ground cover will replace lawns, agricultural areas, and other areas to restore buffer quality and continuity. Enhanced buffers should:

- Increase biofiltration of runoff flowing into the creek from riparian areas;
- Reduce bank erosion, and thus sediment supply, from areas directly adjacent to the creek;
- Remove potential pollutant runoff from lawns; and
- Shade the creek, which will reduce stream temperatures and increase the DO saturation concentration, which potentially increases ambient DO concentrations.

7.7.10 Miller Creek Stream Channel Restoration and Enhancement

Approximately 1,500 ft of the Miller Creek channel south of the Vacca Farm site will be restored and enhanced by repairing and re-vegetating eroding and hardened streambanks and by installing large woody debris in the channel. These restoration activities are intended to provide water quality benefits to Miller Creek by reducing erosion and sediment supply.

7.7.11 Level 2 Hydrologic Controls

As discussed in Section 2.1, all STIA impervious surfaces draining to Miller and Des Moines creeks will have Level 2 hydrologic controls. Level 2 hydrologic controls will limit the duration of erosive flows, in turn benefiting water quality by reducing suspended solids, turbidity, and sedimentation.

7.8 STORMWATER FACILITY MAINTENANCE

Maintenance of existing stormwater facilities is covered by the *STIA Stormwater Pollution Prevention Plan* (SWPPP; Port of Seattle 1999d). Additionally, inspection and maintenance manuals exist for larger, complex facilities such as Tyee Pond and the Miller Creek Detention Facility (Parametrix 1999c). The SWPPP will be updated to provide for inspection and maintenance of new ponds and vaults, including the following procedures:

- Inspect facilities annually—check orifices, hardware, vegetation (if applicable), and sedimentation; if conditions warrant, inspect more frequently.
- Check facility outlets for signs of erosion.
- Maintain inspection records for at least 5 years.
- Remove accumulated sediment in excess of 6 inches.
- Maintain vegetation.
- Maintain facility hardware.

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COMPREHENSIVE STORMWATER MANAGEMENT PLAN

VOLUME 2—APPENDIX A

HYDROLOGIC EVALUATION OF STORMWATER DRAINAGE BASIN CHANGES AND DETENTION POND PERFORMANCE BETWEEN 1994 AND MASTER PLAN COMPLETION

SEATTLE-TACOMA INTERNATIONAL AIRPORT
MASTER PLAN UPDATE IMPROVEMENTS

FOR AGENCY REVIEW

Prepared for

PORT OF SEATTLE
Seattle-Tacoma International Airport
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December 2000
556-2912-001 (28)

PREFACE

Comprehensive Stormwater Management Plan
Seattle-Tacoma International Airport
Master Plan Update Improvements

July 2001

This document contains replacement pages developed in response to comments received from the Washington State Department of Ecology (Ecology) on Volumes 1 through 4 of the December 2000 Comprehensive Stormwater Management Plan (SMP) for the Seattle-Tacoma International Airport Master Plan Update Improvements. A facilitated process was used to document specific revisions required by Ecology to the December 2000 SMP. Each SMP volume contains an itemized list of replacement pages, and the replacement pages are identified by a July 2001 footer.

SMP VOLUME 2
JULY 2001 REPLACEMENT PAGES

Preface (before pg. *i*)
List of Volume 2 Replacement Pages
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Figure A-1b (pg. A-2c)
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Table A-3 (pgs. A-4 through A-9a)
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Figure A-11 (pg. A-30)
ATTACHMENT A:
- Tables A-1a and A-1b (*STIA basins only*) (24 pgs.)

ATTACHMENT C:
- Cover page
- Miller Creek Watershed Detention Pond Performance Data:
  - Computation of Basic Statistics (2 pgs.)
  - SDN3A (11 pgs.)
  - SDN3/3X (12 pgs.)
  - SDN4X/2X (16 pgs.)
  - SDW1B (11 pgs.)
  - SDN1 (14 pgs.)
  - SDW1A (13 pgs.)
  - *Note: SDN6 and NEPL not included since not revised*
- Miller Creek Watershed Additional Points of Compliance Performance Data:
  - Cover page
  - SR509 (9 pgs.)
  - MCDF (10 pgs.)
  - Lake Reba (9 pgs.)
- Walker Creek Watershed Detention Pond Performance Data:
  - SDW2 (South 12th Street) (18 pgs.)
- Des Moines Creek Watershed Detention Pond Performance Data:
  - SDS7 (7 pgs.)

SMP VOLUME 2

JULY 2001 REPLACEMENT PAGES (CONTINUED)

ATTACHMENT C (CONTINUED):

- Des Moines Creek Watershed Additional Points of Compliance Performance Data:
  - Cover Page
  - SDS POC-1 (8 pgs.)
  - SDS POC-2 (8 pgs.)
  - South 200th Street (7 pgs.)
  - *Note: SASA Inline Facility Analysis not included since not revised*

ATTACHMENT D:

- Miller Creek Watershed HSPF Input Files:
  - Predevelopment Conditions (21 pgs.)
  - 2006 Conditions (56 pgs.)
- Walker Creek Watershed HSPF Input Files:
  - Predevelopment Conditions (9 pgs.)
  - 2006 Conditions (10 pgs.)
- Des Moines Watershed HSPF Input Files:
  - Predevelopment Conditions (19 pgs.)
  - 2006 Conditions (21 pgs.)

Note: Listed page totals do not include "guidance" pages (the guidance pages do not need to be inserted as replacement pages).

APPENDIX A

TABLE OF CONTENTS

ATTACHMENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

This appendix summarizes changes made to the Hydrologic Simulation Program – FORTRAN (HSPF) hydrologic data used to model the hydrology of Miller, Walker, and Des Moines Creek watersheds with completion of Master Plan Update (MPU) improvement projects. The future project condition (2006) considered changes to the subbasin boundaries assumed in the model (but not the watershed boundaries), the effect of new embankment fill, additional impervious area, and enlarged or new detention facilities.

Section 2 discusses hydrologic data changes. The changes included subbasin boundaries, land use, impervious area, soils and wetlands, period of hydrologic record, and calibration of airport fill parameters.

Section 3 explains how detention facility design standards were determined, the assumptions made for detention planning purposes, and the basis for target flow determination to achieve preliminary design criteria. This section also compares hydrologic conditions prior to and with the proposed project.

Section 4 compares the flood frequency and flow duration at several evaluation locations within each watershed. These hydrologic analyses show the changes between the pre- and post-project conditions. The amount of detention volume required to achieve the stormwater design criteria was also determined.

Conclusions are presented in Section 5 and references are provided in Section 6.

Attachment A contains the subbasin characteristics information for Miller, Walker, and Des Moines Creek watersheds. Attachment B contains 1998 embankment fill calibration data. Attachment C contains HSPF and KCRTS subbasin detention pond performance data and additional points of compliance performance data for Miller, Walker, and Des Moines Creeks. Attachment D contains the HSPF input files for Miller, Walker, and Des Moines Creek watersheds.

2. HYDROLOGIC DATA

Hydrologic conditions that are expected to change between the base year (1994) HSPF model calibration period and future (2006) Master Plan Update completion period are described in this section. These changes include land use, impervious cover, soils, and wetlands. In addition, this section describes the hydrologic data used to determine target flows for the points of compliance for stormwater quantity management.

A series of figures are presented showing the future conditions in the subsequent subsections. GIS data were used to create tables that calculated the pervious and impervious land segments input data for the HSPF model. Tables A-1a and A1b (Attachment A) summarize the results and show the model land segments input data used to simulate predevelopment and future conditions for Miller and Walker Creeks. Both predevelopment and future conditions are based on the future subbasin boundaries.[1] The analysis of the land area conditions is discussed in the subsequent sections. Tables A-2a and A-2b (Attachment A) provide similar information for Des Moines Creek.

2.1 SUBBASIN DRAINAGE BOUNDARIES

Construction of the Third Runway project and diversion of stormwater to the Industrial Wastewater System (IWS) drainage network (Subbasin 2) are expected to alter the location of several subbasin boundaries (compared to their position in 1994). Figures A-1a and A-1b show the future (2006) and existing (1994) watershed boundaries and the future and existing subbasin boundaries. These figures depict the approximate location of the subbasin boundaries within the area where hydrologic conditions may change between 1994 and 2006. No major hydrologic changes are anticipated to the subbasin boundaries outside of this area. These boundaries were assumed identical to the 1994 condition used to calibrate the HSPF models. Figure A-1c shows the future watershed and subbasin boundaries for Miller, Walker, and Des Moines Creek watersheds that were used for the predevelopment and future conditions modeling described in this document.

2.2 LAND USE CHANGES

Table A-3 contains a list of the principal Master Plan Update improvement projects that will require stormwater detention, the stormwater detention facilities that will serve these projects, and estimated dates of construction.

The proposed Seattle-Tacoma International Airport (STIA) drainage subbasin boundaries and future land uses that are projected based on the Master Plan Update improvement projects and preliminary drainage improvements design are shown in Figure A-2. A comparison between

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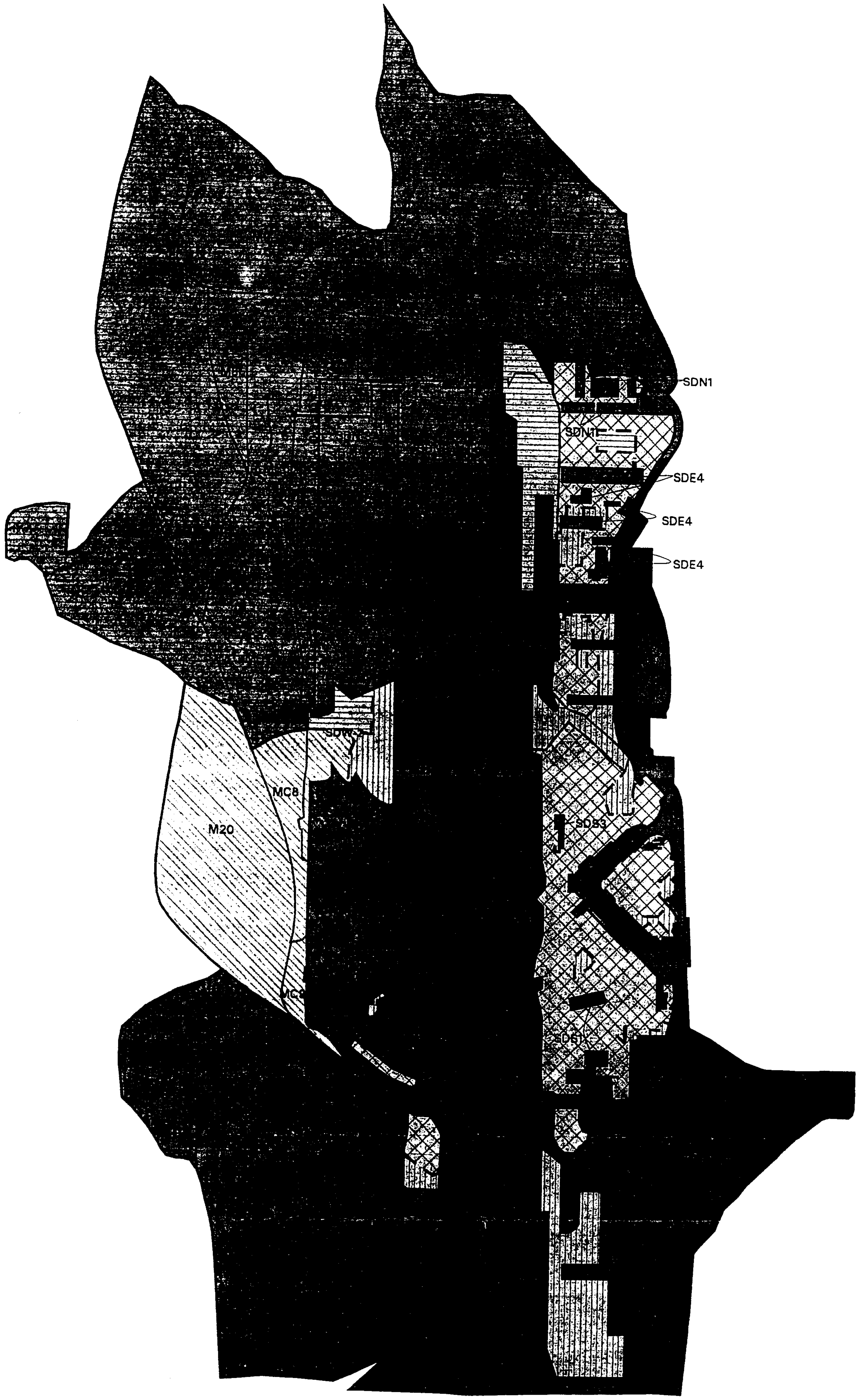
[1] The Walker Creek predevelopment condition is referred to as MC-8B special, which is a combination of the calibrated MC-8B plus a portion of calibrated MC-7, MC-8, and MC-9. The predevelopment MC-8B special condition is compared to the SDW2 future condition.

Figures A-2 and B1-4 (contained in Appendix B) shows that the storm drain system (SDS) subbasins encompass additional areas that were not included in the 1994 drainage pattern.



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July 2001
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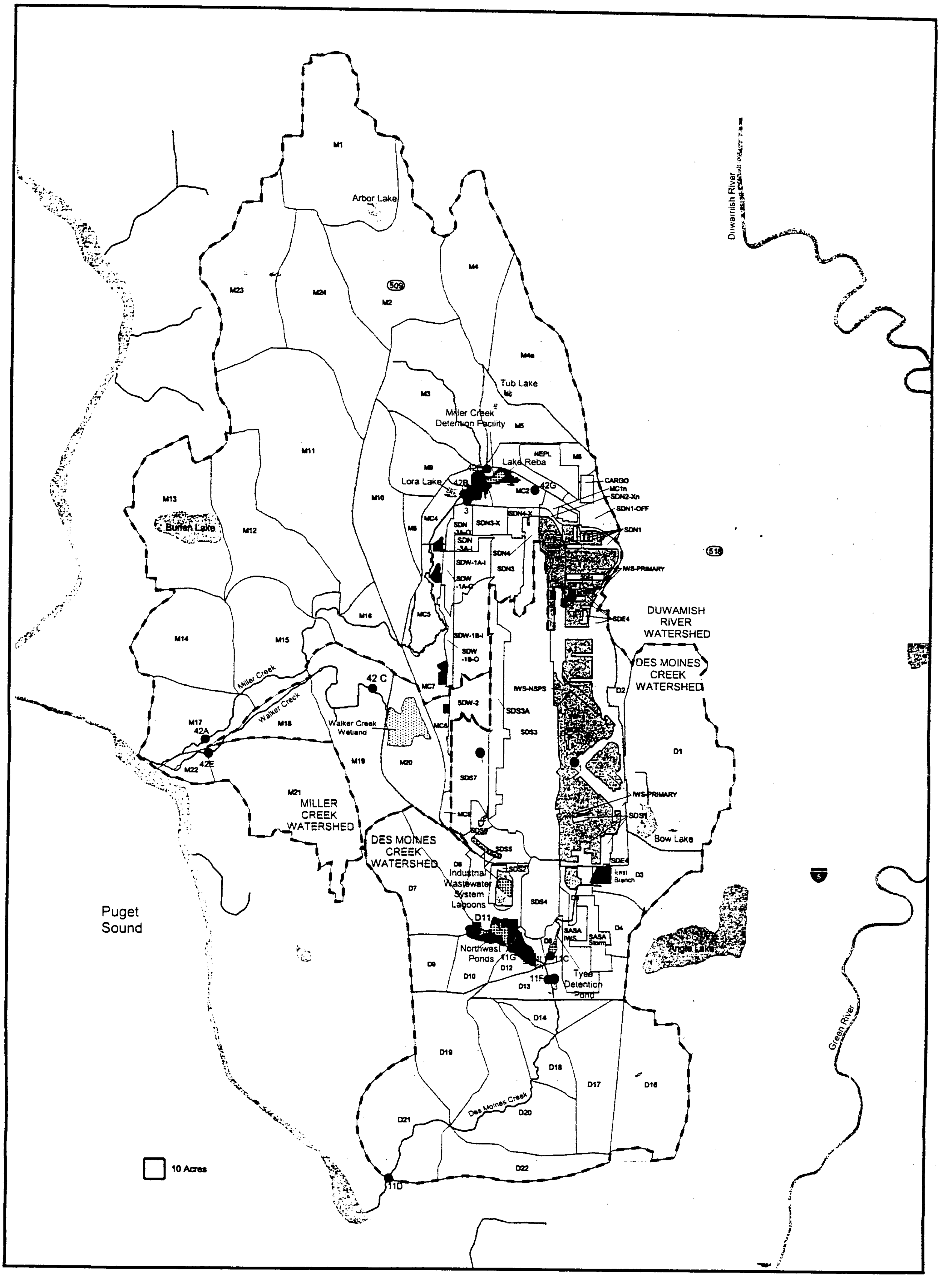
N

0 500 1000 1500

Scale in Feet

Existing Miller Creek Watershed
Existing Walker Creek Watershed
Existing DesMoines Creek Watershed
Existing IWS
Future Miller Creek Watershed
Future Walker Creek Watershed
Future DesMoines Creek Watershed
Future IWS
Existing Watershed Boundary
Future Watershed Boundary
Future (2006) Subbasin Boundary

Figure A-1b
Future and Existing Watersheds with Future (2006) Subbasins



Parametrix, Inc. Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 8/00 File:K:\GIS\2912\Arcview\rrseatac_apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Detention boundaries estimated by Parametrix, Inc.
Note: STIA Subbasin GIS coverage obtained where conditions may change between 1994 base conditions and other conditions; subbasin boundaries shown outside of STIA area are for illustration and reference only. The subbasin boundary between M18 and M15/M17 was revised from the previous model as shown, and the basin areas were revised. Modeling input parameters for areas outside of the STIA area are provided by other studies.

July 2001
556-2912-001 (28)

N

1000 0 1000 2000 Feet

1:36,000

Roads

Future (2006) Drainage Subbasins

STIA Area (see note)

Constructed Water Features

Watershed Boundary

Subwatershed Boundary

Rivers

Water Bodies

Detention Facilities (existing and proposed)

IWS Drainage Area

Precipitation Gauging Stations:
Type 1 - National Weather Service (Gauge relocated 1996)
Type 2 - POS Rainfall Monitoring
Type 3 - King County Rainfall Monitoring

Stream Flow
King County Gauging Stations:
42A - Miller Ck @ SW 175th Pl & 12th Ave SW
42B - Miller Ck @ Lake Reba/RDF Outlet
42C - Walker Ck @ 171st Pl
42E - Walker Ck @ 12th Ave SW
42F - Miller Ck @ SR518
42G - Miller Ck @ East Branch
11D - Des Moines Ck near mouth
11F - Des Moines Ck @ Golf Course
11C - Des Moines Ck @ Tyee Pond
11G - Des Moines Ck @ NW Ponds

Figure A-1c
Miller Creek and Des Moines Creek Watersheds 2006

Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management.[a]

Activity	Construction Start	Construction End	Permanent Stormwater Detention Provided?	Year MPU in Service[b]	Facility (Year in Service)	New or Retrofit	Comment
A. RUNWAY AND TAXIWAYS							
Runway Safety Area							
Runway 34R Safety Fill	1/96	12/96	Yes	T	SDS(5)	Retrofit	No new impervious; detention was not required when the facility was built
Auburn Wetlands Mitigation	8/01	6/04	No	—	N/A	—	No new impervious
Miller Creek Relocation	4/02	12/02	No	—	N/A	—	No new impervious
Vacca Farm Floodplain Restoration	3/02	12/02	No	—	N/A	—	No new impervious
154th / 156th Street Relocation	4/02	10/03	Yes[c]	3	MCDF (T)	Retrofit	No new net impervious; detention provided in regional facility
Safety Areas 16R/16L	5/04	10/05	Yes	5	SDN2x/4x (4)	New	New fill and impervious
Miller Creek Sewer Relocation	3/02	12/02	No	—	N/A	—	No new impervious
Embankment							
Property Acquisition, Street and Utility Vacation	1/98	12/04	No	—	N/A	—	Impervious area removed
Borrow sites 1, 3A, and 4	6/02	6/06	No[g]	—	Temporary detention	—	Cleared and graded areas will drain to temporary TESC ponds
Phase 1 1997 Embankment Stockpile	6/97	11/97	No[d]	—	Temporary detention	—	Cleared and graded areas will drain to temporary TESC ponds
Phase 2 1998 Embankment Fill	3/98	10/98	No[e]	6	Temporary detention	New	Cleared and graded areas will drain to temporary TESC ponds
Phase 3 1999 Embankment Fill	3/99	3/01	No[e]	6	Temporary detention	New	Cleared and graded areas will drain to temporary TESC ponds
Phase 4 2000-2001 Embankment Fill	5/01	1/02	No[e]	6	Temporary detention	New	Cleared and graded areas will drain to temporary TESC ponds

Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued).[a]

Activity	Construction Start	Construction End	Permanent Stormwater Detention Provided?	Year MPU In Service[b]	Facility (Year in Service)	New or Retrofit	Comment
Temporary SR-518 Interchange	5/02	10/02	No[d,g]	—	Temporary detention	—	New temporary impervious
Temporary SR-509 Interchange	6/01	10/01	No[d,g]	—	Temporary detention	—	New temporary impervious
FAA & NAVAIDS							
Relocation of Airborne Cargo	10/99	8/00	Yes	T	SASA (4)	Retrofit	Retrofit existing conditions, no net new impervious
New ATCT	3/00	9/02	Yes	4	SASA (4)	Retrofit	Retrofit existing conditions, no net new impervious
Relocate ASR	6/01	8/04	Yes	4	On-site detention ponds	New	New impervious
ASDE, NAVAIDS	6/01	8/04	No[g,f]	4	—	New or retrofit	New impervious or retrofit existing conditions
Airfield							
Interconnecting Taxiways 16R-34L	4/94	12/95	Yes	T	1) SDN3x (4)[i] 2) SDN2x/4x (4)[i] 3) SDS3 (6)	Retrofit	Retrofit existing conditions
Phase 1 1998 Taxiway Construction	4/98	6/98	Yes	T	SDS3A (T) 1) SDN3x (4)[i] 2) SDN2x/4x (4)[i] 3) SDS3 (6)	New	Retrofit existing conditions, new impervious in SDS3
Phase 2 1999 Taxiway Construction	3/99	12/99	Yes	T	SDS3A (T) 1) SDN3x (4)[i] 2) SDN2x/4x (4)[i] 3) SDS3 (6)	New	Retrofit existing conditions, new impervious in SDS3

Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued).[a]

Activity	Construction Start	Construction End	Permanent Stormwater Detention Provided?	Year MPU in Service[b]	Facility (Year in Service)	New or Retrofit	Comment
Phase 3 2002-2004 Runway 16X/34X	3/05	12/06	Yes	6	1) SDS7 (5) 2) SDW1A (6) 3) SDW1B (6) 4) SDW2 (6) 5) SDN3A (5)	New	New impervious
Other							
New Snow Equipment Storage	11/96	9/97	Yes	T	SDS3 (6)	New	New impervious areas are included in runway/taxiway drainage
B. TERMINAL AND LANDSIDE IMPROVEMENTS – 1996-2000 (PHASE I)							
Terminal/Roadways							
Central Terminal Expansion	3/02	11/04	Yes	4	SASA (4)	Retrofit	Retrofit existing conditions
Expansion of Concourse A (South Terminal)	12/99	12/03	Yes	3	SASA (4)	Retrofit	Retrofit existing conditions
Improvements to Main Terminal Roads (Ground access and seismic improvements, widen lower terminal drive, widen north entry drive)	3/97	9/99	Yes	T	SASA (4)	Retrofit	Retrofit existing conditions
Satellite Transit Shuttle System Rehab	2/00	12/01	No	—	N/A	—	Drains to IWS
Westin Hotel			Yes	—	SASA (4)	Retrofit	Project cancelled but included in SMP, no net new impervious, will be retrofitted by SASA facility

Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued).[a]

Activity	Construction		Permanent Stormwater Detention Provided?	Year MPU In Service[b]	Facility (Year in Service)	New or Retrofit	Comment
	Start	End					
Air Cargo							
Redevelopment of North Air Cargo (ground support equipment relocation)	2001	2006	Yes	6	SDN1 (6)	Retrofit, New	Retrofit existing conditions. Increase in SDN1 is offset by previous SDN1 and SDN2 reroutes to IWS.
Runway/Apron							
Removal of displaced threshold on Runway 16L	2000	2000	Yes	—	SDN2x/4x	Retrofit	No net new impervious
Parking							
Main Garage Expansion to South, North, East	2/98	5/00	No	T	N/A	—	Drains to IWS
NEPL, Phase 1	7/97	7/98	Yes	T	NEPL retrofit vault (4)	Retrofit	Retrofit existing NEPL
C. TERMINAL AND LANDSIDE IMPROVEMENTS – 2000-2005 (PHASE II)							
SASA							
SASA Site preparation	2004	2006	No[d]	—	N/A	—	Cleared and graded areas will drain to TESC ponds
SASA and Access Taxiways	2004	2007	Yes	7	SASA (4)	New	Retrofit existing conditions, new impervious (SDS and IWS)
Ground Support Equipment Location	2004	2006	Yes	6	SASA (4)	New	Retrofit existing conditions, new impervious
Ground/Corporate Aviation Facilities (SASA)	2004	2006	Yes	6	SASA (4)	New	Retrofit existing conditions, new impervious
Relocation of United Maintenance Complex to SASA	2004	2006	Yes	6	SASA (4)	New	Retrofit existing conditions, new impervious at SASA

Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued).[a]

Activity	Construction Start	Construction End	Permanent Stormwater Detention Provided?	Year MPU In Service[b]	Facility (Year In Service)	New or Retrofit	Comment
Terminal/Roadways							
Improved Access and Circulation Roadway Improvements	2001	2005	Yes	5	SASA (4)	Retrofit	Retrofit existing conditions, no new net impervious
First Phase of North Unit Terminal (South Pier)	2006	2008	Yes[h]	8	SASA (4)	Retrofit	Retrofit existing conditions, no new net impervious
Ramps off SR-518, S. 160th Improvements			No[g]	—	N/A	—	Project cancelled
North Unit Terminal Roadways	2006	2008	Yes[h]	8	SASA (4)	Retrofit	Retrofit existing conditions, no new net impervious
New ARFF (fire station)	2006	2007	Yes[h]	7	SASA (4)	Retrofit	Retrofit existing conditions
Improvements to South Access Connector Roadway	2006	2008	Yes	8	SASA (4)	Retrofit, New	Retrofit existing conditions and new impervious
Air Cargo							
Continued Expansion of North Cargo Facilities	2001	2005	Yes	5	Cargo vault (4)	Retrofit	Retrofit existing conditions
Runway/Apron							
Dual Taxiway 34R	2010	2015	Yes	15	SDS4 (5)	Retrofit	Retrofit existing conditions
Parking							
Expansion of NEPL to 6000 stalls	2002	2004	No[g]	4		New	New impervious, project not included in SMP
First Phase of North Unit Terminal Parking Structure	2006	2009	Yes	9	SASA(4)	Retrofit	Retrofit existing conditions

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Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued).[a]

Activity	Construction Start	Construction End	Permanent Stormwater Detention Provided?	Year MPU in Service[b]	Facility (Year in Service)	New or Retrofit	Comment
D. TERMINAL AND LANDSIDE IMPROVEMENTS – 2006-2010 (PHASE III)							
Terminal/Roadways							
Expansion of North Unit Terminal (North Pier)	2006	2010	Yes[h]	10	SASA (4)	Retrofit	Retrofit existing conditions
Complete Connectors to South Access Roadway	2006	2010	Yes	10	SASA (4)	Retrofit	Retrofit existing conditions
Air Cargo							
Cargo Warehouse at 24th Avenue South	2006	2010	Yes	10	Cargo vault (4)	New	Retrofit existing conditions, new impervious
Runway/Apron							
Extension of Runway 34R by 600 feet	2006	2010	Yes	10	SDS4 (5)	New, Retrofit	Retrofit existing conditions
Additional Taxiway Exits on 16L/34R	2006	2010	—[g]	—	N/A	—	Future project not included in SMP
Parking							
Additional Expansion of Main Parking Garage	2006	2010	No[g]	—	N/A	—	Future project not included in SMP
Additional Expansion of North Employee Parking Lot	2006	2010	—[g]	—	N/A	—	Future project not included in SMP
Expand North Unit Parking Structure	2010	2013	—[g]	—	N/A	—	Future project not included in SMP
E. TERMINAL AND LANDSIDE IMPROVEMENTS – 2010-2020 (PHASE IV)							
SR-509 Extension/South Access							
SR-509 Extension/South Access	2005	2010	—	—	N/A	—	WSDOT project/ New impervious

Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued).[a]

Note: T = End of 2000.

[a] Projects with new impervious surface, changed land cover, or change from IWS to SDS. Based on information presented in Master Plan Update FEIS and subsequent schedules. Schedule of Phase II-IV projects is approximate, and schedule and data on all projects are subject to change. Schedule assumes Section 404 permit granted in Summer 2001.

[b] End of first calendar year following approval of permit. For example, if permit is issued in 2001, year 1 is the end of 2001.

[c] Construction of 154th below the MCDF will be offset by removal of existing houses in the MC4, MC5, and MC6 basins. 154th upstream of the MCDF will be controlled by the MCDF outlet.

[d] Temporary construction facility. Temporary detention provided. No permanent detention required.

[e] Detention included in TESC facilities. At final buildout, detention is included in Airfield phase 3.

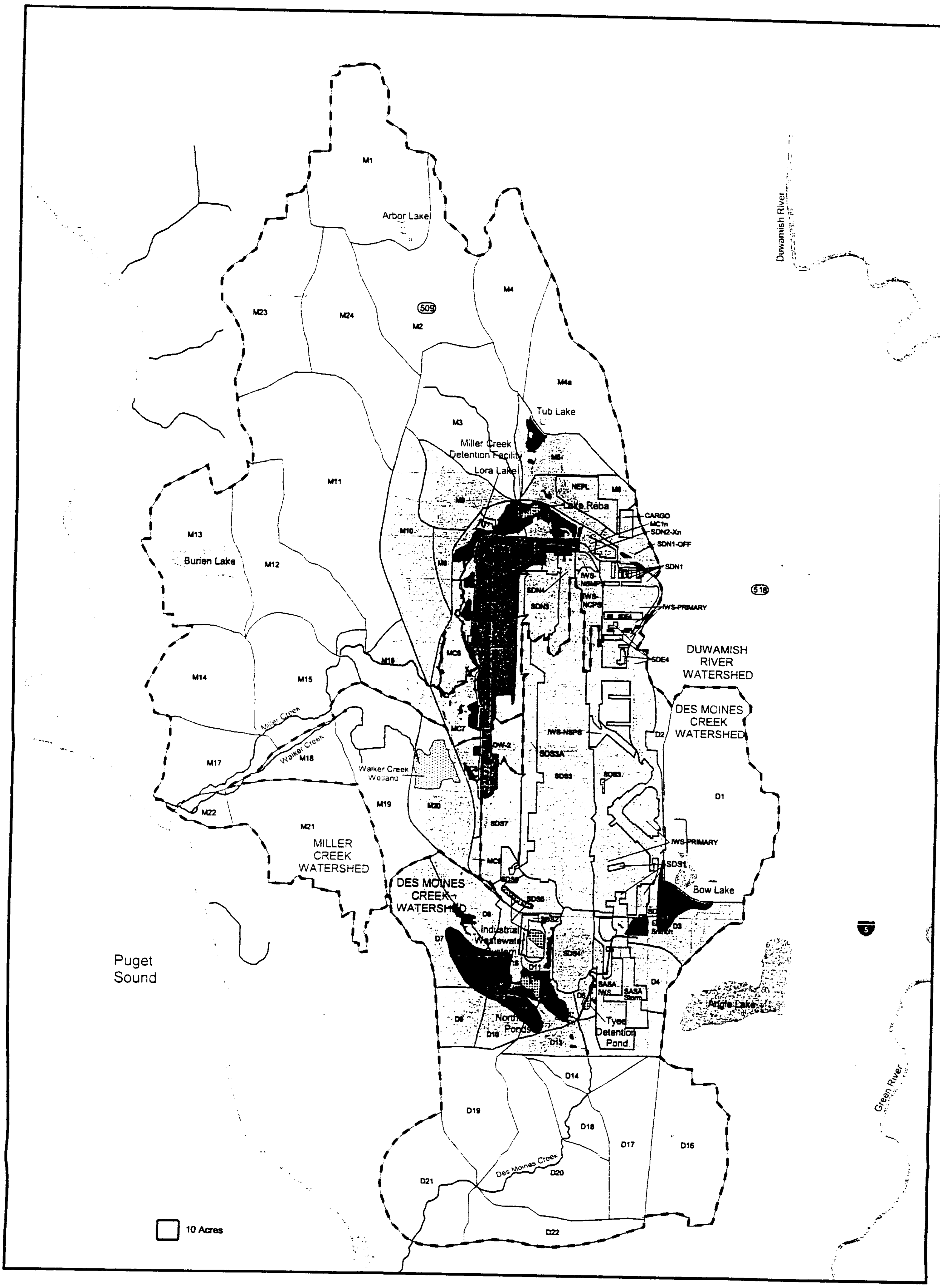
[f] New navigation facilities will require revisions to SMP if there is new impervious area required.

[g] Not included in MPU SMP.

[h] Project was included in SMP but is under evaluation for modification. The SMP considers original project proposal. Increases in net impervious area will require revisions to the SMP.

[i] New impervious areas in Miller Creek basin are temporarily offset by IWS diversions.

AR 046484



Parametrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File: K:\Gis\2912\Arcview\rsestac-apoxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Detention boundaries estimated by Parametrix, Inc.
Estimated wetland boundaries are based on field reconaissance by Parametrix, Inc.
Note: Subbasin boundaries shown outside of STIA area are for illustration and reference only.

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N
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Roads
Future (2006) Drainage Subbasins
STIA Area (see note)
Watershed Boundary
Subwatershed Boundary

Rivers
Water Bodies
Detention Facilities (existing and proposed)
Constructed Water Features

Outwash
Till
Fill
Wetland
Lacustrine

Figure A-4
STIA Drainage Subbasins and 2006 Soils/ Wetland Areas

AR 046485

The procedure used for sizing detention facilities required comparison of the hydrologic regime between two land use conditions—project and pre-project. Assumptions were used to estimate the land area under a pre-project condition since this is different from the present (and 1994 base) condition. The assumptions for Miller and Des Moines Creek models are shown on Tables A-5 and A-6.

2.3 IMPERVIOUS AREA

The STIA subbasin impervious surface areas for the future condition are shown in Figure A-3. The additional impervious areas include the Third Runway and taxiway areas, cargo handling areas, and employee parking areas.

In acquisition areas, the amount of impervious area will be reduced due to the demolition of residential and other building structures. These impervious surfaces were deleted from the GIS impervious cover layer, leaving only roads as the principal impervious surface in those acquisition subbasins.

The EIA fractions developed during model calibration (Appendix B) were adopted for other subbasins for future condition hydrologic modeling. Effective impervious area was assumed to be 100 percent of the total impervious area for the airport land use category. In addition, the EIA was assumed to be 100 percent of impervious area for the transportation land use category.

2.4 SOILS AND WETLANDS

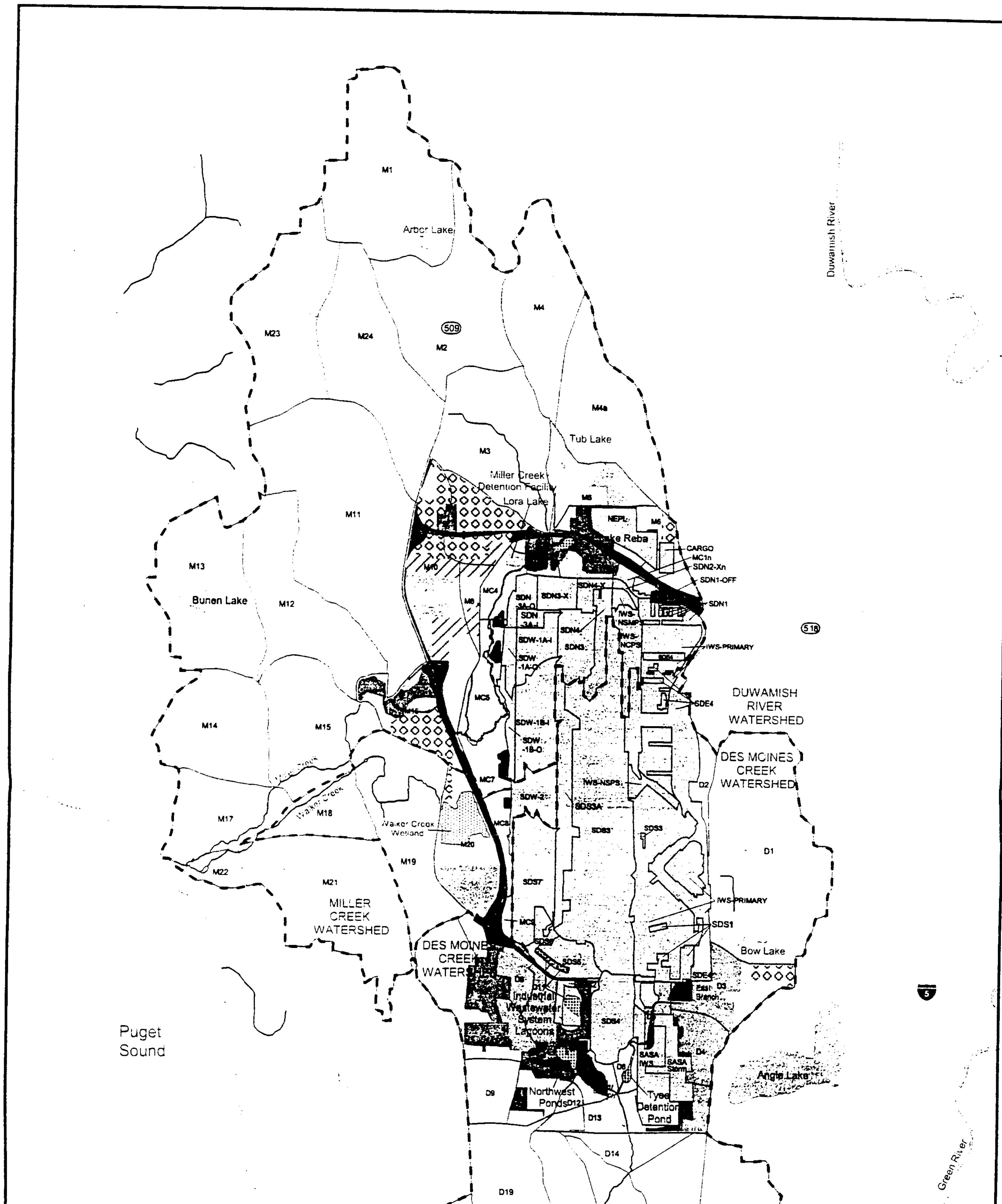
The subbasin boundaries and soils and wetland coverage for future conditions are shown in Figure B1-5. Wetland delineation was based on the sources shown in the figure. The sources are similar to the sources used for the 1994 soil and wetland coverage (Figure B1-5 in Appendix B). However, where embankment or other construction would result in the loss of wetland areas, the wetland areas were removed (Figure A-4). Wetland mitigation and compensation is proposed at a site outside of the Miller/Walker and Des Moines watersheds; therefore, the effect of wetland loss was included in the HSPF model.

A special embankment fill category was added to the soil's GIS layer for 2006 conditions. Preliminary (30 percent) design drawings were used to delineate the areal extent of the fill for the Third Runway project. The coverage was included in the GIS analysis of soil type in each STIA subbasin.

The 1994 slope map was reanalyzed to consider new embankment fills. The future condition slope analysis is shown in Figure A-5.

2.5 HYDROLOGIC ROUTING

The HSPF model routes subbasin flows (surface, interflow, and groundwater) to the outlet of each subbasin unless otherwise specified by the user. The changes to groundwater routings developed for subbasins upstream of the MCDF, and groundwater input from non-contiguous



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Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Estimated wetland boundaries are based on field reconnaissance by Parametrix, Inc.
Land use data interpreted from 1993 STIA aerial photograph (Walker and Assoc. 1993).
Note: Subbasin boundaries shown outside of STIA area are for illustration and reference only.

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N

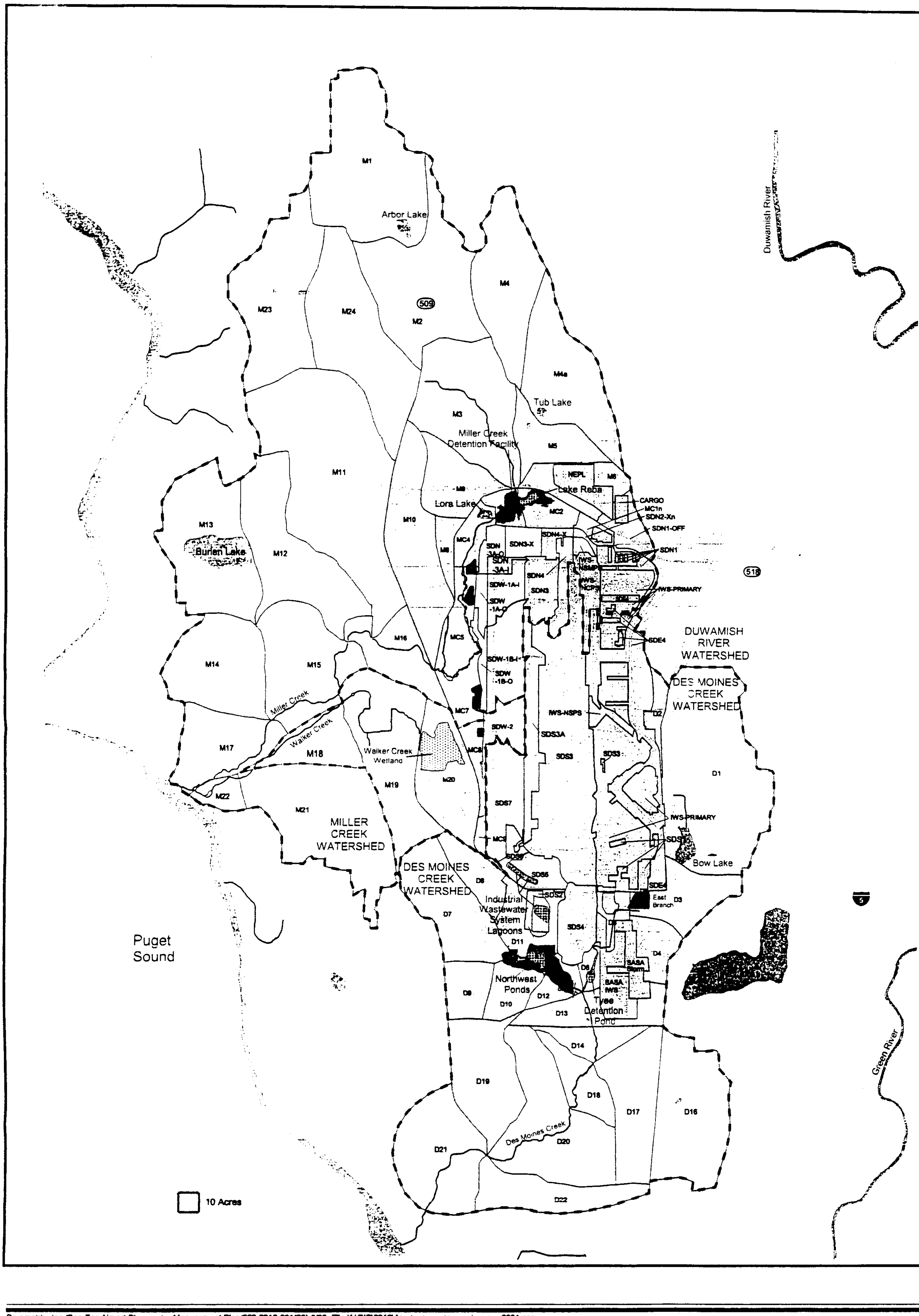
1000 0 1000 2000 Feet

1:36,000

Roads
Future (2006) Drainage Subbasins
STIA Area (see note)
Watershed Boundary
Subwatershed Boundary
Rivers
Water Bodies
Constructed Water Features
Detention Facilities (existing and proposed)
Sea-Tac Airport
Commercial
Open/Grass
Transportation
Low Density Residential
High Density Residential
Multi-Family Residential
Forest

Figure A-2
STIA Drainage Subbasins and 2006 Land Use

AR 046487



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Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Detention boundaries estimated by Parametrix, Inc.
Impervious surface data interpreted from 1993 STIA aerial photograph (Walker and Assoc. 1993).
Note: STIA Subbasin GIS coverage obtained where conditions may change between 2006 base conditions and other conditions; subbasin boundaries shown outside of STIA area are for illustration and reference only.

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N

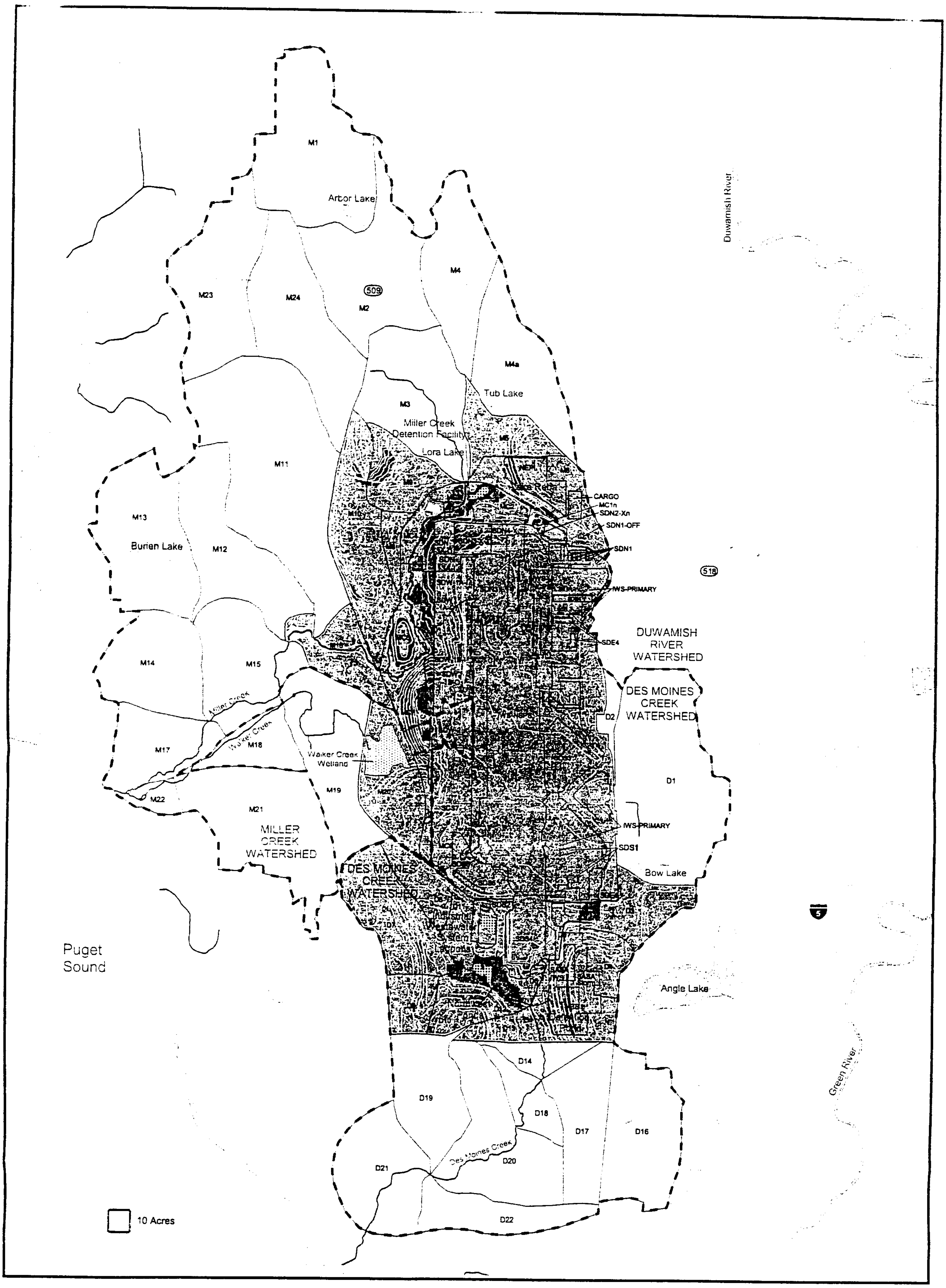
1000 0 1000 2000 Feet

1:36,000

Roads
Future (2006) Drainage Subbasins
STIA Area (see note)
Watershed Boundary
Subwatershed Boundary
Rivers
Water Bodies
Constructed Water Features
Detention Facilities (existing and proposed)
Impervious Areas

Figure A-3
STIA Subbasins
Future Impervious
Areas

AR 046488



Parametrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File: K:\Gis\2912\Arcview\rseatac-apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. USGS Des Moines Quadrangle Map Revised 1973 (U.S. Army Corps of Engineers).
Note: Subbasin boundaries shown outside of STIA area are for illustration and reference only.

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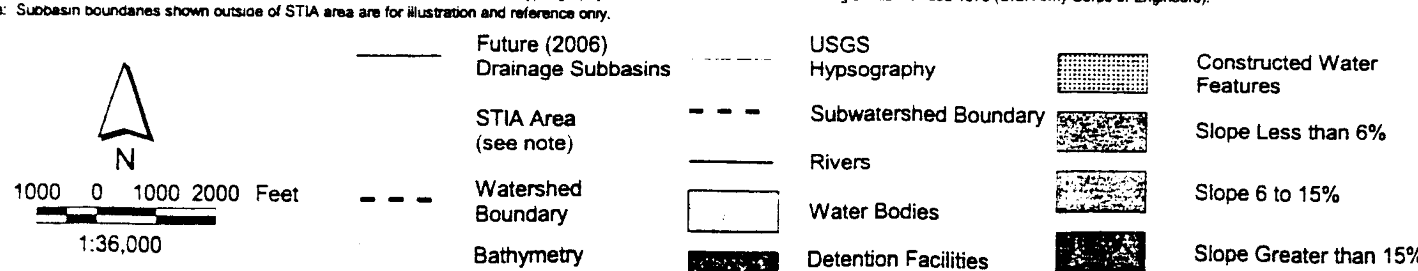


Figure A-5
STIA Subbasins and Future Slope Map

AR 046489

aquifer areas in the Des Moines Creek subbasins (determined during HSPF model calibration). were included in the future condition model for Des Moines Creek.

Other changes for future conditions made in the hydrologic routing scheme included the following:

1. SDW subbasin changes proposed in the west draining portion of the Third Runway project;
2. Additional flows from the North Employee Parking Lot (NEPL) and Cargo subbasins;
3. Overflows from the North Cargo and North Snow Melt Pump Stations; and
4. Elimination of SDN2, which drains to the IWS system.

2.6 PERIOD OF HYDROLOGIC RECORD

The analysis of future hydrologic conditions (and comparison to pre-development conditions) was conducted using an extended hydrologic record relative to the period used for the HSPF model calibration. The Miller Creek and Walker Creek model was calibrated using a hydrologic record from October 1992 through August 1996 for reasons described in Appendix B. The Des Moines Creek model was calibrated using a hydrologic record from January 1994 through September 1996, as described in Appendix B.

Long-term records are recommended for flood frequency and flow duration analyses, typically a minimum of 10 years (U.S. Department of Interior 1982). The period used for evaluation of detention facility requirements described in this appendix was based on the rainfall and evaporation data from October 1948 though September 1996 (a 49-year record).

Long-term precipitation and evaporation records were used as follows:

- Hourly precipitation records for STIA (NOAA Weather Service station) from October 1948 through September 1996; and
- Daily pan evaporation data (based on the Puyallup Experiment Station) from October 1948 through September 1996 obtained from King County DNR.

2.7 CALIBRATION OF AIRPORT FILL PARAMETERS

A preliminary analysis was made of the stormwater runoff during a 1-month period (late January through late February 1999) at the 1998 embankment fill site to calibrate HSPF PWATER parameter values. The Hydrocomp Forecast and Analysis Model (HFAM) computer program was used for this analysis. This program incorporates the same numerical algorithms for hydrologic processes as HSPF, but has additional features that facilitate the study of surface runoff, interflow, and base flow components.

The 1998 embankment fill site was approximately 19.4 acres in size. It was constructed over an area formerly sloping toward Miller Creek in the north end of the new runway fill (Figure A-4). The fill overlies an area mapped as till soil. The original site was cleared and grubbed prior to placement of a gravel underdrain layer beneath the fill. The fill was a combination of materials (called for in the specifications) that had similar gradations. Groups 1A, 2, and 3 fill materials were placed. Group 2 material (Port of Seattle 1998) has the following specifications:

Sieve Size	Percent Passing
6-inch	100
3-inch	70 – 700
¾-inch	50 – 85
US No. 4 (0.18-inch)	30 – 65
US No. 40 (0.02-inch)	5 – 30
US No. 200 (0.003-inch)	0 – 12

Surface runoff was collected and piped to a sedimentation pond at the base of the fill. In addition, the pond collected interflow and base flow since its elevation was well below the base of the fill. During monitoring, numerous seeps were observed that fed into the sedimentation pond.

The volume of water collected in the pond was recorded. Precipitation and evaporation data were obtained from the National Weather Service rainfall gage at STIA and the Puyallup Experimental Station (Figure A-1). When sufficient rainfall resulted in water treatment operations, water level records were kept. These data were used to estimate the mean daily flow from the site. The flow estimate was the sum of direct surface and interflow runoff plus base flow (shallow groundwater).

HFAM was used to simulate a 52-month period of streamflow. For comparison purposes, a conceptual model of the entire Miller/Walker Creek watershed during the same period was also constructed. The conceptual model included only till, outwash, and impervious land segments representing the total acreage in each soil/cover category based on the drainage area at King County Streamflow Gage 42A (near the mouth of Miller Creek). The purpose of the conceptual Miller/Walker Creek model was to compare the proportion of surface runoff, interflow, and base flow between the other pervious/impervious land segments and airport embankment fill. The conceptual model did not include detention facility or channel routing characteristics.

The conceptual pervious areas were assigned the PWATER parameters determined during the model calibration process. The initial values used for airport fill were those determined for till soil. An interactive process was used to adjust the PWATER parameters. The first parameters to be adjusted included those that significantly affected the amount of outflow from the fill site. The water balance was determined to be suitable when the total outflow volume from the site was within 10 percent of that observed during January and February 1999.

Other PWATER parameters were adjusted to calibrate the hydrograph recession, baseflow recession rates, and peak flow rates.

The results of the calibration are summarized in Table A-4 and detailed in Attachment B.

Table A-4. Summary of embankment fill parameter calibration.

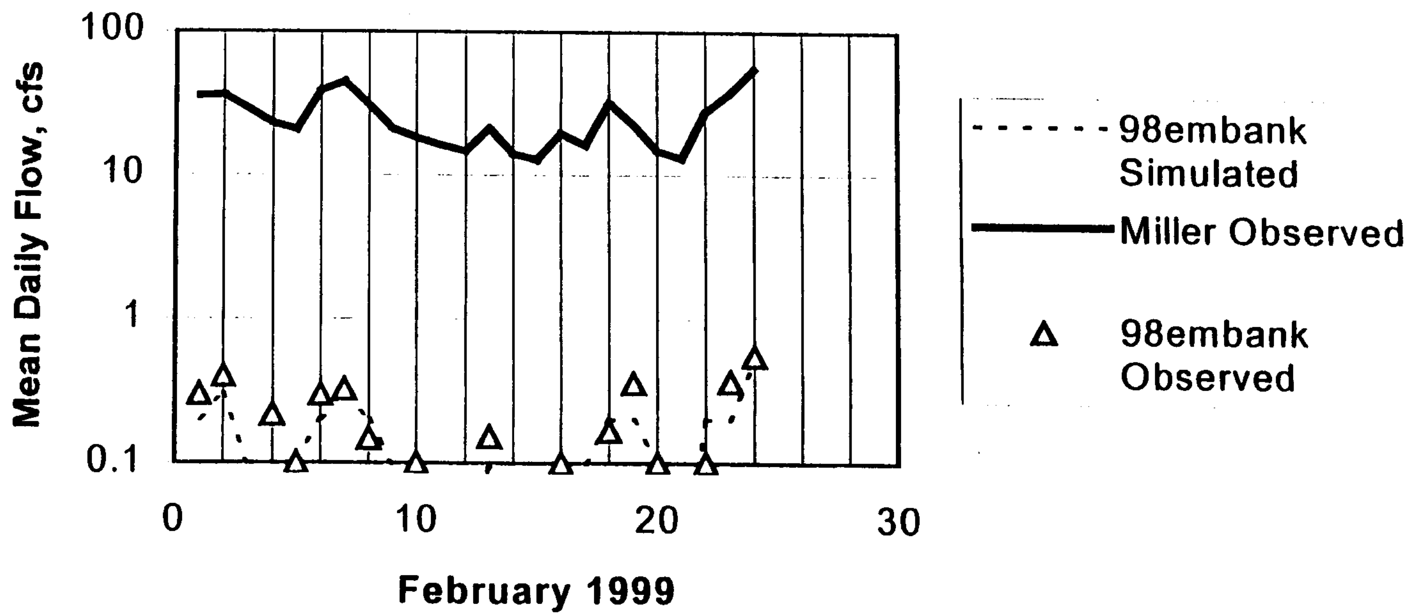
PWATER Parameter	Fill Material Value
LZSN	7.5
INFILT	0.02
INFEXP	2.0
DEEPFR	0.10
BASETP	0.0
UZSN	0.28
AGWRC	0.90
INTFW	6.0
LZETP	0.6
IRC	0.15
AGWETP	0.0
CEPSC	0.10
NSUR	0.25
LSUR	300
SLSUR	0.07

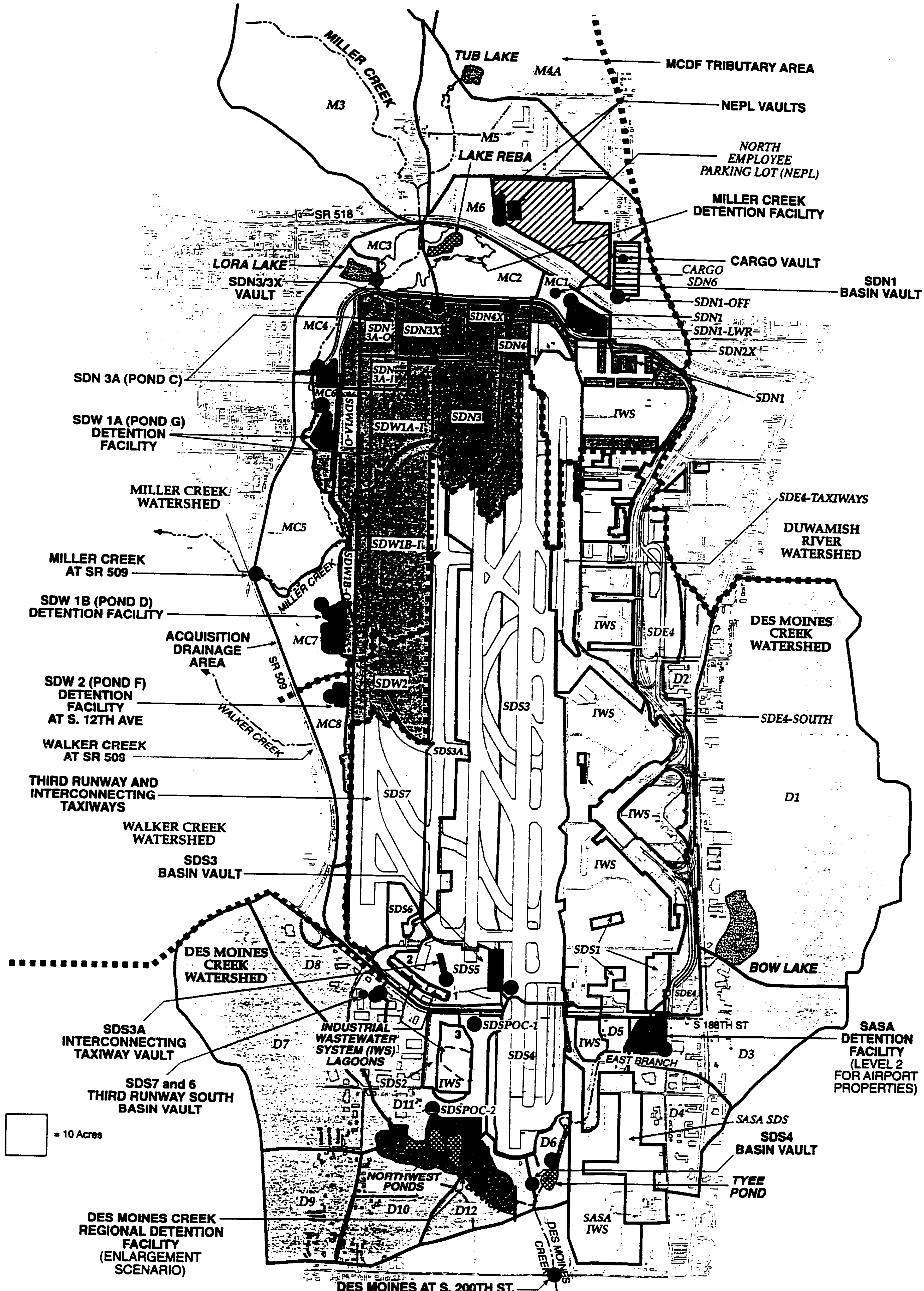
Compared to till, the fill has the following characteristics:

1. The fill is deeper and has a greater lower zone storage (LZSN);
2. The fill has up to 12 percent fines (silt and clay) and lower infiltration at the compacted surface; therefore, it has a lower INFILT value;
3. The fill overlies the till layer so it has about the same order of deep percolation loss as the till (i.e., DEEPFR is about the same);
4. The fill has no losses from base flow or groundwater to ET pathways; therefore, BASETP and AGWETP are zero;
5. The fill has a fast groundwater recession rate, resulting in a similar AGWRC to till;
6. The fill has a faster interflow recession rate and therefore a lower IRC;
7. The fill has a much greater proportion of water moving as interflow and therefore a higher INTFW; and
8. The fill has about the same upper zone storage (UZSN) as till.

The simulated versus observed mean daily flow is compared in Figure A-6. The observed flow at the Miller Creek gage near the mouth is included for reference. Most mean daily flow fluctuation at the 1998 embankment corresponds to fluctuation near the mouth. There are exceptions, such as on February 2 and 4. The accuracy of the estimated embankment flow was limited by the frequency at which pond levels were recorded, which limited close correlation between simulated and observed daily flow. Nonetheless, the total observed runoff volume for February 1999 was approximately 6.83 acre-feet in comparison to the simulated runoff volume of 6.87 acre-feet—a difference of about 0.5 percent.

Figure A-6. Comparison of Simulated 1998 Embankment Flow to Observed Embankment and Miller Creek Flow During Calibration





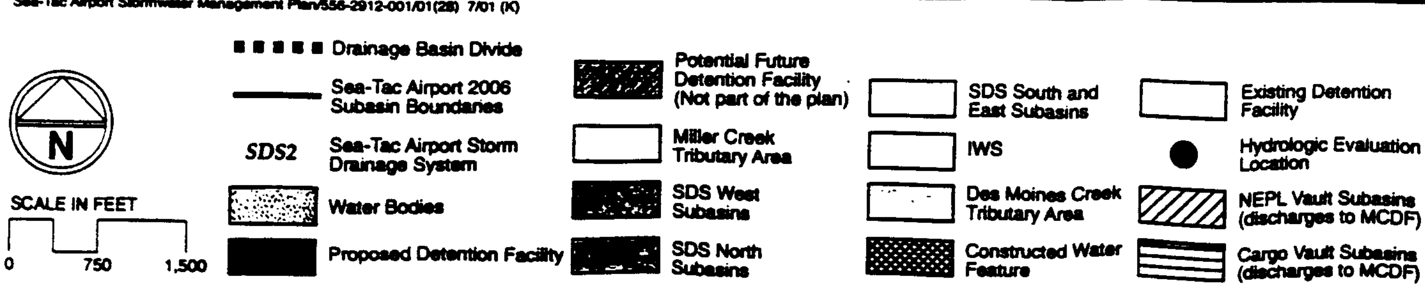


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Figure A-7
Future Land Use and Existing/Proposed Detention Facility Locations

The pre-project condition data combined land use and subbasin boundary coverages (Table A-5). This coverage was distributed uniformly across existing soil type (e.g., till or outwash soil has 10 percent impervious area covering the pervious land segment). The impervious area was assumed to be 100 percent effective in terms of surface runoff. The 2006 subbasin boundaries for areas within STIA that would be impacted were used to determine the pervious and impervious land segment inputs for the HSPF model. The subbasin boundaries needed to be consistent between pre- and post-project conditions to evaluate detention size requirements resulting from changed land use conditions.

3.1.2 Des Moines Creek Factors

Evaluation of detention facility requirements within the Des Moines Creek drainage basin followed the same process as for Miller and Walker Creeks. The same statistical analyses were performed to verify detention facility compliance. All detention facilities within the Des Moines Creek basin were sized to the previously discussed pre-project conditions.

3.2 DETENTION FACILITY SIZING

Each onsite (STIA) detention facility was sized using a two-step process. In the first step, the King County Runoff Time Series (KCRTS) program was used to create an initial set of stage-volume-discharge relationships. KCRTS was then used to generate a preliminary estimate of orifice size and detention volume required to achieve the design standard. Soil and impervious cover information from Tables A-1(a and b) and A-2 (a and b)(Attachment A) was used to develop the facility size. An airport fill category was created with the assistance of King County DNR. The PWATER parameters described in Section 2.7 were used to develop a special runoff file. The runoff file was used with other soil runoff files to estimate streamflow at each detention site.

In the second step, the stage-volume-discharge relationships obtained from the KCRTS analysis were used as input into the HSPF model. Pre-project and post-project simulations were performed and the statistical output was compared to determine whether the design standard was achieved. If the project condition flow exceeded the pre-project condition flow for the evaluation point, the facility design was reanalyzed using KCRTS and the process was repeated until satisfactory design configurations were obtained. Final outlet configuration data are provided in Attachment C.

4. COMPARISON OF PRE-PROJECT AND PROJECT CONDITIONS

The detention facility volumes required to achieve design standards are summarized in Table A-7. The table indicates the maximum storage that occurs during the future project condition simulation when discharge is controlled such that the project flow range (½ Q_2 to Q_{50}) is less than the pre-project flow range over the same time duration.

4.1 ANNUAL FLOOD FREQUENCY ANALYSIS

The pre-project and project (2006) peak flood flows for 2-, 10-, 25-, 50-, and 100-year return periods are summarized in Tables A-8 and A-9 and the corresponding back-up output data are contained in Attachment C (printout and graphs provide detailed information from the SWSTAT program). Peak project flows are less than to pre-project flows except at the NEPL facility. This facility was constructed based on the Enhanced Level 1 design standard. To achieve Level 2 design, a new detention facility operating in parallel with the existing one is proposed.

4.2 FLOW FREQUENCY ANALYSIS

The flow frequency results from the SWSTAT program are contained in Attachment C. The curves show the project flow regime compared to the pre-project flow regime. The project flows are less for flows between one-half of the 2-year peak flow to the 50-year peak flow. The results for downstream points of evaluation are shown in Figures A-8 through A-11. The flow frequency comparison at SASA shown in Attachment C shows the pre- and project conditions for STIA property retrofit.

The flow frequency curves (Figure A-11) for Des Moines Creek at South 200 Street show the pre-project target flow regime will be achieved by the project on-site detention facilities if it becomes necessary to retrofit SASA for all contributing area upstream. Figure A-11 assumes that the Des Moines Creek Regional Detention Facility is not constructed.

Table A-7. Summary of required detention facility volumes.

Watershed	Hydrologic Evaluation Point	Volume Required (acre-ft)	Type of Facility[a]	Comments
Miller Creek	NEPL	13.9[b]	Vault	In addition to existing 4 ac-ft
	CARGO	4.5	Vault	
	SDN2x + SDN4x	14.4	Vault	
	SDN3/3x	25.2	Vault	
	SDN1	5.5	Vault	
	SDN3A	Pond: 14.8 / Vault: 7.0	Pond/Vault	
	SDW1A	Pond: 25.5 / Vault: 7.4	Pond/Vault	Infiltration used
	SDW1B	53.6	Pond	Infiltration used
Total Miller Creek		**171.8**		
Walker Creek	**SDW2**	**10.9**	**Pond**	
Des Moines Creek	SASA Detention Facility	33.4[c]	Pond	
	Interconnecting taxiway (SDS3A)	5.4	Vault	
	Third Runway South (SDS7 and 6)	21.7	Vault	
	SDS3	88.0	Vault	
	SDS4	12.9	Vault	
Total Des Moines Creek		**161.4**		

a Types of facilities: Vault – enclosure with multiple orifice outlets on vertical riser with overflow spillway; Pond – open earth construction with netting or other means to provide wildlife deterrent.

b Volume needed to retrofit existing facility.

c Retrofit STIA area only.

Table A-8. Summary of flood peak flow frequency results for Miller and Walker Creek subbasins (all values are cubic feet per second).

Return Period	NEPL		CARGO		SDW2		SDW1B		SDN3A (Vacca)	
Peak	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	0.61	0.22	0.12	0.05	1.04	0.31	0.66	0.22	0.26	0.09
Q_2	1.22	0.44	0.24	0.09	2.07	0.62	1.31	0.45	0.52	0.18
Q_{10}	1.70	0.73	0.33	0.14	3.83	1.80	2.04	0.56	0.72	0.32
Q_{25}	1.96	0.96	0.38	0.18	4.78	3.11	2.52	0.59	0.83	0.44
Q_{50}	2.16	1.18	0.42	0.21	5.51	4.66	2.92	0.62	0.92	0.56
Q_{100}	2.37	1.46	0.46	0.25	6.26	6.91	3.37	0.64	1.01	0.70

Return Period	SDW1A		SDN3, SDN3X		Combined SDN2X/SDN4/SDN4X		Miller Creek at RDF		
Peak	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project	Pre-Project	1994[a]	Project
1/2 Q_2	0.15	0.006	0.69	0.27	0.52	0.19	19.33	21.55	19.55
Q_2	0.30	0.01	1.38	0.53	1.04	0.38	38.65	43.10	39.11
Q_{10}	0.56	0.05	1.93	0.81	1.45	0.56	55.17	58.44	55.61
Q_{25}	0.78	0.12	2.25	0.99	1.67	0.67	63.17	65.75	63.59
Q_{50}	0.98	0.25	2.49	1.14	1.85	0.77	69.05	71.10	69.45
Q_{100}	1.24	0.52	2.74	1.31	2.03	0.87	74.87	76.37	75.25

Return Period	Miller Creek at Lake Reba			Miller Creek at SR509			Walker Creek at South 12th Street		SDN1	
Peak	Pre-Project	1994[a]	Project	Pre-Project	1994[a]	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	2.41	5.95	2.50	20.96	24.98	22.30	1.04	0.31	0.28	0.12
Q_2	4.82	11.90	5.00	41.90	49.96	44.60	2.07	0.62	0.55	0.24
Q_{10}	7.29	16.55	7.41	62.97	69.99	64.41	3.83	1.80	0.76	0.40
Q_{25}	8.75	18.93	8.79	73.07	79.34	73.57	4.78	3.11	0.87	0.53
Q_{50}	9.93	20.73	9.91	80.43	86.08	80.14	5.51	4.66	0.96	0.66
Q_{100}	11.20	22.56	11.10	87.68	92.67	86.53	6.26	6.91	1.05	0.83

[a] 1994 conditions from calibration modeling.

Table A-9. Summary of flood peak flow frequency results for Des Moines Creek subbasins (all values are cubic feet per second).

Return Period Peak	SASA[a]		SDS3		SDS3A	
	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	31.95	13.57	6.03	2.40	1.23	1.52
Q_2	63.90	27.13	12.06	4.79	2.45	3.05
Q_{10}	97.35	44.54	21.07	10.85	4.28	7.80
Q_{25}	116.65	56.20	26.92	16.51	5.47	12.09
Q_{50}	132.17	66.34	31.92	22.46	6.49	16.50
Q_{100}	148.69	77.82	37.52	30.39	7.62	22.26

Return Period Peak	SDS4		SDS - Point of Compliance #1		SDS - Point of Compliance #2	
	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	0.86	0.35	7.16	4.22	9.97	8.75
Q_2	1.72	0.69	14.32	8.44	19.94	17.51
Q_{10}	2.65	1.29	24.92	17.82	31.50	26.81
Q_{25}	3.21	1.80	31.91	25.67	38.68	32.46
Q_{50}	3.67	2.29	37.94	33.41	44.68	37.12
Q_{100}	4.17	2.92	44.73	43.17	51.27	42.19

Return Period Peak	SDS7		Des Moines Creek @ S. 200 St.	
	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	1.44	0.64	45.88	35.51
Q_2	2.88	1.28	91.75	71.03
Q_{10}	5.13	2.77	155.01	113.48
Q_{25}	6.64	4.27	197.03	140.54
Q_{50}	7.95	5.91	233.38	163.42
Q_{100}	9.45	8.16	274.46	188.79

[a] STIA basins plus non-STIA basins D1 and D2 routed to pond. Retrofitting applied only to STIA drainage areas.

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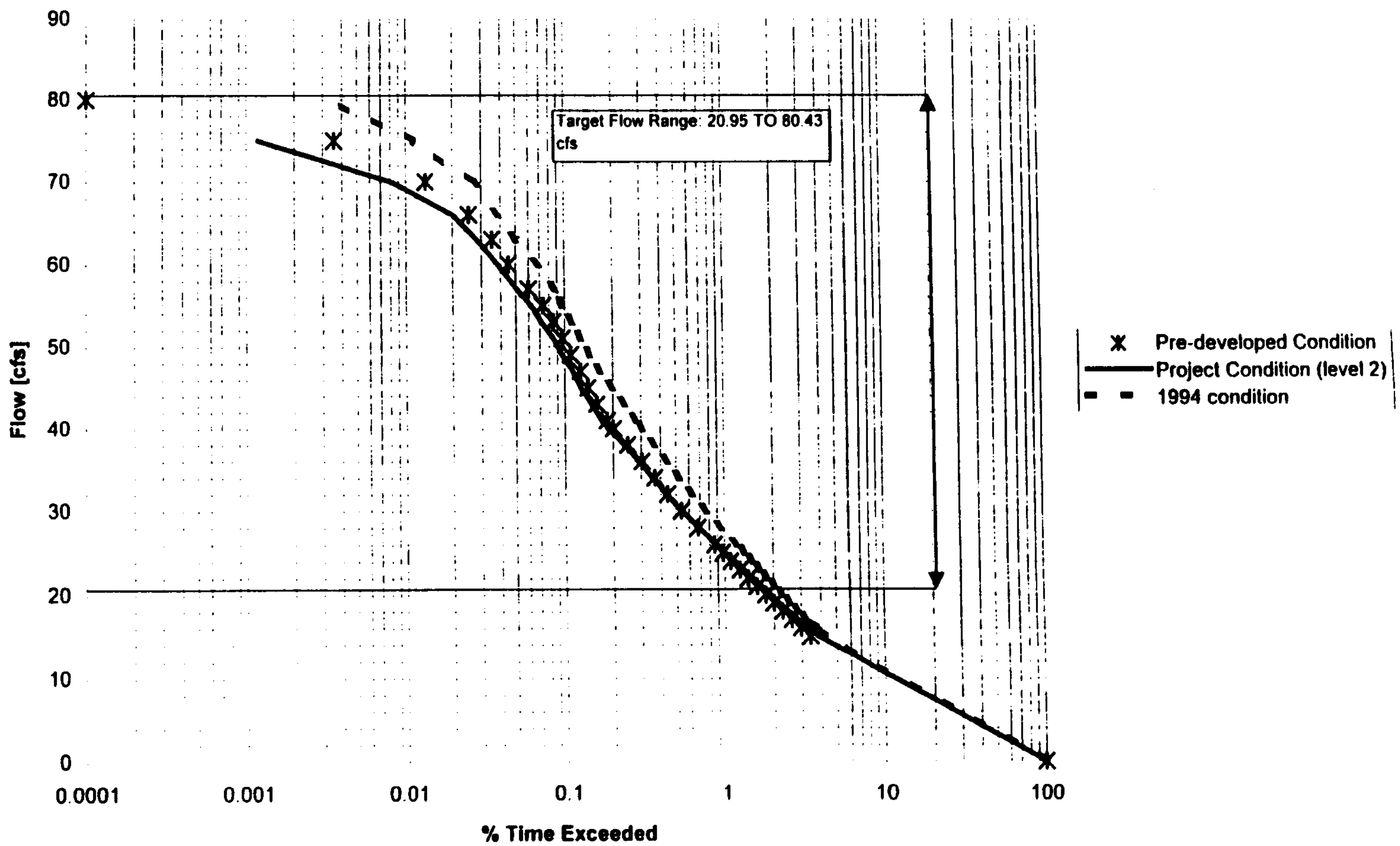

Figure A-8
Flow Duration Curve for
Miller Creek at SR509

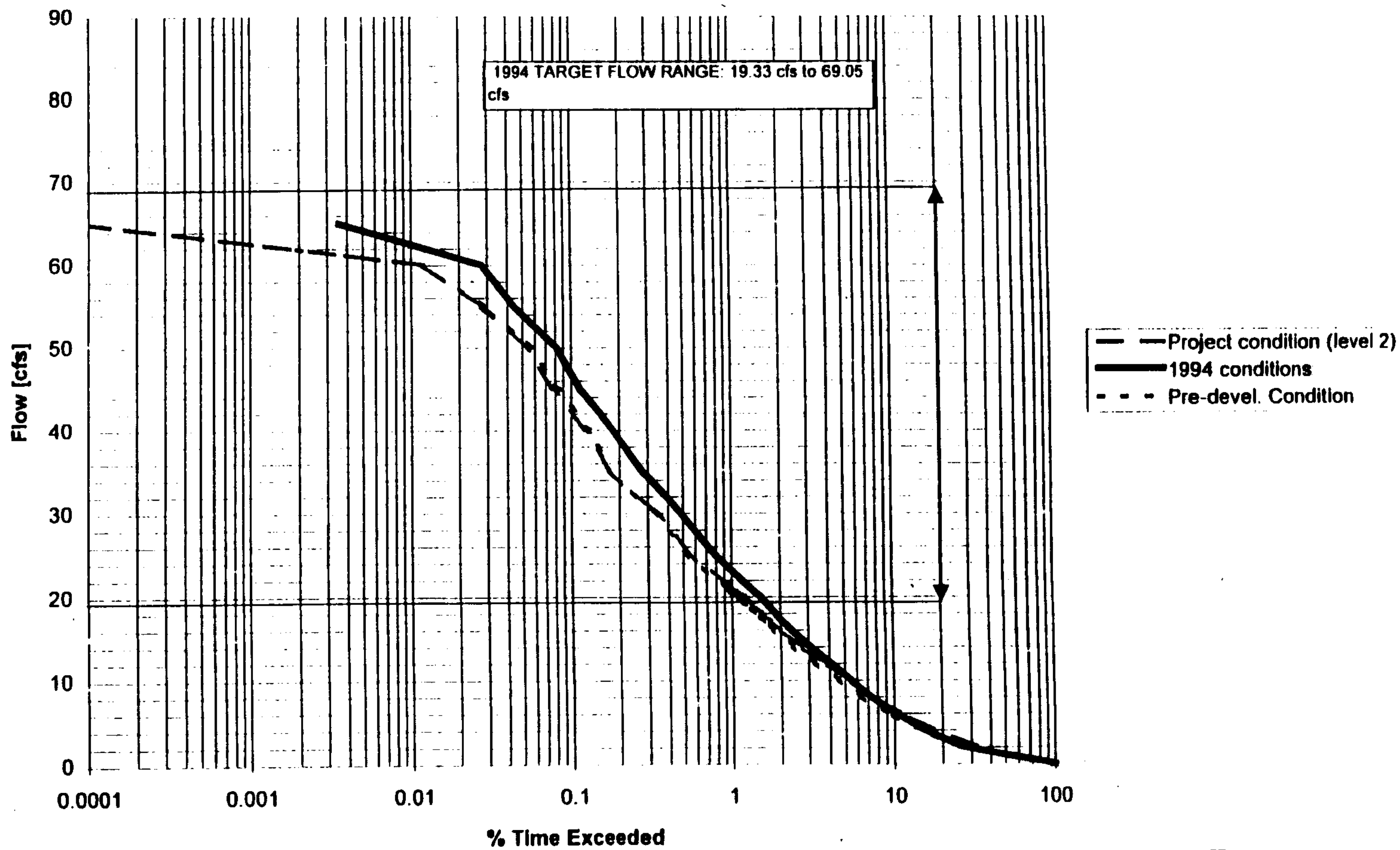

Figure A-9
Flow Duration Curve for
Miller Creek at MCDF

July 2001
556-2912-001 (28)

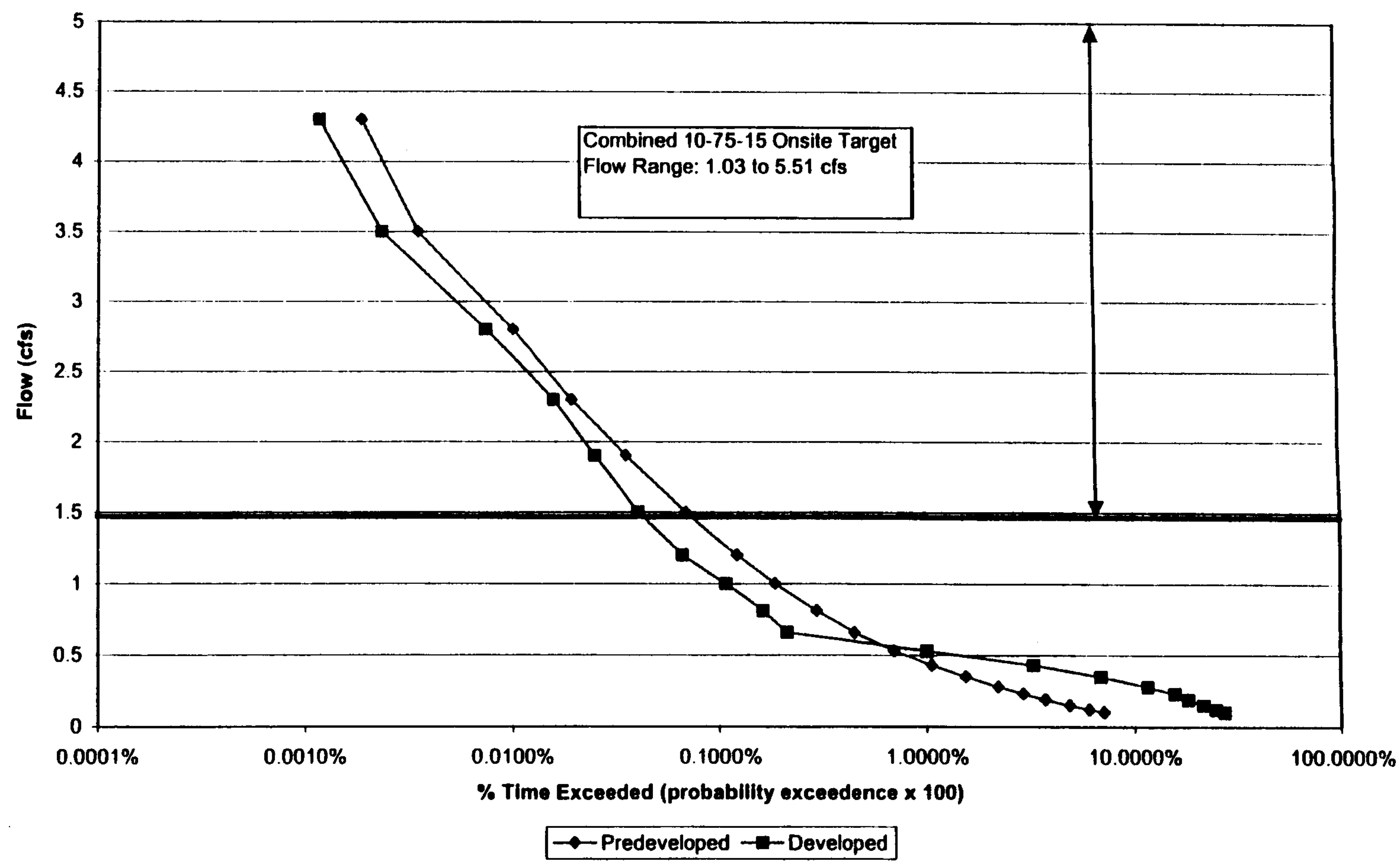

Figure A-10
Flow Duration Curve for
Walker Creek at South 12th Street

July 2001
556-2912-001 (28)

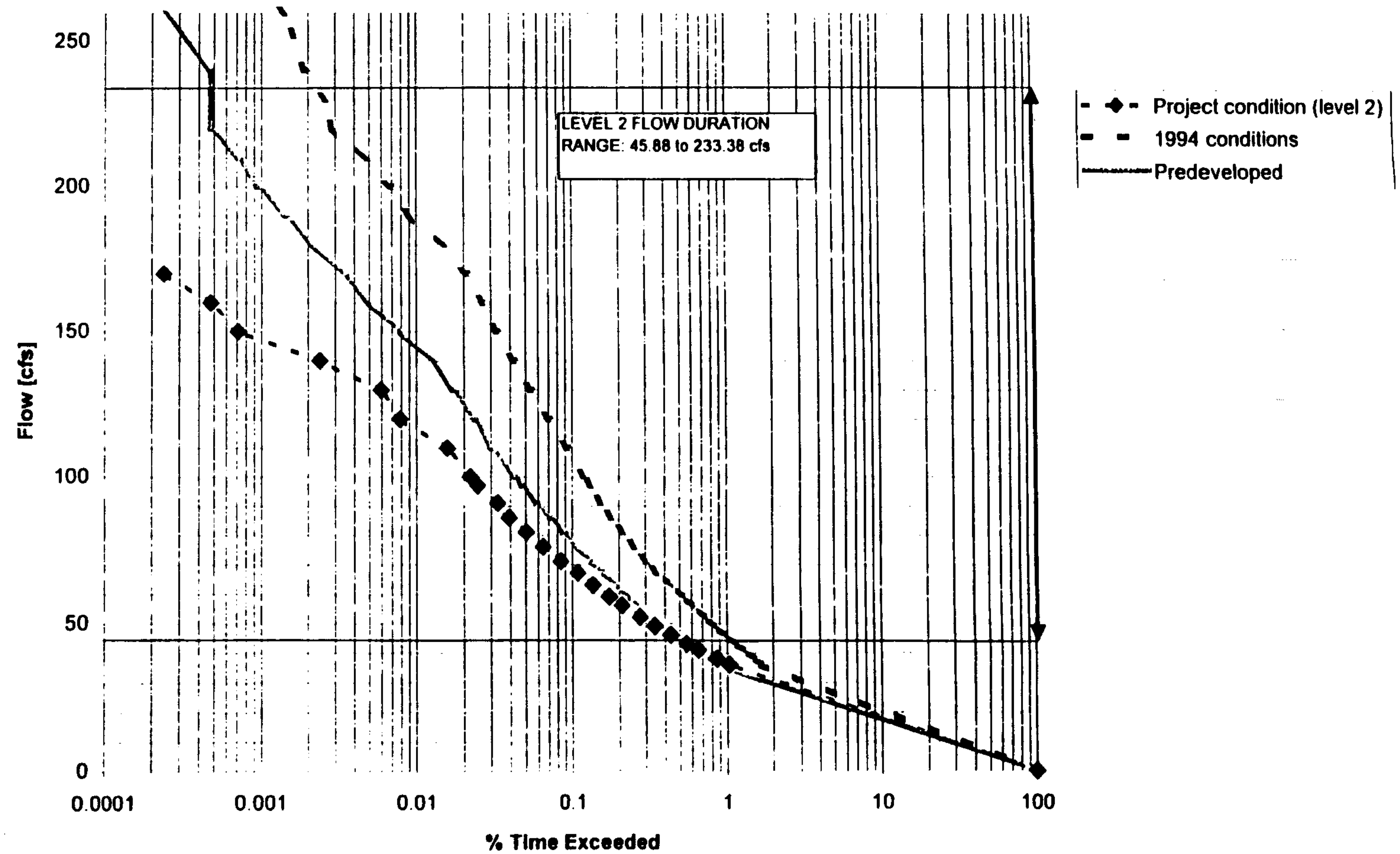

Figure A-11
Flow Duration Curves for Des Moines Creek at South 200th Street

5. CONCLUSIONS

5.1 MILLER/WALKER CREEK

Detention facilities have been sized for subbasins draining to Miller and Walker Creeks that will meet Level 2 design standards. The maximum storage volumes that are detained during the HSPF simulation of project conditions are shown in Table A-7. Each facility controls runoff rates to less than pre-project conditions for the Level 2 flow duration analysis. The HSPF input files and outlet configurations derived from KCRTS used to develop the facility sizes are provided in Attachments C and D.

The analysis of detention for the North Employees Parking Lot (NEPL) assumed that 6 acres of impervious area would drain to the existing vault, and the remaining area (10 acres till grass and 36.3 acres impervious) would drain to a new vault. The existing vault outlet works will need to be reconfigured. Output from the KCRTS program is provided in Attachment C.

5.2 DES MOINES CREEK

Detention facilities have been sized for subbasins draining to Des Moines Creek that will meet Level 2 design standards. The maximum storage volumes detained during the HSPF simulation are shown in Table A-7. Each facility controls runoff rates to less than the pre-project (target) flow rates. The HSPF input files and outlet configurations derived from KCRTS used to develop the facility sizes are provided in Attachments C and D.

An analysis has been provided that shows the volume required for meeting Level 2 design criteria for the SASA detention facility in the event this detention facility is proposed to retrofit the non-STIA tributary area to predevelopment conditions. If the SASA detention facility were only required to provide stormwater management benefits for the STIA portion of the watershed, the size would be significantly less, as shown on Table A-7.

6. REFERENCES

HNTB. 2000. Personal communication with Alan Black. July 2000.

Port of Seattle. 1998. Third Runway embankment construction division 2, sitework specification.

U.S. Department of Interior Geological Survey. 1982. Guidelines for determining flood flow frequency for flood frequency analysis, Bulletin #17B.

ATTACHMENT A

**Tables A-1a, A-1b,
A-2a, and A-2b**

Tables

Legend for Tables A-1a and A-1b

Soil Types:

M	Modified land (Holocene)
Qb	Beach deposits (Holocene)
Qpf	Sedimentary deposits of pre-Fraser glaciation age (Pleistocene)
Qu	Surficial deposits, undivided (Holocene and Pleistocene)
Qvi	Ice-contact deposits
Qvr	Recessional outwash deposits
Qvrl	Silt-dominated lowland lacustrine deposits
Qvt	Till
Qvu	Vashon drift, undivided
Qw	Wetland deposits (Holocene)
Qyal	Younger alluvium (Holocene)
SA	Wetland
TIA	Total impervious area
EIA	Effective impervious area

Land Use Types:

AP	Commercial airport and measured EIA
C	Commercial
TR	Transport
MF	Multi-family
HD	High density residential
LD	Low density residential
G	Grass or open
F	Forest

Bare ground asphalt
Bare rock concrete
Develop high intensity
Develop medium intensity
Develop low intensity

PERLND number refers to the unique soil pervious land segment in HSPF.
IMPLND refers to the impervious land segment.

shaded subbasins included in the STIA subbasin characteristics evaluation area.

Explanation of Calculation of Effective Impervious Area for Tables A-1a and A-1b

Unshaded Basins:

Table	Basins
A-1a	M1, M2, M3, M4, M4A, M11, M12, M13, M14, M15, M17, M18, M19, M21, M22, M23, M24
A-1b	M1, M2, M3, M4, M4A, M11, M12, M13, M14, M15, M17, M18, M19, M21, M22, M23, M24

Effective Impervious Area

Total acreage within the basin for a given land use and soil type * EIA percentage

Pervious Area

Total acreage within the basin for a given land use and soil type * (1 - EIA percentage)

STIA (shaded) Basins:

Table	Basins
A-1a	M8, M9, M10, M16, M20, MC4, MC5, MC6, MC7, MC8, MC9, SDN1-OFF, SDN3A, SDW1A, SDW1B, SDW2
A-1b	M5, M6, M8, M9, M10, M16, M20, MC1, MC2, MC3, MC4, MC5, MC6, MC7, MC8, MC9, CARGO, NEPL, SDN1, SDN1-LWR, SDN1-OFF, SDN2X, SDN3, SDN3A, SDN3X, SDN4, SDN4X, NCPS, NSMPS, IWS-Miller, SDW1A, SDW1B, SDW2

Effective Impervious Area

land use AP and TR: impervious acreage from GIS analyses

all other land use categories: total acreage within the basin for a given land use and soil type * EIA percentage

Pervious Area

land use AP and TR: pervious acreage within the basin for a given land use and soil type

all other land use categories: total acreage within the basin for a given land use and soil type * (1 - EIA percentage)

Remaining Pre-Development Condition Basins (Table A-1a):

Basins
M1, M2, M3, M4, M4A, M5, M6, MC1, MC2, MC3, NEPL, CARGO, SDN1, SDN1-LWR, SDN2X, SDN3, SDN3X, SDN4, SDN4X, NCPS, NSMPS, IWS-Miller

These basins drain to the MCDF under pre-development conditions.

Effective Impervious Area

Total impervious area is 10 percent of the total basin acreage not including wetland area.

Pervious Area

75 percent of the total basin acreage not including wetland area is distributed as forest. 15 percent of the total basin acreage not including wetland area is distributed as grass. Forest and grass areas distributed proportionately to till and outwash according to the till and outwash total acreage proportions.

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)														
		% of total basin equal to EIA	M-1 to M-22												MC-1 to MC-9	
			M-5		M-8		M-9		M-10		M-16		M-20		MC-1n	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMM	Qvr	85%	0.53	3.01	-	-	-	-	5.35	30.34	0.02	0.12	7.04	39.91	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	0.46	2.60	-	-	-	-
	Qvt	85%	2.18	12.34	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	-	-	-	-	-	-	-	-	-	-	1.74	-	0.10	-
	Qvr	0%	-	-	-	-	3.83	-	11.34	-	7.22	-	10.76	-	3.82	-
	Qvrl	0%	-	-	-	-	-	-	-	-	3.48	-	0.95	-	-	-
	Qvt	0%	-	-	-	-	0.36	-	4.32	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	0.01	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	7.21	-	16.75	-	5.40	-	11.38	-	0.37
MF	Qvr	47%	0.62	0.55	6.68	5.92	5.13	4.55	19.97	17.71	1.19	1.06	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	0.20	0.17	-	-	-	-
HD	Qvr	15%	-	-	0.48	0.08	46.39	8.19	6.98	1.23	15.22	2.69	3.66	0.65	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	16.63	2.94	0.16	0.03	-	-
	Qvt	15%	-	-	-	-	14.03	2.48	19.60	3.46	-	-	-	-	-	-
	Qw	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	0.16	0.01	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	0.01	0.00	-	-	-	-
	Qvr	4%	9.67	0.40	14.21	0.59	1.26	0.05	51.59	2.15	5.78	0.24	20.81	0.87	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	9.38	0.39	0.00	0.00	-	-
	Qvt	4%	-	-	-	-	-	-	8.02	0.33	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.07	-
	Qvr	0%	39.23	-	0.84	-	0.10	-	-	-	1.98	-	11.16	-	7.33	-
	Qvrl	0%	-	-	-	-	-	-	-	-	0.00	-	9.37	-	-	-
	Qvt	0%	8.11	-	-	-	-	-	-	-	-	-	0.31	-	-	-
	Qw	0%	0.47	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total	M-1 to M-22												MC-1 to MC-9	
		basin	M-5		M-8		M-9		M-10		M-16		M-20		MC-1n	
Land	Soil	equal to		Effective		Effective		Effective		Effective		Effective		Effective		Effective
Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
F	M	0%	-	-	-	-	-	-	-	-	1.17	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	0.77	-	-	-	-	-
	Qvr	0%	-	-	-	-	0.05	-	-	-	19.26	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	9.76	-	-	-	-	-
	Qvt	0%	-	-	-	-	4.98	-	4.15	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	10.27	-	-	-	-	-	-	-	-	-	33.43	-	0.27	-
	Lake		0.44		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		-		-		-		0.00		-		-		-	
Basin total:			71.08	16.31	22.21	6.60	76.14	22.47	131.32	71.98	92.70	15.62	99.40	52.83	11.60	0.37
PERLND areas:																
(16)	Till-Forest		-		-		4.98		4.15		10.93		-		-	
(26)	Till-Grass		10.29		-		14.38		31.94		30.30		12.53		0.17	
(34)	Outwash-Forest		-		-		0.05		-		20.03		-		-	
(44)	Outwash-Grass		50.05		22.21		56.71		95.23		31.43		53.43		11.15	
(54)	Wetland		10.74		-		0.01		-		-		33.43		0.27	
	subtotal:		71.08		22.21		76.14		131.32		92.70		99.40		11.60	
IMPLND areas:																
	EIA			16.31		6.60		22.47		71.98		15.62		52.83		0.37
Basin total:			87.39		28.80		98.61		203.30		108.32		152.23		11.97	
Percent Impervious				18.7%		22.9%		22.8%		35.4%		14.4%		34.7%		3.1%

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Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres) MC-1 to MC-9													
		% of total basin	MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	2.55	-	1.32	-	-	-	-	-	-	-	0.02	-	1.19	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	0.22	-	0.43	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	0.27	-	0.01	-	-	-	-	-	-	-	-	-	0.01
MF	Qvr	47%	-	-	-	-	0.07	0.06	0.71	0.63	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	9.41	1.66	0.30	0.05	1.74	0.31	2.77	0.49	3.70	0.65
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	-	-	-	-	-	-	-	-	9.06	1.60	3.97	0.70
	Qw	15%	-	-	-	-	0.92	0.16	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	2.55	0.11	3.43	0.14	30.11	1.25	11.82	0.49	23.01	0.96	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	0.08	0.00	-	-
	Qvt	4%	-	-	-	-	-	-	13.49	0.56	-	-	0.05	0.00	-	-
	Qw	4%	-	-	-	-	0.33	0.01	-	-	-	-	-	-	-	-
OG	M	0%	0.62	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	7.86	-	1.16	-	6.56	-	-	-	-	-	4.74	-	13.83	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	0.04	-	0.11	-
	Qw	0%	0.55	-	0.05	-	7.51	-	-	-	-	-	-	-	-	-

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	MC-1 to MC-9													
			MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	6.66	-	5.53	-	0.05	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	4.17	-	1.28	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	10.30	-	0.52	-	5.95	-	7.60	-	0.99	-	3.47	-	2.56	-
	Lake		2.98		-		3.33		0.76		0.29		0.24		-	
	Mcrk-df		7.00		13.17		-		-		-		-		-	
	Other		-		-		-		-		-		-		-	
Basin total:			33.04	0.27	12.83	0.11	34.24	2.04	52.21	2.50	14.55	0.80	43.24	3.05	25.36	1.36
PERLND areas:																
(16)	Till-Forest		0.08		-		-		-		-		-		-	
(26)	Till-Grass		0.64		-		-		13.49		-		9.23		4.08	
(34)	Outwash-Forest		6.66		5.53		0.05		-		-		-		-	
(44)	Outwash-Grass		10.41		5.03		19.47		31.13		13.56		30.54		18.72	
(54)	Wetland		15.25		2.27		14.72		7.60		0.99		3.47		2.56	
	subtotal:		33.04		12.83		34.24		52.21		14.55		43.24		25.36	
IMPLND areas:																
	EIA			0.27		0.11		2.04		2.50		0.80		3.05		1.36
Basin total:			33.31		12.94		36.28		54.71		15.35		46.29		26.73	
Percent impervious				0.8%		0.9%		5.6%		4.6%		5.2%		6.6%		5.1%

AR 046512

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total	MC-1 to MC-9										SDS Basins			
		basin	MC-9		CARGO		NEPL		M-6		M-6X**		SDN-1		SDN1-LWR	
Land	Soil	equal to		Effective		Effective		Effective		Effective		Effective		Effective		Effective
Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
STIA	M	0%	1.31	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	0.47	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	1.93	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	0.17	-	-	-
	TIA	100%	-	0.23	-	-	-	-	-	-	-	-	-	8.69	-	-
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	0.15	0.87	0.08	0.44	0.23	1.31	-	-	-	-
TRANS	M	0%	1.76	-	-	-	-	-	0.03	-	0.03	-	-	-	-	-
	Qvr	0%	0.33	-	-	-	-	-	3.44	-	3.44	-	0.78	-	0.10	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	0.01	-	0.01	-	0.03	-	-	-
	TIA	100%	-	0.01	-	-	-	-	-	4.79	-	4.79	-	1.22	-	0.38
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	6.09	1.07	-	-	5.70	1.01	5.70	1.01	-	-	-	-
	Qw	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	6.37	-	-	-	-	-	0.21	-	0.21	-	-	-	-	-
	Qvr	0%	0.41	-	-	-	2.40	-	8.35	-	10.74	-	1.05	-	4.87	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	0.96	-	21.32	-	14.35	-	35.66	-	1.82	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	MC-1 to MC-9										SDS Basins			
			MC-9		CARGO		NEPL		M-6		M-6X**		SDN-1		SDN1-LWR	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	0.07	-	0.07	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	8.78	-	13.43	-	22.21	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	8.77	-	1.37	-	10.14	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	-	-	-	-	-	-	0.80	-	0.80	-	-	-	0.07	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		0.07		-		-		-	
	Other		-		-		-		0.01		0.01		-		-	
Basin total:			10.19	0.24	7.04	1.07	41.42	0.87	47.84	6.23	89.26	7.11	6.24	9.90	5.04	0.38
PERLND areas:																
(16)	Till-Forest		-		6.09		23.15		1.43		24.58		7.27		-	
(26)	Till-Grass		9.44		1.22		4.63		20.37		25.00		1.45		-	
(34)	Outwash-Forest		-		-		8.57		13.43		22.00		4.69		4.01	
(44)	Outwash-Grass		0.74		-		1.71		11.79		13.50		0.94		0.96	
(54)	Wetland		-		-		-		0.82		0.82		0.20		0.07	
	subtotal:		10.19		7.31		38.06		47.84		85.90		14.55		5.04	
IMPLND areas:																
	EIA			0.24		0.81		4.23		6.23		10.46		1.59		0.38
Basin total:			10.43		8.12		42.29		54.07		96.36		16.14		5.42	
Percent Impervious				2.3%		10.0%		10.0%		11.5%		10.9%		9.9%		7.0%

AR 046514

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	SDS Basins													
			SDN1-OFF		SDN-2Xn		SDN-3		SDN-3A-I		SDN-3A-O		SDN-3X		SDN-4	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	6.62	-	-	-	-	-	-	-	19.72	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-
	Qvt	0%	-	-	-	-	18.87	-	-	-	-	-	-	-	0.06	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	14.50	-	-	-	-	-	-	-	2.63
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	0.68	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.28	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	1.76	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	1.63	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	7.88	-	-	-	-	-	-	-	-	-	-	-	-
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	2.12	0.37	8.28	1.46	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	14.65	2.58	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	0.62	0.03	0.16	0.01	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	0.00	-	1.14	-	0.02	-	-	-	-	-	-	-	4.70	-
	Qvr	0%	0.37	-	3.12	-	-	-	1.09	-	1.74	-	5.01	-	3.18	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	3.40	-	-	-	7.85	-	5.27	-	-	-	6.94	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

AR 046515

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	SDS Basins													
			SDN1-OFF		SDN-2Xn		SDN-3		SDN-3A-I		SDN-3A-O		SDN-3X		SDN-4	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	1.03	-	8.09	-	12.20	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	0.65	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	0.04	-	-	-	-	-	-	-	0.19	-	0.57	-	-	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		0.04		-		-		-		-		-		-	
Basin total:			25.81	10.46	4.26	-	33.36	14.50	10.13	0.40	18.45	1.47	25.38	-	27.69	2.63
PERLND areas:																
(16)	Till-Forest		21.99		0.85		35.89		4.18		-		4.71		20.23	
(26)	Till-Grass		4.40		0.28		7.18		1.18		-		1.57		4.41	
(34)	Outwash-Forest		3.96		2.34		-		3.72		14.80		13.89		2.50	
(44)	Outwash-Grass		0.79		0.78		-		1.05		3.47		4.63		0.55	
(54)	Wetland		1.67		-		-		-		0.19		0.57		-	
	subtotal:		32.81		4.26		43.07		10.13		18.45		25.38		27.69	
IMPLND areas:																
	EIA			3.46		-		4.79		0.40		1.47		-		2.63
Basin total:			36.27		4.26		47.86		10.52		19.92		25.38		30.32	
Percent impervious				9.5%		0.0%		10.0%		3.8%		7.4%		0.0%		8.7%

AR 046516

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	SDS Basins		IWS Basins						SDS Basins					
			SDN-4X		IWS-NCPS		IWS-NSMPS		IWS-Miller		SDW-1A-I		SDW-1A-O		SDW-1B-I	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	1.83	-	6.52	-	1.97	-	0.06	-	-	-	-	-	14.15	-
	Qvr	0%	0.66	-	-	-	1.02	-	0.08	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	0.33	-	-	-	-	-	0.47	-
	Qw	0%	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-
	TIA	100%	-	1.05	-	28.79	-	0.04	-	30.41	-	-	-	-	-	2.02
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	-	-	0.50	-	-	-	-	-	-
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	0.06	0.01	0.75	0.13
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	-	-	-	-	-	-	-	-	-	-	4.63	0.82
	Qw	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	8.50	0.35	12.14	0.51	4.95	0.21
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	0.22	-	0.41	-	1.73	-	-	-	-	-	-	-	2.49	-
	Qvr	0%	9.51	-	-	-	1.86	-	8.55	-	4.18	-	-	-	14.61	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	0.71	-	-	-	-	-	3.83	-	24.10	-	-	-	31.33	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

AR 046517

Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	SDS Basins		IWS Basins						SDS Basins					
			SDN-4X		IWS-NCPS		IWS-NSMPS		IWS-Miller		SDW-1A-I		SDW-1A-O		SDW-1B-I	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	1.22	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	-	-	-	-	-	-	-	-	0.33	-	2.63	-	3.31	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		-		-		-		-		-		-		-	
Basin total:			14.14	1.05	6.93	28.79	6.58	0.04	12.86	30.92	37.11	0.35	14.84	0.52	76.68	3.18
PERLND areas:																
(16)	Till-Forest		2.43		26.79		2.80		26.61		19.00		-		41.99	
(26)	Till-Grass		0.59		5.36		0.91		5.32		6.09		-		11.67	
(34)	Outwash-Forest		8.96		-		2.17		6.22		8.86		9.54		15.42	
(44)	Outwash-Grass		2.16		-		0.70		1.24		2.84		2.66		4.29	
(54)	Wetland		-		-		-		0.00		0.33		2.63		3.31	
	subtotal:		14.14		32.14		6.58		39.40		37.11		14.84		76.68	
IMPLND areas:																
	EIA			1.05		3.57		0.04		4.38		0.35		0.52		3.18
Basin total:			15.18		35.71		6.63		43.78		37.47		15.36		79.86	
Percent Impervious				6.9%		10.0%		0.7%		10.0%		0.9%		3.4%		4.0%

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Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)								Sub-basin Area (ac)	
		% of total	SDS Basins								SDS Basin	
		basin	SDW-1B-O		SDW-2		Total		Percent of Total		Special MC-8b	
Land	Soil	equal to		Effective		Effective		Effective		Effective		Effective
Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
STIA	M	0%	-	-	19.07	-	71.25	-	4.85%	0.00%	0.69	-
	Qvr	0%	-	-	-	-	2.25	-	0.15%	0.00%	-	-
	Qvt	0%	-	-	0.54	-	22.20	-	1.51%	0.00%	0.63	-
	Qw	0%	-	-	-	-	0.18	-	0.01%	0.00%	-	-
	TIA	100%	-	-	-	1.94	-	90.30	0.00%	6.14%	-	0.28
COMM	Qvr	85%	-	-	-	-	12.95	73.39	0.88%	4.99%	-	-
	Qvrl	85%	-	-	-	-	0.46	2.60	0.03%	0.18%	-	-
	Qvt	85%	-	-	-	-	2.41	13.66	0.16%	0.93%	-	-
TRANS	M	0%	-	-	-	-	4.33	-	0.29%	0.00%	-	-
	Qvr	0%	-	-	-	-	49.99	-	3.40%	0.00%	-	-
	Qvrl	0%	-	-	-	-	4.44	-	0.30%	0.00%	-	-
	Qvt	0%	-	-	-	-	6.43	-	0.44%	0.00%	-	-
	Qw	0%	-	-	-	-	2.33	-	0.16%	0.00%	-	-
	TIA	100%	-	-	-	-	-	56.16	0.00%	3.82%	-	-
MF	Qvr	47%	-	-	-	-	34.37	30.48	2.34%	2.07%	-	-
	Qvrl	47%	-	-	-	-	0.20	0.17	0.01%	0.01%	-	-
HD	Qvr	15%	0.89	0.16	1.54	0.27	95.06	16.78	6.46%	1.14%	4.28	0.76
	Qvrl	15%	-	-	-	-	16.79	2.96	1.14%	0.20%	-	-
	Qvt	15%	4.21	0.74	6.26	1.11	83.98	14.82	5.71%	1.01%	6.59	1.16
	Qw	15%	-	-	-	-	0.92	0.16	0.06%	0.01%	-	-
LD	M	4%	-	-	-	-	0.16	0.01	0.01%	0.00%	-	-
	Qu	4%	-	-	-	-	0.01	0.00	0.00%	0.00%	-	-
	Qvr	4%	6.30	0.26	-	-	188.30	7.85	12.80%	0.53%	-	-
	Qvrl	4%	-	-	-	-	9.46	0.39	0.64%	0.03%	-	-
	Qvt	4%	-	-	-	-	21.56	0.90	1.47%	0.06%	-	-
	Qw	4%	-	-	-	-	0.33	0.01	0.02%	0.00%	-	-
OG	M	0%	-	-	0.41	-	18.40	-	1.25%	0.00%	1.85	-
	Qvr	0%	-	-	0.78	-	164.14	-	11.16%	0.00%	16.42	-
	Qvrl	0%	-	-	-	-	9.37	-	0.64%	0.00%	-	-
	Qvt	0%	-	-	11.55	-	142.00	-	9.66%	0.00%	11.16	-
	Qw	0%	-	-	-	-	8.59	-	0.58%	0.00%	-	-

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)							
		% of total	SDS Basins							
		basin	SDW-1B-O		SDW-2		Total		Percent of Total	
Land	Soil	equal to		Effective		Effective		Effective		Effective
Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
F	M	0%	-	-	-	-	1.32	-	0.09%	0.00%
	Qu	0%	-	-	-	-	0.77	-	0.05%	0.00%
	Qvr	0%	-	-	-	-	68.20	-	4.64%	0.00%
	Qvrl	0%	-	-	-	-	9.76	-	0.66%	0.00%
	Qvt	0%	-	-	-	-	19.92	-	1.35%	0.00%
	Qw	0%	-	-	-	-	5.44	-	0.37%	0.00%
	Wetland	0%	4.43	-	1.13	-	81.62	-	5.55%	0.00%
	Lake		-		-		8.04		0.55%	0.00%
	Mcrk-df		-		-		20.24		1.38%	0.00%
	Other		-		-		0.04		0.00%	0.00%
Basin total:			15.84	1.16	41.29	3.31	1159.88	310.64	78.88%	21.12%
PERLND areas:										
(16)	Till-Forest		3.26		30.91		299.72		19.68%	
(26)	Till-Grass		0.68		8.68		222.50		14.61%	
(34)	Outwash-Forest		6.17		1.69		163.27		10.72%	
(44)	Outwash-Grass		1.30		0.48		492.15		32.32%	
(54)	Wetland		4.43		1.13		106.66		7.00%	
	subtotal:		15.84		42.89		1284.31		84.34%	
IMPLND areas:										
	EIA			1.16		1.71		238.51		15.66%
Basin total:			17.00		44.60		1522.81		100.00%	
Percent Impervious				6.8%		3.8%				

Land Use		Sub-basin Area (ac)	
		SDS Basin	
		Special MC-8b	
			Effective
		Pervious	Impervious
F	M	-	-
	Qu	-	-
	Qvr	-	-
	Qvrl	-	-
	Qvt	-	-
	Qw	-	-
	Wetland	1.05	-
	Lake	-	
	Mcrk-df	-	
	Other	-	
Basin total:		42.66	2.20
PERLND areas:			
(16)	Till-Forest	16.38	
(26)	Till-Grass	4.37	
(34)	Outwash-Forest	16.47	
(44)	Outwash-Grass	4.39	
(54)	Wetland	1.05	
	subtotal:	42.66	
IMPLND areas:			
	EIA		2.20
Basin total:		44.86	
Percent Impervious			4.9%

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Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to	Non-STIA Basins of M-1 to M-24													
			M-1		M-2		M-3		M-4		M-4A		M-11		M-12	
	Soil			Effective		Effective		Effective		Effective		Effective		Effective		Effective
Land Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
Bare	M	85%	-	-	0.49	2.77	-	-	0.00	0.01	0.37	2.11	0.24	1.33	-	-
Ground	Qb	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asphalt	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	0.76	4.31	0.85	4.82	1.58	8.96	0.56	3.18	0.99	5.61	11.64	65.96	1.21	6.86
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.67	3.77	1.21	6.88
	Qvt	85%	3.62	20.53	1.99	11.26	0.10	0.56	0.12	0.71	0.54	3.03	9.34	52.91	5.32	30.15
	Qw	85%	-	-	-	-	-	-	-	-	0.07	0.37	-	-	0.25	1.42
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	0.01	0.04	-	-
Rock	Qvr	85%	0.05	0.26	-	-	0.02	0.13	-	-	-	-	0.59	3.36	0.11	0.62
Concrete	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	0.07	0.39	-	-	-	-	-	-	0.05	0.26	0.26	1.48	0.14	0.80
Develop	M	85%	-	-	0.22	1.27	-	-	-	-	0.08	0.47	0.11	0.61	-	-
High	Qb	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	0.43	2.46	0.06	0.34	0.59	3.33	0.23	1.31	0.10	0.57	7.59	42.99	0.50	2.81
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.12	0.70	0.18	1.03
	Qvt	85%	0.87	4.95	0.47	2.68	0.24	1.38	0.08	0.45	1.70	9.64	5.96	33.78	2.64	14.97
	Qw	85%	0.00	0.02	-	-	-	-	-	-	0.00	0.02	-	-	0.27	1.52
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop	M	10%	-	-	0.43	0.05	-	-	0.87	0.10	1.89	0.21	0.67	0.07	-	-
Medium	Qb	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	10%	25.02	2.78	23.96	2.66	30.84	3.43	43.41	4.82	11.93	1.33	34.17	3.80	29.76	3.31
	Qvrl	10%	-	-	-	-	-	-	-	-	-	-	1.07	0.12	4.03	0.45
	Qvt	10%	153.51	17.06	113.34	12.59	51.26	5.70	37.01	4.11	19.59	2.18	161.00	17.89	65.20	7.24
	Qvu	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	10%	0.42	0.05	-	-	0.04	0.00	-	-	0.35	0.04	-	-	0.05	0.01
	Qyal	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop.	M	4%	-	-	-	-	-	-	1.01	0.04	1.81	0.08	0.45	0.02	-	-
Low	Qb	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	10.82	0.45	13.18	0.55	42.19	1.76	44.72	1.86	49.05	2.04	10.49	0.44	21.25	0.89
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	0.15	0.01	3.02	0.13
	Qvt	4%	66.93	2.79	77.05	3.21	49.44	2.06	43.74	1.82	27.82	1.16	36.85	1.54	18.11	0.75
	Qvu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	1.98	0.08	-	-	-	-	-	-	0.82	0.03	-	-	0.07	0.00
	Qyal	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	Non-STIA Basins of M-1 to M-24													
			M-1		M-2		M-3		M-4		M-4A		M-11		M-12	
Land Use	Soil Type	EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Grass	M	0%	-	-	0.62	-	-	-	0.01	-	2.76	-	-	-	-	-
	Qb	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	0.95	-	0.65	-	27.67	-	3.14	-	16.01	-	1.17	-	2.16	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.62	-
	Qvt	0%	7.36	-	5.44	-	7.34	-	3.11	-	5.04	-	1.04	-	0.71	-
	Qw	0%	0.39	-	-	-	-	-	-	-	1.28	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forest	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.07	-	0.46	-	16.02	-	3.75	-	22.06	-	1.32	-	5.64	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.08	-
	Qvt	0%	3.41	-	5.56	-	8.26	-	2.95	-	8.66	-	0.89	-	0.31	-
	Qw	0%	1.08	-	-	-	-	-	-	-	0.66	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland		-		-		-		-		9.32		-		-	
	Lake		4.59		-		-		-		2.13		-		0.65	
	Other		-		-		-		-		-		-		-	
Basin total:			280.75	56.14	244.78	42.22	235.59	27.30	184.72	18.43	173.62	29.14	285.78	230.80	162.84	79.83
PERLND areas:																
perlnd 16	Till-forest		3.41		5.56		8.26		2.95		8.66		0.89		0.39	
perlnd 26	Till-grass		232.36		200.05		108.38		85.95		61.64		217.92		101.18	
perlnd 34	Outwash-forest		3.07		0.46		16.02		3.75		22.06		1.32		5.64	
perlnd 44	Outwash-grass		38.03		38.71		102.89		92.06		78.09		65.65		54.98	
perlnd 54	Wetland		3.87		-		0.04		-		12.50		-		0.64	
	subtotal:		280.75		244.78		235.59		184.72		182.95		285.78		162.84	
IMPLND areas:																
	EIA			56.14		42.22		27.30		18.43		29.14		230.80		79.83
Basin total:			336.89		286.99		262.89		203.14		212.09		516.59		242.67	
Percent Impervious				16.7%		14.7%		10.4%		9.1%		13.7%		44.7%		32.9%

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Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	Non-STIA Basins of M-1 to M-24													
			M-13		M-14		M-15		M-17		M-18		M-19		M-21	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ground	Qb	85%	-	-	-	-	-	-	0.06	0.31	-	-	-	-	-	-
Asphalt	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	-	-	0.02	0.13	0.99	5.61	0.24	1.39	-	-	2.12	12.02	2.55	14.45
	Qvrl	85%	-	-	-	-	0.42	2.38	-	-	-	-	0.03	0.14	-	-
	Qvt	85%	1.09	6.20	0.81	4.60	0.03	0.19	-	-	-	-	0.08	0.46	0.66	3.76
	Qw	85%	-	-	-	-	-	-	0.01	0.04	-	-	-	-	-	-
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rock	Qvr	85%	-	-	-	-	-	-	0.19	1.05	-	-	0.02	0.10	0.09	0.52
Concrete	Qvrl	85%	-	-	-	-	0.05	0.26	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	0.12	0.66	-	-	-	-	-	-	-	-	0.03	0.15
Develop	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High	Qb	85%	-	-	-	-	-	-	0.03	0.16	-	-	-	-	-	-
Intensity	Qpf	85%	-	-	-	-	0.03	0.15	-	-	-	-	-	-	-	-
	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	-	-	0.02	0.13	0.14	0.77	0.56	3.15	0.01	0.05	0.41	2.31	0.92	5.20
	Qvrl	85%	-	-	-	-	0.12	0.66	-	-	-	-	0.11	0.60	-	-
	Qvt	85%	0.87	4.95	0.35	1.97	0.07	0.39	-	-	-	-	0.27	1.52	1.15	6.51
	Qw	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop	M	10%	-	-	-	-	-	-	-	-	-	-	0.71	0.08	-	-
Medium	Qb	10%	-	-	-	-	-	-	0.17	0.02	-	-	-	-	-	-
Intensity	Qpf	10%	-	-	0.16	0.02	1.37	0.15	2.75	0.31	-	-	-	-	-	-
	Qvi	10%	-	-	-	-	-	-	-	-	-	-	-	-	1.47	0.16
	Qvr	10%	-	-	13.61	1.51	20.11	2.23	5.84	0.65	6.70	0.74	45.89	5.10	52.06	5.78
	Qvrl	10%	-	-	-	-	3.38	0.38	-	-	-	-	21.79	2.42	-	-
	Qvt	10%	122.70	13.63	82.83	9.20	27.53	3.06	1.20	0.13	2.21	0.25	16.06	1.78	75.17	8.35
	Qvu	10%	-	-	-	-	-	-	0.07	0.01	-	-	-	-	-	-
	Qw	10%	-	-	-	-	-	-	0.38	0.04	-	-	-	-	-	-
	Qyal	10%	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.00
Develop.	M	4%	-	-	-	-	-	-	-	-	-	-	1.23	0.05	-	-
Low	Qb	4%	-	-	-	-	-	-	0.05	0.00	-	-	-	-	-	-
Intensity	Qpf	4%	-	-	2.21	0.09	3.36	0.14	8.61	0.36	-	-	-	-	-	-
	Qu	4%	-	-	-	-	1.42	0.06	-	-	-	-	0.10	0.00	-	-
	Qvi	4%	-	-	-	-	-	-	-	-	-	-	-	-	2.87	0.12
	Qvr	4%	-	-	23.03	0.96	55.70	2.32	51.91	2.16	41.48	1.73	44.89	1.87	57.86	2.41
	Qvrl	4%	-	-	-	-	7.20	0.30	-	-	-	-	37.05	1.54	-	-
	Qvt	4%	69.05	2.88	33.29	1.39	9.84	0.41	14.64	0.61	12.79	0.53	12.72	0.53	52.24	2.18
	Qvu	4%	-	-	-	-	-	-	0.40	0.02	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	0.98	0.04	-	-	-	-	-	-
	Qyal	4%	-	-	-	-	-	-	0.82	0.03	-	-	-	-	0.36	0.02

Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	Non-STIA Basins of M-1 to M-24													
			M-13		M-14		M-15		M-17		M-18		M-19		M-21	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Grass	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qb	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	0.20	-	0.45	-	0.99	-	-	-	-	-	-	-
	Qvr	0%	-	-	2.66	-	2.97	-	9.39	-	1.03	-	2.13	-	5.18	-
	Qvrl	0%	-	-	-	-	0.23	-	-	-	-	-	1.70	-	-	-
	Qvt	0%	3.96	-	1.28	-	0.70	-	0.47	-	1.08	-	0.34	-	3.66	-
	Qw	0%	-	-	-	-	-	-	0.55	-	-	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	0.04	-	-	-	-	-	-	-
Forest	M	0%	-	-	-	-	-	-	-	-	-	-	0.32	-	-	-
	Qpf	0%	-	-	2.48	-	-	-	1.83	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	3.20	-	-	-	-	-	0.24	-	-	-
	Qvi	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	10.98	-	46.89	-	29.25	-	20.95	-	8.15	-	5.96	-
	Qvrl	0%	-	-	-	-	0.41	-	-	-	-	-	12.09	-	-	-
	Qvt	0%	0.79	-	0.24	-	6.18	-	0.90	-	0.76	-	0.30	-	7.61	-
	Qw	0%	-	-	-	-	-	-	0.27	-	-	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	3.73	-	-	-	-	-	0.13	-
	Wetland		-		-		-		-		-		-		-	
	Lake		41.70		-		-		0.24		-		0.25		-	
	Other		-		-		-		-		-		-		-	
Basin total:			198.47	27.66	174.29	20.66	192.75	19.47	136.33	10.49	87.00	3.30	208.72	30.53	269.99	49.63
PERLND areas:																
perlnd 16	Till forest		0.79		0.24		6.59		0.90		0.76		12.72		7.61	
perlnd 26	Till-grass		197.68		118.67		49.55		16.31		16.08		92.07		132.91	
perlnd 34	Outwash-forest		-		13.46		50.09		34.82		20.95		8.39		6.09	
perlnd 44	Outwash-grass		-		41.91		86.52		82.11		49.22		95.55		123.39	
perlnd 54	Wetland		-		-		-		2.19		-		-		-	
	subtotal:		198.47		174.29		192.75		136.33		87.00		208.72		269.99	
IMPLND areas:																
	EIA			27.66		20.66		19.47		10.49		3.30		30.53		49.63
Basin total:			226.12		194.94		212.22		146.82		90.30		239.25		319.62	
Percent Impervious				12.2%		10.6%		9.2%		7.1%		3.7%		12.8%		15.5%

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Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use			Sub-basin Areas (acres)									
		% of total basin equal to EIA	Non-STIA Basins of M-1 to M-24									
			M-22		M-23		M-24		Total		Percent of Total	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare	M	85%	-	-	-	-	1.19	6.75	2.29	12.98	0.06%	0.32%
Ground	Qb	85%	0.20	1.11	-	-	-	-	0.25	1.43	0.01%	0.04%
Asphalt	Qvi	85%	0.00	0.01	-	-	-	-	0.00	0.01	0.00%	0.00%
	Qvr	85%	-	-	1.12	6.34	2.54	14.41	27.19	154.06	0.67%	3.78%
	Qvrl	85%	-	-	0.17	0.96	-	-	2.49	14.14	0.06%	0.35%
	Qvt	85%	-	-	3.61	20.44	3.69	20.88	31.00	175.66	0.76%	4.31%
	Qw	85%	0.06	0.32	-	-	-	-	0.38	2.15	0.01%	0.05%
	Qyal	85%	0.02	0.13	-	-	-	-	0.02	0.13	0.00%	0.00%
Bare	M	85%	-	-	-	-	-	-	0.01	0.04	0.00%	0.00%
Rock	Qvr	85%	-	-	0.16	0.93	0.53	3.02	1.76	10.00	0.04%	0.25%
Concrete	Qvrl	85%	-	-	-	-	-	-	0.05	0.26	0.00%	0.01%
	Qvt	85%	-	-	0.16	0.91	0.07	0.39	0.89	5.05	0.02%	0.12%
Develop	M	85%	-	-	-	-	0.17	0.97	0.59	3.32	0.01%	0.08%
High	Qb	85%	0.04	0.25	-	-	-	-	0.07	0.41	0.00%	0.01%
Intensity	Qpf	85%	-	-	-	-	-	-	0.03	0.15	0.00%	0.00%
	Qvi	85%	0.02	0.11	-	-	-	-	0.02	0.11	0.00%	0.00%
	Qvr	85%	-	-	0.33	1.88	1.45	8.20	13.33	75.53	0.33%	1.85%
	Qvrl	85%	-	-	0.22	1.27	-	-	0.75	4.25	0.02%	0.10%
	Qvt	85%	-	-	1.38	7.83	1.33	7.54	17.39	98.56	0.43%	2.42%
	Qw	85%	0.02	0.13	-	-	-	-	0.30	1.69	0.01%	0.04%
	Qyal	85%	0.12	0.66	-	-	-	-	0.12	0.66	0.00%	0.02%
Develop	M	10%	-	-	-	-	2.47	0.27	7.04	0.78	0.17%	0.02%
Medium	Qb	10%	0.14	0.02	-	-	-	-	0.31	0.03	0.01%	0.00%
Intensity	Qpf	10%	-	-	-	-	-	-	4.28	0.48	0.11%	0.01%
	Qvi	10%	4.17	0.46	-	-	-	-	5.65	0.63	0.14%	0.02%
	Qvr	10%	0.07	0.01	28.90	3.21	40.50	4.50	412.77	45.86	10.13%	1.13%
	Qvrl	10%	-	-	2.78	0.31	-	-	33.04	3.67	0.81%	0.09%
	Qvt	10%	-	-	111.89	12.43	103.71	11.52	1144.19	127.13	28.09%	3.12%
	Qvu	10%	-	-	-	-	-	-	0.07	0.01	0.00%	0.00%
	Qw	10%	0.81	0.09	-	-	-	-	2.05	0.23	0.05%	0.01%
	Qyal	10%	1.31	0.15	-	-	-	-	1.33	0.15	0.03%	0.00%
Develop.	M	4%	-	-	-	-	0.19	0.01	4.68	0.20	0.11%	0.00%
Low	Qb	4%	-	-	-	-	-	-	0.05	0.00	0.00%	0.00%
Intensity	Qpf	4%	-	-	-	-	-	-	14.18	0.59	0.35%	0.01%
	Qu	4%	-	-	-	-	-	-	1.51	0.06	0.04%	0.00%
	Qvi	4%	6.50	0.27	-	-	-	-	9.37	0.39	0.23%	0.01%
	Qvr	4%	0.71	0.03	14.46	0.60	17.88	0.74	499.61	20.82	12.26%	0.51%
	Qvrl	4%	-	-	2.73	0.11	-	-	50.15	2.09	1.23%	0.05%
	Qvt	4%	-	-	29.04	1.21	18.29	0.76	571.83	23.83	14.04%	0.58%
	Qvu	4%	-	-	-	-	-	-	0.40	0.02	0.01%	0.00%
	Qw	4%	0.42	0.02	-	-	-	-	4.26	0.18	0.10%	0.00%
	Qyal	4%	4.61	0.19	-	-	-	-	5.80	0.24	0.14%	0.01%

Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use	Soil Type	% of total basin equal to EIA	M-22 Pervious	M-22 Effective Impervious	M-23 Pervious	M-23 Effective Impervious	M-24 Pervious	M-24 Effective Impervious	Total Pervious	Total Effective Impervious	Percent of Total Pervious	Percent of Total Effective Impervious
Grass	M	0%	-	-	-	-	0.89	-	4.29	-	0.11%	0.00%
	Qb	0%	0.01	-	-	-	-	-	0.01	-	0.00%	0.00%
	Qpf	0%	-	-	-	-	-	-	1.63	-	0.04%	0.00%
	Qvr	0%	0.08	-	0.87	-	6.39	-	82.44	-	2.02%	0.00%
	Qvrl	0%	-	-	0.79	-	-	-	3.34	-	0.08%	0.00%
	Qvt	0%	-	-	3.37	-	3.43	-	48.31	-	1.19%	0.00%
	Qw	0%	1.83	-	-	-	-	-	4.05	-	0.10%	0.00%
	Qyal	0%	1.49	-	-	-	-	-	1.53	-	0.04%	0.00%
Forest	M	0%	-	-	-	-	-	-	0.32	-	0.01%	0.00%
	Qpf	0%	-	-	-	-	-	-	4.31	-	0.11%	0.00%
	Qu	0%	-	-	-	-	-	-	3.44	-	0.08%	0.00%
	Qvi	0%	0.64	-	-	-	-	-	0.64	-	0.02%	0.00%
	Qvr	0%	1.32	-	2.25	-	2.02	-	180.10	-	4.42%	0.00%
	Qvrl	0%	-	-	1.03	-	-	-	13.61	-	0.33%	0.00%
	Qvt	0%	-	-	2.06	-	-	-	48.88	-	1.20%	0.00%
	Qw	0%	0.07	-	-	-	-	-	2.08	-	0.05%	0.00%
	Qyal	0%	2.35	-	-	-	-	-	6.21	-	0.15%	0.00%
	Wetland		-		-		-		9.32		0.23%	
	Lake		0.47		0.94		0.33		51.30		1.26%	
	Other		-		-		-		-		0.00%	
Basin total:			27.01	3.95	207.33	58.44	206.74	79.98	3286.03	787.96	80.66%	19.34%
PERLND areas:												
perlnd 16	Till-forest		-		3.09		-		62.82		1.54%	
perlnd 26	Till-grass		-		156.15		135.43		1922.33		47.19%	
perlnd 34	Outwash-forest		4.30		2.25		2.02		194.70		4.78%	
perlnd 44	Outwash-grass		19.49		45.84		69.29		1083.74		26.60%	
perlnd 54	Wetland		3.21		-		-		22.44		0.55%	
	subtotal:		27.01		207.33		206.74		3286.03		80.66%	
IMPLND areas:												
	EIA			3.95		58.44		79.98		787.96		19.34%
Basin total:			30.96		265.77		286.72		4073.98		100.00%	
Percent Impervious				12.8%		22.0%		27.9%				

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	M-1 to M-22												MC-1 to MC-9	
			M-5		M-8		M-9		M-10		M-16		M-20		MC-1n	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	3.19	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.14	-
	TIA	100%	-	-	-	0.00	-	-	-	-	-	-	-	-	-	1.63
COMM	Qvr	85%	0.53	3.01	-	-	-	-	5.35	30.34	0.02	0.12	7.04	39.91	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	0.46	2.60	-	-	-	-
	Qvt	85%	2.18	12.34	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	-	-	-	-	-	-	-	-	-	-	1.74	-	0.10	-
	Qvr	0%	-	-	-	-	3.83	-	11.33	-	7.22	-	10.76	-	3.84	-
	Qvrl	0%	-	-	-	-	-	-	-	-	3.48	-	0.95	-	-	-
	Qvt	0%	-	-	-	-	0.36	-	4.32	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	0.01	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	7.21	-	16.76	-	5.40	-	11.38	-	0.35
MF	Qvr	47%	0.62	0.55	6.68	5.92	5.13	4.55	19.97	17.71	1.19	1.06	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	0.20	0.17	-	-	-	-
HD	Qvr	15%	-	-	0.48	0.08	46.39	8.19	6.98	1.23	15.22	2.69	3.66	0.65	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	16.63	2.94	0.16	0.03	-	-
	Qvt	15%	-	-	-	-	14.03	2.48	19.60	3.46	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	0.15	0.01	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	0.01	0.00	-	-	-	-
	Qvr	4%	9.67	0.40	14.21	0.59	1.26	0.05	51.59	2.15	5.35	0.22	20.81	0.87	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	8.95	0.37	0.00	0.00	-	-
	Qvt	4%	-	-	-	-	-	-	8.02	0.33	-	-	-	-	-	-
OG	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.04	-
	Qvr	0%	39.23	-	0.84	-	0.10	-	-	-	2.82	-	11.16	-	2.41	-
	Qvrl	0%	-	-	-	-	-	-	-	-	0.06	-	9.37	-	-	-
	Qvt	0%	8.12	-	-	-	-	-	-	-	-	-	0.31	-	-	-
	Qw	0%	0.47	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin	M-1 to M-22												MC-1 to MC-9	
			M-5		M-8		M-9		M-10		M-16		M-20		MC-1n	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	-	-	1.17	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	0.77	-	-	-	-	-
	Qvr	0%	-	-	-	-	0.05	-	-	-	19.26	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	9.76	-	-	-	-	-
	Qvt	0%	-	-	-	-	4.98	-	4.15	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	10.27	-	-	-	-	-	-	-	-	-	33.43	-	0.27	-
	Lake		0.44		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		-		-		-		0.00		-		-		-	
Basin total:			71.08	16.31	22.21	6.60	76.14	22.47	131.32	71.98	92.73	15.58	99.40	52.83	9.99	1.98
PERLND areas:																
(16)	Till-Forest		-		-		4.98		4.15		10.93		-		-	
(26)	Till-Grass		10.29		-		14.38		31.94		29.93		12.53		0.14	
(34)	Outwash-Forest		-		-		0.05		-		20.03		-		-	
(44)	Outwash-Grass		50.05		22.21		56.71		95.22		31.83		53.43		9.44	
(45)	Fill		-		-		-		-		-		-		0.14	
(54)	Wetland		10.74		-		0.01		-		-		33.43		0.27	
	subtotal:		71.08		22.21		76.14		131.32		92.73		99.40		9.99	
IMPLND areas:																
	EIA			16.31		6.60		22.47		71.98		15.58		52.83		1.98
Basin total:			87.39		28.80		98.61		203.30		108.32		152.23		11.97	
Percent Impervious				18.7%		22.9%		22.8%		35.4%		14.4%		34.7%		16.5%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres) MC-1 to MC-9													
		% of total basin	MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.08	-	0.59	-	3.16	-	0.42	-	11.72	-	0.02	-	1.14	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	3.17	-	2.27	-
	Qw	0%	0.03	-	0.18	-	0.26	-	-	-	-	-	-	-	-	-
	Fill	0%	2.22	-	1.07	-	4.23	-	-	-	0.09	-	-	-	-	-
	TIA	100%	-	2.27	-	1.41	-	3.31	-	0.02	-	0.26	-	0.03	-	-
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	2.55	-	1.32	-	-	-	-	-	-	-	0.02	-	1.19	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	0.22	-	0.43	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	0.27	-	0.01	-	-	-	-	-	-	-	-	-	0.01
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	0.46	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.57	-	2.99	-	13.36	-	33.42	-	2.37	-	31.75	-	16.60	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	0.07	-	-	-
	Qvt	0%	-	-	-	-	-	-	13.43	-	-	-	8.03	-	2.97	-
	Qw	0%	0.49	-	-	-	6.36	-	-	-	-	-	-	-	-	-

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres) MC-1 to MC-9													
		% of total basin equal to	MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8	
Land Use	Soil Type	EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.60	-	3.70	-	0.27	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	4.23	-	1.20	-	0.35	-	-	-	-	-	-	-	-	-
	Fill	0%	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	10.16	-	0.04	-	5.02	-	7.44	-	0.90	-	3.20	-	2.54	-
	Lake		2.98		-		3.30		0.73		0.29		0.24		-	
	Mcrk-df		7.00		13.17		-		-		-		-		-	
	Other		-		-		-		-		-		-		-	
Basin total:			30.77	2.54	11.52	1.42	33.00	3.31	54.71	0.02	15.09	0.26	46.26	0.03	26.72	0.01
PERLND areas:																
(16)	Till-Forest		0.08		-		-		-		-		-		-	
(26)	Till-Grass		0.53		-		-		13.43		-		11.26		5.25	
(34)	Outwash-Forest		3.60		3.70		0.27		-		-		-		-	
(44)	Outwash-Grass		9.20		4.91		16.51		33.84		14.10		31.80		18.93	
(45)	Fill		2.22		1.07		4.23		-		0.09		-		-	
(54)	Wetland		15.14		1.84		11.98		7.44		0.90		3.20		2.54	
	subtotal:		30.77		11.52		33.00		54.71		15.09		46.26		26.72	
IMPLND areas:																
	EIA			2.54		1.42		3.31		0.02		0.26		0.03		0.01
Basin total:			33.31		12.94		36.31		54.74		15.35		46.29		26.73	
Percent Impervious				7.6%		11.0%		9.1%		0.0%		1.7%		0.1%		0.0%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	MC-1 to MC-9										SDS Basins			
			MC-9		CARGO		NEPL		M-6		M-6X**		SDN-1		SDN1-LWR	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	2.42	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	0.12	-	-	-	10.00	-	-	-	10.00	-	0.51	-	0.03	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	1.97	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	0.17	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	0.39	-	8.12	-	32.29	-	-	-	32.29	-	11.46	-	0.19
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	0.08	0.44	0.08	0.44	-	-	-	-
TRANS	M	0%	1.76	-	-	-	-	-	0.03	-	0.03	-	-	-	-	-
	Qvr	0%	0.33	-	-	-	-	-	3.45	-	3.45	-	0.78	-	0.10	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	0.01	-	0.01	-	0.03	-	-	-
	TIA	100%	-	0.01	-	-	-	-	-	4.78	-	4.78	-	1.22	-	0.38
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	-	-	-	-	5.70	1.01	5.70	1.01	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	5.10	-	-	-	-	-	0.21	-	0.21	-	-	-	-	-
	Qvr	0%	0.30	-	-	-	-	-	8.34	-	8.34	-	-	-	4.66	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	14.36	-	14.36	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	MC-1 to MC-9										SDS Basins			
			MC-9		CARGO		NEPL		M-6		M-6X**		SDN-1		SDN1-LWR	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	0.07	-	0.07	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	13.44	-	13.44	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	1.35	-	1.35	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	-	-	-	-	-	-	0.80	-	0.80	-	-	-	0.07	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		0.07		0.07		-		-	
	Other		-		-		-		0.01		0.01		-		-	
Basin total:			10.03	0.40	-	8.12	10.00	32.29	47.84	6.23	57.84	38.52	3.46	12.68	4.86	0.56
PERLND areas:																
(16)	Till-Forest		-		-		-		1.42		1.42		-		-	
(26)	Till-Grass		9.28		-		-		20.38		20.38		1.97		-	
(34)	Outwash-Forest		-		-		-		13.44		13.44		-		-	
(44)	Outwash-Grass		0.76		-		10.00		11.79		21.79		1.29		4.79	
(45)	Fill		-		-		-		-		-		-		-	
(54)	Wetland		-		-		-		0.82		0.82		0.20		0.07	
	subtotal:		10.03		-		10.00		47.84		57.84		3.46		4.86	
IMPLND areas:																
	EIA			0.40		8.12		32.29		6.23		38.52		12.68		0.56
Basin total:			10.43		8.12		42.29		54.07		96.36		16.14		5.42	
Percent Impervious				3.8%		100.0%		76.4%		11.5%		40.0%		78.6%		10.4%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	SDS Basins													
			SDN1-OFF		SDN-2Xn		SDN-3		SDN-3A-I		SDN-3A-O		SDN-3X		SDN-4	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	0.63	-	4.73	-	-	-	-	-	-	-	15.69	-
	Qvr	0%	-	-	2.40	-	-	-	-	-	0.03	-	-	-	1.31	-
	Qvt	0%	-	-	-	-	18.83	-	0.08	-	-	-	1.61	-	0.06	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	0.86	-	-	-	4.58	-	17.54	-	23.77	-	0.99	-
	TIA	100%	-	-	-	0.36	-	24.30	-	5.87	-	2.35	-	0.00	-	12.26
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	0.68	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.28	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	1.76	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	1.63	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	7.88	-	-	-	-	-	-	-	-	-	-	-	-
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	0.70	0.12	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	0.30	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	19.87	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin	SDS Basins													
			SDN1-OFF		SDN-2Xn		SDN-3		SDN-3A-I		SDN-3A-O		SDN-3X		SDN-4	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		0.04		-		-		-		-		-		-	
Basin total:			28.27	8.00	3.90	0.36	23.56	24.30	4.66	5.87	17.57	2.35	25.38	0.00	18.06	12.26
PERLND areas:																
(16)	Till-Forest		-		-		-		-		-		-		-	
(26)	Till-Grass		23.01		0.63		23.56		0.08		-		1.61		15.75	
(34)	Outwash-Forest		-		-		-		-		-		-		-	
(44)	Outwash-Grass		3.58		2.40		-		-		0.03		-		1.31	
(45)	Fill		-		0.86		-		4.58		17.54		23.77		0.99	
(54)	Wetland		1 67		-		-		-		-		-		-	
	subtotal:		28.27		3.90		23.56		4.66		17.57		25.38		18.06	
IMPLND areas:																
	EIA			8.00		0.36		24.30		5.87		2.35		0.00		12.26
Basin total:			36.27		4.26		47.86		10.52		19.92		25.38		30.32	
Percent Impervious				22.1%		8.5%		50.8%		55.7%		11.8%		0.0%		40.4%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	SDS Basins		IWS Basins				SDS Basins							
			SDN-4X		IWS-NCPS		IWS-NSMPS		SDW-1A-I		SDW-1A-O		SDW-1B-I		SDW-1B-O	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	1.35	-	4.78	-	2.69	-	-	-	-	-	11.17	-	-	-
	Qvr	0%	0.75	-	-	-	1.97	-	-	-	0.69	-	-	-	2.39	-
	Qvt	0%	0.57	-	-	-	-	-	4.28	-	-	-	9.20	-	0.89	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	8.31	-	-	-	0.01	-	19.41	-	13.03	-	35.97	-	10.30	-
	TIA	100%	-	4.21	-	30.93	-	1.95	-	13.78	-	1.64	-	23.52	-	3.42
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin	SDS Basins		IWS Basins				SDS Basins							
			SDN-4X		IWS-NCPS		IWS-NSMPS		SDW-1A-I		SDW-1A-O		SDW-1B-I		SDW-1B-O	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.00	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		-		-		-		-		-		-		-	
Basin total:			10.97	4.21	4.78	30.93	4.67	1.95	23.69	13.78	13.72	1.64	56.33	23.52	13.58	3.42
PERLND areas:																
(16)	Till-Forest		-		-		-		-		-		-		-	
(26)	Till-Grass		1.92		4.78		2.69		4.28		-		20.37		0.89	
(34)	Outwash-Forest		-		-		-		-		-		-		-	
(44)	Outwash-Grass		0.75		-		1.97		-		0.69		-		2.39	
(45)	Fill		8.31		-		0.01		19.41		13.03		35.97		10.30	
(54)	Wetland		-		-		-		-		-		-		0.00	
	subtotal:		10.97		4.78		4.67		23.69		13.72		56.33		13.58	
IMPLND areas:																
	EIA			4.21		30.93		1.95		13.78		1.64		23.52		3.42
Basin total:			15.18		35.71		6.63		37.47		15.36		79.86		17.00	
Percent Impervious				27.7%		86.6%		29.5%		36.8%		10.7%		29.5%		20.1%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)					
		% of total basin equal to EIA	SDS Basins					
			SDW-2		Total		Percent of Total	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	20.39	-	63.91	-	4.48%	0.00%
	Qvr	0%	1.51	-	41.93	-	2.94%	0.00%
	Qvt	0%	6.49	-	48.52	-	3.40%	0.00%
	Qw	0%	-	-	0.64	-	0.04%	0.00%
	Fill	0%	6.70	-	108.34	-	7.59%	0.00%
	TIA	100%	-	9.51	-	188.10	0.00%	13.18%
COMM	Qvr	85%	-	-	12.95	73.39	0.91%	5.14%
	Qvrl	85%	-	-	0.46	2.60	0.03%	0.18%
	Qvt	85%	-	-	2.26	12.78	0.16%	0.90%
TRANS	M	0%	-	-	4.33	-	0.30%	0.00%
	Qvr	0%	-	-	50.01	-	3.50%	0.00%
	Qvrl	0%	-	-	4.44	-	0.31%	0.00%
	Qvt	0%	-	-	6.43	-	0.45%	0.00%
	Qw	0%	-	-	2.33	-	0.16%	0.00%
	TIA	100%	-	-	-	55.64	0.00%	3.90%
MF	Qvr	47%	-	-	33.59	29.78	2.35%	2.09%
	Qvrl	47%	-	-	0.20	0.17	0.01%	0.01%
HD	Qvr	15%	-	-	72.73	12.84	5.10%	0.90%
	Qvrl	15%	-	-	16.79	2.96	1.18%	0.21%
	Qvt	15%	-	-	40.03	7.06	2.81%	0.50%
LD	M	4%	-	-	0.15	0.01	0.01%	0.00%
	Qu	4%	-	-	0.01	0.00	0.00%	0.00%
	Qvr	4%	-	-	102.88	4.29	7.21%	0.30%
	Qvrl	4%	-	-	8.95	0.37	0.63%	0.03%
	Qvt	4%	-	-	8.02	0.33	0.56%	0.02%
OG	M	0%	-	-	5.80	-	0.41%	0.00%
	Qvr	0%	-	-	174.23	-	12.21%	0.00%
	Qvrl	0%	-	-	9.50	-	0.67%	0.00%
	Qvt	0%	-	-	67.09	-	4.70%	0.00%
	Qw	0%	-	-	7.32	-	0.51%	0.00%

Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)					
		% of total	SDS Basins					
		basin	SDW-2		Total		Percent of Total	
Land	Soil	equal to		Effective		Effective		Effective
Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
F	M	0%	-	-	1.32	-	0.09%	0.00%
	Qu	0%	-	-	0.77	-	0.05%	0.00%
	Qvr	0%	-	-	40.33	-	2.83%	0.00%
	Qvrl	0%	-	-	9.76	-	0.68%	0.00%
	Qvt	0%	-	-	10.49	-	0.73%	0.00%
	Qw	0%	-	-	5.78	-	0.40%	0.00%
	Fill	0%	-	-	0.00	-	0.00%	0.00%
	Wetland	0%	-	-	74.19	-	5.20%	0.00%
	Lake		-		7.98		0.56%	
	Mcrk-df		-		20.24		1.42%	
	Other		-		0.04		0.00%	
Basin total:			35.09	9.51	1036.47	390.34	72.64%	27.36%
PERLND areas:								
(16)	Till-Forest		-		21.56		1.46%	
(26)	Till-Grass		26.88		287.76		19.45%	
(34)	Outwash-Forest		-		41.10		2.78%	
(44)	Outwash-Grass		1.51		491.45		33.23%	
(45)	Fill		6.70		149.21		10.09%	
(54)	Wetland		-		90.26		6.10%	
	subtotal:		35.09		1081.34		73.11%	
IMPLND areas:								
	EIA			9.51		397.75		26.89%
Basin total:			44.60		1479.09		100.00%	
Percent Impervious				21.3%				

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	Non-STIA Basins of M-1 to M-24													
			M-1		M-2		M-3		M-4		M-4A		M-11		M-12	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare	M	85%	-	-	0.49	2.77	-	-	0.00	0.01	0.37	2.11	0.24	1.33	-	-
Ground	Qb	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asphalt	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	0.76	4.31	0.85	4.82	1.58	8.96	0.56	3.18	0.99	5.61	11.64	65.96	1.21	6.86
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.67	3.77	1.21	6.88
	Qvt	85%	3.62	20.53	1.99	11.26	0.10	0.56	0.12	0.71	0.54	3.03	9.34	52.91	5.32	30.15
	Qw	85%	-	-	-	-	-	-	-	-	0.07	0.37	-	-	0.25	1.42
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	0.01	0.04	-	-
Rock	Qvr	85%	0.05	0.26	-	-	0.02	0.13	-	-	-	-	0.59	3.36	0.11	0.62
Concrete	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	0.07	0.39	-	-	-	-	-	-	0.05	0.26	0.26	1.48	0.14	0.80
Develop	M	85%	-	-	0.22	1.27	-	-	-	-	0.08	0.47	0.11	0.61	-	-
High	Qb	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	0.43	2.46	0.06	0.34	0.59	3.33	0.23	1.31	0.10	0.57	7.59	42.99	0.50	2.81
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.12	0.70	0.18	1.03
	Qvt	85%	0.87	4.95	0.47	2.68	0.24	1.38	0.08	0.45	1.70	9.64	5.96	33.78	2.64	14.97
	Qw	85%	0.00	0.02	-	-	-	-	-	-	0.00	0.02	-	-	0.27	1.52
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop	M	10%	-	-	0.43	0.05	-	-	0.87	0.10	1.89	0.21	0.67	0.07	-	-
Medium	Qb	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	10%	25.02	2.78	23.96	2.66	30.84	3.43	43.41	4.82	11.93	1.33	34.17	3.80	29.76	3.31
	Qvrl	10%	-	-	-	-	-	-	-	-	-	-	1.07	0.12	4.03	0.45
	Qvt	10%	153.51	17.06	113.34	12.59	51.26	5.70	37.01	4.11	19.59	2.18	161.00	17.89	65.20	7.24
	Qvu	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	10%	0.42	0.05	-	-	0.04	0.00	-	-	0.35	0.04	-	-	0.05	0.01
	Qyal	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop.	M	4%	-	-	-	-	-	-	1.01	0.04	1.81	0.08	0.45	0.02	-	-
Low	Qb	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	10.82	0.45	13.18	0.55	42.19	1.76	44.72	1.86	49.05	2.04	10.49	0.44	21.25	0.89
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	0.15	0.01	3.02	0.13
	Qvt	4%	66.93	2.79	77.05	3.21	49.44	2.06	43.74	1.82	27.82	1.16	36.85	1.54	18.11	0.75
	Qvu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	1.98	0.08	-	-	-	-	-	-	0.82	0.03	-	-	0.07	0.00
	Qyal	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total	Non-STIA Basins of M-1 to M-24													
		basin	M-1		M-2		M-3		M-4		M-4A		M-11		M-12	
	Soil	equal to		Effective		Effective		Effective		Effective		Effective		Effective		Effective
Land Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
Grass	M	0%	-	-	0.62	-	-	-	0.01	-	2.76	-	-	-	-	-
	Qb	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	0.95	-	0.65	-	27.67	-	3.14	-	16.01	-	1.17	-	2.16	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.62	-
	Qvt	0%	7.36	-	5.44	-	7.34	-	3.11	-	5.04	-	1.04	-	0.71	-
	Qw	0%	0.39	-	-	-	-	-	-	-	1.28	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forest	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.07	-	0.46	-	16.02	-	3.75	-	22.06	-	1.32	-	5.64	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.08	-
	Qvt	0%	3.41	-	5.56	-	8.26	-	2.95	-	8.66	-	0.89	-	0.31	-
	Qw	0%	1.08	-	-	-	-	-	-	-	0.66	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland		-		-		-		-		9.32		-		-	
	Lake		4.59		-		-		-		2.13		-		0.65	
	Other		-		-		-		-		-		-		-	
Basin total:			280.75	56.14	244.78	42.22	235.59	27.30	184.72	18.43	173.62	29.14	285.78	230.80	162.84	79.83
PERLND areas:																
perlnd 16	Till-forest		3.41		5.56		8.26		2.95		8.66		0.89		0.39	
perlnd 26	Till-grass		232.36		200.05		108.38		85.95		61.64		217.92		101.18	
perlnd 34	Outwash-forest		3.07		0.46		16.02		3.75		22.06		1.32		5.64	
perlnd 44	Outwash-grass		38.03		38.71		102.89		92.06		78.09		65.65		54.98	
perlnd 54	Wetland		3.87		-		0.04		-		12.50		-		0.64	
	subtotal:		280.75		244.78		235.59		184.72		182.95		285.78		162.84	
IMPLND areas:																
	EIA			56.14		42.22		27.30		18.43		29.14		230.80		79.83
Basin total:			336.89		286.99		262.89		203.14		212.09		516.59		242.67	
Percent Impervious				16.7%		14.7%		10.4%		9.1%		13.7%		44.7%		32.9%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total	Non-STIA Basins of M-1 to M-24													
		basin	M-13		M-14		M-15		M-17		M-18		M-19		M-21	
	Soil	equal to		Effective		Effective		Effective		Effective		Effective		Effective		Effective
Land Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ground	Qb	85%	-	-	-	-	-	-	0.06	0.31	-	-	-	-	-	-
Asphalt	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	-	-	0.02	0.13	0.99	5.61	0.24	1.39	-	-	2.12	12.02	2.55	14.45
	Qvrl	85%	-	-	-	-	0.42	2.38	-	-	-	-	0.03	0.14	-	-
	Qvt	85%	1.09	6.20	0.81	4.60	0.03	0.19	-	-	-	-	0.08	0.46	0.66	3.76
	Qw	85%	-	-	-	-	-	-	0.01	0.04	-	-	-	-	-	-
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rock	Qvr	85%	-	-	-	-	-	-	0.19	1.05	-	-	0.02	0.10	0.09	0.52
Concrete	Qvrl	85%	-	-	-	-	0.05	0.26	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	0.12	0.66	-	-	-	-	-	-	-	-	0.03	0.15
Develop	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High	Qb	85%	-	-	-	-	-	-	0.03	0.16	-	-	-	-	-	-
Intensity	Qpf	85%	-	-	-	-	0.03	0.15	-	-	-	-	-	-	-	-
	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	-	-	0.02	0.13	0.14	0.77	0.56	3.15	0.01	0.05	0.41	2.31	0.92	5.20
	Qvrl	85%	-	-	-	-	0.12	0.66	-	-	-	-	0.11	0.60	-	-
	Qvt	85%	0.87	4.95	0.35	1.97	0.07	0.39	-	-	-	-	0.27	1.52	1.15	6.51
	Qw	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop	M	10%	-	-	-	-	-	-	-	-	-	-	0.71	0.08	-	-
Medium	Qb	10%	-	-	-	-	-	-	0.17	0.02	-	-	-	-	-	-
Intensity	Qpf	10%	-	-	0.16	0.02	1.37	0.15	2.75	0.31	-	-	-	-	-	-
	Qvi	10%	-	-	-	-	-	-	-	-	-	-	-	-	1.47	0.16
	Qvr	10%	-	-	13.61	4.51	20.11	2.23	5.84	0.65	6.70	0.74	45.89	5.10	52.06	5.78
	Qvrl	10%	-	-	-	-	3.38	0.38	-	-	-	-	21.79	2.42	-	-
	Qvt	10%	122.70	13.63	82.83	9.20	27.53	3.06	1.20	0.13	2.21	0.25	16.06	1.78	75.17	8.35
	Qvu	10%	-	-	-	-	-	-	0.07	0.01	-	-	-	-	-	-
	Qw	10%	-	-	-	-	-	-	0.38	0.04	-	-	-	-	-	-
	Qyal	10%	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.00
Develop.	M	4%	-	-	-	-	-	-	-	-	-	-	1.23	0.05	-	-
Low	Qb	4%	-	-	-	-	-	-	0.05	0.00	-	-	-	-	-	-
Intensity	Qpf	4%	-	-	2.21	0.09	3.36	0.14	8.61	0.36	-	-	-	-	-	-
	Qu	4%	-	-	-	-	1.42	0.06	-	-	-	-	0.10	0.00	-	-
	Qvi	4%	-	-	-	-	-	-	-	-	-	-	-	-	2.87	0.12
	Qvr	4%	-	-	23.03	0.96	55.70	2.32	51.91	2.16	41.48	1.73	44.89	1.87	57.86	2.41
	Qvrl	4%	-	-	-	-	7.20	0.30	-	-	-	-	37.05	1.54	-	-
	Qvt	4%	69.05	2.88	33.29	1.39	9.84	0.41	14.64	0.61	12.79	0.53	12.72	0.53	52.24	2.18
	Qvu	4%	-	-	-	-	-	-	0.40	0.02	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	0.98	0.04	-	-	-	-	-	-
	Qyal	4%	-	-	-	-	-	-	0.82	0.03	-	-	-	-	0.36	0.02

AR 046541

Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	Non-STIA Basins of M-1 to M-24													
			M-13		M-14		M-15		M-17		M-18		M-19		M-21	
Land Use	Soil Type	EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Grass	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qb	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	0.20	-	0.45	-	0.99	-	-	-	-	-	-	-
	Qvr	0%	-	-	2.66	-	2.97	-	9.39	-	1.03	-	2.13	-	5.18	-
	Qvrl	0%	-	-	-	-	0.23	-	-	-	-	-	1.70	-	-	-
	Qvt	0%	3.96	-	1.28	-	0.70	-	0.47	-	1.08	-	0.34	-	3.66	-
	Qw	0%	-	-	-	-	-	-	0.55	-	-	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	0.04	-	-	-	-	-	-	-
Forest	M	0%	-	-	-	-	-	-	-	-	-	-	0.32	-	-	-
	Qpf	0%	-	-	2.48	-	-	-	1.83	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	3.20	-	-	-	-	-	0.24	-	-	-
	Qvi	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	10.98	-	46.89	-	29.25	-	20.95	-	8.15	-	5.96	-
	Qvrl	0%	-	-	-	-	0.41	-	-	-	-	-	12.09	-	-	-
	Qvl	0%	0.79	-	0.24	-	6.18	-	0.90	-	0.76	-	0.30	-	7.61	-
	Qw	0%	-	-	-	-	-	-	0.27	-	-	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	3.73	-	-	-	-	-	0.13	-
	Wetland		-		-		-		-		-		-		-	
	Lake		41.70		-		-		0.24		-		0.25		-	
	Other		-		-		-		-		-		-		-	
Basin total:			198.47	27.66	174.29	20.66	192.75	19.47	136.33	10.49	87.00	3.30	208.72	30.53	269.99	49.63
PERLND areas:																
perlnd 16	Till-forest		0.79		0.24		6.59		0.90		0.76		12.72		7.61	
perlnd 26	Till-grass		197.68		118.67		49.55		16.31		16.08		92.07		132.91	
perlnd 34	Outwash-forest		-		13.46		50.09		34.82		20.95		8.39		6.09	
perlnd 44	Outwash-grass		-		41.91		86.52		82.11		49.22		95.55		123.39	
perlnd 54	Wetland		-		-		-		2.19		-		-		-	
	subtotal:		198.47		174.29		192.75		136.33		87.00		208.72		269.99	
IMPLND areas:																
	EIA			27.66		20.66		19.47		10.49		3.30		30.53		49.63
Basin total:			226.12		194.94		212.22		146.82		90.30		239.25		319.62	
Percent Impervious				12.2%		10.6%		9.2%		7.1%		3.7%		12.8%		15.5%

AR 046542

Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)									
		% of total basin equal to EIA	Non-STIA Basins of M-1 to M-24									
			M-22		M-23		M-24		Total		Percent of Total	
Land Use	Soil Type	EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare	M	85%	-	-	-	-	1.19	6.75	2.29	12.98	0.06%	0.32%
Ground	Qb	85%	0.20	1.11	-	-	-	-	0.25	1.43	0.01%	0.04%
Asphalt	Qvi	85%	0.00	0.01	-	-	-	-	0.00	0.01	0.00%	0.00%
	Qvr	85%	-	-	1.12	6.34	2.54	14.41	27.19	154.06	0.67%	3.78%
	Qvrl	85%	-	-	0.17	0.96	-	-	2.49	14.14	0.06%	0.35%
	Qvt	85%	-	-	3.61	20.44	3.69	20.88	31.00	175.66	0.76%	4.31%
	Qw	85%	0.06	0.32	-	-	-	-	0.38	2.15	0.01%	0.05%
	Qyal	85%	0.02	0.13	-	-	-	-	0.02	0.13	0.00%	0.00%
Bare	M	85%	-	-	-	-	-	-	0.01	0.04	0.00%	0.00%
Rock	Qvr	85%	-	-	0.16	0.93	0.53	3.02	1.76	10.00	0.04%	0.25%
Concrete	Qvrl	85%	-	-	-	-	-	-	0.05	0.26	0.00%	0.01%
	Qvt	85%	-	-	0.16	0.91	0.07	0.39	0.89	5.05	0.02%	0.12%
Develop	M	85%	-	-	-	-	0.17	0.97	0.59	3.32	0.01%	0.08%
High	Qb	85%	0.04	0.25	-	-	-	-	0.07	0.41	0.00%	0.01%
Intensity	Qpf	85%	-	-	-	-	-	-	0.03	0.15	0.00%	0.00%
	Qvi	85%	0.02	0.11	-	-	-	-	0.02	0.11	0.00%	0.00%
	Qvr	85%	-	-	0.33	1.88	1.45	8.20	13.33	75.53	0.33%	1.85%
	Qvrl	85%	-	-	0.22	1.27	-	-	0.75	4.25	0.02%	0.10%
	Qvt	85%	-	-	1.38	7.83	1.33	7.54	17.39	98.56	0.43%	2.42%
	Qw	85%	0.02	0.13	-	-	-	-	0.30	1.69	0.01%	0.04%
	Qyal	85%	0.12	0.66	-	-	-	-	0.12	0.66	0.00%	0.02%
Develop	M	10%	-	-	-	-	2.47	0.27	7.04	0.78	0.17%	0.02%
Medium	Qb	10%	0.14	0.02	-	-	-	-	0.31	0.03	0.01%	0.00%
Intensity	Qpf	10%	-	-	-	-	-	-	4.28	0.48	0.11%	0.01%
	Qvi	10%	4.17	0.46	-	-	-	-	5.65	0.63	0.14%	0.02%
	Qvr	10%	0.07	0.01	28.90	3.21	40.50	4.50	412.77	45.86	10.13%	1.13%
	Qvrl	10%	-	-	2.78	0.31	-	-	33.04	3.67	0.81%	0.09%
	Qvt	10%	-	-	111.89	12.43	103.71	11.52	1144.19	127.13	28.09%	3.12%
	Qvu	10%	-	-	-	-	-	-	0.07	0.01	0.00%	0.00%
	Qw	10%	0.81	0.09	-	-	-	-	2.05	0.23	0.05%	0.01%
	Qyal	10%	1.31	0.15	-	-	-	-	1.33	0.15	0.03%	0.00%
Develop.	M	4%	-	-	-	-	0.19	0.01	4.68	0.20	0.11%	0.00%
Low	Qb	4%	-	-	-	-	-	-	0.05	0.00	0.00%	0.00%
Intensity	Qpf	4%	-	-	-	-	-	-	14.18	0.59	0.35%	0.01%
	Qu	4%	-	-	-	-	-	-	1.51	0.06	0.04%	0.00%
	Qvi	4%	6.50	0.27	-	-	-	-	9.37	0.39	0.23%	0.01%
	Qvr	4%	0.71	0.03	14.46	0.60	17.88	0.74	499.61	20.82	12.26%	0.51%
	Qvrl	4%	-	-	2.73	0.11	-	-	50.15	2.09	1.23%	0.05%
	Qvt	4%	-	-	29.04	1.21	18.29	0.76	571.83	23.83	14.04%	0.58%
	Qvu	4%	-	-	-	-	-	-	0.40	0.02	0.01%	0.00%
	Qw	4%	0.42	0.02	-	-	-	-	4.26	0.18	0.10%	0.00%
	Qyal	4%	4.61	0.19	-	-	-	-	5.80	0.24	0.14%	0.01%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)									
		% of total basin equal to EIA	Non-STIA Basins of M-1 to M-24									
			M-22		M-23		M-24		Total		Percent of Total	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Grass	M	0%	-	-	-	-	0.89	-	4.29	-	0.11%	0.00%
	Qb	0%	0.01	-	-	-	-	-	0.01	-	0.00%	0.00%
	Qpf	0%	-	-	-	-	-	-	1.63	-	0.04%	0.00%
	Qvr	0%	0.08	-	0.87	-	6.39	-	82.44	-	2.02%	0.00%
	Qvrl	0%	-	-	0.79	-	-	-	3.34	-	0.08%	0.00%
	Qvt	0%	-	-	3.37	-	3.43	-	48.31	-	1.19%	0.00%
	Qw	0%	1.83	-	-	-	-	-	4.05	-	0.10%	0.00%
	Qyal	0%	1.49	-	-	-	-	-	1.53	-	0.04%	0.00%
Forest	M	0%	-	-	-	-	-	-	0.32	-	0.01%	0.00%
	Qpf	0%	-	-	-	-	-	-	4.31	-	0.11%	0.00%
	Qu	0%	-	-	-	-	-	-	3.44	-	0.08%	0.00%
	Qvi	0%	0.64	-	-	-	-	-	0.64	-	0.02%	0.00%
	Qvr	0%	1.32	-	2.25	-	2.02	-	180.10	-	4.42%	0.00%
	Qvrl	0%	-	-	1.03	-	-	-	13.61	-	0.33%	0.00%
	Qvt	0%	-	-	2.06	-	-	-	48.88	-	1.20%	0.00%
	Qw	0%	0.07	-	-	-	-	-	2.08	-	0.05%	0.00%
	Qyal	0%	2.35	-	-	-	-	-	6.21	-	0.15%	0.00%
	Wetland		-		-		-		9.32		0.23%	
	Lake		0.47		0.94		0.33		51.30		1.26%	
	Other		-		-		-		-		0.00%	
Basin total:			27.01	3.95	207.33	58.44	206.74	79.98	3286.03	787.96	80.66%	19.34%
PERLND areas:												
perlnd 16	Till-forest		-		3.09		-		62.82		1.54%	
perlnd 26	Till-grass		-		156.15		135.43		1922.33		47.19%	
perlnd 34	Outwash-forest		4.30		2.25		2.02		194.70		4.78%	
perlnd 44	Outwash-grass		19.49		45.84		69.29		1083.74		26.60%	
perlnd 54	Wetland		3.21		-		-		22.44		0.55%	
	subtotal:		27.01		207.33		206.74		3286.03		80.66%	
IMPLND areas:												
	EIA			3.95		58.44		79.98		787.96		19.34%
Basin total:			30.96		265.77		286.72		4073.98		100.00%	
Percent Impervious				12.8%		22.0%		27.9%				

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Legend for Tables A-2a and A-2b

Soil Types:

TFF	Till, forest, flat
TFM	Till, forest, moderate
TFS	Till, forest, steep
TGF	Till, grass, flat
TGM	Till, grass, moderate
TGS	Till, grass, steep
FLF	Fill, flat
FLM	Fill, moderate
FLS	Fill, steep
FL	Fill (all slopes)
LAC	Lacustrine
OFF	Outwash forest, flat
OFM	Outwash forest, moderate
OFS	Outwash forest, steep
OF	Outwash forest (all slopes)
OGF	Outwash grass, flat
OGM	Outwash grass, moderate
OGS	Outwash grass, steep
OG	Outwash grass (all slopes)
SA	Wetland
EIA	Effective impervious area

Land Use Types:

AP	Commercial airport and measured EIA
C	Commercial
TR	Transport
MF	Multi-family
HD	High density residential
LD	Low density residential
G	Grass or open
F	Forest

PERLND number refers to the unique soil and slope pervious land segment in HSPF.
IMPLND refers to the impervious land segment.
Network factors are the area for each PERLND or IMPLND divided by 12.

shaded subbasins included in the STIA subbasin characteristics evaluation area.

[a] - Land use is extrapolated.

[b] - Areas prorated to new subbasin total areas from previous version of model.

Explanation of Calculations of Effective Impervious Area for Tables A-2a and A-2b

Unshaded Basins:

Table	Basins
A-2a	DM14, DM18
A-2b	DM1, DM2, DM14, DM16, DM17, DM18, DM19, DM20, DM21, DM22

Acreage by soil type is extrapolated.

Unshaded Basins:

Table	Basins
A-2a	DM6, DM10
A-2b	DM3, DM4, DM5, DM6, DM7, DM8, DM9, DM10, DM11, DM12, DM13

Effective Impervious Area

Total area within the basin for a given land use, soil type, and slope * EIA percentage

Pervious Area

Total area within the basin for a given land use, soil type, and slope * (1 - EIA percentage)

STIA (shaded) Basins:

Table	Basins
A-2a	SDS2, SDS5, SDS6, SSMPS, IWS-West, IWS-SASA
A-2b	SDE4, SDS1, SDS2, SDS3, SDS3A, SDS4, SDS5, SDS6, SDS7, SASA, NSPS, Primary, SSMPS, IWS-SASA

Effective Impervious Area

Total impervious area within the basin for a given land use (from GIS analysis) * fraction contribution for specific soil type and slope . Impervious area distributed among present soil types and slopes according to fraction contribution to basin area.

Pervious Area

Total pervious area within the basin for a given land use, soil type, and slope.

Remaining Pre-Development Condition Basins (Table A-2a):

Table	Basins
A-2a:	DM1, DM2, DM16, DM17, DM19, DM20, DM21, DM22, SDE4, SDS1, SDS3, SDS3A, SDS4, SDS7, SASA, NSPS, Primary, SSMPS, IWS-SASA

Effective Impervious Area

Total impervious area is 10 percent of the total basin acreage not including wetland area. Impervious area distributed proportionately to the grass and forest pervious areas.

Pervious Area

75 percent of the total basin acreage not including wetland area is distributed as forest. 15 percent of the total basin acreage not including wetland area is distributed as grass. Forest and grass areas distributed proportionately to till and outwash according to the till and outwash total acreage proportions.

Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)														
		% of total basin equal to EIA	Bow Lake		East Branch										West Branch (NW Ponds)	
			DM-1		DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%					-	-	-	-	0.16	-	-	-	-	-
	TGM	0%					-	-	-	-	1.57	-	-	-	-	-
	TGS	0%					-	-	-	-	-	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	-	-
	OGF	0%					-	-	-	-	-	-	-	-	-	-
	OGM	0%					-	-	-	-	-	-	-	-	-	-
	TIA						-	-		-		0.08		-		-
COMM	TGF	85%					2.79	15.81	3.71	21.05	0.00	0.00	-	-	-	-
	TGM	85%					3.29	18.63	3.38	19.17	1.44	8.15	-	-	-	-
	TGS	85%					-	-	-	-	-	-	-	-	-	-
	LAC	85%					3.09	17.52	-	-	-	-	-	-	2.15	12.17
	OGF	85%					-	-	-	-	-	-	0.01	0.06	0.65	3.70
	OGM	85%					-	-	-	-	0.28	1.56	0.00	0.02	0.07	0.39
TRANS	TGF	30%					-	-	-	-	-	-	-	-	-	-
	OGF	30%					-	-	-	-	-	-	-	-	-	-
	OGM	30%					-	-	-	-	-	-	-	-	-	-
	TIA						-	-		-		-		-		-
MF	TGF	47%					-	-	-	-	-	-	-	-	-	-
	TGM	47%					-	-	-	-	-	-	-	-	-	-
	OGF	47%					-	-	-	-	-	-	-	-	-	-
	OGM	47%					-	-	-	-	-	-	-	-	-	-
	OGS	47%					-	-	-	-	-	-	-	-	-	-
HD	TGF	30%					9.67	4.14	-	-	-	-	-	-	0.96	0.41
	TGM	30%					0.43	0.19	-	-	-	-	-	-	-	-
	TGS	30%					-	-	-	-	-	-	-	-	-	-
	LAC	30%					1.39	0.59	-	-	-	-	-	-	-	-
LD	TGF	13%					14.66	2.19	-	-	-	-	-	-	26.29	3.93
	TGM	13%					7.21	1.08	-	-	-	-	-	-	-	-
	TGS	13%					-	-	-	-	-	-	-	-	-	-
	LAC	13%					1.21	0.18	-	-	-	-	-	-	5.93	0.89
	OGF	13%					-	-	-	-	-	-	-	-	37.35	5.58
	OGM	13%					-	-	-	-	-	-	-	-	11.55	1.73
	OGS	13%					-	-	-	-	-	-	-	-	0.09	0.01
OG	TGF	0%					-	-	-	-	1.96	-	4.83	-	-	-
	TGM	0%					-	-	-	-	0.80	-	1.57	-	-	-
	TGS	0%					-	-	-	-	-	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	-	-
	OGF	0%					-	-	-	-	0.18	-	8.49	-	-	-
	OGM	0%					-	-	-	-	0.51	-	-		-	-

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	Bow Lake		East Branch										West Branch (NW Ponds)	
			DM-1		DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%					-	-	1.59	-	-	-	-	-	4.21	-
	TFM	0%					-	-	1.91	-	2.08	-	-	-	-	-
	TFS	0%					-	-	-	-	-	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	22 07	-
	OFF	0%					-	-	-	-	-	-	0.02	-	15 40	-
	OFM	0%					-	-	-	-	0.88	-	-	-	8.23	-
	Wetland	0%					0.16		0.06		1.36		3.74		6.62	
	Lake		12.19		-		-		-		-		0.03		-	
	Other						0.02		0.06		-		-		0.01	
Basin total:			-		-		43.90	60.33	10.65	40.21	11.21	9.80	18.67	0.08	141.59	28.81
PERLND areas:																
(16)	TF		10.32		-		-		38.11		12.18		4.81		26.28	
(26)	TG		132.94		14.78		43.74		7.62		2.44		1.57		35.33	
(34)	OF		7 19		-		-		-		2.56		6.45		23.63	
(44)	OG		92 36		-		-		-		0.51		2.10		49.72	
(54)	Wetland		14 11		-		0.16		0.06		1.36		3.74		6 62	
	subtotal:		256.92		14.78		43.90		45.79		19.05		18.67		141.59	
IMPLND areas:																
	EIA			171.29		9.85		60.33		5.08		1.97		0.08		28.81
Basin total:			428.21		24.64		104.22		50.87		21.01		18.75		170.40	
Percent Impervious				40.0%		40.0%		57.9%		10.0%		9.4%		0.4%		16.9%
			DM-1		DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
NETWORK FACTORS																
PERLND 16	(TF)		0.860		-		-		3.175		1.015		0.400		2.190	
PERLND 26	(TG)		11.078		1.232		3.645		0.635		0.203		0.131		2.944	
PERLND 34	(OF)		0.599		-		-		-		0.213		0.538		1.970	
PERLND 44	(OG)		7.697		-		-		-		0.043		0.175		4.143	
PERLND 54	(SA)		1.176		-		0.013		0.005		0.113		0.312		0.552	
IMPLND 14	(EIA)		14.274		0.821		5.027		0.423		0.164		0.007		2.401	
SUM			35.684		2.053		8.685		4.239		1.751		1.563		14.200	

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	West Branch (NW Ponds)								Upper Main					
			DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	TGM	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGF	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	TIA			-		-		-		-		-		-		
COMM	TGF	85%	1.86	10.54	-	-	-	-	1.36	7.72	-	-	2.59	14.66		
	TGM	85%	-	-	-	-	-	-	-	-	-	-	0.04	0.20		
	TGS	85%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	85%	-	-	-	-	-	-	1.12	6.35	-	-	-	-		
	OGF	85%	2.28	12.89	-	-	-	-	2.89	16.37	-	-	-	-		
	OGM	85%	-	-	-	-	-	-	-	-	-	-	-	-		
TRANS	TGF	30%	4.81	-	-	-	-	-	0.99	-	-	-	-	-		
	OGF	30%	0.95	-	-	-	-	-	-	-	-	-	-	-		
	OGM	30%	-	-	-	-	-	-	-	-	-	-	-	-		
	TIA			3.98		-		-		2.27		-		-		
MF	TGF	47%	-	-	-	-	-	-	-	-	-	-	-	-		
	TGM	47%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGF	47%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGM	47%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGS	47%	-	-	-	-	-	-	-	-	-	-	-	-		
HD	TGF	30%	-	-	-	-	-	-	-	-	-	-	0.06	0.02		
	TGM	30%	-	-	-	-	-	-	-	-	-	-	-	-		
	TGS	30%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-		
LD	TGF	13%	0.64	0.10	10.27	1.53	6.33	0.95	-	-	-	-	-	-		
	TGM	13%	-	-	2.89	0.43	-	-	-	-	-	-	-	-		
	TGS	13%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	13%	-	-	1.25	0.19	2.50	0.37	-	-	-	-	-	-		
	OGF	13%	10.37	1.55	8.69	1.30	0.67	0.10	-	-	-	-	1.47	0.22		
	OGM	13%	-	-	26.75	4.00	5.39	0.81	-	-	-	-	0.04	0.01		
	OGS	13%	-	-	1.04	0.16	-	-	-	-	-	-	-	-		
OG	TGF	0%	-	-	-	-	-	-	1.42	-	-	-	9.55	-		
	TGM	0%	-	-	-	-	-	-	-	-	-	-	6.52	-		
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	0%	-	-	-	-	0.02	-	-	-	0.01	-	-	-		
	OGF	0%	-	-	-	-	0.06	-	2.72	-	18.81	-	15.48	-		
	OGM	0%	-	-	-	-	0.00	-	-	-	1.93	-	4.35	-		

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	West Branch (NW Ponds)								Upper Main					
			DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%	2.43	-	-	-	0.18	-	3.12	-	-	-	4.95	-		
	TFM	0%	-	-	-	-	-	-	-	-	-	-	6.34	-		
	TFS	0%	-	-	-	-	-	-	-	-	-	-	0.24	-		
	LAC	0%	-	-	0.02	-	11.16	-	0.73	-	6.13	-	0.00	-		
	OFF	0%	8.58	-	-	-	8.80	-	12.28	-	0.02	-	0.02	-		
	OFM	0%	-	-	0.20	-	14.42	-	-	-	4.48	-	14.42	-		
	Wetland	0%	1.93		0.12		8.55		12.43		6.65		1.08			
	Lake		-		-		0.97		5.33		0.63		0.85		-	
	Other		0.01		-		0.00		-		0.00		0.07			
Basin total:			33.84	29.06	51.23	7.60	58.08	2.22	39.06	32.71	38.02	-	67.13	15.11	-	
PERLND areas:																
(16)	TF		2.43		0.02		11.34		3.85		6.13		33.87		5.78	
(26)	TG		7.31		14.41		8.85		4.89		0.01		6.77		3.54	
(34)	OF		8.58		0.20		23.22		12.28		4.50		27.00		23.28	
(44)	OG		13.59		36.48		6.12		5.61		20.73		5.40		14.34	
(54)	Wetland		1.93		0.12		8.55		12.43		6.65		1.08		-	
	subtotal:		33.84		51.23		58.08		39.06		38.02		74.12		46.94	
IMPLND areas:																
	EIA			29.06		7.60		2.22		32.71		-		8.12		4.08
Basin total:			62.90		58.83		60.30		71.77		38.02		82.24		51.02	
Percent Impervious				46.2%		12.9%		3.7%		45.6%		0.0%		9.9%		8.0%
			DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
NETWORK FACTORS																
PERLND 16	(TF)		0.203		0.002		0.945		0.321		0.510		2.823		0.481	
PERLND 26	(TG)		0.609		1.201		0.738		0.408		0.001		0.565		0.295	
PERLND 34	(OF)		0.715		0.017		1.935		1.024		0.375		2.250		1.940	
PERLND 44	(OG)		1.133		3.040		0.510		0.467		1.728		0.450		1.195	
PERLND 54	(SA)		0.161		0.010		0.712		1.036		0.554		0.090		-	
IMPLND 14	(EIA)		2.422		0.634		0.185		2.726		-		0.676		0.340	
SUM			5.242		4.903		5.025		5.981		3.168		6.853		4.252	

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
		% of total	Lower Main Stem													
		basin	DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
Land	Soil	equal to		Effective		Effective		Effective		Effective		Effective		Effective		Effective
Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
STIA	TGF	0%														
	TGM	0%														
	TGS	0%														
	LAC	0%														
	OGF	0%														
	OGM	0%														
	TIA															
COMM	TGF	85%														
	TGM	85%														
	TGS	85%														
	LAC	85%														
	OGF	85%														
	OGM	85%														
TRANS	TGF	30%														
	OGF	30%														
	OGM	30%														
	TIA															
MF	TGF	47%														
	TGM	47%														
	OGF	47%														
	OGM	47%														
	OGS	47%														
HD	TGF	30%														
	TGM	30%														
	TGS	30%														
	LAC	30%														
LD	TGF	13%														
	TGM	13%														
	TGS	13%														
	LAC	13%														
	OGF	13%														
	OGM	13%														
	OGS	13%														
OG	TGF	0%														
	TGM	0%														
	TGS	0%														
	LAC	0%														
	OGF	0%														
	OGM	0%														

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	Lower Main Stem													
			DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%														
	TFM	0%														
	TFS	0%														
	LAC	0%														
	OFF	0%														
	OFM	0%														
	Wetland	0%														
	Lake		0.44		-		-		-		-		-		-	
	Other															
Basin total:			-		-		-		-		-		-		-	
PERLND areas:																
(16)	TF		7.76		24.93		9.47		2.19		48.08		25.72		4.58	
(26)	TG		66.87		27.13		3.32		72.22		79.49		75.68		55.85	
(34)	OF		7.67		36.04		37.81		2.00		33.40		17.14		2.62	
(44)	OG		96.28		39.36		13.27		66.63		55.22		50.46		31.44	
(54)	Wetland		2.19		-		3.60		-		1.39		-		0.19	
	subtotal:		180.77		127.45		67.48		143.04		217.58		168.99		94.67	
IMPLND areas:																
	EIA			50.99		31.86		3.55		31.40		44.56		37.10		23.67
Basin total:			231.75		159.31		71.03		174.44		262.14		206.09		118.34	
Percent Impervious				22.0%		20.0%		5.0%		18.0%		17.0%		18.0%		20.0%
			DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
NETWORK FACTORS																
PERLND 16	(TF)		0.647		2.078		0.789		0.182		4.007		2.143		0.381	
PERLND 26	(TG)		5.573		2.261		0.277		6.019		6.624		6.306		4.654	
PERLND 34	(OF)		0.639		3.003		3.151		0.167		2.784		1.429		0.218	
PERLND 44	(OG)		8.023		3.280		1.106		5.552		4.602		4.205		2.620	
PERLND 54	(SA)		0.183		-		0.300		-		0.116		-		0.016	
IMPLND 14	(EIA)		4.249		2.655		0.296		2.617		3.714		3.091		1.972	
SUM			19.313		13.276		5.919		14.537		21.845		17.174		9.862	

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	SDS Basins													
			SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%	34.49	-	-	-	160.47	-	50.52	-	6.17	-	-	-	31.99	-
	TGM	0%	1.77	-	-	-	5.07	-	10.06	-	-	-	-	-	-	-
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	0.78	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	9.96	-	-	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	0.45	-	-	-	-	-
	TIA			97.69		11.54		177.95		7.05		19.09		-		0.39
COMM	TGF	85%	1.69	9.58	0.81	4.61	-	-	-	-	-	-	0.05	0.30	-	-
	TGM	85%	0.16	0.92	0.12	0.66	0.00	0.00	-	-	-	-	-	-	-	-
	TGS	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	85%	1.28	7.25	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	85%	-	-	-	-	-	-	-	-	-	-	0.15	0.83	-	-
	OGM	85%	-	-	-	-	-	-	-	-	0.01	0.08	-	-	-	-
TRANS	TGF	30%	-	-	-	-	-	-	-	-	0.01	-	0.12	-	0.08	-
	OGF	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA			-		-		-		-		-		0.36		-
MF	TGF	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	TGF	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGS	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	TGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGS	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	TGF	0%	10.57	-	-	-	-	-	-	-	2.96	-	-	-	-	-
	TGM	0%	-	-	-	-	-	-	2.14	-	-	-	-	-	-	-
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	25.08	-	-	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	0.60	-	-	-	-	-

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	SDS Basins													
			SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%	-	-	-	-	-	-	-	-	-	-	2.76	-	-	-
	TFM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TFS	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OFF	0%	-	-	-	-	-	-	-	-	0.14	-	4.06	-	-	-
	OFM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	-		-		-		-		-		0.52		-	
	Lake		-		-		-		-		-		-		-	
	Other		0.13		-	-	-		-		-		-		-	
Basin total:			50.74	115.45	0.93	16.81	165.53	177.95	62.72	7.05	45.39	19.17	7.66	1.49	32.07	0.39
PERLND areas:																
(16)	TF		124.64		13.31		257.61		52.33		11.29		2.70		24.34	
(26)	TG		24.93		2.66		51.52		10.47		2.26		0.54		4.87	
(34)	OF		-		-		-		-		37.13		3.78		-	
(44)	OG		-		-		-		-		7.43		0.76		-	
(54)	Wetland		-		-		-		-		-		0.52		-	
	subtotal:		149.56		15.97		309.14		62.80		58.11		8.29		29.21	
IMPLND areas:																
	EIA			16.62		1.77		34.35		6.98		6.46		0.86		3.25
Basin total:			166.18		17.74		343.49		69.78		64.56		9.15		32.46	
Percent impervious				10.0%		10.0%		10.0%		10.0%		10.0%		9.4%		10.0%
			SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
NETWORK FACTORS																
PERLND 16	(TF)		10.386		1.109		21.468		4.361		0.941		0.225		2.029	
PERLND 26	(TG)		2.077		0.222		4.294		0.872		0.188		0.045		0.406	
PERLND 34	(OF)		-		-		-		-		3.094		0.315		-	
PERLND 44	(OG)		-		-		-		-		0.619		0.063		-	
PERLND 54	(SA)		-		-		-		-		-		0.043		-	
IMPLND 14	(EIA)		1.385		0.148		2.862		0.581		0.538		0.072		0.270	
SUM			13.849		1.478		28.624		5.815		5.380		0.762		2.705	

AR 046554

Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to EIA	SDS Basins						IWS Basins							
			SDS-6		SDS-7		SASA		NSPS		PRIMARY		WEST		SASA	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%	11.12	-	20.55	-	-	-	0.32	-	11.95	-	2.72	-	-	-
	TGM	0%	-	-	0.23	-	-	-	-	-	0.96	-	-	-	-	-
	TGS	0%	-	-	0.28	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.37	-
	TIA			4.27		6.56		-		13.48		231.69		0.44		-
COMM	TGF	85%	-	-	-	-	1.37	7.76	-	-	0.23	1.30	-	-	0.02	0.13
	TGM	85%	-	-	-	-	0.19	1.10	-	-	0.08	0.48	-	-	0.48	2.71
	TGS	85%	-	-	-	-	-	-	-	-	-	-	-	-	0.20	1.15
	LAC	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	85%	-	-	-	-	-	-	-	-	-	-	-	-	0.01	0.04
	OGM	85%	-	-	-	-	0.01	0.08	-	-	-	-	-	-	0.44	2.51
TRANS	TGF	30%	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA			0.00		-		-		-		-		-		-
MF	TGF	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	TGF	30%	-	-	0.95	0.41	-	-	-	-	-	-	-	-	-	-
	TGM	30%	-	-	1.15	0.49	-	-	-	-	-	-	-	-	-	-
	TGS	30%	-	-	1.29	0.55	-	-	-	-	-	-	-	-	-	-
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	TGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGS	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	TGF	0%	1.31	-	49.88	-	-	-	-	-	0.05	-	-	-	0.32	-
	TGM	0%	-	-	2.01	-	0.19	-	-	-	0.12	-	-	-	9.00	-
	TGS	0%	-	-	1.91	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	4.59	-	-	-	-	-	-	-	-	-	0.09	-
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-	2.71	

AR 046555

Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
			SDS Basins						IWS Basins							
		% of total basin	SDS-6		SDS-7		SASA		NSPS		PRIMARY		WEST		SASA	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%	-	-	-	-	12.32	-	-	-	-	-	2.67	-	1.08	-
	TFM	0%	-	-	-	-	9.89	-	-	-	-	-	-	-	28.69	-
	TFS	0%	-	-	-	-	0.58	-	-	-	-	-	-	-	6.80	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OFF	0%	-	-	-	-	-	-	-	-	-	-	6.14	-	0.04	-
	OFM	0%	-	-	-	-	0.23	-	-	-	-	-	-	-	0.20	-
	Wetland	0%	-		0.39		0.54		-		-		0.00		1.34	
	Lake		-		-		-		-		-		6.65		-	
	Other		-		-		-		-		-		-		-	
Basin total:			12.46	4.27	83.24	8.01	25.33	8.94	0.32	13.48	13.40	233.48	11.53	0.44	51.79	6.53
PERLND areas:																
(16)	TF		12.54		64.70		25.05		10.35		185.16		4.37		37.93	
(26)	TG		2.51		13.96		5.01		2.07		37.03		1.24		7.59	
(34)	OF		-		3.44		0.24		-		-		4.60		4.80	
(44)	OG		-		0.74		0.05		-		-		1.31		0.96	
(54)	Wetland		-		0.39		0.54		-		-		0.00		1.34	
	subtotal:		15.05		83.24		30.90		12.42		222.19		11.53		52.63	
IMPLND areas:																
	EIA			1.67		8.01		3.37		1.38		24.69		0.44		5.70
Basin total:			16.72		91.25		34.27		13.80		246.87		11.97		58.32	
Percent Impervious				10.0%		8.8%		9.8%		10.0%		10.0%		3.7%		9.8%
			SDS-6		SDS-7		SASA		NSPS		PRIMARY		WEST		SASA	
NETWORK FACTORS																
PERLND 16	(TF)		1.045		5.392		2.088		0.863		15.430		0.364		3.161	
PERLND 26	(TG)		0.209		1.164		0.418		0.173		3.086		0.104		0.632	
PERLND 34	(OF)		-		0.287		0.020		-		-		0.384		0.400	
PERLND 44	(OG)		-		0.062		0.004		-		-		0.109		0.080	
PERLND 54	(SA)		-		0.033		0.045		-		-		0.000		0.112	
IMPLND 14	(EIA)		0.139		0.668		0.281		0.115		2.057		0.037		0.475	
SUM			1.394		7.605		2.856		1.150		20.573		0.997		4.860	

AR 046556

Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use		
Land Use	Soil Type	% of total basin equal to EIA
STIA	TGF	0%
	TGM	0%
	TGS	0%
	LAC	0%
	OGF	0%
	OGM	0%
	TIA	
COMM	TGF	85%
	TGM	85%
	TGS	85%
	LAC	85%
	OGF	85%
	OGM	85%
TRANS	TGF	30%
	OGF	30%
	OGM	30%
	TIA	
MF	TGF	47%
	TGM	47%
	OGF	47%
	OGM	47%
	OGS	47%
HD	TGF	30%
	TGM	30%
	TGS	30%
	LAC	30%
LD	TGF	13%
	TGM	13%
	TGS	13%
	LAC	13%
	OGF	13%
	OGM	13%
	OGS	13%
OG	TGF	0%
	TGM	0%
	TGS	0%
	LAC	0%
	OGF	0%
	OGM	0%

Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use				
Land Use	Soil Type	% of total basin equal to EIA		
F	TFF	0%		
	TFM	0%		
	TFS	0%		
	LAC	0%		
	OFF	0%		
	OFM	0%		
	Wetland	0%		
	Lake			
	Other			
Basin total:			Total	Percent
PERLND areas:				
(16)	TF		1104.15	30.31%
(26)	TG		831.41	22.82%
(34)	OF		329.58	9.05%
(44)	OG		610.85	16.77%
(54)	Wetland		66.99	1.84%
	subtotal:		2942.99	80.79%
IMPLND areas:				
	EIA		699.88	19.21%
Basin total:			3642.86	100.00%
Percent Impervious				
			Total	Percent
NETWORK FACTORS				
PERLND 16	(TF)		92.01	30.31%
PERLND 26	(TG)		69.28	22.82%
PERLND 34	(OF)		27.46	9.05%
PERLND 44	(OG)		50.90	16.77%
PERLND 54	(SA)		5.58	1.84%
IMPLND 14	(EIA)		58.32	19.21%
SUM			303.57	100.00%

AR 046558

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
		% of total basin	Bow Lake		East Branch										West Branch (NW Ponds)	
			DM-1		DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
Land Use	Soil Type	equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%					-	-	-	-	0.16	-	-	-	-	-
	TGM	0%					-	-	-	-	1.53	-	-	-	-	-
	TGS	0%					-	-	-	-	-	-	-	-	-	-
	FLF	0%					-	-	-	-	-	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	-	-
	OGF	0%					-	-	-	-	-	-	-	-	-	-
	OGM	0%					-	-	-	-	0.00	-	-	-	-	-
	TIA							-		0.08		0.27		-		-
COMM	TGF	85%					2.54	14.37	3.71	21.04	0.00	0.00	-	-	-	-
	TGM	85%					2.44	13.83	3.38	19.17	1.37	7.79	-	-	-	-
	LAC	85%					3.09	17.52	-	-	-	-	-	-	2.15	12.17
	OGF	85%					-	-	-	-	-	-	0.01	0.06	0.65	3.70
	OGM	85%					-	-	-	-	0.27	1.53	0.00	0.02	0.07	0.39
TRANS	TGF	30%					-	-	-	-	-	-	-	-	-	-
	OGF	30%					-	-	-	-	-	-	-	-	-	-
	OGM	30%					-	-	-	-	-	-	-	-	-	-
	TIA							-		-		-		-		-
HD	TGF	30%					9.67	4.14	-	-	-	-	-	-	0.96	0.41
	TGM	30%					0.43	0.19	-	-	-	-	-	-	-	-
	LAC	30%					1.39	0.59	-	-	-	-	-	-	-	-
LD	TGF	13%					14.66	2.19	-	-	-	-	-	-	26.29	3.93
	TGM	13%					7.21	1.08	-	-	-	-	-	-	-	-
	LAC	13%					1.21	0.18	-	-	-	-	-	-	5.93	0.89
	OGF	13%					-	-	-	-	-	-	-	-	37.35	5.58
	OGM	13%					-	-	-	-	-	-	-	-	11.55	1.73
	OGS	13%					-	-	-	-	-	-	-	-	0.09	0.01
OG	TGF	0%					-	-	-	-	1.97	-	4.83	-	-	-
	TGM	0%					-	-	-	-	0.78	-	1.57	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	-	-
	OGF	0%					-	-	-	-	0.15	-	8.49	-	-	-
	OGM	0%					-	-	-	-	0.51	-	-	-	-	-
F	TFF	0%					-	-	1.52	-	-	-	-	-	4.21	-
	TFM	0%					-	-	1.91	-	2.07	-	-	-	-	-
	TFS	0%					-	-	-	-	-	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	22.07	
	OFF	0%					-	-	-	-	-	-	0.02	-	15.40	-
	OFM	0%					-	-	-	-	0.88	-	-	-	8.23	

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
		% of	Bow Lake		East Branch										West Branch (NW Ponds)	
		total	DM-1		DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
Land	Soil	basin		Effective		Effective		Effective		Effective		Effective		Effective		Effective
Use	Type	equal to	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
	Wetland	0%					0.07		0.06		1.35		3.74		6.62	
	Lake		12.19		-		-		-		-		0.03		-	
	sasa-dp						7.42		-		0.28		-		-	
	Other						0.02		0.06		-		-		0.01	
Basin total:			-		-		42.71	54.10	10.58	40.28	11.05	9.59	18.67	0.08	141.59	28.81
PERLND areas:																
(16)	TF		10.32		-		-		3.43		2.07		-		26.28	
(26)	TG		132.94		14.78		42.64		7.10		5.82		6.41		35.33	
(45)	FL		-		-		-		-		-		-		-	
(34)	OF		7.19		-		-		-		0.88		0.02		23.63	
(44)	OG		92.36		-		-		-		0.93		8.50		49.72	
(54)	SA		14.11		-		0.07		0.06		1.35		3.74		6.62	
	subtotal:		256.92		14.78		42.71		10.58		11.05		18.67		141.59	
IMPLND areas:																
	EIA			171.29		9.85		54.10		40.28		9.59		0.08		28.81
Basin total:			428.21		24.64		96.81		50.87		20.64		18.75		170.40	
Percent Impervious				40.0%		40.0%		55.9%		79.2%		46.5%		0.4%		16.9%
			DM-1		DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
NETWORK FACTORS																
PERLND 16	(TF)		0.860		-		-		0.286		0.173		-		2.190	
PERLND 26	(TG)		11.078		1.232		3.553		0.591		0.485		0.534		2.944	
PERLND 45	(FL)		-		-		-		-		-		-		-	
PERLND 34	(OF)		0.599		-		-		-		0.074		0.002		1.970	
PERLND 44	(OG)		7.697		-		-		-		0.077		0.709		4.143	
PERLND 54	(SA)		1.176		-		0.006		0.005		0.112		0.312		0.552	
IMPLND 14	(EIA)		14.274		0.821		4.508		3.357		0.799		0.007		2.401	
SUM			35.684		2.053		8.067		4.239		1.720		1.563		14.200	

AR 046560

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
		% of total basin	West Branch (NW Ponds)								Upper Main				Lower Main Stem	
			DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
Land	Soil			Effective		Effective		Effective		Effective		Effective		Effective		Effective
Use	Type	equal to	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
STIA	TGF	0%	-	-	-	-	-	-	-	-	-	-	0.00	-		
	TGM	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	FLF	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGF	0%	-	-	-	-	-	-	0.00	-	-	-	-	-		
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	TIA			-		-		-		-		-		0.00		
COMM	TGF	85%	1.86	10.54	-	-	-	-	1.36	7.72	-	-	2.59	14.66		
	TGM	85%	-	-	-	-	-	-	-	-	-	-	0.04	0.20		
	LAC	85%	-	-	-	-	-	-	1.12	6.35	-	-	-	-		
	OGF	85%	2.28	12.89	-	-	-	-	2.89	16.37	-	-	-	-		
	OGM	85%	-	-	-	-	-	-	-	-	-	-	-	-		
TRANS	TGF	30%	4.81	-	-	-	-	-	0.99	-	-	-	-	-		
	OGF	30%	0.95	-	-	-	-	-	-	-	-	-	-	-		
	OGM	30%	-	-	-	-	-	-	-	-	-	-	-	-		
	TIA			3.98		-		-		2.27		-		-		
HD	TGF	30%	-	-	-	-	-	-	-	-	-	-	0.06	0.02		
	TGM	30%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-		
LD	TGF	13%	0.64	0.10	10.27	1.53	6.33	0.95	-	-	-	-	-	-		
	TGM	13%	-	-	2.89	0.43	-	-	-	-	-	-	-	-		
	LAC	13%	-	-	1.25	0.19	2.50	0.37	-	-	-	-	-	-		
	OGF	13%	10.37	1.55	8.69	1.30	0.67	0.10	-	-	-	-	1.47	0.22		
	OGM	13%	-	-	26.75	4.00	5.39	0.81	-	-	-	-	0.04	0.01		
	OGS	13%	-	-	1.04	0.16	-	-	-	-	-	-	-	-		
OG	TGF	0%	-	-	-	-	-	-	1.42	-	-	-	9.55	-		
	TGM	0%	-	-	-	-	-	-	-	-	-	-	6.52	-		
	LAC	0%	-	-	-	-	0.02	-	-	-	0.01	-	-	-		
	OGF	0%	-	-	-	-	0.06	-	2.72	-	18.81	-	15.48	-		
	OGM	0%	-	-	-	-	0.00	-	-	-	1.93	-	4.35	-		
F	TFF	0%	2.43	-	-	-	0.18	-	3.12	-	-	-	4.94	-		
	TFM	0%	-	-	-	-	-	-	-	-	-	-	6.35	-		
	TFS	0%	-	-	-	-	-	-	-	-	-	-	0.24	-		
	LAC	0%	-	-	0.02	-	11.16	-	0.73	-	6.13	-	0.00	-		
	OFF	0%	8.58	-	-	-	8.80	-	12.28	-	0.02	-	0.02	-		
	OFM	0%	-	-	0.20	-	14.42	-	-	-	4.48	-	14.42	-		

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
		% of	West Branch (NW Ponds)								Upper Main				Lower Main Stem	
		total	DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
Land	Soil	basin		Effective		Effective		Effective		Effective		Effective		Effective		Effective
Use	Type	equal to	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
	Wetland	0%	1.93		0.12		8.55		12.43		6.65		1.07			
	Lake		-		-		0.97		5.33		0.63		0.85		-	
	sasa-dp		-		-		-		-		-		-			
	Other		0.01		-		0.00		-		0.00		0.07			
Basin total:			33.84	29.06	51.23	7.60	58.08	2.22	39.06	32.71	38.02	-	67.13	15.11	-	
PERLND areas:																
(16)	TF		2.43		0.02		11.34		3.85		6.13		11.53		5.78	
(26)	TG		7.31		14.41		8.85		4.89		0.01		18.75		3.54	
(45)	FL		-		-		-		-		-		-		-	
(34)	OF		8.58		0.20		23.22		12.28		4.50		14.44		23.28	
(44)	OG		13.59		36.48		6.12		5.61		20.73		21.33		14.34	
(54)	SA		1.93		0.12		8.55		12.43		6.65		1.07		-	
	subtotal:		33.84		51.23		58.08		39.06		38.02		67.13		46.94	
IMPLND areas:																
	EIA			29.06		7.60		2.22		32.71		-		15.11		4.08
Basin total:			62.90		58.83		60.30		71.77		38.02		82.24		51.02	
Percent Impervious				46.2%		12.9%		3.7%		45.6%		0.0%		18.4%		8.0%
			DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
NETWORK FACTORS																
PERLND 16	(TF)		0.203		0.002		0.945		0.321		0.510		0.961		0.481	
PERLND 26	(TG)		0.609		1.201		0.738		0.408		0.001		1.562		0.295	
PERLND 45	(FL)		-		-		-		-		-		-			
PERLND 34	(OF)		0.715		0.017		1.935		1.024		0.375		1.203		1.940	
PERLND 44	(OG)		1.133		3.040		0.510		0.467		1.728		1.778		1 195	
PERLND 54	(SA)		0.161		0.010		0.712		1.036		0.554		0.089		-	
IMPLND 14	(EIA)		2.422		0.634		0.185		2.726		-		1.259		0.340	
SUM			5.242		4.903		5.025		5.981		3.168		6.853		4.252	

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
			Lower Main Stem													
			DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
Land Use	Soil Type	% of total basin equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%														
	TGM	0%														
	TGS	0%														
	FLF	0%														
	LAC	0%														
	OGF	0%														
	OGM	0%														
	TIA															
COMM	TGF	85%														
	TGM	85%														
	LAC	85%														
	OGF	85%														
	OGM	85%														
TRANS	TGF	30%														
	OGF	30%														
	OGM	30%														
	TIA															
HD	TGF	30%														
	TGM	30%														
	LAC	30%														
LD	TGF	13%														
	TGM	13%														
	LAC	13%														
	OGF	13%														
	OGM	13%														
	OGS	13%														
OG	TGF	0%														
	TGM	0%														
	LAC	0%														
	OGF	0%														
	OGM	0%														
F	TFF	0%														
	TFM	0%														
	TFS	0%														
	LAC	0%														
	OFF	0%														
	OFM	0%														

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
		% of total basin	Lower Main Stem													
			DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
Land Use	Soil Type	equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
	Wetland	0%														
	Lake		0.44		-		-		-		-		-		-	
	sasa-dp															
	Other															
Basin total:			-		-		-		-		-		-		-	
PERLND areas:																
(16)	TF		7.76		24.93		9.47		2.19		48.08		25.72		4.58	
(26)	TG		66.87		27.13		3.32		72.22		79.49		75.68		55.85	
(45)	FL		-		-		-		-		-		-		-	
(34)	OF		7.67		36.04		37.81		2.00		33.40		17.14		2.62	
(44)	OG		96.28		39.36		13.27		66.63		55.22		50.46		31.44	
(54)	SA		2.19		-		3.60		-		1.39		-		0.19	
	subtotal:		180.77		127.45		67.48		143.04		217.58		168.99		94.67	
IMPLND areas:																
	EIA			50.99		31.86		3.55		31.40		44.56		37.10		23.67
Basin total:			231.75		159.31		71.03		174.44		262.14		206.09		118.34	
Percent Impervious				22.0%		20.0%		5.0%		18.0%		17.0%		18.0%		20.0%
			DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
NETWORK FACTORS																
PERLND 16	(TF)		0.647		2.078		0.789		0.182		4.007		2.143		0.381	
PERLND 26	(TG)		5.573		2.261		0.277		6.019		6.624		6.306		4.654	
PERLND 45	(FL)		-		-		-		-		-		-		-	
PERLND 34	(OF)		0.639		3.003		3.151		0.167		2.784		1.429		0.218	
PERLND 44	(OG)		8.023		3.280		1.106		5.552		4.602		4.205		2.620	
PERLND 54	(SA)		0.183		-		0.300		-		0.116		-		0.016	
IMPLND 14	(EIA)		4.249		2.655		0.296		2.617		3.714		3.091		1.972	
SUM			19.313		13.276		5.919		14.537		21.845		17.174		9.862	

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Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to	SDS Basins													
			SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%	37.54	-	1.09	-	144.03	-	34.64	-	6.76	-	2.87	-	28.20	-
	TGM	0%	0.98	-	0.30	-	0.28	-	-	-	-	-	-	-	-	-
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FLF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	1.60	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	24.91	-	4.61	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	0.40	-	-	-	-	-
	TIA			126.09		16.32		199.17		35.14		32.48		0.67		4.18
COMM	TGF	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	TGF	30%	-	-	-	-	-	-	-	-	0.01	-	0.12	-	0.08	-
	OGF	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA			-		-		-		-		0.00		0.36		-
HD	TGF	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	TGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	TGF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F	TFF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TFM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TFS	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OFF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OFM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
		% of total basin	SDS Basins													
			SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
Land Use	Soil Type	equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
	Wetland	0%	-		-		-		-		-		0.52		-	
	Lake		-		-		-		-		-		-		-	
	sasa-dp		0.03		0.04		-		-		-		-		-	
	Other		0.13		-		-		-		-		-		-	
Basin total:			40.12	126.09	1.39	16.32	144.31	199.17	34.64	35.14	32.08	32.48	8.12	1.03	28.28	4.18
PERLND areas:																
(16)	TF		-		-		-		-		-		-		-	
(26)	TG		40.12		1.39		144.31		34.64		6.77		2.99		28.28	
(45)	FL		-		-		-		-		-		-		-	
(34)	OF		-		-		-		-		-		-		-	
(44)	OG		-		-		-		-		25.31		4.61		-	
(54)	SA		-		-		-		-		-		0.52		-	
	subtotal:		40.12		1.39		144.31		34.64		32.08		8.12		28.28	
IMPLND areas:																
	EIA			126.09		16.32		199.17		35.14		32.48		1.03		4.18
Basin total:			166.21		17.71		343.49		69.78		64.56		9.15		32.46	
Percent Impervious				75.9%		92.2%		58.0%		50.4%		50.3%		11.3%		12.9%
			SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
NETWORK FACTORS																
PERLND 16	(TF)		-		-		-		-		-		-		-	
PERLND 26	(TG)		3.344		0.115		12.026		2.886		0.564		0.249		2.356	
PERLND 45	(FL)		-		-		-		-		-		-		-	
PERLND 34	(OF)		-		-		-		-		-		-		-	
PERLND 44	(OG)		-		-		-		-		2.109		0.384		-	
PERLND 54	(SA)		-		-		-		-		-		0.043		-	
IMPLND 14	(EIA)		10.507		1.360		16.598		2.928		2.707		0.086		0.348	
SUM			13.851		1.476		28.624		5.815		5.380		0.762		2.705	

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Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)											
		% of total basin equal to	SDS Basins						IWS Basins					
			SDS-6		SDS-7		SASA		NSPS		PRIMARY		SASA	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%	13.51	-	45.69	-	0.01	-	0.31	-	6.52	-	-	-
	TGM	0%	-	-	-	-	0.00	-	-	-	0.86	-	0.05	-
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-
	FLF	0%	-	-	5.48	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	3.93	-	-	-	-	-	6.15	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	0.00	-	0.04	-
	TIA			3.18		36.15		34.26		13.44		288.58		58.32
COMM	TGF	85%	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	85%	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	85%	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	85%	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	85%	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	TGF	30%	0.03	-	-	-	-	-	-	-	0.00	-	-	-
	OGF	30%	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	30%	-	-	-	-	-	-	-	-	0.00	-	-	-
	TIA			0.00		-		-		-		0.50		-
HD	TGF	30%	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	30%	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-
LD	TGF	13%	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	13%	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	13%	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	13%	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	13%	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	13%	-	-	-	-	-	-	-	-	-	-	-	-
OG	TGF	0%	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	0%	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-
F	TFF	0%	-	-	-	-	-	-	-	-	-	-	-	-
	TFM	0%	-	-	-	-	-	-	-	-	-	-	-	-
	TFS	0%	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-
	OFF	0%	-	-	-	-	-	-	-	-	-	-	-	-
	OFM	0%	-	-	-	-	-	-	-	-	-	-	-	-

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
		% of total basin	SDS Basins						IWS Basins							
			SDS-6		SDS-7		SASA		NSPS		PRIMARY		SASA			
Land Use	Soil Type	equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious		
	Wetland	0%	-		-		-		-		0.00		0.01			
	Lake		-		-		-		-		6.65		-			
	sasa-dp		-		-		-		-		-		-			
	Other		-		-		-		-		-		-			
Basin total:			13.54	3.18	55.10	36.15	0.01	34.26	0.31	13.44	13.53	289.08	0.11	58.32		
PERLND areas:															Total	Percent
(16)	TF		-		-		-		-		-		-		205.89	5.60%
(26)	TG		13.54		45.69		0.01		0.31		7.38		0.05		1008.80	27.42%
(45)	FL		-		5.48		-		-		-		-		5.48	0.15%
(34)	OF		-		-		-		-		-		-		254.91	6.93%
(44)	OG		-		3.93		-		-		6.15		0.04		662.40	18.01%
(54)	SA		-		-		-		-		0.00		0.01		64.63	1.76%
	subtotal:		13.54		55.10		0.01		0.31		13.53		0.11		2202.11	59.86%
IMPLND areas:																
	EIA			3.18		36.15		34.26		13.44		289.08		58.32	1476.77	40.14%
Basin total:			16.72		91.25		34.27		13.75		302.62		58.42		3678.88	100.00%
Percent Impervious				19.0%		39.6%		100.0%		97.8%		95.5%		99.8%		
			SDS-6		SDS-7		SASA		NSPS		PRIMARY		SASA		Total	Percent
NETWORK FACTORS																
PERLND 16	(TF)		-		-		-		-		-		-		17.16	5.60%
PERLND 26	(TG)		1.128		3.808		0.001		0.026		0.615		0.004		84.07	27.42%
PERLND 45	(FL)		-		0.457		-		-		-		-		0.46	0.15%
PERLND 34	(OF)		-		-		-		-		-		-		21.24	6.93%
PERLND 44	(OG)		-		0.327		-		-		0.512		0.004		55.20	18.01%
PERLND 54	(SA)		-		-		-		-		0.000		0.001		5.39	1.76%
IMPLND 14	(EIA)		0.265		3.013		2.855		1.120		24.090		4.860		123.06	40.14%
SUM			1.394		7.605		2.856		1.146		25.218		4.869		306.57	100.00%

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ATTACHMENT B

1998 Embankment Fill Calibration Data

HFAM INPUT DATA FILE

```
Index Number:        1001
Name:               Till at Seatac
melev      :        400.0
eldif      :          0.0
Lat. (deg min):        0   0

Linkages with Meteorologic Stations: Station - Mult. Factor

 PR:        101    1.000
 T :          0    0.000
 ET:        105    0.750
 W :          0    0.000
 SR:          0    0.000

PWATER PARAMETERS:

 cepsc  :   0.100     uzsn    :    0.800     lzsn    :    5.000
 infexp :   2.000     infilt  :    0.250     intfw   :    2.500
 agwrc  :  0.9000     irc     :   0.5000     deepfr  :   0.0700
 nsur   :  0.3500     lsur    :  300.000     slsur   :   0.1000
 basetp :  0.0000     lzetp   :   0.7000     agwetp  :   0.0000
 petmax :   40.00     petmin  :    35.00

No snow simulation
```

```
Index Number:        1002
Name:               Outwash at Seatac
melev      :        400.0
eldif      :          0.0
Lat. (deg min):        0   0

Linkages with Meteorologic Stations: Station - Mult. Factor

 PR:        101    1.000
 T :          0    0.000
 ET:        105    0.750
 W :          0    0.000
 SR:          0    0.000

PWATER PARAMETERS:

 cepsc  :   0.250     uzsn    :    0.900     lzsn    :    5.500
 infexp :   2.000     infilt  :    0.330     intfw   :    4.500
 agwrc  :  0.9960     irc     :   0.6600     deepfr  :   0.0600
 nsur   :  0.3500     lsur    :  300.000     slsur   :   0.1000
 basetp :  0.0000     lzetp   :   0.9000     agwetp  :   0.0000
 petmax :   40.00     petmin  :    35.00

No snow simulation
```

```
Index Number:        1003
Name:               Impevious at Seatac
melev      :        400.0
eldif      :          0.0
Lat. (deg min):        0   0

Linkages with Meteorologic Stations: Station - Mult. Factor

 PR:        101    1.000
 T :          0    0.000
 ET:        105    0.750
 W :          0    0.000
 SR:          0    0.000
```

PWATER PARAMETERS:

cepsc	:	0.100	uzsn	:	0.050	lzsn	:	0.040
infexp	:	2.000	infilt	:	0.005	intfw	:	1.000
agwrc	:	0.7000	irc	:	0.5000	deepfr	:	0.0000
nsur	:	0.3000	lsur	:	300.000	slsur	:	0.0200
basetp	:	0.0000	lzetp	:	0.7000	agwetp	:	0.0000
petmax	:	40.00	petmin	:	35.00			

No snow simulation

Index Number: 1004
Name: New Airport Fill-Sea
melev : 400.0
eldif : 0.0
Lat. (deg min): 0 0

Linkages with Meteorologic Stations: Station - Mult. Factor

PR:	101	1.000
T :	0	0.000
ET:	105	0.750
W :	0	0.000
SR:	0	0.000

PWATER PARAMETERS:

cepsc	:	0.150	uzsn	:	0.280	lzsn	:	7.500
infexp	:	2.000	infilt	:	0.020	intfw	:	6.000
agwrc	:	0.9000	irc	:	0.1500	deepfr	:	0.1000
nsur	:	0.2500	lsur	:	300.000	slsur	:	0.1500
basetp	:	0.0000	lzetp	:	0.7000	agwetp	:	0.0000
petmax	:	40.00	petmin	:	35.00			

No snow simulation

```
**** REACH:*******
 Index Number:     500
 Name:                    Millerreach
  Precip. station      Mult. Factor
          101                 1.00
  Evap. station        Mult. Factor
          105                 1.00
  3    No. of land segm contributing
     Segment       Area [acres]
     1001          1601.0
     1002          1480.0
     1003          1035.0
  0    No. of aquifer elements contributing
  1    No. of flow elements contributing
   Flow Element     Mult. Factor
          400             1.0
 Flags: (on=1,off=0)
     Historic Flow /  Real T. Flow /  External T.S.
             1              0               0
   STCOR[ft]  SURFAREA[ac] SEEPFACTR[1/hr]  KS[-]
      0.00         0.20         0.00        0.300
   BWIDTH[ft]    TWIDTH[ft]    HEIGHT[ft]   LENGTH[mi]
     15.00        30.00         5.00        5.000
    NCH [-]      NFP [-]      SO  [-]      SFP  [-]
    0.0800       0.1000       0.0500       0.1000
       0.10   {Initial flow [ cfs]}
**** REACH:*******
 Index Number:     400
 Name:             98embankment Pond
  Precip. station      Mult. Factor
          101                 1.00
  Evap. station        Mult. Factor
          105                 0.75
  1    No. of land segm contributing
     Segment       Area [acres]
     1004             19.4
  0    No. of aquifer elements contributing
  0    No. of flow elements contributing
 Flags: (on=1,off=0)
     Historic Flow /  Real T. Flow /  External T.S.
             1              0               0
   STCOR[ft]  SURFAREA[ac] SEEPFACTR[1/hr]  KS[-]
      0.00         0.58         0.00        0.500
   BWIDTH[ft]    TWIDTH[ft]    HEIGHT[ft]   LENGTH[mi]
     20.00        35.00         3.00        0.140
    NCH [-]      NFP [-]      SO  [-]      SFP  [-]
    0.0350       0.0500       0.0050       0.2000
       0.00   {Initial flow [ cfs]}
```


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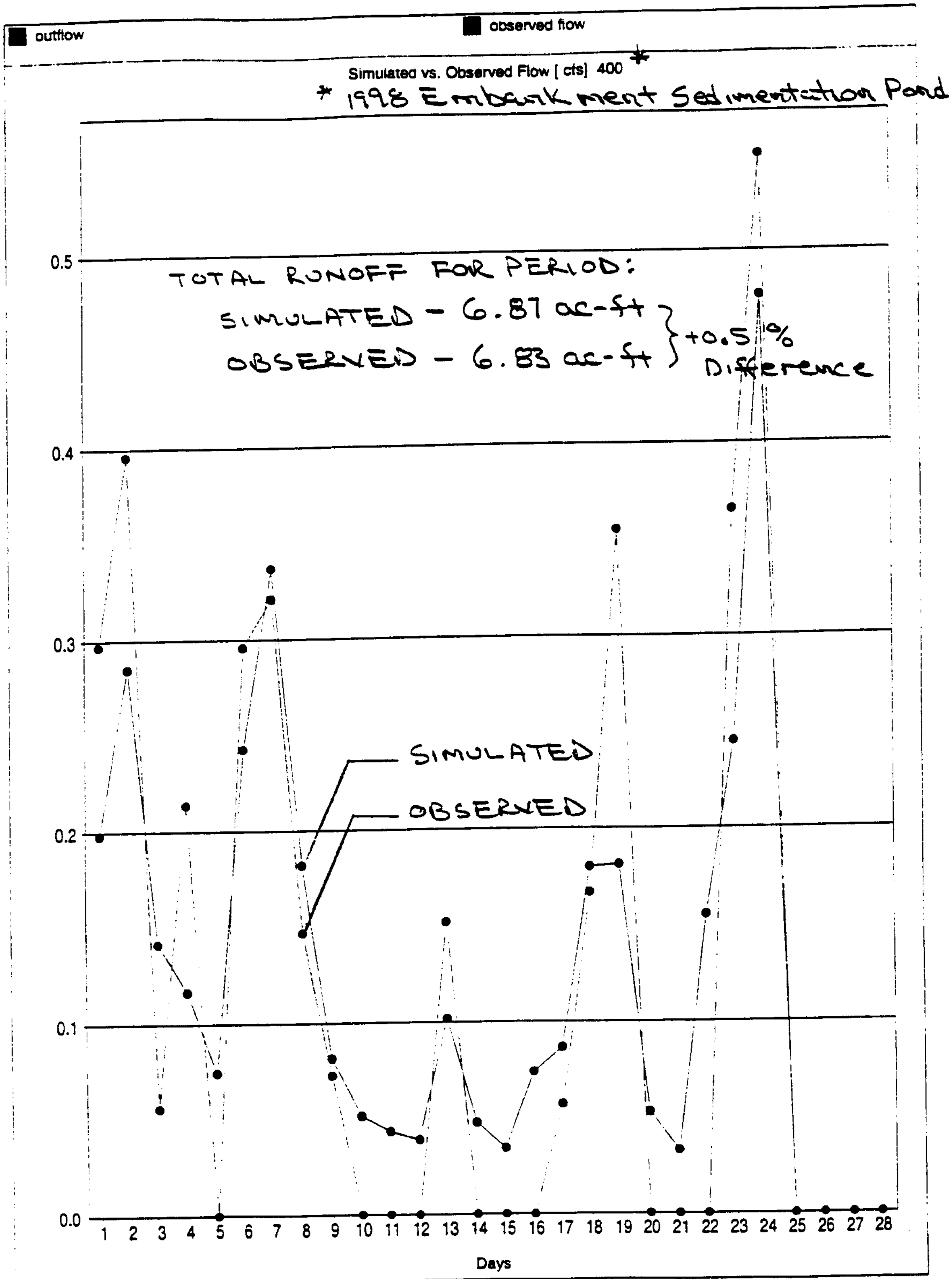
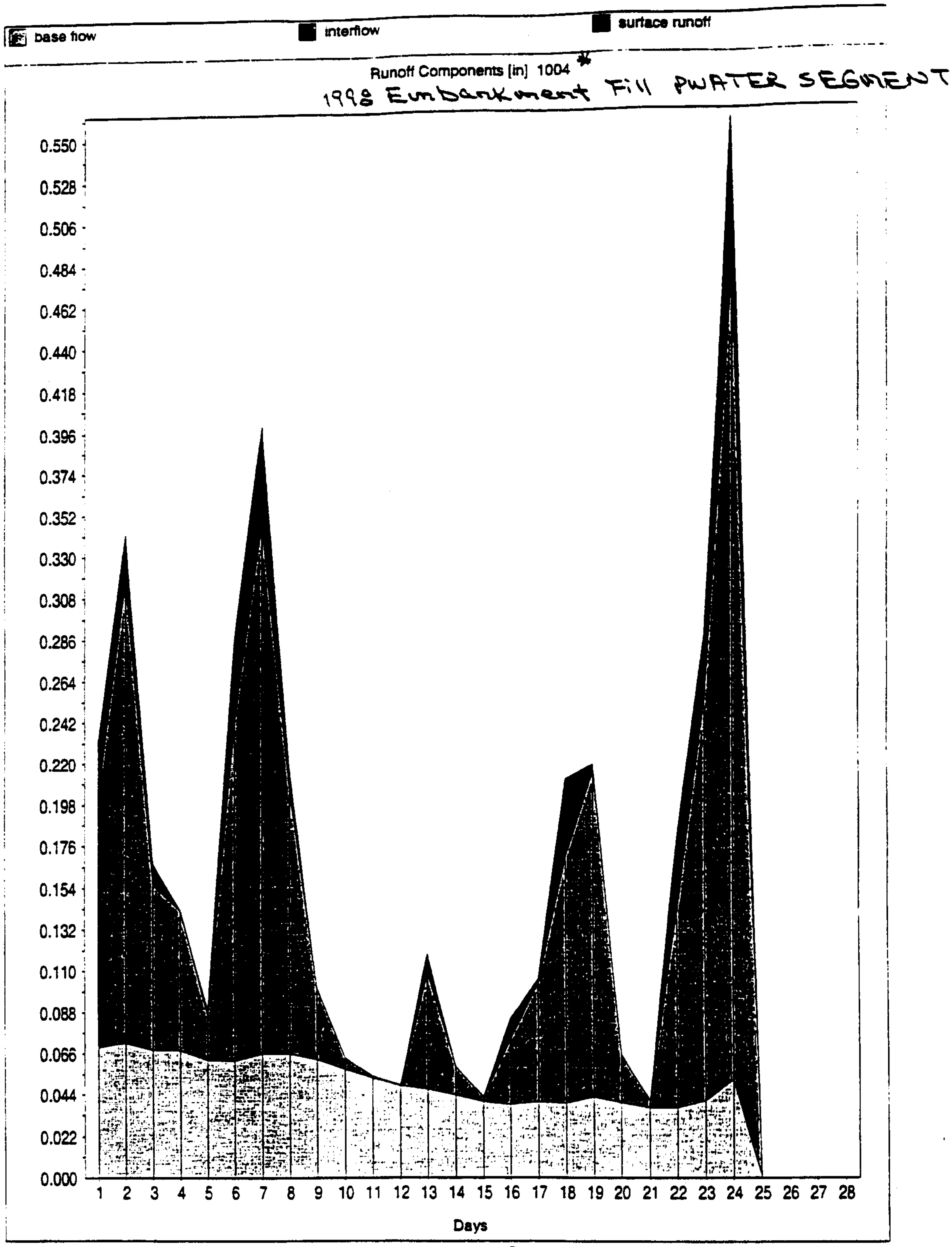


February 1999



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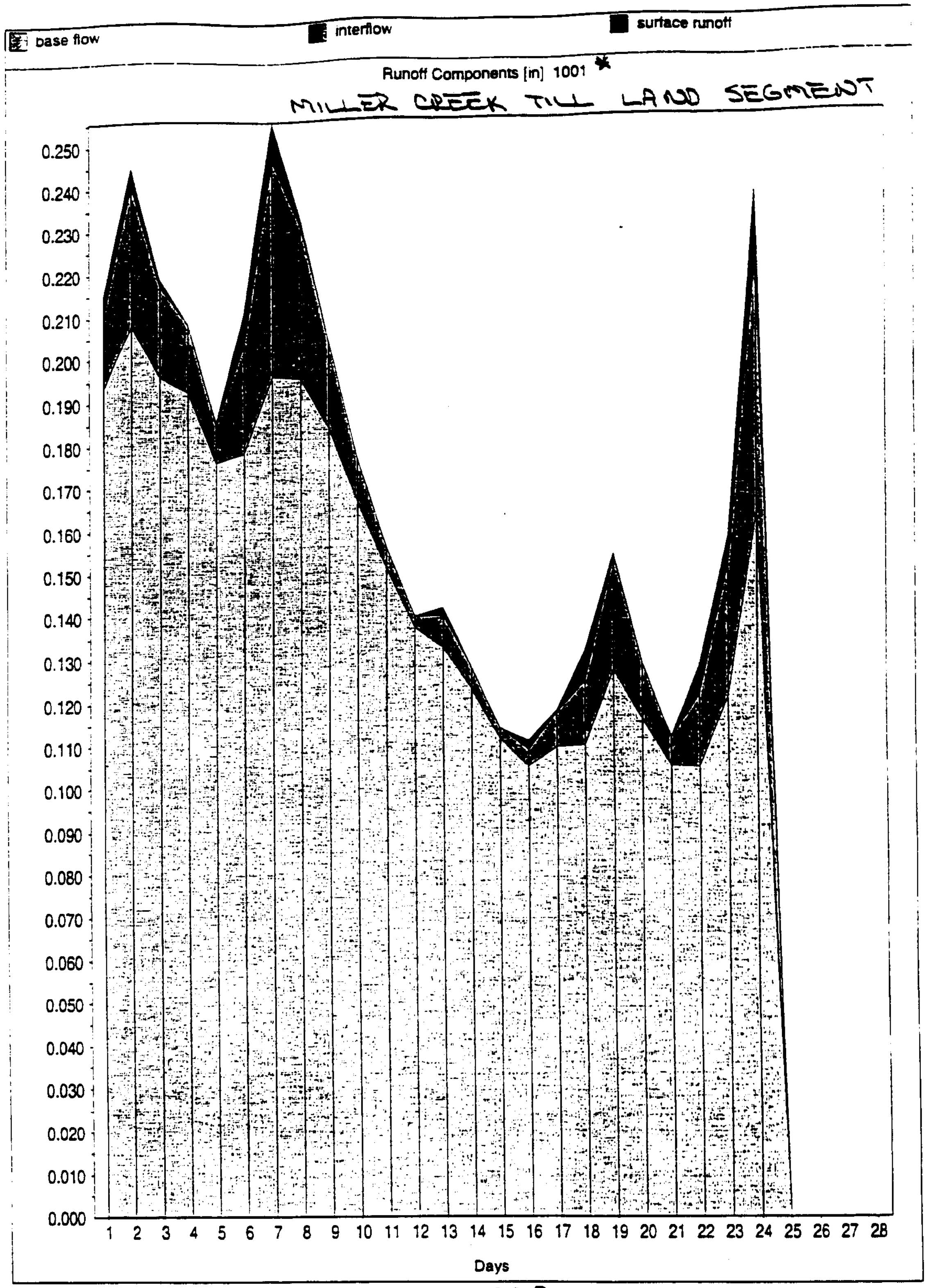

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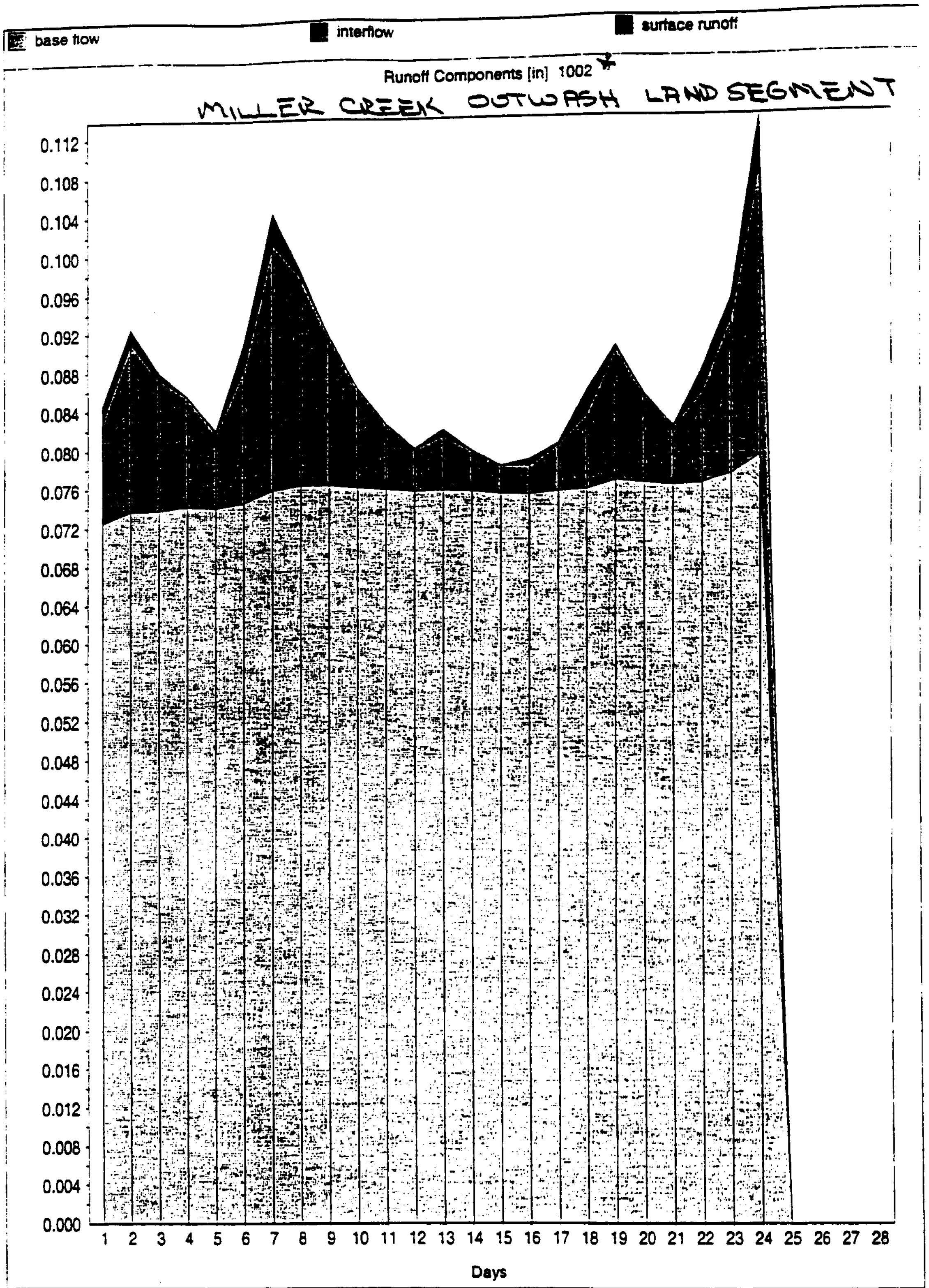

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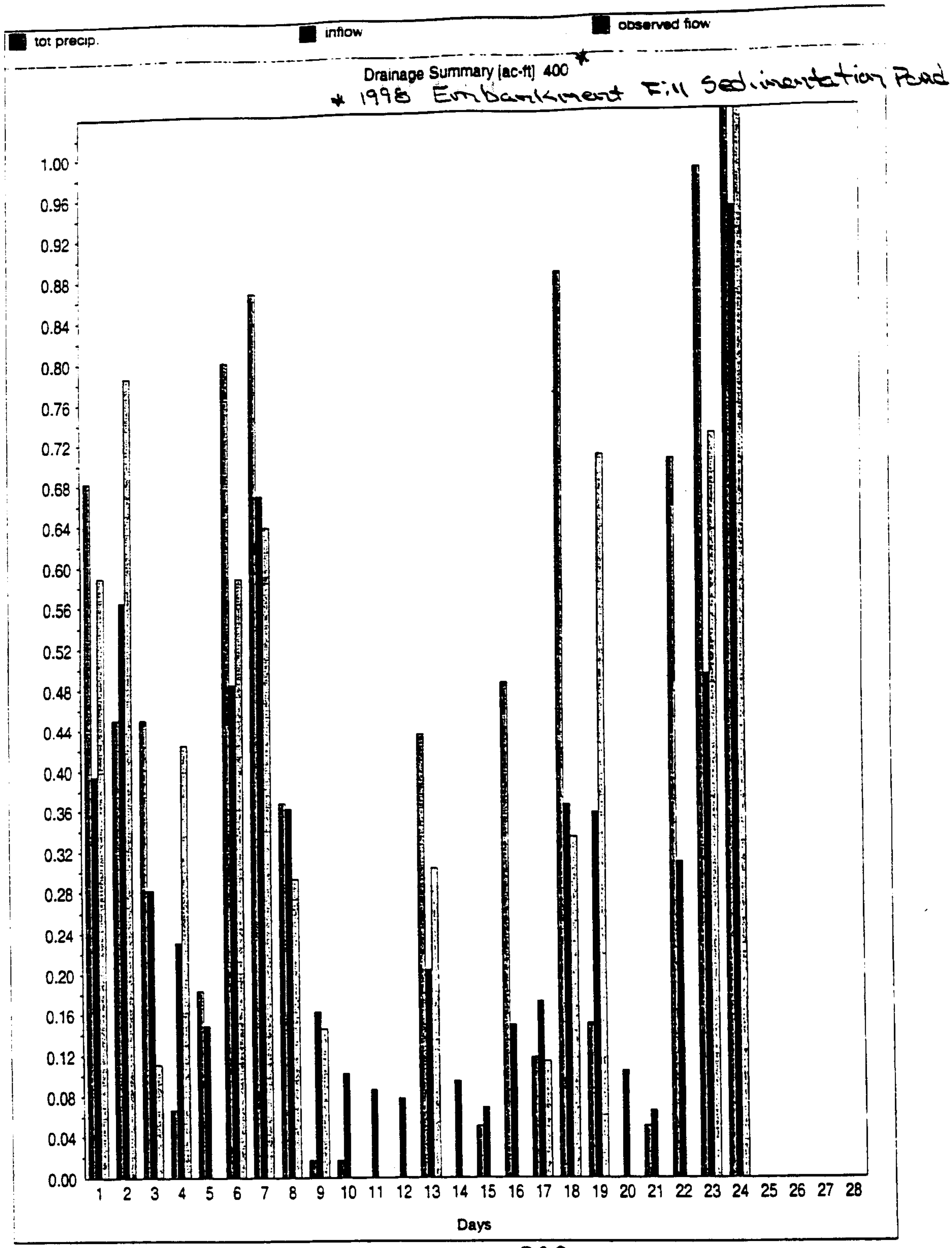

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ATTACHMENT C

HSPF and KCRTS Subbasin Detention Pond Performance Data and Additional Points of Compliance Performance Data

Miller Creek Watershed

Subbasin Detention Pond Performance Data:

- Cargo (SDN6)
- SDN3A
- SDS3/3X
- SDN4X/2X
- SDW1B
- SDN1
- SDW1A
- NEPL

Additional Points of Compliance Performance Data:

- SR509
- MCDF
- Lake Reba

Walker Creek Watershed

Subbasin Detention Pond Performance Data:

- SDW2 (South 12th Street)

Des Moines Creek Watershed

Subbasin Detention Pond Performance Data

- SDS3
- SDS3A
- SDS4
- SDS7
- SASA

Additional Points of Compliance Performance Data:

- SDS POC-1
- SDS POC-2
- SASA Inline Facility Analysis
- South 200th Street

MILLER CREEK WATERSHED
DETENTION POND PERFORMANCE DATA
(HSPF AND KCRTS BACKUP)

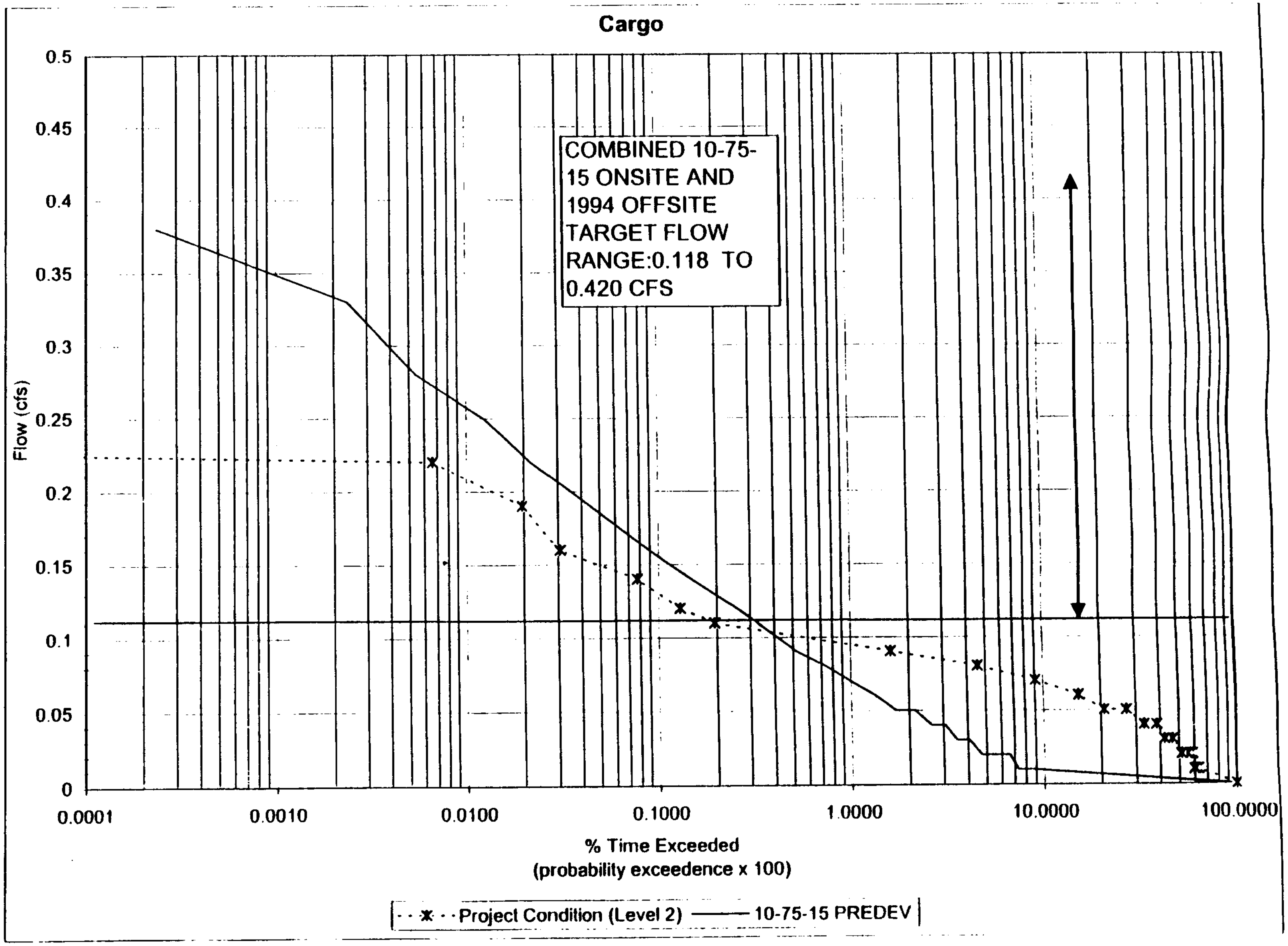
- CARGO (SDN6)
- SDN3A
- SDN3/3X
- SDN4X/2X
- SDW1B
- SDN1
- SDW1A
- NEPL

Computation of Basic statistics.

DATA-SET NUMBER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER OF DATA VALUES USED	NUMBER OF DATA VALUES UNUSED	
106	0.000	0.238	0.029	0.027	423142	578	CARGO - Flow
663	0.000	12.852	1.401	1.896	423311	409	- Stage
763	0.000	4.543	0.495	0.670	423691	29	- Volume
122	0.000	0.814	0.059	0.050	313685	110035	SDN3A pond - Flow
656	0.000	9.615	1.216	1.550	327579	96141	- Stage
756	0.000	14.771	1.727	2.224	318771	104949	- Volume
125	0.000	0.892	0.064	0.062	423720	0	SDN3A Flow at POC
111	0.000	0.080	0.021	0.013	423720	0	SD3A vault - Flow
650	0.000	10.873	2.349	2.102	423720	0	- Stage
750	0.000	6.990	1.510	1.351	423720	0	- Volume
103	0.000	1.572	0.138	0.157	413313	10407	SDN3/3X - Flow
664	0.000	19.581	1.355	2.285	405405	18315	- Stage
764	0.000	25.218	1.708	2.922	414066	9654	- Volume
139	0.000	1.259	0.088	0.106	411497	12223	SDN4X/2X - Flow
666	0.000	18.203	1.072	1.904	399238	24482	- Stage
766	0.000	14.365	0.820	1.486	412123	11597	- Volume
121	0.000	0.000	0.000	0.000	0	423720	SDW1B inf. tank - Storm flow
120	0.000	0.185	0.047	0.058	319351	104369	- Infiltrat.
655	0.000	2.607	0.635	0.821	335867	87853	- Stage
755	0.000	0.037	0.008	0.011	378385	45335	- Volume
211	0.000	0.627	0.187	0.153	333715	90005	SDW1B pond - Flow
651	0.000	11.708	1.819	2.137	333714	90006	- Stage
751	0.000	53.625	5.362	7.632	333714	90006	- Volume
7001	0.000	0.627	0.187	0.153	333715	90005	SDW1B Flow at POC
102	0.000	0.857	0.049	0.060	422660	1060	SDN1 - Flow
601	0.000	10.983	0.723	1.134	422786	934	- Stage
602	0.000	5.547	0.365	0.572	423691	29	- Volume
107	0.000	0.000	0.000	0.000	0	423720	SDW1A inf. tank - Storm flow
108	0.000	0.297	0.141	0.124	313896	109824	- Infiltrat.
652	0.000	2.739	1.247	1.140	328783	94937	- Stage
752	0.000	0.038	0.015	0.016	375222	48498	- Volume
1090	0.000	0.000	0.000	0.000	0	423720	SDW1A vault - Emergency flow
109	0.000	0.147	0.113	0.054	185231	238489	- Infiltrat.
657	0.000	10.737	1.171	1.639	190073	233647	- Stage
757	0.000	7.394	0.478	0.955	320320	103400	- Volume
112	0.000	0.601	0.006	0.010	263051	160669	SDW1A pond - Storm flow
1120	0.000	0.150	0.088	0.071	263048	160672	- Pumping to infilt.
654	0.000	11.088	1.499	2.280	275272	148448	- Stage
754	0.000	25.504	2.416	4.204	275338	148382	- Volume
7000	0.000	0.601	0.006	0.010	263051	160669	SDW1A Flow at POC
105	0.000	0.289	0.021	0.019	423720	0	NEPL exist. vault - Flow
662	0.000	16.188	2.094	2.481	423720	0	- Stage
762	0.000	3.628	0.469	0.556	423720	0	- Volume
119	0.000	1.709	0.100	0.108	423691	29	NEPL new vault - Flow
667	0.000	18.648	1.507	2.270	423405	315	- Stage

DATA-SET NUMBER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER OF DATA VALUES USED	UNUSED	
767	0.000	13.871	1.120	1.688	423720	0	- Volume
210	0.000	32.717	0.211	0.708	349087	74633	SDW1B Flow splitter - Total inflow
110	0.001	23.019	0.787	1.178	74381	349339	- Outflow to Pond D
115	0.000	0.189	0.049	0.061	302483	121237	- Outflow to Infiltr.
399	0.000	10.112	0.501	0.575	423719	1	Lake Reba Flow at POC
114	0.044	64.300	2.503	4.335	423719	1	MCRDF Flow at POC
118	0.376	76.927	4.048	5.146	423720	0	SR-509 Flow at POC

CARGO (SDN6)



Cargo
COMBINED 10-75-15 ONSITE AND 1994 OFFSITE TARGET FLOW RANGE:0.118 TO 0.420 CFS
Flow (cfs)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
100.0000
% Time Exceeded
(probability exceedence x 100)
Project Condition (Level 2)
10-75-15 PREDEV

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III
distributions are for preliminary computations.
User is responsible for assessment and
interpretation.

HOURLY FLOW CARGO (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.235	0.402	0.264	0.189	0.192
0.221	0.216	0.228	0.254	0.233
0.193	0.211	0.213	0.212	0.218
0.219	0.205	0.201	0.306	0.356
0.182	0.205	0.199	0.314	0.172
0.252	0.279	0.174	0.220	0.343
0.354	0.269	0.267	0.360	0.272
0.231	0.186	0.248	0.360	0.186
0.259	0.375	0.346	0.215	0.172
0.175	0.212	0.306		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.618
Variance (logs)	0.011
Standard Deviation (logs)	0.103
Skewness (logs)	0.562
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.200
Coefficient of Variation (logs)	-0.167

1

HOURLY FLOW CARGO (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.153
0.9500	1.05	0.170
0.9000	1.11	0.181
0.8000	1.25	0.196
0.5000	2.00	0.236
0.2000	5.00	0.292
0.1000	10.00	0.330
0.0400	25.00	0.381
0.0200	50.00	0.420
0.0100	100.00	0.461
0.0050	200.00	0.503

$\frac{1}{2}Q_2 = 0.118$
$Q_{50} = 0.420$

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III
distributions are for preliminary computations.
User is responsible for assessment and
interpretation.

HOURLY FLOW CARGO (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.084	0.105	0.238	0.075	0.111
0.092	0.081	0.185	0.091	0.093
0.092	0.104	0.102	0.075	0.098
0.107	0.105	0.094	0.102	0.089
0.090	0.098	0.092	0.177	0.105
0.098	0.088	0.088	0.071	0.094
0.069	0.160	0.088	0.106	0.093
0.078	0.076	0.093	0.104	0.084
0.080	0.106	0.124	0.093	0.071
0.071	0.102	0.221		

The following 7 statistics are based on non-zero values.

Mean (logs)	-1.006
Variance (logs)	0.014
Standard Deviation (logs)	0.118
Skewness (logs)	1.689
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.099
Coefficient of Variation (logs)	-0.117

1

HOURLY FLOW CARGO (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.072
0.9500	1.05	0.074
0.9000	1.11	0.076
0.8000	1.25	0.079
0.5000	2.00	0.092
0.2000	5.00	0.118
0.1000	10.00	0.141
0.0400	25.00	0.178
0.0200	50.00	0.212
0.0100	100.00	0.251
0.0050	200.00	0.297

$1/2 Q_2 = 0.046$
$Q_{50} = 0.212$

1

Simulated - HOURLY FLOW CARGO (PREDEV)
Observed - HOURLY FLOW CARGO (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	156588	0.002	*	0.004	*	-0.002	*
0.01	4405	0.010	100.0	0.011	104.7	-0.010	-91.2
0.01	7907	0.012	99.1	0.012	102.6	-0.011	-91.0
0.01	6794	0.014	99.0	0.014	102.6	-0.013	-91.3
0.02	6063	0.016	98.8	0.016	102.6	-0.014	-90.0
0.02	7826	0.018	98.1	0.019	100.6	-0.017	-90.9
0.02	15235	0.021	97.6	0.022	101.2	-0.019	-89.2
0.02	21873	0.024	96.6	0.025	100.1	-0.022	-88.8
0.03	18154	0.028	95.3	0.028	97.6	-0.026	-89.3
0.03	15553	0.031	94.6	0.032	97.2	-0.029	-88.8
0.04	23140	0.035	93.5	0.036	95.9	-0.033	-88.4
0.04	26061	0.040	92.6	0.041	94.9	-0.038	-88.0
0.05	25962	0.045	91.5	0.046	93.6	-0.043	-87.9
0.05	23067	0.051	90.4	0.053	92.6	-0.049	-87.0
0.06	26449	0.059	89.1	0.060	91.3	-0.057	-86.1
0.07	19335	0.066	87.3	0.068	89.5	-0.064	-84.7
0.08	12506	0.073	85.3	0.075	87.6	-0.071	-82.6
0.09	5975	0.081	81.3	0.084	84.1	-0.078	-78.0
0.11	276	0.083	73.9	0.086	76.4	-0.077	-68.6
0.12	222	0.090	69.2	0.093	71.9	-0.086	-66.7
0.14	199	0.105	70.5	0.109	73.0	-0.099	-66.2
0.16	47	0.100	58.5	0.103	60.7	-0.089	-52.1
0.19	55	0.110	53.8	0.118	57.3	-0.106	-52.0
0.22	28	0.119	52.2	0.127	55.8	-0.118	-51.9
0.25	0	0.000	0.0	0.000	0.0	0.000	0.0
0.28	0	0.000	0.0	0.000	0.0	0.000	0.0
0.33	0	0.000	0.0	0.000	0.0	0.000	0.0
0.38	0	0.000	0.0	0.000	0.0	0.000	0.0
0.43	0	0.000	0.0	0.000	0.0	0.000	0.0
0.50	0	0.000	0.0	0.000	0.0	0.000	0.0
0.57	0	0.000	0.0	0.000	0.0	0.000	0.0
0.66	0	0.000	0.0	0.000	0.0	0.000	0.0
0.76	0	0.000	0.0	0.000	0.0	0.000	0.0
0.87	0	0.000	0.0	0.000	0.0	0.000	0.0
1.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.026	*	0.036	*	-0.025	*

Standard error of estimate = 0.03
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW CARGO (PREDEV)
Observed - HOURLY FLOW CARGO (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

Limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	*****	*****	91.35	36.96	100.00	100.00	0.00	0.00
0.01	2160	4405	0.51	1.04	8.65	63.04	0.01	0.01
0.01	3661	7907	0.86	1.87	8.14	62.00	0.01	0.01
0.01	2876	6794	0.68	1.60	7.28	60.14	0.01	0.01
0.02	2456	6063	0.58	1.43	6.60	58.54	0.02	0.02
0.02	3045	7826	0.72	1.85	6.02	57.10	0.02	0.02
0.02	2500	15235	0.59	3.60	5.30	55.26	0.02	0.02
0.02	2785	21873	0.66	5.16	4.71	51.66	0.02	0.02
0.03	2309	18154	0.54	4.28	4.05	46.50	0.03	0.03
0.03	1857	15553	0.44	3.67	3.51	42.22	0.03	0.03
0.04	1983	23140	0.47	5.46	3.07	38.54	0.04	0.04
0.04	1961	26061	0.46	6.15	2.60	33.08	0.04	0.04
0.05	1834	25962	0.43	6.13	2.14	26.93	0.05	0.05
0.05	1602	23067	0.38	5.44	1.70	20.81	0.06	0.06
0.06	1429	26449	0.34	6.24	1.33	15.36	0.07	0.07
0.07	1051	19335	0.25	4.56	0.99	9.12	0.08	0.08
0.08	938	12506	0.22	2.95	0.74	4.56	0.09	0.09
0.09	813	5975	0.19	1.41	0.52	1.61	0.10	0.10
0.11	311	276	0.07	0.07	0.33	0.20	0.11	0.11
0.12	453	222	0.11	0.05	0.25	0.13	0.13	0.13
0.14	249	199	0.06	0.05	0.15	0.08	0.15	0.15
0.16	188	47	0.04	0.01	0.09	0.03	0.17	0.17
0.19	97	55	0.02	0.01	0.04	0.02	0.20	0.20
0.22	40	28	0.01	0.01	0.02	0.01	0.23	0.23
0.25	29	0	0.01	0.00	0.01	0.00	0.27	0.00
0.28	13	0	0.00	0.00	0.01	0.00	0.31	0.00
0.33	9	0	0.00	0.00	0.00	0.00	0.35	0.00
0.38	1	0	0.00	0.00	0.00	0.00	0.40	0.00
0.43	0	0	0.00	0.00	0.00	0.00	0.00	0.00
0.50	0	0	0.00	0.00	0.00	0.00	0.00	0.00
0.57	0	0	0.00	0.00	0.00	0.00	0.00	0.00
0.66	0	0	0.00	0.00	0.00	0.00	0.00	0.00
0.76	0	0	0.00	0.00	0.00	0.00	0.00	0.00
0.87	0	0	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720	423720	100.00	100.00			0.00	0.03

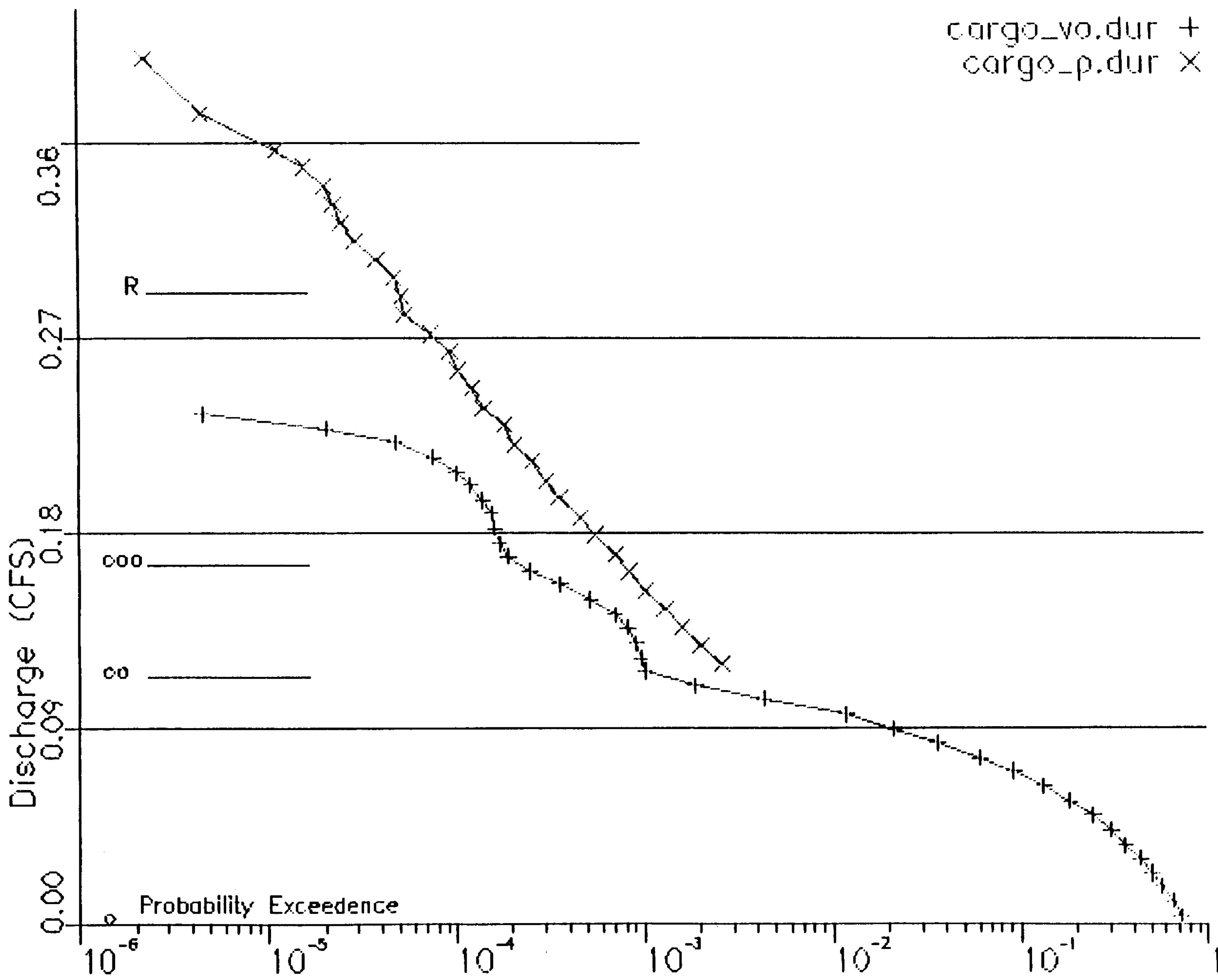
578 Observed values are zero
73111 Simulated values are zero
578 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
72533 Observed values are not zero when simulated are

Simulated - HOURLY FLOW CARGO (PREDEV)
Observed - HOURLY FLOW CARGO (2006)

Lower class limit	Number of occurrences between indicated deviations	-60%	-30%	-10%	0%	10%	30%	60%
0.00	154615	340	156	73	67	105	1232	0
0.01	4231	46	20	3	4	15	86	0
0.01	7552	96	42	15	11	22	169	0
0.01	6501	80	24	15	15	22	137	0
0.02	5750	99	29	16	7	23	139	0
0.02	7447	92	49	15	15	30	178	0
0.02	14324	260	87	45	46	74	399	0
0.02	20472	406	175	57	80	129	554	0
0.03	16929	394	176	64	59	105	427	0

0.03	14470	368	158	66	60	87	344	0
0.04	21401	654	252	105	99	160	469	0
0.04	23970	815	315	131	116	186	528	0
0.05	23782	920	386	152	104	159	459	0
0.05	21052	893	337	126	120	156	383	0
0.06	24022	1137	387	154	134	203	412	0
0.07	17375	993	323	107	103	157	277	0
0.08	11119	725	242	79	63	93	185	0
0.09	5094	492	150	56	27	48	108	0
0.11	229	21	6	1	3	7	9	0
0.12	149	58	4	3	0	4	4	0
0.14	139	46	3	2	0	4	5	0
0.16	21	20	3	0	0	0	3	0
0.19	22	25	3	3	0	2	0	0
0.22	9	15	2	1	1	0	0	0
0.25	0	0	0	0	0	0	0	0
0.28	0	0	0	0	0	0	0	0
0.33	0	0	0	0	0	0	0	0
0.38	0	0	0	0	0	0	0	0
0.43	0	0	0	0	0	0	0	0
0.50	0	0	0	0	0	0	0	0
0.57	0	0	0	0	0	0	0	0
0.66	0	0	0	0	0	0	0	0
0.76	0	0	0	0	0	0	0	0
0.87	0	0	0	0	0	0	0	0
1.00	0	0	0	0	0	0	0	0

	400675	8995	3329	1289	1134	1791	6507	0



cargo_vo.dur +
cargo_p.dur ×
Discharge (CFS)
0.00
0.09
0.18
0.27
0.36
R
coo
co
Probability Exceedence
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1

AR 046589

CARGO VAULT

Retention/Detention Facility

Type of Facility:	Detention Vault
Facility Length:	140.00 ft
Facility Width:	110.00 ft
Facility Area:	15400. sq. ft
Effective Storage Depth:	14.00 ft
Stage 0 Elevation:	0.00 ft
Storage Volume:	215600. cu. ft
Riser Head:	14.00 ft
Riser Diameter:	24.00 inches
Number of orifices:	3

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.13	0.128	
2	10.80	1.25	0.076	4.0
3	12.00	1.50	0.086	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.01	0.01	154.	0.004	0.004	0.00
0.02	0.02	308.	0.007	0.005	0.00
0.04	0.04	616.	0.014	0.006	0.00
0.05	0.05	770.	0.018	0.007	0.00
0.06	0.06	924.	0.021	0.008	0.00
0.07	0.07	1078.	0.025	0.009	0.00
0.08	0.08	1232.	0.028	0.010	0.00
0.09	0.09	1386.	0.032	0.011	0.00
0.37	0.37	5698.	0.131	0.021	0.00
0.64	0.64	9856.	0.226	0.028	0.00
0.92	0.92	14168.	0.325	0.033	0.00
1.19	1.19	18326.	0.421	0.037	0.00
1.47	1.47	22638.	0.520	0.042	0.00
1.74	1.74	26796.	0.615	0.045	0.00
2.02	2.02	31108.	0.714	0.049	0.00
2.29	2.29	35266.	0.810	0.052	0.00
2.56	2.56	39424.	0.905	0.055	0.00
2.84	2.84	43736.	1.004	0.058	0.00
3.11	3.11	47894.	1.099	0.061	0.00
3.39	3.39	52206.	1.198	0.063	0.00
3.66	3.66	56364.	1.294	0.066	0.00
3.94	3.94	60676.	1.393	0.068	0.00
4.21	4.21	64834.	1.488	0.070	0.00
4.49	4.49	69146.	1.587	0.073	0.00
4.76	4.76	73304.	1.683	0.075	0.00
5.03	5.03	77462.	1.778	0.077	0.00
5.31	5.31	81774.	1.877	0.079	0.00
5.58	5.58	85932.	1.973	0.081	0.00
5.86	5.86	90244.	2.072	0.083	0.00
6.13	6.13	94402.	2.167	0.085	0.00
6.41	6.41	98714.	2.266	0.087	0.00

CARGO VAULT

6.68	6.68	102872.	2.362	0.089	0.00
6.96	6.96	107184.	2.461	0.091	0.00
7.23	7.23	111342.	2.556	0.092	0.00
7.51	7.51	115654.	2.655	0.094	0.00
7.78	7.78	119812.	2.751	0.096	0.00
8.05	8.05	123970.	2.846	0.097	0.00
8.33	8.33	128282.	2.945	0.099	0.00
8.60	8.60	132440.	3.040	0.101	0.00
8.88	8.88	136752.	3.139	0.102	0.00
9.15	9.15	140910.	3.235	0.104	0.00
9.43	9.43	145222.	3.334	0.105	0.00
9.70	9.70	149380.	3.429	0.107	0.00
9.98	9.98	153692.	3.528	0.108	0.00
10.25	10.25	157850.	3.624	0.110	0.00
10.53	10.53	162162.	3.723	0.111	0.00
10.80	10.80	166320.	3.818	0.113	0.00
10.81	10.81	166474.	3.822	0.113	0.00
10.83	10.83	166782.	3.829	0.114	0.00
10.84	10.84	166936.	3.832	0.116	0.00
10.85	10.85	167090.	3.836	0.118	0.00
10.87	10.87	167398.	3.843	0.121	0.00
10.88	10.88	167552.	3.846	0.125	0.00
10.89	10.89	167706.	3.850	0.126	0.00
10.90	10.90	167860.	3.854	0.127	0.00
10.92	10.92	168168.	3.861	0.128	0.00
11.19	11.19	172326.	3.956	0.141	0.00
11.47	11.47	176638.	4.055	0.151	0.00
11.74	11.74	180796.	4.151	0.159	0.00
12.00	12.00	184800.	4.242	0.165	0.00
12.02	12.02	185108.	4.249	0.166	0.00
12.03	12.03	185262.	4.253	0.168	0.00
12.05	12.05	185570.	4.260	0.171	0.00
12.06	12.06	185724.	4.264	0.174	0.00
12.08	12.08	186032.	4.271	0.179	0.00
12.09	12.09	186186.	4.274	0.184	0.00
12.11	12.11	186494.	4.281	0.188	0.00
12.13	12.13	186802.	4.288	0.190	0.00
12.40	12.40	190960.	4.384	0.213	0.00
12.67	12.67	195118.	4.479	0.230	0.00
12.95	12.95	199430.	4.578	0.245	0.00
13.22	13.22	203588.	4.674	0.258	0.00
13.50	13.50	207900.	4.773	0.270	0.00
13.77	13.77	212058.	4.868	0.282	0.00
14.00	14.00	215600.	4.949	0.291	0.00
14.10	14.10	217140.	4.985	0.910	0.00
14.20	14.20	218680.	5.020	2.040	0.00
14.30	14.30	220220.	5.056	3.500	0.00
14.40	14.40	221760.	5.091	5.230	0.00
14.50	14.50	223300.	5.126	7.200	0.00
14.60	14.60	224840.	5.162	9.360	0.00
14.70	14.70	226380.	5.197	11.720	0.00
14.80	14.80	227920.	5.232	13.850	0.00
14.90	14.90	229460.	5.268	14.670	0.00
15.00	15.00	231000.	5.303	15.450	0.00
15.10	15.10	232540.	5.338	16.200	0.00
15.20	15.20	234080.	5.374	16.900	0.00
15.30	15.30	235620.	5.409	17.580	0.00

CARGO VAULT

15.40	15.40	237160.	5.444	18.240	0.00
15.50	15.50	238700.	5.480	18.870	0.00
15.60	15.60	240240.	5.515	19.480	0.00
15.70	15.70	241780.	5.551	20.070	0.00
15.80	15.80	243320.	5.586	20.650	0.00

CARGO VAULT

```
Route Time Series through Facility
  Inflow Time Series File:cargo_d.tsf
 Outflow Time Series File:cargo_vo

Inflow/Outflow Analysis
   Peak Inflow Discharge:         3.60 CFS at  0:00 on Oct 26 in 1986
  Peak Outflow Discharge:        0.236 CFS at 12:00 on Jan  2 in 1997
    Peak Reservoir Stage:        12.78  Ft
     Peak Reservoir Elev:        12.78  Ft
  Peak Reservoir Storage:    196834.    Cu-Ft
                        :         4.519 Ac-Ft
```

CARGO VAULT

Flow Frequency Analysis
Time Series File:cargo_p.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.615 StdDev= 0.103
Skew= 0.476

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			0.455		100.00	0.990
Computed Peaks			0.417		50.00	0.980
Computed Peaks			0.380		25.00	0.960
Computed Peaks			0.331		10.00	0.900
Computed Peaks			0.321		8.00	0.875
Computed Peaks			0.294		5.00	0.800
Computed Peaks			0.238		2.00	0.500
Computed Peaks			0.202		1.30	0.231

Flow Frequency Analysis
Time Series File:cargo_vo.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -1.114 StdDev= 0.105
Skew= 1.159

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks (CFS)	- - (ft)	Rank	Return Period	Prob
Computed Peaks			0.264	13.35		100.00	0.990
Computed Peaks			0.220	12.52		50.00	0.980
Computed Peaks			0.184	12.09		25.00	0.960
Computed Peaks			0.144	11.28		10.00	0.900
Computed Peaks			0.137	11.12		8.00	0.875
Computed Peaks			0.119	10.86		5.00	0.800
Computed Peaks			0.092	7.10		2.00	0.500
Computed Peaks			0.080	5.41		1.30	0.231

CARGO VAULT

Duration Comparison Anaylsis
Base File: cargo_p.tsf
New File: cargo_vo.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.120	0.25E-02	0.99E-03	-61.0	0.25E-02	0.120	0.107	-10.5
0.129	0.20E-02	0.92E-03	-53.2	0.20E-02	0.129	0.109	-15.6
0.138	0.15E-02	0.79E-03	-48.4	0.15E-02	0.138	0.111	-19.9
0.147	0.12E-02	0.59E-03	-52.6	0.12E-02	0.147	0.112	-23.9
0.156	0.95E-03	0.35E-03	-63.1	0.95E-03	0.156	0.127	-18.6
0.165	0.79E-03	0.21E-03	-74.1	0.79E-03	0.165	0.138	-16.8
0.175	0.63E-03	0.17E-03	-72.3	0.63E-03	0.175	0.146	-16.3
0.184	0.51E-03	0.16E-03	-68.2	0.51E-03	0.184	0.149	-18.7
0.193	0.40E-03	0.15E-03	-63.1	0.40E-03	0.193	0.153	-20.5
0.202	0.32E-03	0.12E-03	-61.2	0.32E-03	0.202	0.158	-21.6
0.211	0.26E-03	0.96E-04	-63.8	0.26E-03	0.211	0.161	-23.6
0.220	0.21E-03	0.55E-04	-74.2	0.21E-03	0.220	0.164	-25.3
0.229	0.18E-03	0.21E-04	-88.9	0.18E-03	0.229	0.172	-25.1
0.238	0.14E-03	0.00E+00	-100.0	0.14E-03	0.238	0.194	-18.5
0.248	0.13E-03	0.00E+00	-100.0	0.13E-03	0.248	0.201	-18.7
0.257	0.11E-03	0.00E+00	-100.0	0.11E-03	0.257	0.208	-19.1
0.266	0.89E-04	0.00E+00	-100.0	0.89E-04	0.266	0.213	-19.7
0.275	0.71E-04	0.00E+00	-100.0	0.71E-04	0.275	0.216	-21.5
0.284	0.53E-04	0.00E+00	-100.0	0.53E-04	0.284	0.220	-22.4
0.293	0.50E-04	0.00E+00	-100.0	0.50E-04	0.293	0.221	-24.8
0.302	0.46E-04	0.00E+00	-100.0	0.46E-04	0.302	0.222	-26.6
0.311	0.37E-04	0.00E+00	-100.0	0.37E-04	0.311	0.224	-28.2
0.321	0.27E-04	0.00E+00	-100.0	0.27E-04	0.321	0.226	-29.4
0.330	0.23E-04	0.00E+00	-100.0	0.23E-04	0.330	0.228	-31.0
0.339	0.21E-04	0.00E+00	-100.0	0.21E-04	0.339	0.229	-32.3
0.348	0.16E-04	0.00E+00	-100.0	0.16E-04	0.348	0.231	-33.6
0.357	0.11E-04	0.00E+00	-100.0	0.11E-04	0.357	0.232	-35.0
0.366	0.46E-05	0.00E+00	-100.0	0.46E-05	0.366	0.234	-36.0
0.375	0.23E-05	0.00E+00	-100.0	0.23E-05	0.375	0.236	-37.2
0.384	0.23E-05	0.00E+00	-100.0	0.23E-05	0.384	0.236	-38.7
0.394	0.23E-05	0.00E+00	-100.0	0.23E-05	0.394	0.236	-40.1

There is no positive excursion

Maximum negative excursion = 0.165 cfs (-41.3%)
occuring at 0.401 cfs on the Base Data:cargo_p.tsf
and at 0.236 cfs on the New Data:cargo_vo.tsf

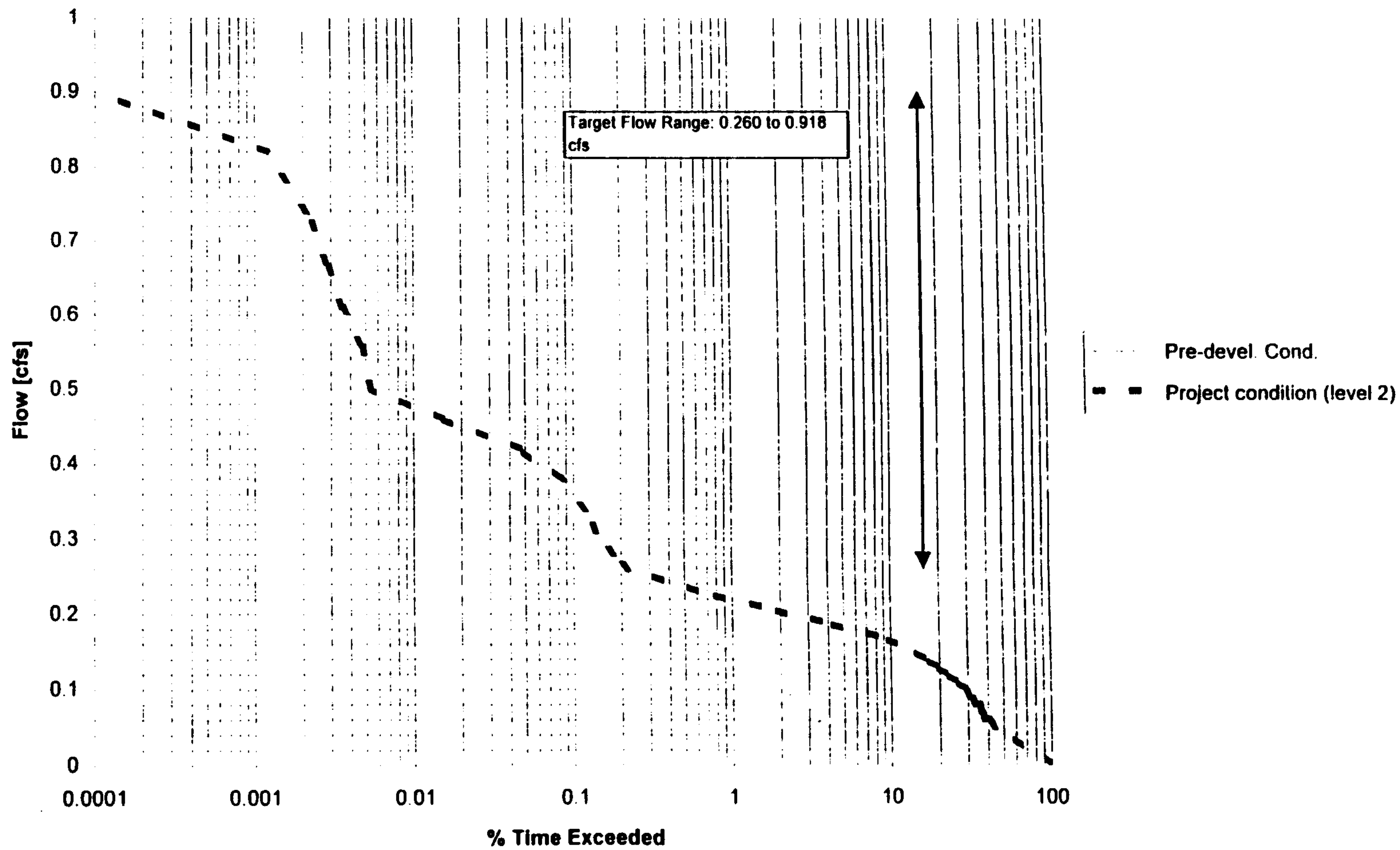
CARGO VAULT

```
+-Land Use Summary--------------------------------------------------+
|Till Forest              6.09 acres                                |
|Till Pasture             0.00 acres                                |
|Till Grass               1.22 acres                                |
|Airport Fill             0.00 acres                                |
|Outwash Forest           0.00 acres                                |
|Outwash Pasture          0.00 acres                                |
|Outwash Grass            0.00 acres                                |
|Wetland                  0.00 acres                                |
|Impervious               0.81 acres                                |
|-------------------------------------------------------------------|
|          Total Area :   8.12 acres                                |
|        Scale Factor :   1.00      Hourly      Historic            |
|-------------------------------------------------------------------|
|                                                                   |
|    Time Series: cargo_p                                           |
|-------------------------------------------------------------------|
|                       Compute Time Series                         |
|                        Modify User Input                          |
+-------------------------------------------------------------------+

+-Land Use Summary--------------------------------------------------+
|Till Forest              0.00 acres                                |
|Till Pasture             0.00 acres                                |
|Till Grass               0.00 acres                                |
|Airport Fill             0.00 acres                                |
|Outwash Forest           0.00 acres                                |
|Outwash Pasture          0.00 acres                                |
|Outwash Grass            0.00 acres                                |
|Wetland                  0.00 acres                                |
|Impervious               8.12 acres                                |
|-------------------------------------------------------------------|
|          Total Area :   8.12 acres                                |
|        Scale Factor :   1.00      Hourly      Historic            |
|-------------------------------------------------------------------|
|                                                                   |
|    Time Series: cargo_d                                           |
|-------------------------------------------------------------------|
|                       Compute Time Series                         |
|                        Modify User Input                          |
+-------------------------------------------------------------------+
```

SDN3A

MILLER at SDN3A



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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN3A (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.536	0.916	0.576	0.384	0.435
0.499	0.490	0.519	0.569	0.531
0.430	0.468	0.474	0.489	0.491
0.496	0.466	0.451	0.698	0.814
0.403	0.461	0.457	0.731	0.393
0.573	0.619	0.402	0.507	0.791
0.818	0.606	0.602	0.458	0.611
0.522	0.429	0.537	0.529	0.431
0.597	0.826	0.767	0.487	0.400
0.403	0.487	0.696		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.273
Variance (logs)	0.010
Standard Deviation (logs)	0.098
Skewness (logs)	0.717
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.203
Coefficient of Variation (logs)	-0.358

1

HOURLY FLOW SDN3A (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.356
0.9500	1.05	0.388
0.9000	1.11	0.409
0.8000	1.25	0.440
0.5000	2.00	0.519
0.2000	5.00	0.637
0.1000	10.00	0.720
0.0400	25.00	0.831
0.0200	50.00	0.918
0.0100	100.00	1.009
0.0050	200.00	1.105

$1/2 Q_2 = 0.260$ cfs
$Q_{50} = 0.918$ cfs

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN3A poc (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.166	0.275	0.892	0.154	0.218
0.204	0.167	0.395	0.191	0.187
0.198	0.198	0.228	0.140	0.188
0.220	0.191	0.191	0.229	0.190
0.194	0.198	0.184	0.435	0.193
0.210	0.182	0.181	0.080	0.168
0.125	0.224	0.170	0.207	0.194
0.147	0.117	0.184	0.187	0.133
0.155	0.206	0.218	0.177	0.135
0.129	0.195	0.465		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.710
Variance (logs)	0.026
Standard Deviation (logs)	0.163
Skewness (logs)	1.634
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.078
Coefficient of Variation (logs)	-0.229

HOURLY FLOW SDN3A poc (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.126
0.9500	1.05	0.130
0.9000	1.11	0.135
0.8000	1.25	0.144
0.5000	2.00	0.177
0.2000	5.00	0.251
0.1000	10.00	0.321
0.0400	25.00	0.439
0.0200	50.00	0.555
0.0100	100.00	0.699
0.0050	200.00	0.878

$1/2\,Q_2 = 0.089$ cfs
$Q_{50} = 0.555$ cfs

Simulated - HOURLY FLOW SDN3A (PREDEV)
Observed - HOURLY FLOW SDN3A poc (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	235575	0.018	103.7	0.028	125.1	-0.014	-86.7
0.05	18130	0.054	97.8	0.057	103.8	-0.046	-83.9
0.06	7669	0.060	96.3	0.063	100.9	-0.053	-85.1
0.06	7039	0.065	95.9	0.067	99.3	-0.059	-87.2
0.07	6312	0.070	96.0	0.073	100.2	-0.063	-87.2
0.08	6396	0.073	94.8	0.076	97.8	-0.068	-88.2
0.08	10803	0.080	94.7	0.083	97.4	-0.075	-88.6
0.09	10744	0.089	93.7	0.092	96.2	-0.085	-88.8
0.10	15488	0.098	93.7	0.101	95.7	-0.094	-89.5
0.11	14411	0.107	93.3	0.110	95.3	-0.103	-89.8
0.12	11985	0.116	92.9	0.118	94.7	-0.112	-90.0
0.13	12700	0.125	92.6	0.128	94.4	-0.122	-90.0
0.14	21448	0.138	92.5	0.141	94.3	-0.135	-90.0
0.16	11436	0.152	92.0	0.155	93.8	-0.149	-90.3
0.17	18587	0.165	92.0	0.168	93.5	-0.162	-90.5
0.19	8806	0.181	91.3	0.184	92.8	-0.180	-90.5
0.21	3695	0.199	91.2	0.203	92.8	-0.196	-89.5
0.23	1555	0.216	90.2	0.220	91.7	-0.212	-88.5
0.26	175	0.242	89.6	0.247	91.1	-0.239	-88.3
0.28	173	0.268	91.4	0.271	92.4	-0.260	-88.7
0.31	81	0.280	85.7	0.286	87.6	-0.273	-83.6
0.34	166	0.312	87.5	0.317	88.9	-0.307	-86.3
0.38	151	0.352	88.4	0.357	89.6	-0.351	-88.1
0.42	131	0.388	88.9	0.389	89.1	-0.388	-88.9
0.46	41	0.406	86.9	0.407	87.0	-0.406	-86.9
0.50	3	0.397	74.1	0.411	76.9	-0.397	-74.1
0.56	5	0.478	82.5	0.479	82.6	-0.478	-82.5
0.61	3	0.579	90.6	0.579	90.6	-0.579	-90.6
0.67	3	0.553	78.7	0.568	80.7	-0.553	-78.7
0.74	4	0.665	85.5	0.669	86.2	-0.665	-85.5
0.82	5	0.778	89.8	0.779	89.8	-0.778	-89.3
0.90	0	0.000	0.0	0.000	0.0	0.000	0.0
0.99	0	0.000	0.0	0.000	0.0	0.000	0.0
1.10	0	0.000	0.0	0.000	0.0	0.000	0.0
1.20	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.061	99.2	0.085	113.2	-0.057	-87.6

Standard error of estimate = 0.06
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

Simulated - HOURLY FLOW SDN3A (PREDEV)
Observed - HOURLY FLOW SDN3A poc (2006)

Lower class limit	Cases equal or exceeding lower limit & less then upper limit: Cases Sim	Cases Obs	Percent Simulated	Percent Observed	Percent cases equal or exceeding limit Simulated	Percent cases equal or exceeding limit Observed	Average of cases within class limits Simulated	Average of cases within class limits Observed
0.00	**********		95.56	55.60	100.00	100.00	0.00	0.02
0.05	2731	18130	0.64	4.28	4.44	44.40	0.05	0.05
0.06	1193	7669	0.28	1.81	3.79	40.12	0.06	0.06
0.06	1110	7039	0.26	1.66	3.51	38.31	0.07	0.07
0.07	957	6312	0.23	1.49	3.25	36.65	0.07	0.07
0.08	932	6396	0.22	1.51	3.02	35.16	0.08	0.08

0.08	155410803	0.37	2.55	2.80	33.65	0.08	0.08
0.09	142110744	0.34	2.54	2.44	31.10	0.09	0.10
0.10	118815486	0.28	3.66	2.10	28.57	0.11	0.11
0.11	101614411	0.24	3.40	1.82	24.91	0.11	0.11
0.12	81111985	0.19	2.83	1.58	21.51	0.12	0.12
0.13	73712700	0.17	3.00	1.39	18.68	0.13	0.14
0.14	120221448	0.28	5.06	1.22	15.69	0.15	0.15
0.16	45711436	0.11	2.70	0.93	10.62	0.16	0.16
0.17	79518587	0.19	4.39	0.83	7.93	0.18	0.18
0.19	578 8806	0.14	2.08	0.64	3.54	0.20	0.20
0.21	465 3695	0.11	0.87	0.50	1.46	0.22	0.22
0.23	501 1555	0.12	0.37	0.39	0.59	0.24	0.24
0.26	250 175	0.06	0.04	0.27	0.22	0.27	0.27
0.28	276 173	0.07	0.04	0.21	0.18	0.29	0.29
0.31	193 81	0.05	0.02	0.15	0.14	0.32	0.33
0.34	159 166	0.04	0.04	0.10	0.12	0.36	0.36
0.38	97 151	0.02	0.04	0.07	0.08	0.40	0.40
0.42	63 131	0.01	0.03	0.04	0.05	0.44	0.44
0.46	45 41	0.01	0.01	0.03	0.02	0.48	0.47
0.50	28 3	0.01	0.00	0.02	0.01	0.52	0.54
0.56	17 5	0.00	0.00	0.01	0.00	0.59	0.58
0.61	12 3	0.00	0.00	0.01	0.00	0.63	0.64
0.67	10 3	0.00	0.00	0.00	0.00	0.70	0.70
0.74	7 4	0.00	0.00	0.00	0.00	0.79	0.78
0.82	2 5	0.00	0.00	0.00	0.00	0.83	0.87
0.90	1 0	0.00	0.00	0.00	0.00	0.92	0.00
0.99	0 0	0.00	0.00	0.00	0.00	0.00	0.00
1.10	0 0	0.00	0.00	0.00	0.00	0.00	0.00
1.20	0 0	0.00	0.00	0.00	0.00	0.00	0.00
	423720423720	100.00	100.00			0.01	0.06

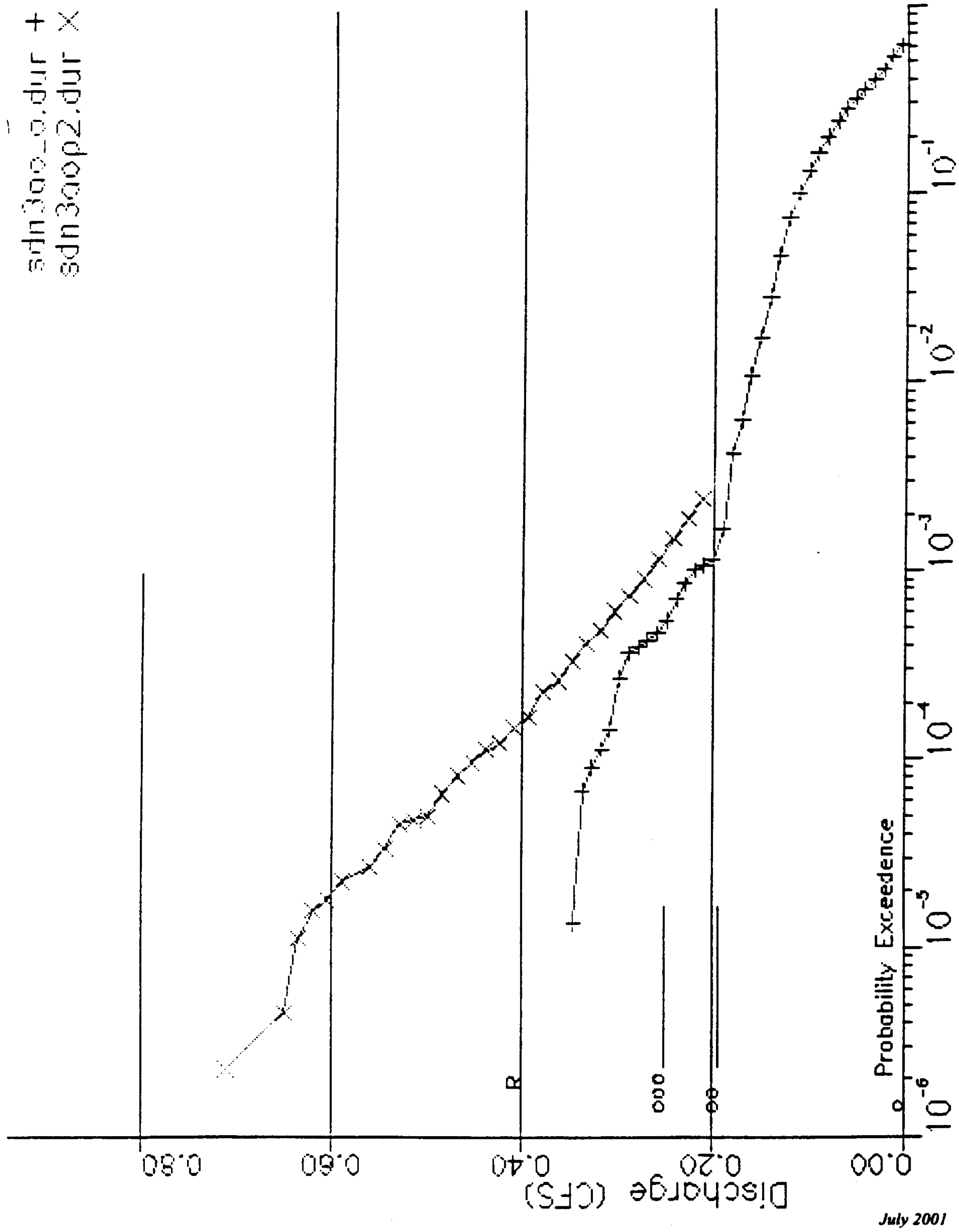
0 Observed values are zero
68593 Simulated values are zero
0 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
68593 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDN3A (PREDEV)
Observed - HOURLY FLOW SDN3A poc (2006)

Lower class limit	Number of occurrences between indicated deviations	-60%	-30%	-10%	0%	10%	30%	60%
0.00	224778	2078	998	389	366	667	6299	0
0.05	16578	354	193	79	73	115	738	0
0.06	7007	168	80	34	37	56	287	0
0.06	6501	158	77	30	21	45	207	0
0.07	5809	154	77	22	30	41	179	0
0.08	5906	161	78	35	28	27	161	0
0.08	9973	280	124	54	48	70	254	0
0.09	9904	307	132	52	45	70	234	0
0.10	14367	437	180	77	57	73	297	0
0.11	13349	475	175	60	60	70	222	0
0.12	11132	375	152	52	49	68	157	0
0.13	11786	431	162	48	49	72	152	0
0.14	19847	738	266	106	83	128	280	0
0.16	10597	420	142	49	48	71	109	0
0.17	17405	618	219	67	42	84	152	0
0.19	8209	370	111	27	23	30	36	0
0.21	3454	128	36	13	13	17	34	0
0.23	1440	74	11	5	4	3	18	0
0.26	166	2	1	1	1	3	1	0
0.28	164	3	2	0	0	1	3	0
0.31	74	4	0	1	0	0	2	0
0.34	154	7	2	0	1	0	2	0
0.38	142	6	1	0	1	1	0	0
0.42	131	0	0	0	0	0	0	0
0.46	41	0	0	0	0	0	0	0
0.50	2	1	0	0	0	0	0	0
0.56	5	0	0	0	0	0	0	0

0.61	3	0	0	0	0	0	0	0
0.67	2	1	0	0	0	0	0	0
0.74	4	0	0	0	0	0	0	0
0.82	5	0	0	0	0	0	0	0
0.90	0	0	0	0	0	0	0	0
0.99	0	0	0	0	0	0	0	0
1.10	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0
	398935	7750	3219	1201	1079	1712	9824	0



July 2001
556-2912-001 (28)

SDN3A Outer Pond

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	2.00	H:1V
Pond Bottom Length:	300.00	ft
Pond Bottom Width:	190.00	ft
Pond Bottom Area:	57000.	sq. ft
Top Area at 1 ft. FB:	79344.	sq. ft
	1.821	acres
Effective Storage Depth:	9.50	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	634518.	cu. ft
	14.567	ac-ft
Riser Head:	9.50	ft
Riser Diameter:	12.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.60	0.208	
2	7.75	1.60	0.078	4.0
3	8.25	1.75	0.072	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	0.00	0.	0.000	0.000	0.00	57000.
0.02	0.02	1140.	0.026	0.009	0.00	57039.
0.03	0.03	1711.	0.039	0.013	0.00	57059.
0.05	0.05	2853.	0.065	0.016	0.00	57098.
0.07	0.07	3995.	0.092	0.018	0.00	57137.
0.08	0.08	4566.	0.105	0.020	0.00	57157.
0.10	0.10	5710.	0.131	0.022	0.00	57196.
0.12	0.12	6854.	0.157	0.024	0.00	57235.
0.13	0.13	7427.	0.170	0.025	0.00	57255.
0.32	0.32	18341.	0.421	0.039	0.00	57629.
0.51	0.51	29326.	0.673	0.049	0.00	58004.
0.69	0.69	39798.	0.914	0.058	0.00	58360.
0.88	0.88	50923.	1.169	0.065	0.00	58737.
1.06	1.06	61527.	1.412	0.072	0.00	59096.
1.25	1.25	72792.	1.671	0.078	0.00	59475.
1.44	1.44	84128.	1.931	0.083	0.00	59856.
1.62	1.62	94935.	2.179	0.088	0.00	60217.
1.81	1.81	106412.	2.443	0.093	0.00	60600.
2.00	2.00	117963.	2.708	0.098	0.00	60984.
2.18	2.18	128973.	2.961	0.103	0.00	61349.
2.37	2.37	140666.	3.229	0.107	0.00	61735.
2.55	2.55	151811.	3.485	0.111	0.00	62102.
2.74	2.74	163647.	3.757	0.115	0.00	62491.
2.93	2.93	175557.	4.030	0.119	0.00	62880.
3.11	3.11	186909.	4.291	0.123	0.00	63250.
3.30	3.30	198964.	4.568	0.126	0.00	63642.
3.49	3.49	211093.	4.846	0.130	0.00	64035.
3.67	3.67	222653.	5.111	0.133	0.00	64409.

3.86	3.86	234928.	5.393	0.136	0.00	64804.
4.05	4.05	247279.	5.677	0.140	0.00	65200.
4.23	4.23	259049.	5.947	0.143	0.00	65577.
4.42	4.42	271546.	6.234	0.146	0.00	65976.
4.60	4.60	283456.	6.507	0.149	0.00	66355.
4.79	4.79	296101.	6.798	0.152	0.00	66756.
4.98	4.98	308823.	7.090	0.155	0.00	67158.
5.16	5.16	320946.	7.368	0.158	0.00	67540.
5.35	5.35	333817.	7.663	0.161	0.00	67944.
5.54	5.54	346765.	7.961	0.163	0.00	68349.
5.72	5.72	359102.	8.244	0.166	0.00	68735.
5.91	5.91	372200.	8.545	0.169	0.00	69142.
6.09	6.09	384681.	8.831	0.171	0.00	69530.
6.28	6.28	397931.	9.135	0.174	0.00	69940.
6.47	6.47	411258.	9.441	0.177	0.00	70351.
6.65	6.65	423956.	9.733	0.179	0.00	70742.
6.84	6.84	437437.	10.042	0.182	0.00	71155.
7.03	7.03	450995.	10.353	0.184	0.00	71570.
7.21	7.21	463913.	10.650	0.186	0.00	71963.
7.40	7.40	477626.	10.965	0.189	0.00	72380.
7.58	7.58	490690.	11.265	0.191	0.00	72776.
7.75	7.75	503094.	11.549	0.193	0.00	73151.
7.77	7.77	504557.	11.583	0.194	0.00	73195.
7.78	7.78	505289.	11.600	0.196	0.00	73217.
7.80	7.80	506754.	11.633	0.199	0.00	73261.
7.82	7.82	508220.	11.667	0.203	0.00	73306.
7.83	7.83	508953.	11.684	0.207	0.00	73328.
7.85	7.85	510420.	11.718	0.213	0.00	73372.
7.87	7.87	511888.	11.751	0.218	0.00	73416.
7.88	7.88	512622.	11.768	0.220	0.00	73438.
8.07	8.07	526615.	12.089	0.237	0.00	73859.
8.25	8.25	539946.	12.395	0.249	0.00	74259.
8.27	8.27	541432.	12.430	0.250	0.00	74303.
8.29	8.29	542918.	12.464	0.253	0.00	74348.
8.30	8.30	543662.	12.481	0.257	0.00	74370.
8.32	8.32	545150.	12.515	0.263	0.00	74415.
8.34	8.34	546638.	12.549	0.270	0.00	74459.
8.36	8.36	548128.	12.583	0.277	0.00	74504.
8.38	8.38	549619.	12.618	0.286	0.00	74548.
8.40	8.40	551110.	12.652	0.289	0.00	74593.
8.58	8.58	564573.	12.961	0.315	0.00	74995.
8.77	8.77	578862.	13.289	0.335	0.00	75420.
8.95	8.95	592474.	13.601	0.354	0.00	75824.
9.14	9.14	606921.	13.933	0.370	0.00	76251.
9.33	9.33	621449.	14.267	0.385	0.00	76680.
9.50	9.50	634518.	14.567	0.399	0.00	77064.
9.60	9.60	642235.	14.744	0.714	0.00	77291.
9.70	9.70	649976.	14.921	1.280	0.00	77517.
9.80	9.80	657739.	15.100	2.020	0.00	77745.
9.90	9.90	665525.	15.278	2.820	0.00	77972.
10.00	10.00	673333.	15.458	3.110	0.00	78200.
10.10	10.10	681165.	15.637	3.370	0.00	78428.
10.20	10.20	689019.	15.818	3.610	0.00	78657.
10.30	10.30	696896.	15.999	3.840	0.00	78885.
10.40	10.40	704796.	16.180	4.050	0.00	79115.
10.50	10.50	712719.	16.362	4.250	0.00	79344.
10.60	10.60	720665.	16.544	4.440	0.00	79574.

10.70	10.70	728634.	16.727	4.620	0.00	79804.
10.80	10.80	736626.	16.911	4.790	0.00	80034.
10.90	10.90	744641.	17.095	4.960	0.00	80265.
11.00	11.00	752679.	17.279	5.130	0.00	80496.
11.10	11.10	760740.	17.464	5.280	0.00	80727.
11.20	11.20	768824.	17.650	5.440	0.00	80959.
11.30	11.30	776932.	17.836	5.580	0.00	81191.
11.40	11.40	785062.	18.023	5.730	0.00	81423.

Route Time Series through Facility
Inflow Time Series File:sdn3aod2.tsf
Outflow Time Series File:sdn3ao_o.tsf

Inflow/Outflow Analysis
Peak Inflow Discharge: 6.30 CFS at 16:00 on Mar 3 in 1950
Peak Outflow Discharge: 0.346 CFS at 11:00 on Feb 11 in 1951
Peak Reservoir Stage: 8.88 Ft
Peak Reservoir Elev: 8.88 Ft
Peak Reservoir Storage: 587002. Cu-Ft
: 13.476 Ac-Ft

Flow Frequency Analysis
Time Series File:sdn3aop2.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.366 StdDev= 0.101
Skew= 0.544

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			0.811		100.00	0.990
Computed Peaks			0.741		50.00	0.980
Computed Peaks			0.674		25.00	0.960
Computed Peaks			0.586		10.00	0.900
Computed Peaks			0.569		8.00	0.875
Computed Peaks			0.520		5.00	0.800
Computed Peaks			0.422		2.00	0.500
Computed Peaks			0.360		1.30	0.231

Flow Frequency Analysis
Time Series File:sdn3ao_o.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.845 StdDev= 0.125
Skew= 0.909

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks (CFS)	- - (ft)	Rank	Return Period	Prob
Computed Peaks			0.336	8.78		100.00	0.990
Computed Peaks			0.294	8.44		50.00	0.980
Computed Peaks			0.256	8.30		25.00	0.960
Computed Peaks			0.210	7.84		10.00	0.900
Computed Peaks			0.202	7.81		8.00	0.875
Computed Peaks			0.178	6.59		5.00	0.800
Computed Peaks			0.137	3.90		2.00	0.500
Computed Peaks			0.114	2.69		1.30	0.231

Duration Comparison Anaylsis
Base File: sdn3aop2.tsf
New File: sdn3ao_o.tsf
Cutoff Units: Discharge in CFS

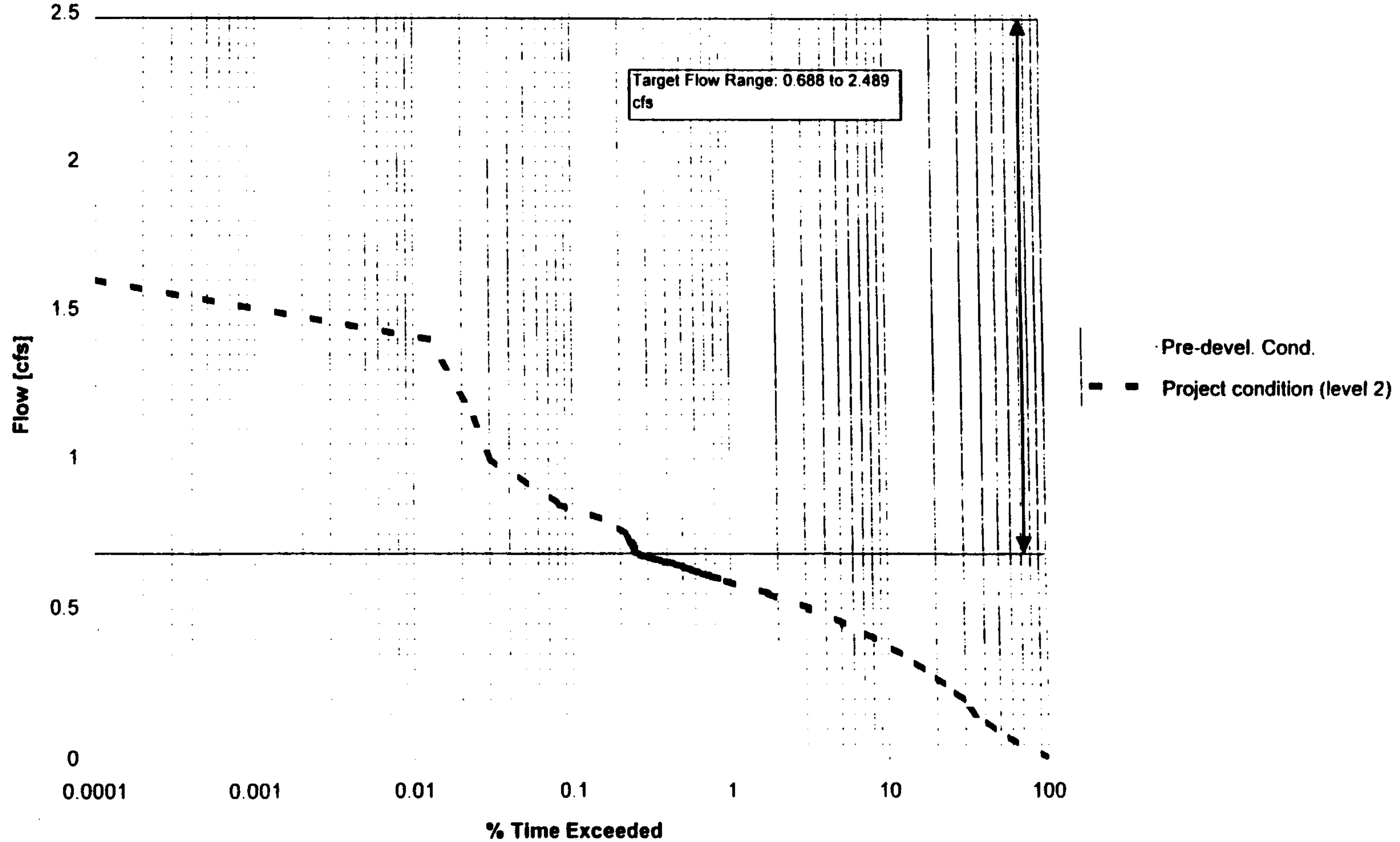
	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.212	0.24E-02	0.11E-02	-55.7	0.24E-02	0.212	0.186	-12.1
0.228	0.18E-02	0.87E-03	-52.7	0.18E-02	0.228	0.189	-16.9
0.244	0.14E-02	0.61E-03	-57.5	0.14E-02	0.244	0.192	-21.4
0.260	0.11E-02	0.46E-03	-58.2	0.11E-02	0.260	0.206	-21.0
0.276	0.85E-03	0.40E-03	-53.1	0.85E-03	0.276	0.229	-17.1
0.293	0.68E-03	0.32E-03	-53.7	0.68E-03	0.293	0.240	-18.1
0.309	0.56E-03	0.13E-03	-76.6	0.56E-03	0.309	0.247	-19.9
0.325	0.44E-03	0.96E-04	-78.4	0.44E-03	0.325	0.264	-18.7
0.341	0.37E-03	0.48E-04	-87.0	0.37E-03	0.341	0.287	-15.9
0.357	0.29E-03	0.00E+00	-100.0	0.29E-03	0.357	0.295	-17.5
0.374	0.23E-03	0.00E+00	-100.0	0.23E-03	0.374	0.299	-20.0
0.390	0.18E-03	0.00E+00	-100.0	0.18E-03	0.390	0.302	-22.6
0.406	0.15E-03	0.00E+00	-100.0	0.15E-03	0.406	0.306	-24.7
0.422	0.12E-03	0.00E+00	-100.0	0.12E-03	0.422	0.313	-25.9
0.438	0.11E-03	0.00E+00	-100.0	0.11E-03	0.438	0.317	-27.7
0.455	0.96E-04	0.00E+00	-100.0	0.96E-04	0.455	0.325	-28.5
0.471	0.80E-04	0.00E+00	-100.0	0.80E-04	0.471	0.332	-29.5
0.487	0.66E-04	0.00E+00	-100.0	0.66E-04	0.487	0.336	-31.0
0.503	0.48E-04	0.00E+00	-100.0	0.48E-04	0.503	0.341	-32.2
0.519	0.48E-04	0.00E+00	-100.0	0.48E-04	0.519	0.341	-34.3
0.536	0.39E-04	0.00E+00	-100.0	0.39E-04	0.536	0.343	-35.9
0.552	0.30E-04	0.00E+00	-100.0	0.30E-04	0.552	0.344	-37.6
0.568	0.25E-04	0.00E+00	-100.0	0.25E-04	0.568	0.345	-39.3
0.584	0.23E-04	0.00E+00	-100.0	0.23E-04	0.584	0.345	-41.0
0.601	0.21E-04	0.00E+00	-100.0	0.21E-04	0.601	0.345	-42.5
0.617	0.16E-04	0.00E+00	-100.0	0.16E-04	0.617	0.345	-44.0
0.633	0.11E-04	0.00E+00	-100.0	0.11E-04	0.633	0.346	-45.4
0.649	0.46E-05	0.00E+00	-100.0	0.46E-05	0.649	0.346	-46.7
0.665	0.23E-05	0.00E+00	-100.0	0.23E-05	0.665	0.346	-47.9
0.682	0.23E-05	0.00E+00	-100.0	0.23E-05	0.682	0.346	-49.2
0.698	0.23E-05	0.00E+00	-100.0	0.23E-05	0.698	0.346	-50.4

There is no positive excursion

Maximum negative excursion = 0.367 cfs (-51.4%)
occuring at 0.713 cfs on the Base Data:sdn3aop2.tsf
and at 0.346 cfs on the New Data:sdn3ao_o.tsf

SDN3/3X

MILLER at SDN3/3X



1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN3/3X (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

1.397	2.509	1.718	1.025	1.141
1.317	1.287	1.375	1.515	1.385
1.150	1.282	1.289	1.260	1.300
1.306	1.231	1.202	1.821	2.114
1.095	1.222	1.182	2.075	1.037
1.496	1.668	1.031	1.302	2.030
2.096	1.607	1.588	1.196	1.569
1.389	1.103	1.497	1.410	1.101
1.530	2.255	2.076	1.279	1.021
1.033	1.257	2.031		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.150
Variance (logs)	0.010
Standard Deviation (logs)	0.102
Skewness (logs)	0.691
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.174
Coefficient of Variation (logs)	0.681

1

HOURLY FLOW SDN3/3X (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.922
0.9500	1.05	1.010
0.9000	1.11	1.069
0.8000	1.25	1.155
0.5000	2.00	1.376
0.2000	5.00	1.703
0.1000	10.00	1.934
0.0400	25.00	2.245
0.0200	50.00	2.489
0.0100	100.00	2.744
0.0050	200.00	3.013

$1/2 Q_2 = 0.688$ cfs
$Q_{50} = 2.489$ cfs

:

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN3/3X (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.497	0.644	1.458	0.446	0.601
0.543	0.502	0.806	0.550	0.538
0.521	0.615	0.620	0.395	0.565
0.584	0.623	0.545	0.617	0.516
0.554	0.593	0.507	1.223	0.617
0.558	0.504	0.487	0.327	0.528
0.380	0.798	0.511	0.599	0.546
0.416	0.349	0.581	0.616	0.406
0.383	0.663	0.675	0.561	0.416
0.357	0.585	0.878		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.256
Variance (logs)	0.015
Standard Deviation (logs)	0.122
Skewness (logs)	1.046
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.022
Coefficient of Variation (logs)	-0.477

1

HOURLY FLOW SDN3/3X (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.359
0.9500	1.05	0.385
0.9000	1.11	0.405
0.8000	1.25	0.437
0.5000	2.00	0.529
0.2000	5.00	0.685
0.1000	10.00	0.809
0.0400	25.00	0.988
0.0200	50.00	1.139
0.0100	100.00	1.307
0.0050	200.00	1.494

$1/2\ Q_2 = 0.265$ cfs
$Q_{50} = 1.139$ cfs

1

Simulated - HOURLY FLOW SDN3/3X (PREDEV)
Observed - HOURLY FLOW SDN3/3X (2006)

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	234244	0.022	*	0.043	*	-0.018	*
0.10	41218	0.119	96.6	0.129	104.8	-0.099	-80.7
0.15	27589	0.161	93.1	0.170	98.1	-0.142	-81.6
0.20	28952	0.205	90.6	0.214	94.1	-0.167	-82.4
0.25	23802	0.243	89.1	0.252	92.1	-0.226	-82.8
0.30	18211	0.287	88.2	0.296	90.8	-0.270	-82.9
0.35	15903	0.324	86.8	0.333	89.3	-0.309	-82.8
0.40	12102	0.365	85.9	0.375	88.2	-0.351	-82.6
0.45	8445	0.404	85.3	0.415	87.7	-0.388	-82.0
0.50	5937	0.438	83.9	0.451	86.3	-0.425	-81.2
0.55	3784	0.478	83.6	0.491	85.7	-0.464	-81.1
0.60	436	0.497	82.2	0.512	84.7	-0.473	-78.1
0.61	458	0.492	80.0	0.507	82.5	-0.476	-77.4
0.62	274	0.496	79.5	0.511	81.8	-0.487	-78.0
0.63	255	0.505	79.6	0.526	82.8	-0.475	-74.8
0.64	300	0.510	79.1	0.524	81.2	-0.487	-75.6
0.65	298	0.484	73.9	0.507	77.4	-0.470	-71.6
0.66	261	0.438	66.0	0.465	70.0	-0.432	-65.1
0.67	145	0.487	72.2	0.517	76.6	-0.463	-68.6
0.68	53	0.578	84.6	0.592	86.6	-0.526	-77.0
0.69	11	0.575	82.7	0.593	85.3	-0.515	-74.2
0.70	19	0.576	81.6	0.599	84.8	-0.484	-68.5
0.71	29	0.602	84.2	0.613	85.7	-0.563	-78.8
0.72	90	0.613	83.3	0.631	85.7	-0.555	-75.4
0.75	278	0.627	80.9	0.642	82.8	-0.589	-76.0
0.80	291	0.597	72.4	0.610	74.1	-0.564	-68.4
0.85	205	0.531	60.9	0.560	64.2	-0.502	-57.5
1.00	41	0.656	58.5	0.674	60.1	-0.656	-58.5
1.20	37	0.793	61.7	0.840	65.1	-0.793	-61.7
1.40	52	0.999	67.4	1.018	68.5	-0.999	-67.4
1.60	0	0.000	0.0	0.000	0.0	0.000	0.0
1.80	0	0.000	0.0	0.000	0.0	0.000	0.0
2.00	0	0.000	0.0	0.000	0.0	0.000	0.0
2.20	0	0.000	0.0	0.000	0.0	0.000	0.0
2.70	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.120	*	0.185	*	-0.110	*

Standard error of estimate = 0.15
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDN3/3X (PREDEV)
Observed - HOURLY FLOW SDN3/3X (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit		Percent cases equal or exceeding limit	Average of cases within class limits
	Cases	Percent		

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		93.69	55.28	100.00	100.00	0.01	0.02
0.10	775541218		1.83	9.73	6.31	44.72	0.12	0.12
0.15	499027589		1.18	6.51	4.48	34.99	0.17	0.17
0.20	343328952		0.81	6.83	3.30	28.48	0.22	0.23
0.25	250923802		0.59	5.62	2.49	21.65	0.27	0.27
0.30	183118211		0.43	4.30	1.90	16.03	0.32	0.33
0.35	141315903		0.33	3.75	1.47	11.73	0.37	0.37
0.40	101112102		0.24	2.86	1.13	7.98	0.42	0.43
0.45	822	8445	0.19	1.99	0.89	5.12	0.47	0.47
0.50	631	5937	0.15	1.40	0.70	3.13	0.52	0.52
0.55	488	3784	0.12	0.89	0.55	1.73	0.57	0.57
0.60	78	436	0.02	0.10	0.44	0.83	0.60	0.60
0.61	79	458	0.02	0.11	0.42	0.73	0.61	0.61
0.62	70	274	0.02	0.06	0.40	0.62	0.62	0.62
0.63	72	255	0.02	0.06	0.38	0.56	0.64	0.64
0.64	75	300	0.02	0.07	0.37	0.50	0.64	0.64
0.65	53	298	0.01	0.07	0.35	0.43	0.66	0.66
0.66	71	261	0.02	0.06	0.34	0.36	0.66	0.66
0.67	71	145	0.02	0.03	0.32	0.30	0.68	0.67
0.68	42	53	0.01	0.01	0.30	0.26	0.68	0.68
0.69	54	11	0.01	0.00	0.29	0.25	0.70	0.69
0.70	41	19	0.01	0.00	0.28	0.25	0.70	0.71
0.71	51	29	0.01	0.01	0.27	0.24	0.71	0.72
0.72	144	90	0.03	0.02	0.26	0.23	0.73	0.74
0.75	182	278	0.04	0.07	0.22	0.21	0.77	0.78
0.80	155	291	0.04	0.07	0.18	0.15	0.82	0.82
0.85	279	205	0.07	0.05	0.14	0.08	0.92	0.87
1.00	177	41	0.04	0.01	0.08	0.03	1.09	1.12
1.20	79	37	0.02	0.01	0.04	0.02	1.29	1.29
1.40	35	52	0.01	0.01	0.02	0.01	1.50	1.48
1.60	21	0	0.00	0.00	0.01	0.00	1.67	0.00
1.80	9	0	0.00	0.00	0.01	0.00	1.90	0.00
2.00	11	0	0.00	0.00	0.00	0.00	2.08	0.00
2.20	2	0	0.00	0.00	0.00	0.00	2.38	0.00
2.70	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720423720		100.00	100.00			0.02	0.13

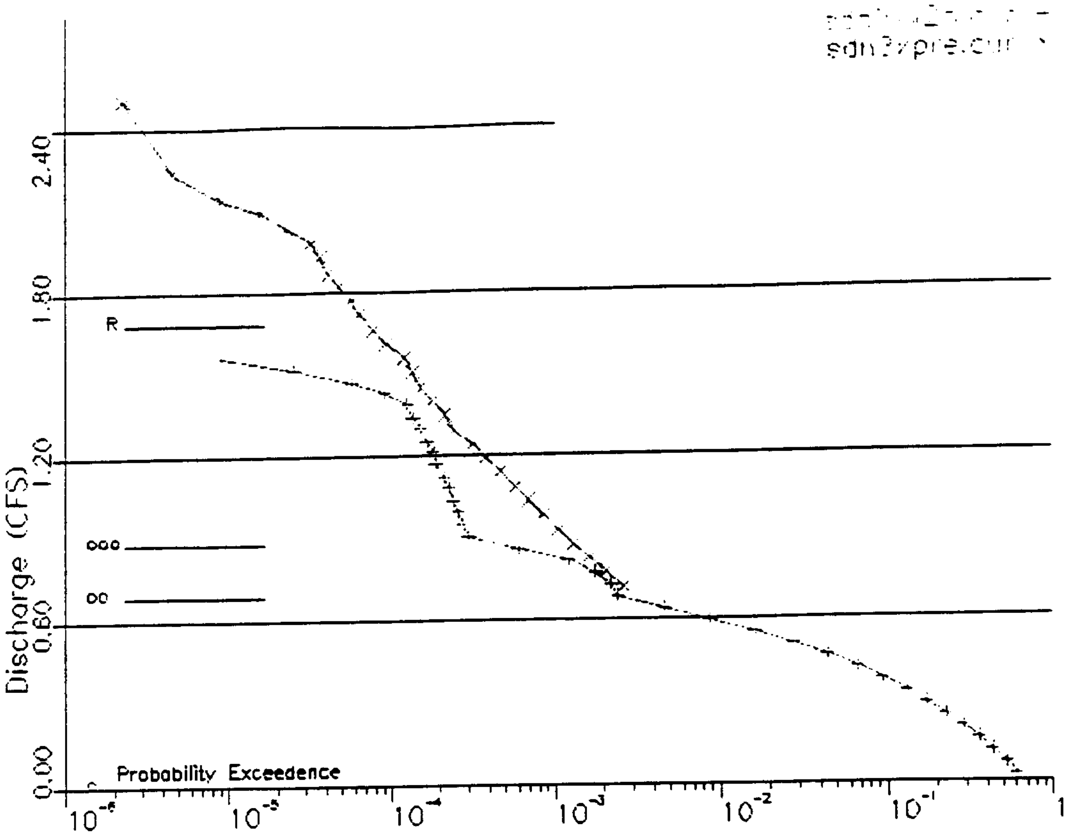
10049 Observed values are zero
68593 Simulated values are zero
10049 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
58544 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDN3/3X (PREDEV)
Observed - HOURLY FLOW SDN3/3X (2006)

Lower class limit	Number of occurrences between indicated deviations	-60%	-30%	-10%	0%	10%	30%	60%
0.00	219357	1453	652	8226	240	445	3871	0
0.10	37154	1042	492	203	185	302	1840	0
0.15	24635	904	410	175	135	254	1076	0
0.20	25759	1085	481	167	149	310	1001	0
0.25	21181	1002	438	170	133	202	676	0
0.30	16279	837	301	99	102	159	434	0
0.35	14219	771	308	96	89	108	312	0
0.40	10805	632	209	55	69	114	218	0

						65	144	0
0.45	7537	432	173	53	41	30	82	0
0.50	5261	384	126	30	24	19	48	0
0.55	3380	247	54	18	18	2	9	0
0.60	375	33	14	2	1	3	4	0
0.61	404	28	8	8	3	1	3	0
0.62	240	18	10	2	0	2	6	0
0.63	216	18	9	4	0	3	7	0
0.64	259	24	3	1	3	2	5	0
0.65	249	21	10	7	4	1	2	0
0.66	162	73	18	4	1	0	4	0
0.67	97	29	12	1	2	1	3	0
0.68	47	0	2	0	0	0	1	0
0.69	9	1	0	0	0	0	2	0
0.70	16	0	0	0	1	0	1	0
0.71	25	3	0	0	0	2	4	0
0.72	80	2	1	0	1	5	7	0
0.75	244	15	5	1	1	1	7	0
0.80	241	35	5	2	0	1	5	0
0.85	131	47	16	4	1	0	0	0
1.00	25	15	1	0	0	0	0	0
1.20	26	7	2	2	0	0	0	0
1.40	39	12	1	0	0	0	0	0
1.60	0	0	0	0	0	0	0	0
1.80	0	0	0	0	0	0	0	0
2.00	0	0	0	0	0	0	0	0
2.20	0	0	0	0	0	0	0	0
2.70	0	0	0	0	0	0	0	
	388452	9170	3761	9330	1203	2032	9772	0


sdn3xpre.cur
R
ooo
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Probability Exceedence
Discharge (CFS)
0.00
0.60
1.20
1.80
2.40
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1

AR 046616

SDN3X
(SDN3 + SDN3X)

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	300.00	ft
Facility Width:	187.00	ft
Facility Area:	56100.	sq. ft
Effective Storage Depth:	20.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	1122000.	cu. ft
Riser Head:	20.00	ft
Riser Diameter:	24.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	2.60	0.820	
2	14.00	1.38	0.126	4.0
3	18.00	4.38	0.736	8.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.03	0.03	1683.	0.039	0.030	0.00
0.05	0.05	2805.	0.064	0.043	0.00
0.08	0.08	4488.	0.103	0.052	0.00
0.11	0.11	6171.	0.142	0.060	0.00
0.14	0.14	7854.	0.180	0.067	0.00
0.16	0.16	8976.	0.206	0.074	0.00
0.19	0.19	10659.	0.245	0.080	0.00
0.22	0.22	12342.	0.283	0.085	0.00
0.61	0.61	34221.	0.786	0.143	0.00
1.00	1.00	56100.	1.288	0.183	0.00
1.39	1.39	77979.	1.790	0.216	0.00
1.79	1.79	100419.	2.305	0.245	0.00
2.18	2.18	122298.	2.808	0.271	0.00
2.57	2.57	144177.	3.310	0.294	0.00
2.96	2.96	166056.	3.812	0.316	0.00
3.35	3.35	187935.	4.314	0.336	0.00
3.75	3.75	210375.	4.830	0.355	0.00
4.14	4.14	232254.	5.332	0.373	0.00
4.53	4.53	254133.	5.834	0.390	0.00
4.92	4.92	276012.	6.336	0.407	0.00
5.31	5.31	297891.	6.839	0.423	0.00
5.71	5.71	320331.	7.354	0.438	0.00
6.10	6.10	342210.	7.856	0.453	0.00
6.49	6.49	364089.	8.358	0.467	0.00
6.88	6.88	385968.	8.861	0.481	0.00
7.28	7.28	408408.	9.376	0.495	0.00
7.67	7.67	430287.	9.878	0.508	0.00
8.06	8.06	452166.	10.380	0.521	0.00
8.45	8.45	474045.	10.883	0.533	0.00
8.84	8.84	495924.	11.385	0.545	0.00
9.24	9.24	518364.	11.900	0.557	0.00

9.63	9.63	540243.	12.402	0.569	0.00
10.02	10.02	562122.	12.905	0.580	0.00
10.41	10.41	584001.	13.407	0.592	0.00
10.80	10.80	605880.	13.909	0.603	0.00
11.20	11.20	628320.	14.424	0.614	0.00
11.59	11.59	650199.	14.927	0.624	0.00
11.98	11.98	672078.	15.429	0.635	0.00
12.37	12.37	693957.	15.931	0.645	0.00
12.77	12.77	716397.	16.446	0.655	0.00
13.16	13.16	738276.	16.948	0.665	0.00
13.55	13.55	760155.	17.451	0.675	0.00
13.94	13.94	782034.	17.953	0.685	0.00
14.00	14.00	785400.	18.030	0.686	0.00
14.01	14.01	785961.	18.043	0.687	0.00
14.03	14.03	787083.	18.069	0.688	0.00
14.04	14.04	787644.	18.082	0.691	0.00
14.06	14.06	788766.	18.108	0.694	0.00
14.07	14.07	789327.	18.120	0.698	0.00
14.09	14.09	790449.	18.146	0.702	0.00
14.10	14.10	791010.	18.159	0.705	0.00
14.11	14.11	791571.	18.172	0.706	0.00
14.13	14.13	792693.	18.198	0.708	0.00
14.52	14.52	814572.	18.700	0.736	0.00
14.91	14.91	836451.	19.202	0.757	0.00
15.31	15.31	858891.	19.717	0.776	0.00
15.70	15.70	880770.	20.220	0.794	0.00
16.09	16.09	902649.	20.722	0.810	0.00
16.48	16.48	924528.	21.224	0.826	0.00
16.87	16.87	946407.	21.727	0.841	0.00
17.27	17.27	968847.	22.242	0.855	0.00
17.66	17.66	990726.	22.744	0.869	0.00
18.00	18.00	1009800.	23.182	0.881	0.00
18.05	18.05	1012605.	23.246	0.888	0.00
18.09	18.09	1014849.	23.298	0.907	0.00
18.14	18.14	1017654.	23.362	0.937	0.00
18.18	18.18	1019898.	23.414	0.975	0.00
18.23	18.23	1022703.	23.478	1.020	0.00
18.27	18.27	1024947.	23.530	1.080	0.00
18.32	18.32	1027752.	23.594	1.150	0.00
18.37	18.37	1030557.	23.658	1.210	0.00
18.76	18.76	1052436.	24.161	1.360	0.00
19.15	19.15	1074315.	24.663	1.480	0.00
19.54	19.54	1096194.	25.165	1.580	0.00
19.93	19.93	1118073.	25.667	1.670	0.00
20.00	20.00	1122000.	25.758	1.680	0.00
20.10	20.10	1127610.	25.886	2.320	0.00
20.20	20.20	1133220.	26.015	3.470	0.00
20.30	20.30	1138830.	26.144	4.950	0.00
20.40	20.40	1144440.	26.273	6.690	0.00
20.50	20.50	1150050.	26.402	8.670	0.00
20.60	20.60	1155660.	26.530	10.860	0.00
20.70	20.70	1161270.	26.659	13.230	0.00
20.80	20.80	1166880.	26.788	15.370	0.00
20.90	20.90	1172490.	26.917	16.210	0.00
21.00	21.00	1178100.	27.045	17.010	0.00
21.10	21.10	1183710.	27.174	17.760	0.00
21.20	21.20	1189320.	27.303	18.490	0.00

21.30	21.30	1194930.	27.432	19.180	0.00
21.40	21.40	1200540.	27.561	19.850	0.00
21.50	21.50	1206150.	27.689	20.490	0.00
21.60	21.60	1211760.	27.818	21.120	0.00
21.70	21.70	1217370.	27.947	21.720	0.00
21.80	21.80	1222980.	28.076	22.310	0.00

Reservoir Routing [R/D Facility]
Years Complete: 50

Inflow/Outflow Analysis

Peak Inflow Discharge: 16.75 CFS at 16:00 on Mar 3 in 1950
Peak Outflow Discharge: 1.57 CFS at 2:00 on Jan 3 in 1997
Peak Reservoir Stage: 19.51 Ft
Peak Reservoir Elev: 19.51 Ft
Peak Reservoir Storage: 1094347. Cu-Ft
: 25.123 Ac-Ft
Storing Time Series File:sdn3xv2o.tsf 50

Facility Routing Complete

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdn3xpre.tsf Mean= 0.163 StdDev= 0.106
Project Location:Sea-Tac Miller Skew= 0.470

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			2.80		100.00	0.990
Computed Peaks			2.56		50.00	0.980
Computed Peaks			2.32		25.00	0.960
Computed Peaks			2.01		10.00	0.900
Computed Peaks			1.95		8.00	0.875
Computed Peaks			1.78		5.00	0.800
Computed Peaks			1.43		2.00	0.500
Computed Peaks			1.20		1.30	0.231

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdn3xv2o.tsf Mean= -0.250 StdDev= 0.135
Project Location:Sea-Tac Miller Skew= 1.310

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			1.53	19.33		100.00	0.990
Computed Peaks			1.29	18.57		50.00	0.980
Computed Peaks			1.08	18.27		25.00	0.960
Computed Peaks			0.852	17.19		10.00	0.900
Computed Peaks			0.812	16.14		8.00	0.875
Computed Peaks			0.703	14.09		5.00	0.800
Computed Peaks			0.527	8.24		2.00	0.500
Computed Peaks			0.442	5.82		1.30	0.231

SDN3X
(SDN3 + SDN3X)

Duration Comparison Anaylsis
Base File: sdn3xpre.tsf
New File: sdn3xv2o.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.712	0.26E-02	0.23E-02	-13.3	0.26E-02	0.712	0.673	-5.5
0.770	0.20E-02	0.18E-02	-12.8	0.20E-02	0.770	0.749	-2.8
0.828	0.16E-02	0.99E-03	-36.9	0.16E-02	0.828	0.785	-5.2
0.886	0.12E-02	0.31E-03	-74.7	0.12E-02	0.886	0.811	-8.5
0.944	0.97E-03	0.28E-03	-71.7	0.97E-03	0.944	0.829	-12.2
1.00	0.78E-03	0.25E-03	-67.6	0.78E-03	1.00	0.844	-15.7
1.06	0.63E-03	0.23E-03	-63.3	0.63E-03	1.06	0.858	-19.1
1.12	0.50E-03	0.21E-03	-57.7	0.50E-03	1.12	0.865	-22.6
1.18	0.40E-03	0.19E-03	-53.1	0.40E-03	1.18	0.871	-25.9
1.23	0.33E-03	0.17E-03	-47.6	0.33E-03	1.23	0.879	-28.8
1.29	0.25E-03	0.16E-03	-37.0	0.25E-03	1.29	1.01	-21.6
1.35	0.21E-03	0.14E-03	-36.2	0.21E-03	1.35	1.11	-17.4
1.41	0.17E-03	0.11E-03	-36.8	0.17E-03	1.41	1.24	-11.8
1.46	0.15E-03	0.66E-04	-56.7	0.15E-03	1.46	1.30	-11.4
1.52	0.13E-03	0.25E-04	-80.0	0.13E-03	1.52	1.39	-9.0
1.58	0.11E-03	0.00E+00	-100.0	0.11E-03	1.58	1.41	-11.1
1.64	0.84E-04	0.00E+00	-100.0	0.84E-04	1.64	1.44	-12.1
1.70	0.66E-04	0.00E+00	-100.0	0.66E-04	1.70	1.46	-13.6
1.75	0.57E-04	0.00E+00	-100.0	0.57E-04	1.75	1.48	-15.9
1.81	0.50E-04	0.00E+00	-100.0	0.50E-04	1.81	1.50	-17.4
1.87	0.41E-04	0.00E+00	-100.0	0.41E-04	1.87	1.51	-19.3
1.93	0.37E-04	0.00E+00	-100.0	0.37E-04	1.93	1.51	-21.6
1.99	0.32E-04	0.00E+00	-100.0	0.32E-04	1.99	1.51	-23.8
2.04	0.21E-04	0.00E+00	-100.0	0.21E-04	2.04	1.53	-25.1
2.10	0.14E-04	0.00E+00	-100.0	0.14E-04	2.10	1.56	-26.0
2.16	0.68E-05	0.00E+00	-100.0	0.68E-05	2.16	1.57	-27.3
2.22	0.46E-05	0.00E+00	-100.0	0.46E-05	2.22	1.57	-29.1
2.27	0.23E-05	0.00E+00	-100.0	0.23E-05	2.27	1.57	-30.9
2.33	0.23E-05	0.00E+00	-100.0	0.23E-05	2.33	1.57	-32.6
2.39	0.23E-05	0.00E+00	-100.0	0.23E-05	2.39	1.57	-34.2
2.45	0.23E-05	0.00E+00	-100.0	0.23E-05	2.45	1.57	-35.8
2.51	0.23E-05	0.00E+00	-100.0	0.23E-05	2.51	1.57	-37.3

There is no positive excursion

Maximum negative excursion = 0.934 cfs (-37.3%)
occuring at 2.51 cfs on the Base Data:sdn3xpre.tsf
and at 1.57 cfs on the New Data:sdn3xv2o.tsf

SDN3X
(SDN3 + SDN3X)

KCRTS: SEATAC MILLER

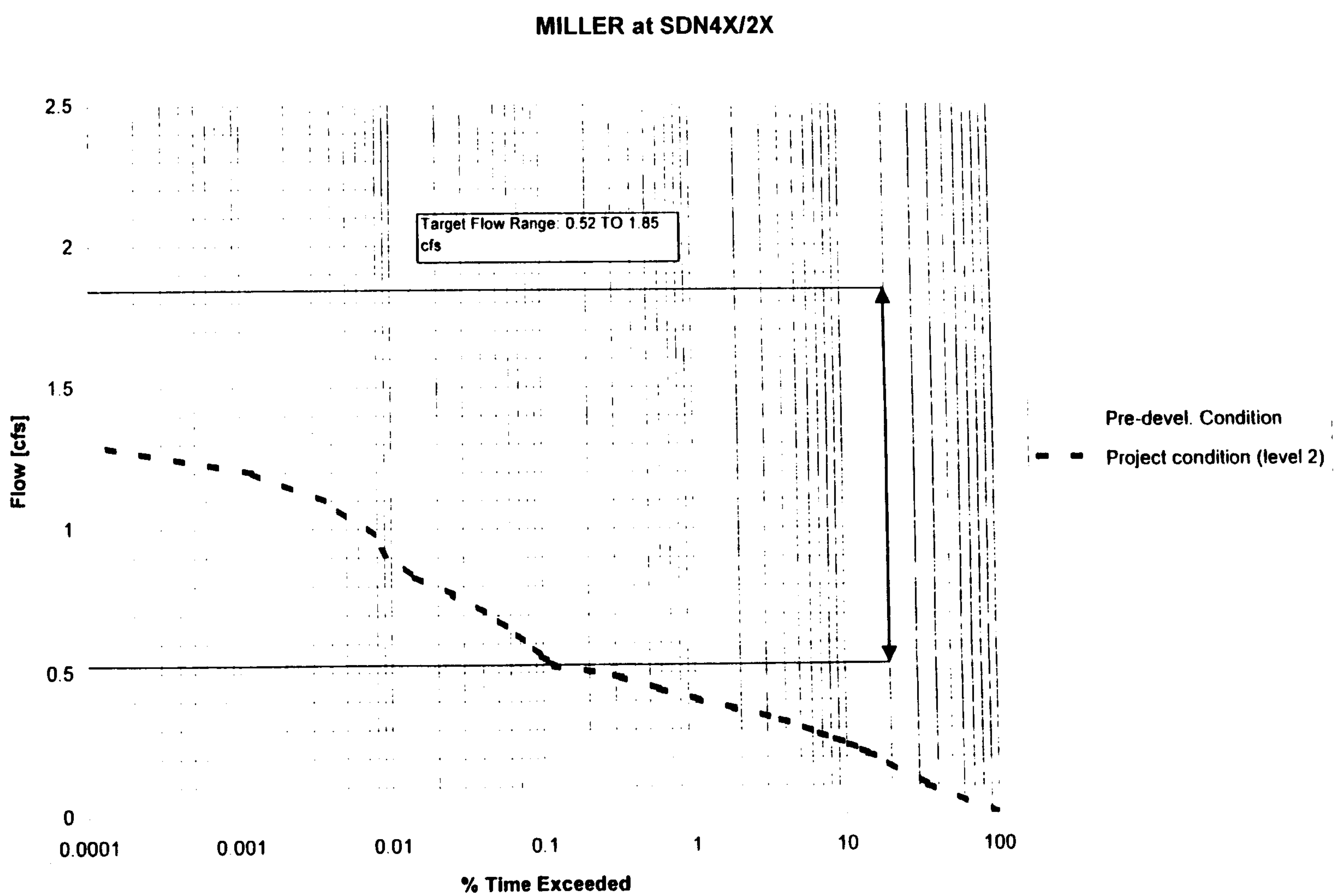
```
+-Land Use Summary------------------------------------------------+
|Till Forest              40.60 acres                             |
|Till Pasture              0.00 acres                             |
|Till Grass                8.75 acres                             |
|Airport Fill              0.00 acres                             |
|Outwash Forest           13.89 acres                             |
|Outwash Pasture           0.00 acres                             |
|Outwash Grass             4.63 acres                             |
|Wetland                   0.57 acres                             |
|Impervious                4.79 acres                             |
|-----------------------------------------------------------------|
|        Total Area :     73.23 acres                             |
|      Scale Factor :      1.00       Hourly       Historic        |
|-----------------------------------------------------------------|
|                                                                 |
|   Time Series: sdn3xpre                                         |
|-----------------------------------------------------------------|
|                     Compute Time Series                         |
|                      Modify User Input                          |
+-----------------------------------------------------------------+
```

```
----------------------------------------------------------------------------------
                 Retrieve runoff files and compute Time Series
```

KCRTS: SEATAC MILLER

```
+-Land Use Summary------------------------------------------------+
|Till Forest               0.00 acres                             |
|Till Pasture              0.00 acres                             |
|Till Grass               25.16 acres                             |
|Airport Fill             23.77 acres                             |
|Outwash Forest            0.00 acres                             |
|Outwash Pasture           0.00 acres                             |
|Outwash Grass             0.00 acres                             |
|Wetland                   0.00 acres                             |
|Impervious               24.30 acres                             |
|-----------------------------------------------------------------|
|        Total Area :     73.23 acres                             |
|      Scale Factor :      1.00       Hourly       Historic        |
|-----------------------------------------------------------------|
|                                                                 |
|   Time Series: sdn3xdev                                         |
|-----------------------------------------------------------------|
|                     Compute Time Series                         |
|                      Modify User Input                          |
+-----------------------------------------------------------------+
```

SDN4X/2X


MILLER at SDN4X/2X
Target Flow Range: 0.52 TO 1.85 cfs
2.5
2
1.5
1
0.5
0
Flow [cfs]
0.0001
0.001
0.01
0.1
1
10
100
% Time Exceeded
Pre-devel. Condition
Project condition (level 2)

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III
distributions are for preliminary computations.
User is responsible for assessment and
interpretation.

HOURLY FLOW SDN4X/2X (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

1.067	1.850	1.196	0.777	0.870
1.002	0.981	1.034	1.150	1.058
0.872	0.952	0.965	0.965	0.988
0.992	0.929	0.911	1.391	1.617
0.823	0.929	0.905	1.460	0.779
1.142	1.262	0.791	0.999	1.559
1.610	1.221	1.209	0.913	1.204
1.047	0.846	1.121	1.056	0.846
1.175	1.698	1.568	0.975	0.785
0.794	0.963	1.418		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.029
Variance (logs)	0.010
Standard Deviation (logs)	0.099
Skewness (logs)	0.692
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.198
Coefficient of Variation (logs)	3.441

1

HOURLY FLOW SDN4X/2X (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.707
0.9500	1.05	0.772
0.9000	1.11	0.816
0.8000	1.25	0.879
0.5000	2.00	1.041
0.2000	5.00	1.279
0.1000	10.00	1.447
0.0400	25.00	1.671
0.0200	50.00	1.846
0.0100	100.00	2.030
0.0050	200.00	2.222

$1/2\,Q_2 = 0.521$ cfs
$Q_{50} = 1.846$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN4X/2X (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.353	0.463	0.870	0.312	0.395
0.368	0.361	0.494	0.374	0.387
0.353	0.454	0.413	0.278	0.390
0.403	0.444	0.377	0.414	0.361
0.379	0.410	0.371	0.814	0.436
0.390	0.348	0.351	0.263	0.380
0.271	0.581	0.364	0.415	0.382
0.289	0.269	0.419	0.453	0.294
0.261	0.519	0.508	0.402	0.296
0.256	0.408	0.732		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.407
Variance (logs)	0.013
Standard Deviation (logs)	0.115
Skewness (logs)	0.981
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.027
Coefficient of Variation (logs)	-0.284

1

HOURLY FLOW SDN4X/2X (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.256
0.9500	1.05	0.276
0.9000	1.11	0.290
0.8000	1.25	0.312
0.5000	2.00	0.375
0.2000	5.00	0.479
0.1000	10.00	0.559
0.0400	25.00	0.673
0.0200	50.00	0.768
0.0100	100.00	0.872
0.0050	200.00	0.986

$1/2\,Q_2 = 0.188$ cfs
$Q_{50} = 0.768$ cfs

Miler Creek at SDN4X/2X

Percent cases equal or exceeding limit

Pre-devel. Condition	Project condition (level 2)	Flow [cfs]
100	100	0
4.82653639	33.4806	0.1
2.24818276	15.28132	0.2
2.0912395	13.81738	0.21
1.8075616	11.42453	0.23
1.57273671	9.377419	0.25
1.37803266	7.307184	0.27
1.20315303	5.835929	0.29
0.99098461	4.076985	0.32
0.86944208	3.029359	0.34
0.71934296	1.813226	0.37
0.58623619	1.051166	0.4
0.4566695	0.567828	0.44
0.36793165	0.325451	0.48
0.32497876	0.210044	0.5
0.28887001	0.11871	0.52
0.25936939	0.105494	0.54
0.22467667	0.094638	0.56
0.16968753	0.07269	0.61
0.12791466	0.055225	0.66
0.09534598	0.040357	0.71
0.07103748	0.025253	0.77
0.04861701	0.013216	0.84
0.03327669	0.009204	0.91
0.0238365	0.007552	0.98
0.01368828	0.00354	1.1
0.0094402	0.00118	1.2
0.00519211	0.0001	1.3
0.00401208	0	1.4
0.00236005	0	1.5
0.00165203	0	1.6
0.000236	0	1.7
0.0001	0	1.9
0	0	2
0	0	2.4

:

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Percent	Root mean square error(2) Average	Percent	Bias(3) Average	Percent
0.00	281856	0.023	*	0.042	*	-0.019	*
0.10	77114	0.134	91.3	0.143	96.2	-0.117	-79.6
0.20	6203	0.180	87.9	0.187	91.2	-0.164	-80.1
0.21	10139	0.193	87.8	0.200	91.2	-0.176	-80.2
0.23	8674	0.209	87.2	0.217	90.4	-0.192	-80.2
0.25	8772	0.224	86.3	0.232	89.3	-0.208	-80.3
0.27	6234	0.239	85.7	0.247	88.5	-0.225	-80.5
0.29	7453	0.259	85.3	0.268	88.1	-0.244	-80.2
0.32	4439	0.277	84.1	0.286	86.8	-0.264	-80.1
0.34	5153	0.294	83.1	0.304	85.8	-0.281	-79.6
0.37	3229	0.319	83.1	0.328	85.7	-0.305	-79.5
0.40	2048	0.347	83.0	0.359	85.8	-0.328	-78.6
0.44	1027	0.370	81.0	0.382	83.7	-0.342	-75.0
0.48	489	0.370	75.6	0.384	78.5	-0.351	-71.7
0.50	387	0.378	73.8	0.390	76.3	-0.361	-70.6
0.52	56	0.397	75.1	0.412	77.9	-0.392	-74.1
0.54	46	0.423	76.9	0.435	79.0	-0.379	-68.9
0.56	93	0.434	74.3	0.443	75.8	-0.403	-69.2
0.61	74	0.425	67.3	0.439	69.6	-0.405	-64.1
0.66	63	0.435	64.0	0.447	65.7	-0.420	-61.7
0.71	64	0.434	59.2	0.450	61.2	-0.426	-58.0
0.77	51	0.510	63.4	0.526	65.4	-0.509	-63.2
0.84	17	0.542	62.7	0.564	65.1	-0.542	-62.7
0.91	7	0.671	71.0	0.698	73.8	-0.571	-60.0
0.98	17	0.778	74.6	0.810	77.6	-0.778	-74.6
1.10	10	0.859	74.4	0.867	75.0	-0.859	-74.4
1.20	5	0.899	72.5	0.905	73.1	-0.899	-72.5
1.30	0	0.000	0.0	0.000	0.0	0.000	0.0
1.40	0	0.000	0.0	0.000	0.0	0.000	0.0
1.50	0	0.000	0.0	0.000	0.0	0.000	0.0
1.60	0	0.000	0.0	0.000	0.0	0.000	0.0
1.70	0	0.000	0.0	0.000	0.0	0.000	0.0
1.90	0	0.000	0.0	0.000	0.0	0.000	0.0
2.00	0	0.000	0.0	0.000	0.0	0.000	0.0
2.40	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.077	*	0.122	*	-0.068	*

Standard error of estimate = 0.10
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		95.17	66.52	100.00	100.00	0.01	0.02
0.10	1092577114		2.58	18.20	4.83	33.48	0.14	0.15
0.20	665	6203	0.16	1.46	2.25	15.28	0.20	0.20
0.21	120210139		0.28	2.39	2.09	13.82	0.22	0.22
0.23	995	8674	0.23	2.05	1.81	11.42	0.24	0.24
0.25	825	8772	0.19	2.07	1.57	9.38	0.26	0.26
0.27	741	6234	0.17	1.47	1.38	7.31	0.28	0.28
0.29	899	7453	0.21	1.76	1.20	5.84	0.30	0.30
0.32	515	4439	0.12	1.05	0.99	4.08	0.33	0.33
0.34	636	5153	0.15	1.22	0.87	3.03	0.35	0.35
0.37	564	3229	0.13	0.76	0.72	1.81	0.38	0.38
0.40	549	2048	0.13	0.48	0.59	1.05	0.42	0.42
0.44	376	1027	0.09	0.24	0.46	0.57	0.46	0.46
0.48	182	489	0.04	0.12	0.37	0.33	0.49	0.49
0.50	153	387	0.04	0.09	0.32	0.21	0.51	0.51
0.52	125	56	0.03	0.01	0.29	0.12	0.53	0.53
0.54	147	46	0.03	0.01	0.26	0.11	0.55	0.55
0.56	233	93	0.05	0.02	0.22	0.09	0.58	0.58
0.61	177	74	0.04	0.02	0.17	0.07	0.63	0.63
0.66	138	63	0.03	0.01	0.13	0.06	0.68	0.68
0.71	103	64	0.02	0.02	0.10	0.04	0.74	0.73
0.77	95	51	0.02	0.01	0.07	0.03	0.80	0.80
0.84	65	17	0.02	0.00	0.05	0.01	0.87	0.86
0.91	40	7	0.01	0.00	0.03	0.01	0.95	0.94
0.98	43	17	0.01	0.00	0.02	0.01	1.03	1.04
1.10	18	10	0.00	0.00	0.01	0.00	1.15	1.15
1.20	18	5	0.00	0.00	0.01	0.00	1.24	1.24
1.30	5	0	0.00	0.00	0.01	0.00	1.36	0.00
1.40	7	0	0.00	0.00	0.00	0.00	1.45	0.00
1.50	3	0	0.00	0.00	0.00	0.00	1.55	0.00
1.60	6	0	0.00	0.00	0.00	0.00	1.64	0.00
1.70	1	0	0.00	0.00	0.00	0.00	1.85	0.00
1.90	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.40	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720423720		100.00	100.00			0.02	0.09

12223 Observed values are zero
73109 Simulated values are zero
12223 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
60886 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	260028	2722	1090	11097	405	712	5802	0
0.10	67700	2967	1300	559	470	780	3338	0
0.20	5422	285	123	45	41	65	222	0
0.21	8863	514	199	84	49	102	328	0
0.23	7597	438	173	65	50	82	269	0
0.25	7676	450	200	55	51	88	252	0
0.27	5450	365	117	48	45	54	155	0
0.29	6524	404	156	54	38	85	192	0

0.32	3870	254	104	37	37	45	92	0
0.34	4489	346	111	40	30	39	98	0
0.37	2818	215	58	31	12	23	72	0
0.40	1777	165	42	11	7	12	34	0
0.44	885	58	28	4	6	7	39	0
0.48	405	42	18	5	4	5	10	0
0.50	299	68	8	1	0	5	6	0
0.52	48	5	0	1	0	2	0	0
0.54	38	5	1	0	0	0	2	0
0.56	83	4	1	1	1	0	3	0
0.61	62	5	2	2	0	1	2	0
0.66	45	14	3	0	0	0	1	0
0.71	29	32	1	0	1	0	1	0
0.77	40	8	1	0	2	0	0	0
0.84	11	5	1	0	0	0	0	0
0.91	5	1	0	0	0	0	1	0
0.98	15	0	1	1	0	0	0	0
1.10	8	2	0	0	0	0	0	0
1.20	4	1	0	0	0	0	0	0
1.30	0	0	0	0	0	0	0	0
1.40	0	0	0	0	0	0	0	0
1.50	0	0	0	0	0	0	0	0
1.60	0	0	0	0	0	0	0	0
1.70	0	0	0	0	0	0	0	0
1.90	0	0	0	0	0	0	0	0
2.00	0	0	0	0	0	0	0	0
2.40	0	0	0	0	0	0	0	0
	384191	9375	3738	12141	1249	2107	10919	0

COMPARISON ANALYSIS
(EXCLUDED DATA OCT 96-JAN 97)

1

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	281005	0.023	*	0.042	*	-0.019	*
0.10	76207	0.134	91.2	0.143	96.1	-0.117	-79.7
0.20	6158	0.180	87.9	0.187	91.1	-0.164	-80.1
0.21	10067	0.193	87.7	0.200	91.2	-0.176	-80.2
0.23	8506	0.209	87.1	0.217	90.4	-0.192	-80.3
0.25	8600	0.224	86.3	0.232	89.4	-0.208	-80.4
0.27	6141	0.239	85.7	0.247	88.5	-0.225	-80.5
0.29	7378	0.259	85.2	0.268	88.0	-0.244	-80.2
0.32	4387	0.277	84.0	0.286	86.8	-0.264	-80.1
0.34	5022	0.294	83.1	0.303	85.8	-0.281	-79.5
0.37	3148	0.318	83.0	0.328	85.6	-0.305	-79.5
0.40	2001	0.346	82.7	0.357	85.5	-0.328	-78.6
0.44	966	0.369	80.9	0.382	83.6	-0.341	-74.7
0.48	451	0.369	75.5	0.383	78.4	-0.349	-71.4
0.50	357	0.376	73.4	0.388	75.7	-0.359	-70.1
0.52	51	0.398	75.2	0.411	77.9	-0.396	-74.8
0.54	42	0.418	75.9	0.431	78.2	-0.370	-67.1
0.56	77	0.428	73.4	0.437	75.0	-0.403	-69.2
0.61	56	0.415	65.7	0.430	68.2	-0.388	-61.4
0.66	39	0.404	59.0	0.415	60.6	-0.380	-55.4
0.71	54	0.416	56.8	0.425	57.9	-0.407	-55.6
0.77	43	0.480	59.6	0.494	61.3	-0.479	-59.4
0.84	12	0.463	53.9	0.476	55.5	-0.463	-53.9
0.91	0	0.000	0.0	0.000	0.0	0.000	0.0
0.98	0	0.000	0.0	0.000	0.0	0.000	0.0
1.10	0	0.000	0.0	0.000	0.0	0.000	0.0
1.20	0	0.000	0.0	0.000	0.0	0.000	0.0
1.30	0	0.000	0.0	0.000	0.0	0.000	0.0
1.40	0	0.000	0.0	0.000	0.0	0.000	0.0
1.50	0	0.000	0.0	0.000	0.0	0.000	0.0
1.60	0	0.000	0.0	0.000	0.0	0.000	0.0
1.70	0	0.000	0.0	0.000	0.0	0.000	0.0
1.90	0	0.000	0.0	0.000	0.0	0.000	0.0
2.00	0	0.000	0.0	0.000	0.0	0.000	0.0
2.40	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.076	*	0.121	*	-0.068	*

Standard error of estimate = 0.10
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

AR 046630

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00**********			95.23	66.78	100.00	100.00	0.01	0.02
0.101077976207			2.56	18.11	4.77	33.22	0.14	0.15
0.20	645	6158	0.15	1.46	2.21	15.10	0.20	0.20
0.21	117510067		0.28	2.39	2.06	13.64	0.22	0.22
0.23	967	8506	0.23	2.02	1.78	11.25	0.24	0.24
0.25	807	8600	0.19	2.04	1.55	9.23	0.26	0.26
0.27	734	6141	0.17	1.46	1.36	7.18	0.28	0.28
0.29	887	7378	0.21	1.75	1.18	5.72	0.30	0.30
0.32	509	4387	0.12	1.04	0.97	3.97	0.33	0.33
0.34	623	5022	0.15	1.19	0.85	2.93	0.35	0.35
0.37	552	3148	0.13	0.75	0.70	1.73	0.38	0.38
0.40	541	2001	0.13	0.48	0.57	0.99	0.42	0.42
0.44	373	966	0.09	0.23	0.44	0.51	0.46	0.46
0.48	179	451	0.04	0.11	0.36	0.28	0.49	0.49
0.50	151	357	0.04	0.08	0.31	0.17	0.51	0.51
0.52	122	51	0.03	0.01	0.28	0.09	0.53	0.53
0.54	141	42	0.03	0.01	0.25	0.08	0.55	0.55
0.56	224	77	0.05	0.02	0.22	0.07	0.58	0.58
0.61	167	56	0.04	0.01	0.16	0.05	0.63	0.63
0.66	131	39	0.03	0.01	0.12	0.04	0.68	0.69
0.71	100	54	0.02	0.01	0.09	0.03	0.74	0.73
0.77	89	43	0.02	0.01	0.07	0.01	0.80	0.81
0.84	59	12	0.01	0.00	0.05	0.00	0.87	0.86
0.91	38	0	0.01	0.00	0.03	0.00	0.95	0.00
0.98	40	0	0.01	0.00	0.02	0.00	1.04	0.00
1.10	18	0	0.00	0.00	0.01	0.00	1.15	0.00
1.20	17	0	0.00	0.00	0.01	0.00	1.24	0.00
1.30	5	0	0.00	0.00	0.01	0.00	1.36	0.00
1.40	7	0	0.00	0.00	0.00	0.00	1.45	0.00
1.50	3	0	0.00	0.00	0.00	0.00	1.55	0.00
1.60	6	0	0.00	0.00	0.00	0.00	1.64	0.00
1.70	1	0	0.00	0.00	0.00	0.00	1.85	0.00
1.90	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.40	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768420768		100.00	100.00			0.02	0.09

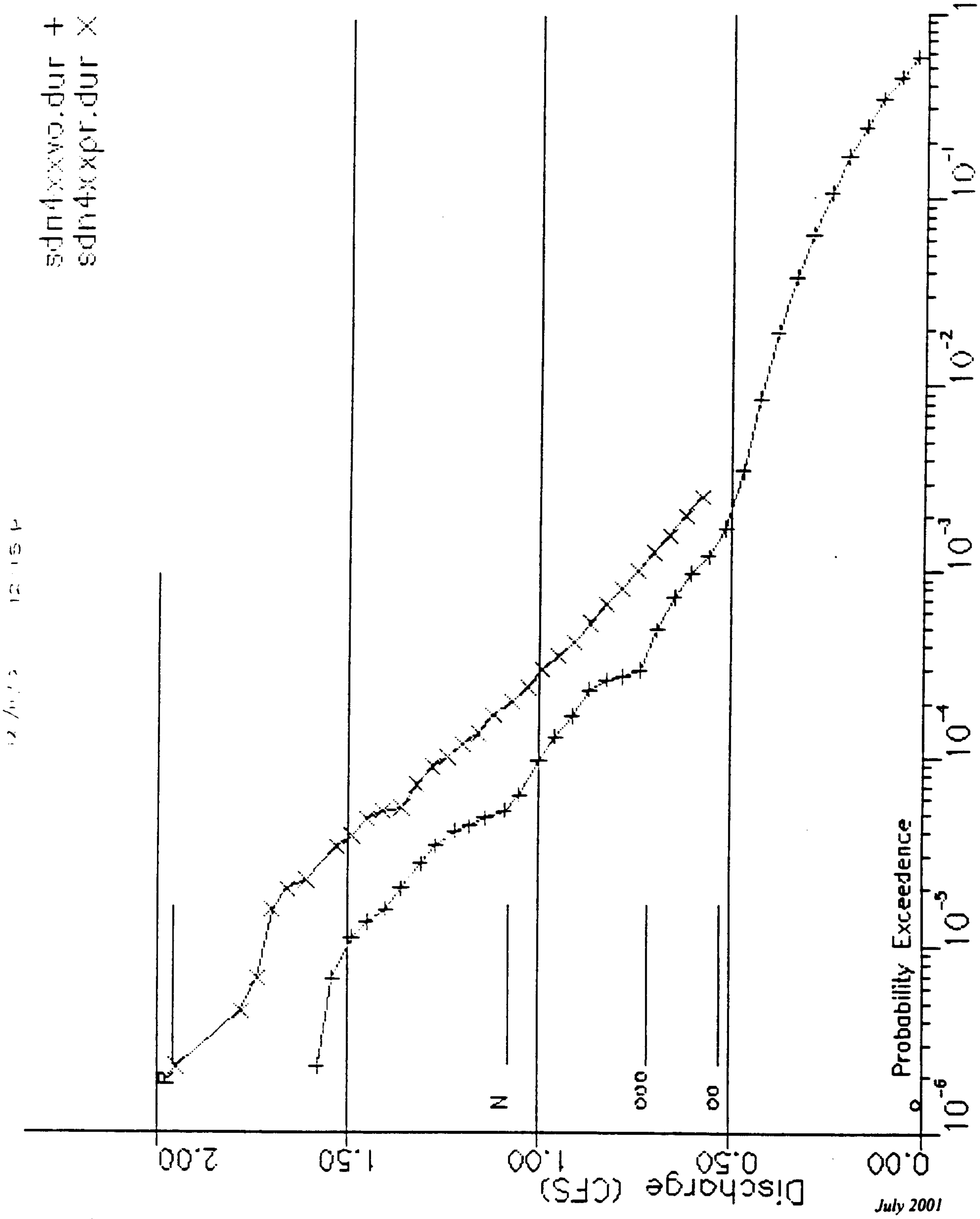
12223 Observed values are zero
73027 Simulated values are zero
12223 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
60804 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class limit	Number of occurrences between indicated deviations	-60%	-30%	-10%	0%	10%	30%	60%
0.00	259230	2711	1080	11093	405	708	5778	0
0.10	66883	2953	1290	555	468	772	3286	0
0.20	5384	282	122	45	40	65	220	0
0.21	8797	513	198	84	49	102	324	0
0.23	7449	429	171	63	49	82	263	0
0.25	7527	446	195	51	49	88	244	0
0.27	5369	362	115	47	44	53	151	0
0.29	6459	401	153	53	38	84	190	0

0.32	3827	252	100	36	37	45	90	0
0.34	4377	335	105	40	30	39	96	0
0.37	2747	210	57	30	12	23	69	0
0.40	1735	165	41	11	7	12	30	0
0.44	836	51	27	4	5	5	38	0
0.48	374	39	16	5	3	4	10	0
0.50	274	66	8	0	0	3	6	0
0.52	44	5	0	1	0	1	0	0
0.54	34	5	1	0	0	0	2	0
0.56	70	2	1	1	1	0	2	0
0.61	47	2	2	2	0	1	2	0
0.66	23	13	2	0	0	0	1	0
0.71	21	31	1	0	0	0	1	0
0.77	32	8	1	0	2	0	0	0
0.84	6	5	1	0	0	0	0	0
0.91	0	0	0	0	0	0	0	0
0.98	0	0	0	0	0	0	0	0
1.10	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0
1.30	0	0	0	0	0	0	0	0
1.40	0	0	0	0	0	0	0	0
1.50	0	0	0	0	0	0	0	0
1.60	0	0	0	0	0	0	0	0
1.70	0	0	0	0	0	0	0	0
1.90	0	0	0	0	0	0	0	0
2.00	0	0	0	0	0	0	0	0
2.40	0	0	0	0	0	0	0	0
	381545	9286	3687	12121	1239	2087	10803	0



July 2001
556-2912-001 (28)

SDN4X2X
(SDN2X + SDN4 + SDN4X)

Retention/Detention Facility

Type of Facility: Detention Vault
Facility Length: 275.00 ft
Facility Width: 125.00 ft
Facility Area: 34375. sq. ft
Effective Storage Depth: 19.00 ft
Stage 0 Elevation: 0.00 ft
Storage Volume: 653125. cu. ft
Riser Head: 19.00 ft
Riser Diameter: 24.00 inches
Number of orifices: 3

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	2.25	0.598	
2	14.50	2.00	0.230	4.0
3	16.50	3.00	0.386	6.0

Top Notch Weir: Rectangular
Length: 4.50 in
Weir Height: 18.00 ft
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.02	0.02	688.	0.016	0.021	0.00
0.05	0.05	1719.	0.039	0.030	0.00
0.07	0.07	2406.	0.055	0.036	0.00
0.09	0.09	3094.	0.071	0.042	0.00
0.12	0.12	4125.	0.095	0.047	0.00
0.14	0.14	4813.	0.110	0.051	0.00
0.16	0.16	5500.	0.126	0.056	0.00
0.19	0.19	6531.	0.150	0.059	0.00
0.63	0.63	21656.	0.497	0.109	0.00
1.07	1.07	36781.	0.844	0.142	0.00
1.51	1.51	51906.	1.192	0.169	0.00
1.95	1.95	67031.	1.539	0.192	0.00
2.40	2.40	82500.	1.894	0.213	0.00
2.84	2.84	97625.	2.241	0.231	0.00
3.28	3.28	112750.	2.588	0.249	0.00
3.72	3.72	127875.	2.936	0.265	0.00
4.16	4.16	143000.	3.283	0.280	0.00
4.61	4.61	158469.	3.638	0.295	0.00
5.05	5.05	173594.	3.985	0.309	0.00
5.49	5.49	188719.	4.332	0.322	0.00
5.93	5.93	203844.	4.680	0.334	0.00
6.37	6.37	218969.	5.027	0.347	0.00
6.82	6.82	234438.	5.382	0.358	0.00
7.26	7.26	249563.	5.729	0.370	0.00
7.70	7.70	264688.	6.076	0.381	0.00
8.14	8.14	279813.	6.424	0.392	0.00
8.58	8.58	294938.	6.771	0.402	0.00
9.02	9.02	310063.	7.118	0.413	0.00
9.47	9.47	325531.	7.473	0.422	0.00

SDN4X2X
(SDN2X + SDN4 + SDN4X)

9.91	9.91	340656.	7.820	0.432	0.00
10.35	10.35	355781.	8.168	0.442	0.00
10.79	10.79	370906.	8.515	0.451	0.00
11.23	11.23	386031.	8.862	0.460	0.00
11.68	11.68	401500.	9.217	0.469	0.00
12.12	12.12	416625.	9.564	0.478	0.00
12.56	12.56	431750.	9.912	0.487	0.00
13.00	13.00	446875.	10.259	0.495	0.00
13.44	13.44	462000.	10.606	0.503	0.00
13.89	13.89	477469.	10.961	0.512	0.00
14.33	14.33	492594.	11.308	0.520	0.00
14.50	14.50	498438.	11.443	0.523	0.00
14.52	14.52	499125.	11.458	0.524	0.00
14.54	14.54	499813.	11.474	0.527	0.00
14.56	14.56	500500.	11.490	0.531	0.00
14.58	14.58	501188.	11.506	0.538	0.00
14.60	14.60	501875.	11.521	0.545	0.00
14.62	14.62	502563.	11.537	0.554	0.00
14.65	14.65	503594.	11.561	0.563	0.00
14.67	14.67	504281.	11.577	0.570	0.00
14.69	14.69	504969.	11.592	0.573	0.00
15.13	15.13	520094.	11.940	0.620	0.00
15.57	15.57	535219.	12.287	0.654	0.00
16.01	16.01	550344.	12.634	0.683	0.00
16.45	16.45	565469.	12.981	0.709	0.00
16.50	16.50	567188.	13.021	0.711	0.00
16.53	16.53	568219.	13.045	0.715	0.00
16.56	16.56	569250.	13.068	0.724	0.00
16.59	16.59	570281.	13.092	0.737	0.00
16.63	16.63	571656.	13.123	0.754	0.00
16.66	16.66	572688.	13.147	0.775	0.00
16.69	16.69	573719.	13.171	0.800	0.00
16.72	16.72	574750.	13.194	0.828	0.00
16.75	16.75	575781.	13.218	0.847	0.00
17.19	17.19	590906.	13.565	0.950	0.00
17.63	17.63	606031.	13.913	1.030	0.00
18.00	18.00	618750.	14.205	1.080	0.00
18.13	18.13	623219.	14.307	1.150	0.00
18.25	18.25	627344.	14.402	1.250	0.00
18.38	18.38	631813.	14.504	1.360	0.00
18.50	18.50	635938.	14.599	1.470	0.00
18.63	18.63	640406.	14.702	1.570	0.00
18.75	18.75	644531.	14.796	1.660	0.00
18.88	18.88	649000.	14.899	1.810	0.00
19.00	19.00	653125.	14.994	1.960	0.00
19.10	19.10	656563.	15.073	2.580	0.00
19.20	19.20	660000.	15.152	3.720	0.00
19.30	19.30	663438.	15.230	5.190	0.00
19.40	19.40	666875.	15.309	6.930	0.00
19.50	19.50	670313.	15.388	8.900	0.00
19.60	19.60	673750.	15.467	11.080	0.00
19.70	19.70	677188.	15.546	13.440	0.00
19.80	19.80	680625.	15.625	15.580	0.00
19.90	19.90	684063.	15.704	16.410	0.00
20.00	20.00	687500.	15.783	17.190	0.00
20.10	20.10	690938.	15.862	17.940	0.00
20.20	20.20	694375.	15.941	18.660	0.00

20.30	20.30	697813.	16.020	19.350	0.00
20.40	20.40	701250.	16.098	20.010	0.00
20.50	20.50	704688.	16.177	20.640	0.00
20.60	20.60	708125.	16.256	21.260	0.00
20.70	20.70	711563.	16.335	21.860	0.00
20.80	20.80	715000.	16.414	22.440	0.00
20.90	20.90	718438.	16.493	23.010	0.00

Route Time Series through Facility
Inflow Time Series File:sdn4xxdv.tsf
Outflow Time Series File:sdn4xxvo

Inflow/Outflow Analysis
Peak Inflow Discharge: 11.01 CFS at 16:00 on Mar 3 in 1950
Peak Outflow Discharge: 1.59 CFS at 12:00 on Jan 2 in 1997
Peak Reservoir Stage: 18.66 Ft
Peak Reservoir Elev: 18.66 Ft
Peak Reservoir Storage: 641421. Cu-Ft
: 14.725 Ac-Ft

Flow Frequency Analysis
Time Series File:sdn4xxpr.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= 0.071 StdDev= 0.103
Skew= 0.496

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			2.22		100.00	0.990
Computed Peaks			2.03		50.00	0.980
Computed Peaks			1.85		25.00	0.960
Computed Peaks			1.61		10.00	0.900
Computed Peaks			1.56		8.00	0.875
Computed Peaks			1.42		5.00	0.800
Computed Peaks			1.15		2.00	0.500
Computed Peaks			0.979		1.30	0.231

Flow Frequency Analysis
Time Series File:sdn4xxvo.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.378 StdDev= 0.144
Skew= 1.926

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			1.37	18.39		100.00	0.990
Computed Peaks			1.09	18.02		50.00	0.980
Computed Peaks			0.872	16.86		25.00	0.960
Computed Peaks			0.646	15.47		10.00	0.900
Computed Peaks			0.610	15.04		8.00	0.875
Computed Peaks			0.515	14.03		5.00	0.800
Computed Peaks			0.379	7.63		2.00	0.500
Computed Peaks			0.328	5.71		1.30	0.231

SDN4X2X

(SDN2X + SDN4 + SDN4X)

Duration Comparison Anaylsis
Base File: sdn4xxpr.tsf
New File: sdn4xxvo.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.573	0.26E-02	0.12E-02	-55.0	0.26E-02	0.573	0.486	-15.2
0.618	0.20E-02	0.90E-03	-54.9	0.20E-02	0.618	0.502	-18.8
0.663	0.15E-02	0.64E-03	-58.4	0.15E-02	0.663	0.517	-22.1
0.708	0.12E-02	0.35E-03	-71.3	0.12E-02	0.708	0.539	-23.9
0.753	0.95E-03	0.29E-03	-69.8	0.95E-03	0.753	0.608	-19.2
0.798	0.77E-03	0.27E-03	-64.4	0.77E-03	0.798	0.639	-19.9
0.843	0.61E-03	0.26E-03	-57.2	0.61E-03	0.843	0.667	-20.9
0.888	0.48E-03	0.20E-03	-58.6	0.48E-03	0.888	0.693	-21.9
0.933	0.39E-03	0.15E-03	-62.6	0.39E-03	0.933	0.703	-24.6
0.978	0.31E-03	0.11E-03	-64.2	0.31E-03	0.978	0.713	-27.1
1.02	0.26E-03	0.84E-04	-67.8	0.26E-03	1.02	0.843	-17.6
1.07	0.21E-03	0.55E-04	-74.2	0.21E-03	1.07	0.884	-17.2
1.11	0.18E-03	0.50E-04	-71.4	0.18E-03	1.11	0.910	-18.2
1.16	0.14E-03	0.46E-04	-66.7	0.14E-03	1.16	0.954	-17.6
1.20	0.12E-03	0.43E-04	-64.2	0.12E-03	1.20	0.971	-19.3
1.25	0.10E-03	0.39E-04	-62.2	0.10E-03	1.25	0.995	-20.3
1.29	0.84E-04	0.32E-04	-62.2	0.84E-04	1.29	1.02	-20.9
1.34	0.64E-04	0.25E-04	-60.7	0.64E-04	1.34	1.05	-21.6
1.38	0.53E-04	0.18E-04	-65.2	0.53E-04	1.38	1.09	-20.9
1.43	0.48E-04	0.16E-04	-66.7	0.48E-04	1.43	1.14	-20.5
1.47	0.41E-04	0.11E-04	-72.2	0.41E-04	1.47	1.24	-15.8
1.52	0.37E-04	0.68E-05	-81.3	0.37E-04	1.52	1.25	-17.3
1.56	0.23E-04	0.46E-05	-80.0	0.23E-04	1.56	1.35	-13.3
1.61	0.23E-04	0.00E+00	-100.0	0.23E-04	1.61	1.35	-15.7
1.65	0.21E-04	0.00E+00	-100.0	0.21E-04	1.65	1.37	-17.3
1.70	0.16E-04	0.00E+00	-100.0	0.16E-04	1.70	1.43	-15.6
1.74	0.68E-05	0.00E+00	-100.0	0.68E-05	1.74	1.54	-11.8
1.79	0.46E-05	0.00E+00	-100.0	0.46E-05	1.79	1.57	-11.9
1.83	0.23E-05	0.00E+00	-100.0	0.23E-05	1.83	1.59	-13.2
1.88	0.23E-05	0.00E+00	-100.0	0.23E-05	1.88	1.59	-15.3
1.92	0.23E-05	0.00E+00	-100.0	0.23E-05	1.92	1.59	-17.3
1.97	0.23E-05	0.00E+00	-100.0	0.23E-05	1.97	1.59	-19.1

There is no positive excursion

Maximum negative excursion = 0.267 cfs (-27.3%)
occuring at 0.981 cfs on the Base Data:sdn4xxpr.tsf
and at 0.713 cfs on the New Data:sdn4xxvo.tsf

SDN4X2X
(SDN2X + SDN4 + SDN4X)

KCRTS: SEATAC-MILLER

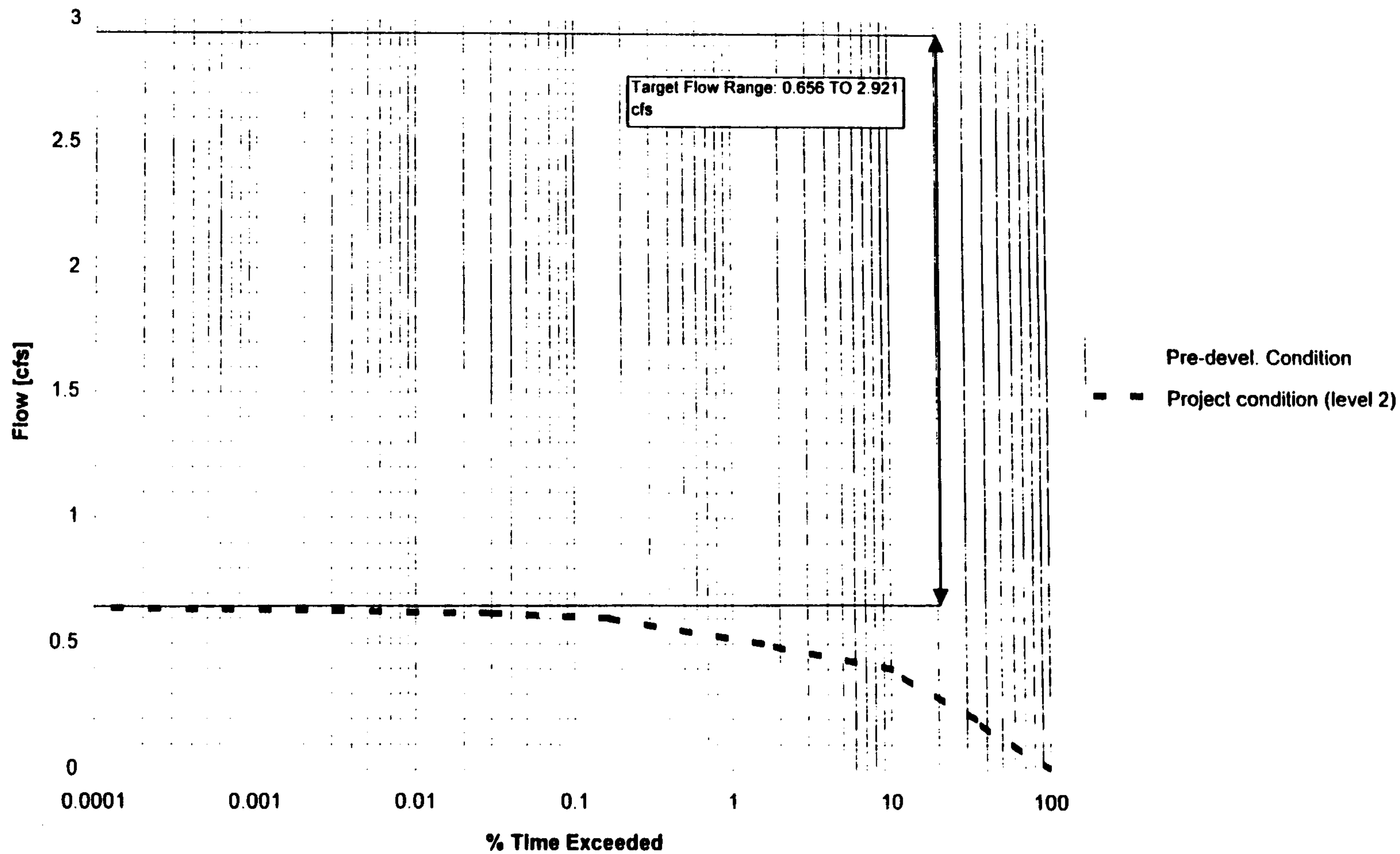
```
+-Land Use Summary------------------------------------------------+
|Till Forest            23.66 acres                               |
|Till Pasture            0.00 acres                               |
|Till Grass              5.29 acres                               |
|Airport Fill            0.00 acres                               |
|Outwash Forest         16.00 acres                               |
|Outwash Pasture         0.00 acres                               |
|Outwash Grass           3.99 acres                               |
|Wetland                 0.00 acres                               |
|Impervious              3.94 acres                               |
|-----------------------------------------------------------------|
|         Total Area :   52.88 acres                               |
|       Scale Factor :    1.00       Hourly      Historic          |
|-----------------------------------------------------------------|
|                                                                 |
|   Time Series: sdn4xxpr                                         |
|-----------------------------------------------------------------|
|                    Compute Time Series                          |
|                     Modify User Input                           |
+-----------------------------------------------------------------+
```

KCRTS: SEATAC-MILLER

```
+-Land Use Summary------------------------------------------------+
|Till Forest             0.00 acres                               |
|Till Pasture            0.00 acres                               |
|Till Grass             18.26 acres                               |
|Airport Fill           10.28 acres                               |
|Outwash Forest          0.00 acres                               |
|Outwash Pasture         0.00 acres                               |
|Outwash Grass           5.71 acres                               |
|Wetland                 0.00 acres                               |
|Impervious             18.66 acres                               |
|-----------------------------------------------------------------|
|         Total Area :   52.91 acres                               |
|       Scale Factor :    1.00       Hourly      Historic          |
|-----------------------------------------------------------------|
|                                                                 |
|   Time Series: sdn4xxdv                                         |
|-----------------------------------------------------------------|
|                    Compute Time Series                          |
|                     Modify User Input                           |
+-----------------------------------------------------------------+
```

SDW1B

MILLER at SDW1B



1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDW1B (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

1.281	2.662	2.365	0.958	1.052
1.219	1.391	1.459	1.412	1.271
1.075	1.338	1.317	1.152	1.209
1.258	1.276	1.129	1.672	1.934
1.095	1.137	1.107	2.728	1.071
1.377	1.568	0.969	1.182	1.842
1.904	1.492	1.470	1.100	1.425
1.415	1.002	1.440	1.356	1.001
1.387	2.144	2.645	1.179	0.928
0.938	1.149	2.792		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.139
Variance (logs)	0.016
Standard Deviation (logs)	0.128
Skewness (logs)	1.039
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.117
Coefficient of Variation (logs)	0.916

1

HOURLY FLOW SDW1B (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.871
0.9500	1.05	0.940
0.9000	1.11	0.992
0.8000	1.25	1.073
0.5000	2.00	1.311
0.2000	5.00	1.719
0.1000	10.00	2.043
0.0400	25.00	2.517
0.0200	50.00	2.921
0.0100	100.00	3.372
0.0050	200.00	3.877

$1/2 Q_2 = 0.656$ cfs
$Q_{50} = 2.921$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDW1B combined POC (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.412	0.571	0.625	0.383	0.512
0.464	0.407	0.601	0.455	0.447
0.450	0.480	0.517	0.361	0.455
0.499	0.469	0.454	0.532	0.444
0.452	0.467	0.416	0.627	0.468
0.486	0.427	0.414	0.260	0.423
0.333	0.541	0.418	0.473	0.455
0.374	0.298	0.450	0.463	0.353
0.357	0.483	0.502	0.439	0.367
0.323	0.461	0.619		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.352
Variance (logs)	0.006
Standard Deviation (logs)	0.080
Skewness (logs)	-0.508
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.084
Coefficient of Variation (logs)	-0.226

1

HOURLY FLOW SDW1B combined POC (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.272
0.9500	1.05	0.321
0.9000	1.11	0.349
0.8000	1.25	0.384
0.5000	2.00	0.452
0.2000	5.00	0.520
0.1000	10.00	0.556
0.0400	25.00	0.592
0.0200	50.00	0.615
0.0100	100.00	0.635
0.0050	200.00	0.653

$1/2 Q_2 = 0.226$ cfs
$Q_{50} = 0.615$ cfs

1

Simulated - HOURLY FLOW SDW1B (PREDEV)
Observed - HOURLY FLOW SDW1B combined POC (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	282679	0.048	*	0.079	*	-0.040	*
0.20	99080	0.262	88.7	0.274	91.4	-0.248	-83.9
0.40	35531	0.366	84.3	0.380	86.9	-0.356	-81.5
0.50	5738	0.447	82.6	0.469	86.6	-0.411	-76.0
0.60	570	0.368	60.5	0.405	66.7	-0.305	-50.2
0.62	122	0.269	43.1	0.306	49.1	-0.230	-36.9
0.64	0	0.000	0.0	0.000	0.0	0.000	0.0
0.66	0	0.000	0.0	0.000	0.0	0.000	0.0
0.68	0	0.000	0.0	0.000	0.0	0.000	0.0
0.70	0	0.000	0.0	0.000	0.0	0.000	0.0
0.72	0	0.000	0.0	0.000	0.0	0.000	0.0
0.75	0	0.000	0.0	0.000	0.0	0.000	0.0
0.80	0	0.000	0.0	0.000	0.0	0.000	0.0
0.90	0	0.000	0.0	0.000	0.0	0.000	0.0
1.00	0	0.000	0.0	0.000	0.0	0.000	0.0
1.10	0	0.000	0.0	0.000	0.0	0.000	0.0
1.20	0	0.000	0.0	0.000	0.0	0.000	0.0
1.30	0	0.000	0.0	0.000	0.0	0.000	0.0
1.40	0	0.000	0.0	0.000	0.0	0.000	0.0
1.60	0	0.000	0.0	0.000	0.0	0.000	0.0
1.70	0	0.000	0.0	0.000	0.0	0.000	0.0
1.80	0	0.000	0.0	0.000	0.0	0.000	0.0
1.90	0	0.000	0.0	0.000	0.0	0.000	0.0
2.00	0	0.000	0.0	0.000	0.0	0.000	0.0
2.10	0	0.000	0.0	0.000	0.0	0.000	0.0
2.20	0	0.000	0.0	0.000	0.0	0.000	0.0
2.30	0	0.000	0.0	0.000	0.0	0.000	0.0
2.40	0	0.000	0.0	0.000	0.0	0.000	0.0
2.50	0	0.000	0.0	0.000	0.0	0.000	0.0
2.60	0	0.000	0.0	0.000	0.0	0.000	0.0
2.70	0	0.000	0.0	0.000	0.0	0.000	0.0
2.80	0	0.000	0.0	0.000	0.0	0.000	0.0
2.90	0	0.000	0.0	0.000	0.0	0.000	0.0
3.00	0	0.000	0.0	0.000	0.0	0.000	0.0
3.10	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.131	*	0.192	*	-0.121	*

Standard error of estimate = 0.15
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDW1B (PREDEV)
Observed - HOURLY FLOW SDW1B combined POC (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		96.65	66.71	100.00	100.00	0.01	0.05
0.20	957999080		2.26	23.38	3.35	33.29	0.28	0.30
0.40	185835531		0.44	8.39	1.09	9.90	0.45	0.44
0.50	1002	5738	0.24	1.35	0.65	1.52	0.55	0.54
0.60	151	570	0.04	0.13	0.41	0.16	0.61	0.61
0.62	138	122	0.03	0.03	0.38	0.03	0.63	0.62
0.64	128	0	0.03	0.00	0.35	0.00	0.65	0.00
0.66	106	0	0.03	0.00	0.31	0.00	0.67	0.00
0.68	110	0	0.03	0.00	0.29	0.00	0.69	0.00
0.70	92	0	0.02	0.00	0.26	0.00	0.71	0.00
0.72	122	0	0.03	0.00	0.24	0.00	0.73	0.00
0.75	157	0	0.04	0.00	0.21	0.00	0.77	0.00
0.80	260	0	0.06	0.00	0.18	0.00	0.84	0.00
0.90	144	0	0.03	0.00	0.11	0.00	0.95	0.00
1.00	96	0	0.02	0.00	0.08	0.00	1.04	0.00
1.10	64	0	0.02	0.00	0.06	0.00	1.15	0.00
1.20	47	0	0.01	0.00	0.04	0.00	1.25	0.00
1.30	35	0	0.01	0.00	0.03	0.00	1.35	0.00
1.40	34	0	0.01	0.00	0.02	0.00	1.49	0.00
1.60	12	0	0.00	0.00	0.02	0.00	1.64	0.00
1.70	9	0	0.00	0.00	0.01	0.00	1.74	0.00
1.80	14	0	0.00	0.00	0.01	0.00	1.86	0.00
1.90	7	0	0.00	0.00	0.01	0.00	1.95	0.00
2.00	3	0	0.00	0.00	0.01	0.00	2.06	0.00
2.10	5	0	0.00	0.00	0.01	0.00	2.16	0.00
2.20	4	0	0.00	0.00	0.00	0.00	2.26	0.00
2.30	6	0	0.00	0.00	0.00	0.00	2.36	0.00
2.40	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.50	1	0	0.00	0.00	0.00	0.00	2.52	0.00
2.60	3	0	0.00	0.00	0.00	0.00	2.65	0.00
2.70	3	0	0.00	0.00	0.00	0.00	2.75	0.00
2.80	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.90	0	0	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
3.10	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720423720		100.00	100.00			0.03	0.15

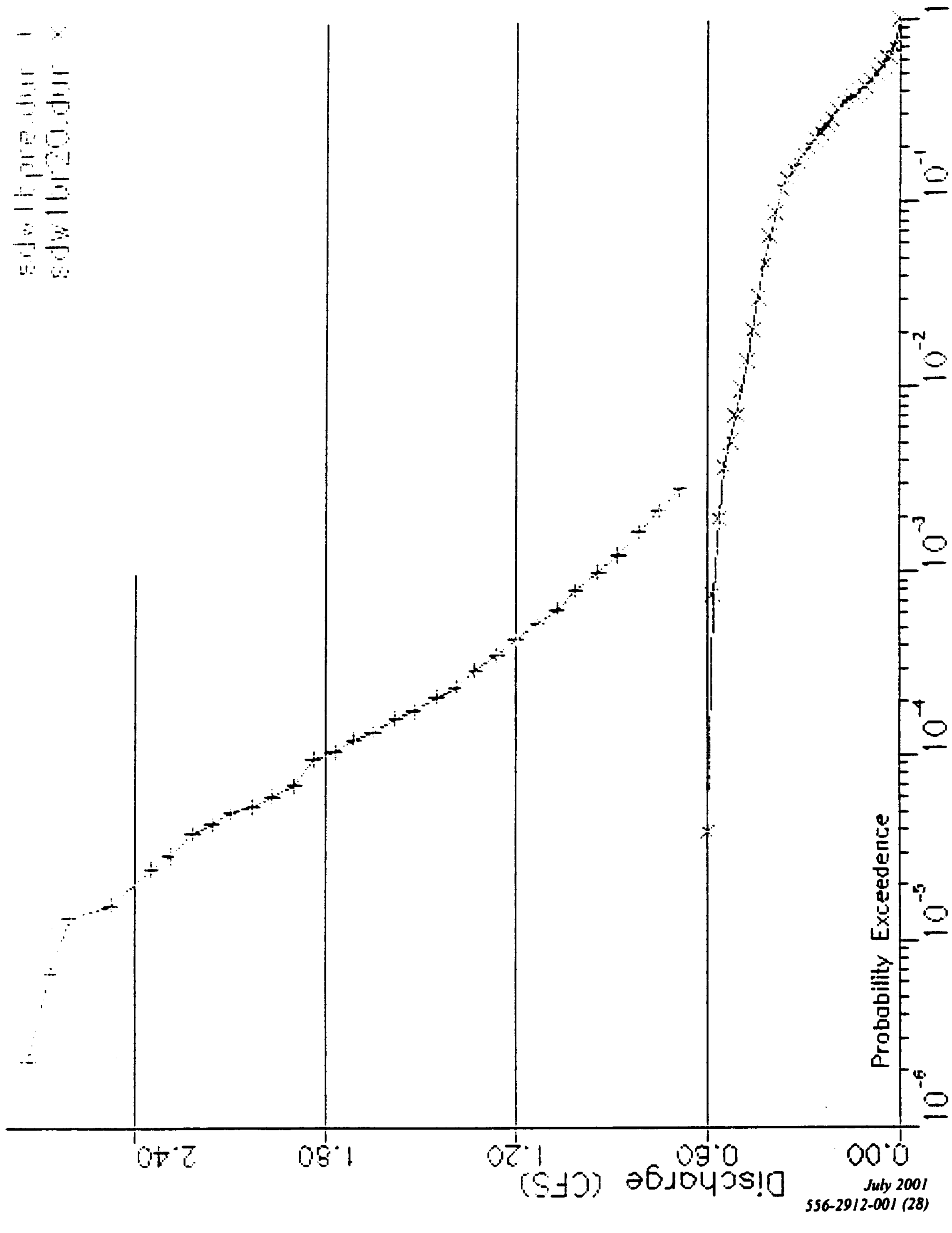
90005 Observed values are zero
68593 Simulated values are zero
65756 Observed values are zero when simulated are zero
24249 Observed values are zero when simulated are not
2837 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDW1B (PREDEV)
Observed - HOURLY FLOW SDW1B combined POC (2006)

Lower class limit	Number of occurrences between indicated deviations	-60%	-30%	-10%	0%	10%	30%	60%
0.00	178756	3130	1444	90555	502	920	7372	0
0.20	89487	4197	1550	562	463	730	2091	0
0.40	31495	2300	645	215	155	233	488	0
0.50	4782	524	149	53	36	46	148	0
0.60	310	131	41	17	13	18	40	0
0.62	40	36	18	8	4	13	3	0
0.64	0	0	0	0	0	0	0	0
0.66	0	0	0	0	0	0	0	0

0.68	0	0	0	0	0	0	0	0
0.70	0	0	0	0	0	0	0	0
0.72	0	0	0	0	0	0	0	0
0.75	0	0	0	0	0	0	0	0
0.80	0	0	0	0	0	0	0	0
0.90	0	0	0	0	0	0	0	0
1.00	0	0	0	0	0	0	0	0
1.10	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0
1.30	0	0	0	0	0	0	0	0
1.40	0	0	0	0	0	0	0	0
1.60	0	0	0	0	0	0	0	0
1.70	0	0	0	0	0	0	0	0
1.80	0	0	0	0	0	0	0	0
1.90	0	0	0	0	0	0	0	0
2.00	0	0	0	0	0	0	0	0
2.10	0	0	0	0	0	0	0	0
2.20	0	0	0	0	0	0	0	0
2.30	0	0	0	0	0	0	0	0
2.40	0	0	0	0	0	0	0	0
2.50	0	0	0	0	0	0	0	0
2.60	0	0	0	0	0	0	0	0
2.70	0	0	0	0	0	0	0	0
2.80	0	0	0	0	0	0	0	0
2.90	0	0	0	0	0	0	0	0
3.00	0	0	0	0	0	0	0	0
3.10	0	0	0	0	0	0	0	0
	304870	10318	3847	91410	1173	1960	10142	0


sdw11bpre.dur
sdw11br20.dur
Probability Exceedence
Discharge (CFS)
0.00
0.60
1.20
1.80
2.40
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1

SDW1B

ROUTE FLOW THROUGH **FLOW SPLITTER** PRIOR TO POND
DISCHARGE A GOES TO INFILTRATION, DISCHARGE B GOES TO POND

FLOW SPLITTER IS A **100 S.F. BOX** WITH **ORIFICE** (DISCHARGE A) CONTROLLING FLOW TO INFILTRATION BASIN AND **WEIR** (DISCHARGE B) CONTROLLING FLOW TO POND D

AFTER ROUTING THROUGH FLOW SPLITTER, ROUTE DISCHARGE B TIME SERIES (SDW1BSPO) THROUGH POND D

FLOW SPLITTER RESERVOIR FILE

Stage (Ft)	Discharge (CFS) A	B	Storage (Cu-Ft)	Perm-Area (Sq-Ft)
0.00	0.000	0.000	0.	0.
0.10	0.050	0.000	10.	0.
0.40	0.110	0.000	40.	0.
0.60	0.130	0.000	60.	0.
0.75	0.150	0.000	75.	0.
0.80	0.150	0.720	80.	0.
1.00	0.170	8.050	100.	0.
1.10	0.180	13.330	110.	0.
1.20	0.190	19.440	120.	0.
1.30	0.190	26.270	130	0.
1.40	0.200	33.750	140.	0.
1.46	0.200	38.530	146.	0.

```
Reservoir Routing [Double Outlet]
 Computing Series:sdw1bini.tsf
       and Series:sdw1bspo.tsf
   Years Complete: 50
                             Inflow/Outflow Analysis
                             -----------------------
   Peak Inflow Discharge:      23.20 CFS at 16:00 on Mar  3 in 1950
Peak A-Outflow Discharge:      0.190 CFS at 16:00 on Mar  3 in 1950
Peak B-Outflow Discharge:      22.75 CFS at 16:00 on Mar  3 in 1950
    Peak Reservoir Stage:       1.25  Ft
     Peak Reservoir Elev:       1.25  Ft
  Peak Reservoir Storage:     125.    Cu-Ft
                        :       0.003 Ac-Ft
                                      Storing Time Series File:sdw1bini.tsf  50
                                      Storing Time Series File:sdw1bspo.tsf  50
```

POND D:

Effective Storage Depth:	14.00	ft
Stage 0 Elevation:	0.00	ft
Riser Head:	14.00	ft
Riser Diameter:	24.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	2.60	0.686	
2	12.80	3.50	0.364	6.0

Top Notch Weir:	Rectangular	
Length:	2.50	in
Weir Height:	13.25	ft

Stage (Ft)	Discharge (CFS) A	B	Storage (Cu-Ft)	Perm-Area (Sq-Ft)
0.00	0.000	0.000	0.	0.
1.00	0.000	0.183	105032.	0.
2.00	0.000	0.257	211715.	0.
3.00	0.000	0.319	321103.	0.
4.00	0.000	0.366	433230.	0.
5.00	0.000	0.411	667352.	0.
6.00	0.000	0.450	903530.	0.
7.00	0.000	0.481	1144090.	0.
8.00	0.000	0.518	1389054.	0.
9.00	0.000	0.550	1638448.	0.
10.00	0.000	0.583	1892299.	0.
11.00	0.000	0.609	2150631.	0.
12.00	0.000	0.634	2413468.	0.
13.00	0.000	0.764	2680839.	0.
14.00	0.000	1.320	2952767.	0.
15.00	0.000	16.600	3049200.	0.

Inflow/Outflow Analysis

Peak Inflow Discharge:	22.75 CFS at 16:00 on Mar 3 in 1950
Peak B-Outflow Discharge:	0.599 CFS at 11:00 on Mar 14 in 1972
Peak Reservoir Stage:	10.63 Ft
Peak Reservoir Elev:	10.63 Ft
Peak Reservoir Storage:	2054369. Cu-Ft
:	47.162 Ac-Ft

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdw1bpre.tsf Mean= 0.152 StdDev= 0.129
Project Location:Sea-Tac Miller Skew= 0.772

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			3.34		100.00	0.990
Computed Peaks			2.93		50.00	0.980
Computed Peaks			2.56		25.00	0.960
Computed Peaks			2.11		10.00	0.900
Computed Peaks			2.03		8.00	0.875
Computed Peaks			1.79		5.00	0.800
Computed Peaks			1.37		2.00	0.500
Computed Peaks			1.13		1.30	0.231

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdw1br20.tsf Mean= -0.360 StdDev= 0.070
Project Location:Sea-Tac Miller Skew= -0.240

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks (CFS)	- - (ft)	Rank	Return Period	Prob
Computed Peaks			0.617	11.33		100.00	0.990
Computed Peaks			0.595	10.47		50.00	0.980
Computed Peaks			0.571	9.63		25.00	0.960
Computed Peaks			0.534	8.50		10.00	0.900
Computed Peaks			0.525	8.23		8.00	0.875
Computed Peaks			0.500	7.53		5.00	0.800
Computed Peaks			0.439	5.72		2.00	0.500
Computed Peaks			0.387	4.47		1.30	0.231

Duration Comparison Anaylsis
Base File: sdw1bpre.tsf
New File: sdw1br20.tsf
Cutoff Units: Discharge in CFS

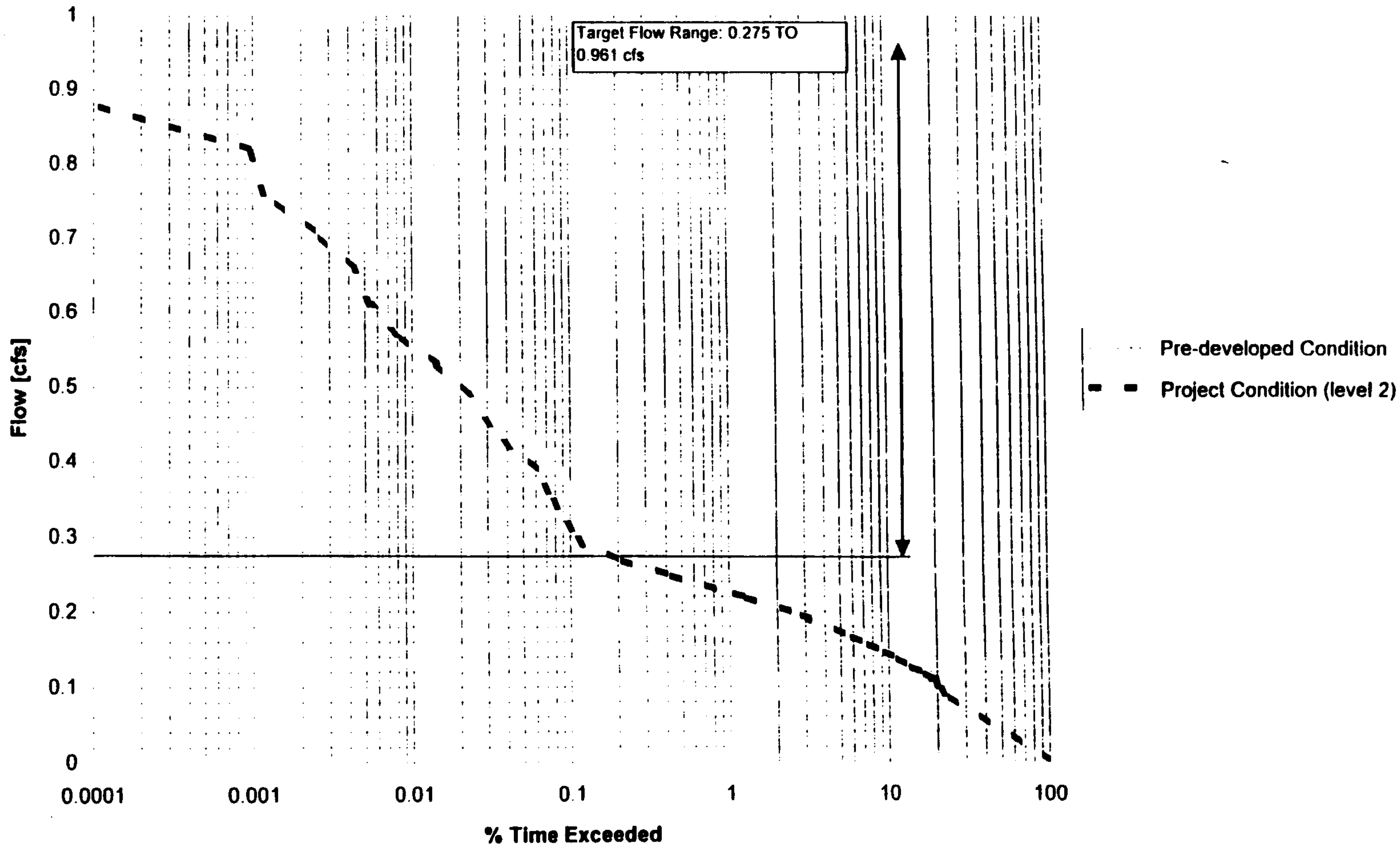
	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.683	0.29E-02	0.00E+00	-100.0	0.29E-02	0.683	0.554	-19.0
0.751	0.21E-02	0.00E+00	-100.0	0.21E-02	0.751	0.562	-25.2
0.819	0.16E-02	0.00E+00	-100.0	0.16E-02	0.819	0.567	-30.8
0.887	0.12E-02	0.00E+00	-100.0	0.12E-02	0.887	0.573	-35.4
0.955	0.95E-03	0.00E+00	-100.0	0.95E-03	0.955	0.578	-39.5
1.02	0.74E-03	0.00E+00	-100.0	0.74E-03	1.02	0.581	-43.2
1.09	0.60E-03	0.00E+00	-100.0	0.60E-03	1.09	0.584	-46.5
1.16	0.49E-03	0.00E+00	-100.0	0.49E-03	1.16	0.586	-49.4
1.23	0.39E-03	0.00E+00	-100.0	0.39E-03	1.23	0.588	-52.1
1.29	0.32E-03	0.00E+00	-100.0	0.32E-03	1.29	0.589	-54.5
1.36	0.27E-03	0.00E+00	-100.0	0.27E-03	1.36	0.590	-56.7
1.43	0.22E-03	0.00E+00	-100.0	0.22E-03	1.43	0.592	-58.6
1.50	0.19E-03	0.00E+00	-100.0	0.19E-03	1.50	0.592	-60.5
1.57	0.17E-03	0.00E+00	-100.0	0.17E-03	1.57	0.593	-62.2
1.63	0.14E-03	0.00E+00	-100.0	0.14E-03	1.63	0.593	-63.7
1.70	0.13E-03	0.00E+00	-100.0	0.13E-03	1.70	0.594	-65.1
1.77	0.11E-03	0.00E+00	-100.0	0.11E-03	1.77	0.595	-66.4
1.84	0.98E-04	0.00E+00	-100.0	0.98E-04	1.84	0.595	-67.6
1.91	0.71E-04	0.00E+00	-100.0	0.71E-04	1.91	0.597	-68.7
1.97	0.62E-04	0.00E+00	-100.0	0.62E-04	1.97	0.597	-69.7
2.04	0.55E-04	0.00E+00	-100.0	0.55E-04	2.04	0.598	-70.7
2.11	0.50E-04	0.00E+00	-100.0	0.50E-04	2.11	0.598	-71.7
2.18	0.43E-04	0.00E+00	-100.0	0.43E-04	2.18	0.598	-72.5
2.25	0.37E-04	0.00E+00	-100.0	0.37E-04	2.25	0.599	-73.3
2.31	0.30E-04	0.00E+00	-100.0	0.30E-04	2.31	0.600	-74.1
2.38	0.18E-04	0.00E+00	-100.0	0.18E-04	2.38	0.601	-74.8
2.45	0.16E-04	0.00E+00	-100.0	0.16E-04	2.45	0.601	-75.5
2.52	0.16E-04	0.00E+00	-100.0	0.16E-04	2.52	0.601	-76.1
2.59	0.14E-04	0.00E+00	-100.0	0.14E-04	2.59	0.601	-76.7
2.65	0.91E-05	0.00E+00	-100.0	0.91E-05	2.65	0.602	-77.3
2.72	0.46E-05	0.00E+00	-100.0	0.46E-05	2.72	0.602	-77.9
2.79	0.23E-05	0.00E+00	-100.0	0.23E-05	2.79	0.603	-78.4

There is no positive excursion

Maximum negative excursion = 2.19 cfs (-78.4%)
occuring at 2.79 cfs on the Base Data:sdw1bpre.tsf
and at 0.603 cfs on the New Data:sdw1br20.tsf

SDN1

MILLER at SDN1



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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN1 PREDEV

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.566	0.948	0.614	0.407	0.460
0.528	0.518	0.548	0.603	0.561
0.456	0.494	0.504	0.514	0.519
0.525	0.495	0.478	0.737	0.859
0.429	0.488	0.481	0.757	0.412
0.605	0.657	0.422	0.534	0.834
0.861	0.642	0.637	0.484	0.644
0.554	0.452	0.573	0.558	0.453
0.629	0.877	0.814	0.515	0.420
0.424	0.513	0.712		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.250
Variance (logs)	0.009
Standard Deviation (logs)	0.097
Skewness (logs)	0.690
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.209
Coefficient of Variation (logs)	-0.388

1

HOURLY FLOW SDN1 PREDEV

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.376
0.9500	1.05	0.409
0.9000	1.11	0.432
0.8000	1.25	0.465
0.5000	2.00	0.549
0.2000	5.00	0.671
0.1000	10.00	0.757
0.0400	25.00	0.872
0.0200	50.00	0.961
0.0100	100.00	1.054
0.0050	200.00	1.152

$\frac{1}{2}Q_2 = 0.275$ cfs
$Q_{50} = 0.961$ cfs

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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III
distributions are for preliminary computations.
User is responsible for assessment and
interpretation.

HOURLY FLOW SDN1 2006

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.212	0.253	0.731	0.188	0.230
0.228	0.233	0.272	0.229	0.243
0.213	0.422	0.249	0.184	0.237
0.251	0.275	0.222	0.244	0.226
0.214	0.236	0.241	0.501	0.266
0.238	0.224	0.232	0.201	0.243
0.183	0.536	0.222	0.245	0.234
0.194	0.209	0.267	0.353	0.209
0.202	0.436	0.432	0.246	0.198
0.179	0.255	0.712		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.587
Variance (logs)	0.021
Standard Deviation (logs)	0.143
Skewness (logs)	1.824
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.061
Coefficient of Variation (logs)	-0.244

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HOURLY FLOW SDN1 2006

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.181
0.9500	1.05	0.185
0.9000	1.11	0.190
0.8000	1.25	0.199
0.5000	2.00	0.236
0.2000	5.00	0.320
0.1000	10.00	0.399
0.0400	25.00	0.534
0.0200	50.00	0.664
0.0100	100.00	0.825
0.0050	200.00	1.023

$\frac{1}{2}Q_2 = 0.118$ cfs
$Q_{50} = 0.664$ cfs

1

Simulated - HOURLY FLOW SDN1 PREDEV
Observed - HOURLY FLOW SDN1 2006

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	329033	0.020	*	0.032	*	-0.018	*
0.09	8879	0.086	90.2	0.089	93.9	-0.079	-83.1
0.10	4017	0.092	89.4	0.095	92.5	-0.086	-84.2
0.11	3696	0.096	89.3	0.100	92.6	-0.089	-82.9
0.11	13281	0.103	89.3	0.106	92.5	-0.096	-83.4
0.12	11523	0.111	88.6	0.114	91.5	-0.103	-82.9
0.13	9382	0.118	87.7	0.122	90.8	-0.111	-82.6
0.14	8931	0.127	87.4	0.131	90.4	-0.119	-82.4
0.15	7276	0.135	87.3	0.140	90.2	-0.127	-82.3
0.16	5911	0.142	86.3	0.147	89.4	-0.135	-81.8
0.17	8415	0.155	86.2	0.160	89.0	-0.146	-81.5
0.19	3414	0.165	85.0	0.171	88.1	-0.157	-80.7
0.20	4903	0.176	83.9	0.182	87.0	-0.168	-80.2
0.22	1684	0.185	82.4	0.192	85.4	-0.177	-78.6
0.23	1713	0.197	82.4	0.203	85.1	-0.186	-78.1
0.25	850	0.210	81.0	0.217	83.8	-0.195	-75.1
0.27	303	0.217	78.7	0.226	81.9	-0.199	-72.3
0.29	72	0.232	77.4	0.240	80.0	-0.204	-68.0
0.31	85	0.247	76.2	0.259	79.8	-0.232	-71.6
0.34	44	0.252	72.1	0.264	75.3	-0.243	-69.5
0.36	55	0.281	74.9	0.294	78.3	-0.264	-70.5
0.39	76	0.299	73.8	0.308	76.2	-0.294	-72.6
0.42	43	0.319	73.6	0.326	75.3	-0.304	-70.1
0.45	40	0.334	71.0	0.352	74.8	-0.330	-70.2
0.49	34	0.373	73.1	0.386	75.6	-0.373	-73.1
0.53	26	0.408	74.7	0.421	77.1	-0.407	-74.5
0.57	11	0.371	62.9	0.406	68.9	-0.363	-61.5
0.61	5	0.488	76.7	0.492	77.4	-0.488	-76.7
0.66	8	0.457	66.5	0.486	70.7	-0.457	-66.5
0.71	5	0.465	64.1	0.481	65.9	-0.465	-64.1
0.76	1	0.706	89.7	0.706	89.7	-0.706	-89.7
0.82	4	0.582	69.5	0.597	71.3	-0.582	-69.5
0.88	0	0.000	0.0	0.000	0.0	0.000	0.0
0.95	0	0.000	0.0	0.000	0.0	0.000	0.0
1.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.044	*	0.070	*	-0.040	*

Standard error of estimate = 0.06
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDN1 PREDEV
Observed - HOURLY FLOW SDN1 2006

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	******	****	97.35	77.65	100.00	100.00	0.00	0.02
0.09	1431	8879	0.34	2.10	2.65	22.35	0.09	0.09
0.10	655	4017	0.15	0.95	2.31	20.25	0.10	0.10
0.11	617	3696	0.15	0.87	2.16	19.30	0.11	0.11
0.11	1066	13281	0.25	3.13	2.01	18.43	0.11	0.12
0.12	945	11523	0.22	2.72	1.76	15.30	0.12	0.12
0.13	781	9382	0.18	2.21	1.54	12.58	0.13	0.13
0.14	672	8931	0.16	2.11	1.35	10.36	0.15	0.15
0.15	573	7276	0.14	1.72	1.19	8.25	0.15	0.15
0.16	546	5911	0.13	1.40	1.06	6.54	0.16	0.16
0.17	832	8415	0.20	1.99	0.93	5.14	0.18	0.18
0.19	366	3414	0.09	0.81	0.73	3.16	0.20	0.19
0.20	550	4903	0.13	1.16	0.65	2.35	0.21	0.21
0.22	247	1684	0.06	0.40	0.52	1.19	0.22	0.22
0.23	387	1713	0.09	0.40	0.46	0.80	0.24	0.24
0.25	314	850	0.07	0.20	0.37	0.39	0.26	0.26
0.27	247	303	0.06	0.07	0.29	0.19	0.28	0.28
0.29	206	72	0.05	0.02	0.23	0.12	0.30	0.30
0.31	222	85	0.05	0.02	0.19	0.10	0.32	0.32
0.34	117	44	0.03	0.01	0.13	0.08	0.35	0.35
0.36	120	55	0.03	0.01	0.11	0.07	0.37	0.38
0.39	87	76	0.02	0.02	0.08	0.06	0.40	0.41
0.42	55	43	0.01	0.01	0.06	0.04	0.43	0.43
0.45	62	40	0.01	0.01	0.04	0.03	0.47	0.47
0.49	44	34	0.01	0.01	0.03	0.02	0.51	0.51
0.53	20	26	0.00	0.01	0.02	0.01	0.55	0.55
0.57	14	11	0.00	0.00	0.01	0.01	0.58	0.59
0.61	17	5	0.00	0.00	0.01	0.01	0.64	0.64
0.66	6	8	0.00	0.00	0.01	0.00	0.67	0.69
0.71	9	5	0.00	0.00	0.00	0.00	0.73	0.72
0.76	3	1	0.00	0.00	0.00	0.00	0.80	0.79
0.82	7	4	0.00	0.00	0.00	0.00	0.85	0.84
0.88	1	0	0.00	0.00	0.00	0.00	0.95	0.00
0.95	0	0	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720	423720	100.00	100.00			0.01	0.05

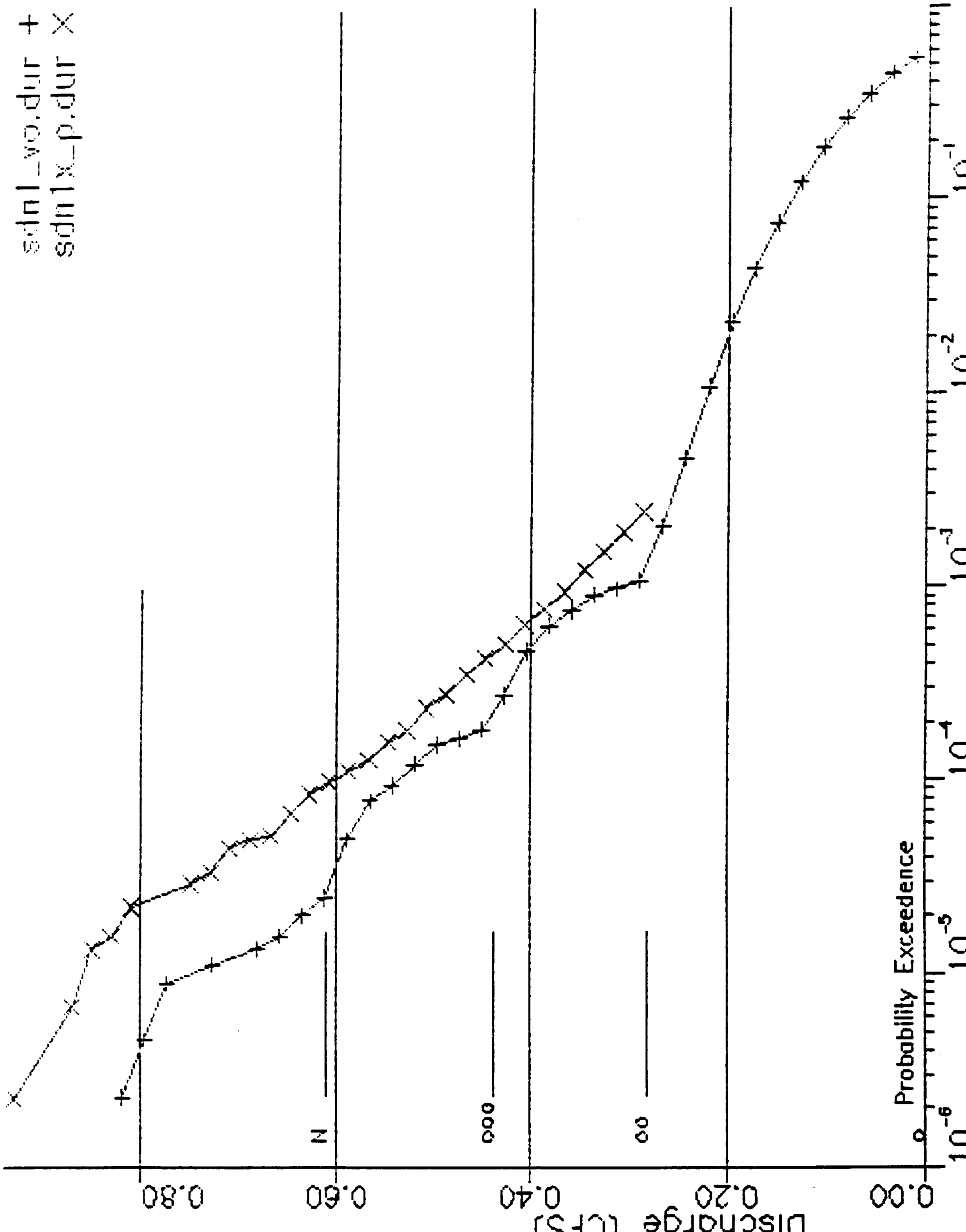
336 Observed values are zero
68593 Simulated values are zero
336 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
68257 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDN1 PREDEV
Observed - HOURLY FLOW SDN1 2006

Lower class limit		Number of occurrences between indicated deviations -60%	-30%	-10%	0%	10%	30%	60%
0.00	315353	3356	1529	829	563	918	6485	0
0.09	7842	404	144	67	63	89	270	0
0.10	3555	172	98	34	24	44	90	0
0.11	3236	191	59	34	21	52	103	0
0.11	11681	605	297	99	92	145	362	0
0.12	10099	592	220	87	76	131	318	0
0.13	8174	478	218	78	74	115	245	0
0.14	7792	492	180	71	70	86	240	0

0.15	6343	394	157	57	56	76	193	0
0.16	5104	353	159	46	39	67	143	0
0.17	7337	470	182	60	63	85	218	0
0.19	2925	236	101	26	20	26	80	0
0.20	4208	320	124	55	35	59	102	0
0.22	1421	129	52	16	14	13	39	0
0.23	1462	133	34	8	13	16	47	0
0.25	720	63	16	5	14	3	29	0
0.27	251	24	8	2	5	3	10	0
0.29	58	7	1	0	0	2	4	0
0.31	73	4	2	2	0	3	1	0
0.34	35	4	2	1	0	1	1	0
0.36	45	4	2	1	1	0	2	0
0.39	65	7	3	0	0	0	1	0
0.42	35	6	0	0	0	0	2	0
0.45	31	4	3	1	0	1	0	0
0.49	27	5	1	1	0	0	0	0
0.53	23	2	0	0	1	0	0	0
0.57	8	1	1	0	1	0	0	0
0.61	4	1	0	0	0	0	0	0
0.66	6	1	1	0	0	0	0	0
0.71	2	3	0	0	0	0	0	0
0.76	1	0	0	0	0	0	0	0
0.82	3	1	0	0	0	0	0	0
0.88	0	0	0	0	0	0	0	0
0.95	0	0	0	0	0	0	0	0
1.00	0	0	0	0	0	0	0	0
---------	397919	8462	3594	1580	1245	1935	8985	0



July 2001
556-2912-001 (28)

Retention/Detention Facility

Type of Facility:	Detention Vault
Facility Length:	200.00 ft
Facility Width:	110.00 ft
Facility Area:	22000. sq. ft
Effective Storage Depth:	12.00 ft
Stage 0 Elevation:	0.00 ft
Storage Volume:	264000. cu. ft
Riser Head:	12.00 ft
Riser Diameter:	24.00 inches
Number of orifices:	3

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.90	0.339	
2	8.20	2.00	0.211	4.0
3	9.70	2.30	0.218	6.0

Top Notch Weir:	Rectangular
Length:	2.40 in
Weir Height:	10.50 ft
Outflow Rating Curve:	None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.02	0.02	440.	0.010	0.014	0.00
0.04	0.04	880.	0.020	0.019	0.00
0.06	0.06	1320.	0.030	0.024	0.00
0.08	0.08	1760.	0.040	0.028	0.00
0.10	0.10	2200.	0.051	0.031	0.00
0.12	0.12	2640.	0.061	0.034	0.00
0.14	0.14	3080.	0.071	0.036	0.00
0.16	0.16	3520.	0.081	0.039	0.00
0.18	0.18	3960.	0.091	0.041	0.00
0.46	0.46	10120.	0.232	0.066	0.00
0.74	0.74	16280.	0.374	0.084	0.00
1.02	1.02	22440.	0.515	0.099	0.00
1.29	1.29	28380.	0.652	0.111	0.00
1.57	1.57	34540.	0.793	0.123	0.00
1.85	1.85	40700.	0.934	0.133	0.00
2.13	2.13	46860.	1.076	0.143	0.00
2.41	2.41	53020.	1.217	0.152	0.00
2.69	2.69	59180.	1.359	0.161	0.00
2.97	2.97	65340.	1.500	0.169	0.00
3.25	3.25	71500.	1.641	0.176	0.00
3.53	3.53	77660.	1.783	0.184	0.00
3.81	3.81	83820.	1.924	0.191	0.00
4.09	4.09	89980.	2.066	0.198	0.00
4.36	4.36	95920.	2.202	0.205	0.00
4.64	4.64	102080.	2.343	0.211	0.00
4.92	4.92	108240.	2.485	0.217	0.00
5.20	5.20	114400.	2.626	0.223	0.00
5.48	5.48	120560.	2.768	0.229	0.00

5.76	5.76	126720.	2.909	0.235	0.00
6.04	6.04	132880.	3.051	0.241	0.00
6.32	6.32	139040.	3.192	0.246	0.00
6.60	6.60	145200.	3.333	0.251	0.00
6.88	6.88	151360.	3.475	0.257	0.00
7.15	7.15	157300.	3.611	0.262	0.00
7.43	7.43	163460.	3.753	0.267	0.00
7.71	7.71	169620.	3.894	0.272	0.00
7.99	7.99	175780.	4.035	0.277	0.00
8.20	8.20	180400.	4.141	0.280	0.00
8.22	8.22	180840.	4.152	0.282	0.00
8.24	8.24	181280.	4.162	0.284	0.00
8.26	8.26	181720.	4.172	0.289	0.00
8.28	8.28	182160.	4.182	0.295	0.00
8.30	8.30	182600.	4.192	0.302	0.00
8.32	8.32	183040.	4.202	0.312	0.00
8.35	8.35	183700.	4.217	0.321	0.00
8.37	8.37	184140.	4.227	0.328	0.00
8.39	8.39	184580.	4.237	0.331	0.00
8.67	8.67	190740.	4.379	0.362	0.00
8.95	8.95	196900.	4.520	0.387	0.00
9.22	9.22	202840.	4.657	0.407	0.00
9.50	9.50	209000.	4.798	0.426	0.00
9.70	9.70	213400.	4.899	0.438	0.00
9.72	9.72	213840.	4.909	0.441	0.00
9.75	9.75	214500.	4.924	0.446	0.00
9.77	9.77	214940.	4.934	0.454	0.00
9.80	9.80	215600.	4.949	0.465	0.00
9.82	9.82	216040.	4.960	0.478	0.00
9.84	9.84	216480.	4.970	0.493	0.00
9.87	9.87	217140.	4.985	0.506	0.00
9.89	9.89	217580.	4.995	0.512	0.00
9.92	9.92	218240.	5.010	0.517	0.00
10.19	10.19	224180.	5.146	0.567	0.00
10.47	10.47	230340.	5.288	0.607	0.00
10.50	10.50	231000.	5.303	0.610	0.00
10.69	10.69	235180.	5.399	0.677	0.00
10.88	10.88	239360.	5.495	0.750	0.00
11.06	11.06	243320.	5.586	0.843	0.00
11.25	11.25	247500.	5.682	0.954	0.00
11.44	11.44	251680.	5.778	1.080	0.00
11.63	11.63	255860.	5.874	1.210	0.00
11.81	11.81	259820.	5.965	1.350	0.00
12.00	12.00	264000.	6.061	1.500	0.00
12.10	12.10	266200.	6.111	2.130	0.00
12.20	12.20	268400.	6.162	3.260	0.00
12.30	12.30	270600.	6.212	4.730	0.00
12.40	12.40	272800.	6.263	6.460	0.00
12.50	12.50	275000.	6.313	8.430	0.00
12.60	12.60	277200.	6.364	10.610	0.00
12.70	12.70	279400.	6.414	12.970	0.00
12.80	12.80	281600.	6.465	15.100	0.00
12.90	12.90	283800.	6.515	15.930	0.00
13.00	13.00	286000.	6.566	16.710	0.00
13.10	13.10	288200.	6.616	17.460	0.00
13.20	13.20	290400.	6.667	18.170	0.00
13.30	13.30	292600.	6.717	18.860	0.00

SDN1 VAULT

13.40	13.40	294800.	6.768	19.520	0.00
13.50	13.50	297000.	6.818	20.150	0.00
13.60	13.60	299200.	6.869	20.770	0.00
13.70	13.70	301400.	6.919	21.360	0.00
13.80	13.80	303600.	6.970	21.940	0.00
13.90	13.90	305800.	7.020	22.500	0.00

SDN1 VAULT

```
Route Time Series through Facility
  Inflow Time Series File:sdn1x_d.tsf
 Outflow Time Series File:sdn1_vo

Inflow/Outflow Analysis
   Peak Inflow Discharge:       5.87 CFS at  0:00 on Oct 26 in 1986
  Peak Outflow Discharge:      0.820 CFS at 12:00 on Jan  2 in 1997
    Peak Reservoir Stage:      11.02  Ft
     Peak Reservoir Elev:      11.02  Ft
  Peak Reservoir Storage:  242353.    Cu-Ft
                        :      5.564 Ac-Ft
```

Flow Frequency Analysis
Time Series File:sdn1x_D.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.236 StdDev= 0.101
Skew= 0.515

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			1.06		100.00	0.990
Computed Peaks			0.993		50.00	0.980
Computed Peaks			0.904		25.00	0.960
Computed Peaks			0.789		10.00	0.900
Computed Peaks			0.765		8.00	0.875
Computed Peaks			0.700		5.00	0.800
Computed Peaks			0.569		2.00	0.500
Computed Peaks			0.485		1.30	0.231

Flow Frequency Analysis
Time Series File:sdn1_vo.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.585 StdDev= 0.150
Skew= 1.684

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			0.849	11.07		100.00	0.990
Computed Peaks			0.684	10.71		50.00	0.980
Computed Peaks			0.550	10.10		25.00	0.960
Computed Peaks			0.410	9.27		10.00	0.900
Computed Peaks			0.387	8.96		8.00	0.875
Computed Peaks			0.326	8.37		5.00	0.800
Computed Peaks			0.237	5.86		2.00	0.500
Computed Peaks			0.200	4.18		1.30	0.231

Duration Comparison Anaylsis
Base File: sdn1x_p.tsf
New File: sdn1_vo.tsf
Cutoff Units: Discharge in CFS

Cutoff	-----Fraction of Time----- Base	New	%Change	---------Check of Tolerance------- Probability	Base	New	%Change
0.285	0.24E-02	0.11E-02	-54.9	0.24E-02	0.285	0.261	-8.4
0.307	0.19E-02	0.10E-02	-47.8	0.19E-02	0.307	0.267	-12.8
0.328	0.15E-02	0.95E-03	-36.0	0.15E-02	0.328	0.273	-16.6
0.349	0.12E-02	0.83E-03	-29.2	0.12E-02	0.349	0.279	-20.0
0.371	0.89E-03	0.70E-03	-21.5	0.89E-03	0.371	0.339	-8.5
0.392	0.73E-03	0.57E-03	-21.1	0.73E-03	0.392	0.365	-7.0
0.413	0.60E-03	0.37E-03	-38.8	0.60E-03	0.413	0.388	-6.2
0.435	0.47E-03	0.23E-03	-51.7	0.47E-03	0.435	0.404	-7.0
0.456	0.39E-03	0.18E-03	-54.1	0.39E-03	0.456	0.409	-10.3
0.477	0.32E-03	0.17E-03	-47.9	0.32E-03	0.477	0.421	-11.7
0.498	0.26E-03	0.16E-03	-40.9	0.26E-03	0.498	0.430	-13.8
0.520	0.20E-03	0.12E-03	-38.6	0.20E-03	0.520	0.438	-15.7
0.541	0.17E-03	0.96E-04	-43.2	0.17E-03	0.541	0.472	-12.8
0.562	0.13E-03	0.82E-04	-39.0	0.13E-03	0.562	0.509	-9.6
0.584	0.11E-03	0.57E-04	-50.0	0.11E-03	0.584	0.529	-9.4
0.605	0.10E-03	0.34E-04	-65.9	0.10E-03	0.605	0.540	-10.8
0.626	0.89E-04	0.21E-04	-76.9	0.89E-04	0.626	0.550	-12.2
0.648	0.71E-04	0.18E-04	-74.2	0.71E-04	0.648	0.575	-11.2
0.669	0.53E-04	0.14E-04	-73.5	0.53E-04	0.669	0.588	-12.1
0.690	0.50E-04	0.14E-04	-72.7	0.50E-04	0.690	0.589	-14.7
0.712	0.46E-04	0.11E-04	-75.0	0.46E-04	0.712	0.590	-17.0
0.733	0.34E-04	0.91E-05	-73.3	0.34E-04	0.733	0.606	-17.3
0.754	0.25E-04	0.91E-05	-63.6	0.25E-04	0.754	0.622	-17.5
0.776	0.23E-04	0.91E-05	-60.0	0.23E-04	0.776	0.625	-19.4
0.797	0.23E-04	0.46E-05	-80.0	0.23E-04	0.797	0.625	-21.6
0.818	0.21E-04	0.23E-05	-88.9	0.21E-04	0.818	0.637	-22.1
0.840	0.14E-04	0.00E+00	-100.0	0.14E-04	0.840	0.693	-17.5
0.861	0.68E-05	0.00E+00	-100.0	0.68E-05	0.861	0.781	-9.3
0.882	0.23E-05	0.00E+00	-100.0	0.23E-05	0.882	0.820	-7.1
0.904	0.23E-05	0.00E+00	-100.0	0.23E-05	0.904	0.820	-9.3
0.925	0.23E-05	0.00E+00	-100.0	0.23E-05	0.925	0.820	-11.4

There is no positive excursion

Maximum negative excursion = 0.188 cfs (-23.1%)
occuring at 0.813 cfs on the Base Data:sdn1x_p.tsf
and at 0.625 cfs on the New Data:sdn1_vo.tsf

Land Use Summary

Till Forest	7.27 acres
Till Pasture	0.00 acres
Till Grass	1.45 acres
Airport Fill	0.00 acres
Outwash Forest	8.74 acres
Outwash Pasture	0.00 acres
Outwash Grass	1.92 acres
Wetland	0.21 acres
Impervious	1.97 acres

Total Area : 21.56 acres
Scale Factor : 1.00 Hourly Historic

Time Series: sdn1x_p

Compute Time Series
Modify User Input

Land Use Summary

Till Forest	0.00 acres
Till Pasture	0.00 acres
Till Grass	1.97 acres
Airport Fill	0.00 acres
Outwash Forest	0.00 acres
Outwash Pasture	0.00 acres
Outwash Grass	6.14 acres
Wetland	0.21 acres
Impervious	13.24 acres

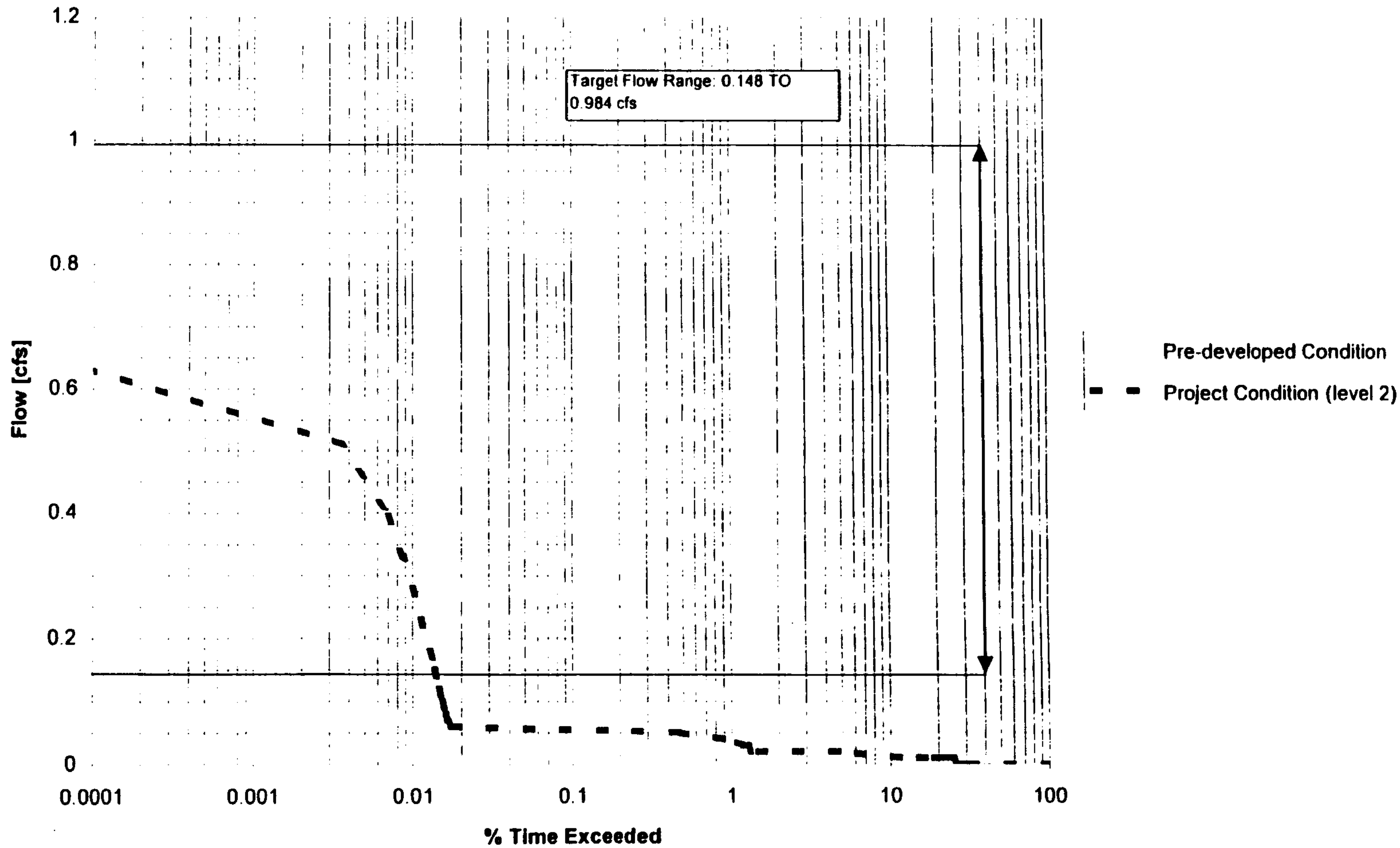
Total Area : 21.56 acres
Scale Factor : 1.00 Hourly Historic

Time Series: sdn1x_d

Compute Time Series
Modify User Input

SDW1A

MILLER at SDW1A



1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDW1A (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.270	0.756	0.849	0.216	0.226
0.265	0.404	0.429	0.316	0.269
0.243	0.346	0.325	0.241	0.268
0.299	0.302	0.255	0.457	0.404
0.266	0.251	0.268	0.923	0.261
0.294	0.361	0.223	0.239	0.372
0.387	0.330	0.321	0.266	0.288
0.335	0.204	0.358	0.336	0.204
0.279	0.513	0.922	0.254	0.189
0.189	0.239	0.959		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.489
Variance (logs)	0.032
Standard Deviation (logs)	0.178
Skewness (logs)	1.397
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.104
Coefficient of Variation (logs)	-0.365

1

HOURLY FLOW SDW1A (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.188
0.9500	1.05	0.200
0.9000	1.11	0.211
0.8000	1.25	0.230
0.5000	2.00	0.296
0.2000	5.00	0.433
0.1000	10.00	0.561
0.0400	25.00	0.777
0.0200	50.00	0.984
0.0100	100.00	1.242
0.0050	200.00	1.560

$1/2 Q_2 = 0.148$ cfs

$Q_{50} = 0.984$ cfs

:

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDW1A combined POC flow (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.013	0.051	0.601	0.012	0.018
0.015	0.013	0.050	0.016	0.016
0.014	0.016	0.019	0.009	0.015
0.018	0.016	0.015	0.019	0.015
0.017	0.016	0.013	0.484	0.016
0.018	0.014	0.013	0.004	0.013
0.009	0.018	0.013	0.016	0.014
0.011	0.008	0.015	0.015	0.010
0.009	0.017	0.017	0.014	0.011
0.007	0.015	0.058		

The following 7 statistics are based on non-zero values.

Mean (logs)	-1.765
Variance (logs)	0.136
Standard Deviation (logs)	0.369
Skewness (logs)	2.904
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.099
Coefficient of Variation (logs)	-0.209

1

HOURLY FLOW SDW1A combined POC flow (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.010
0.9500	1.05	0.010
0.9000	1.11	0.010
0.8000	1.25	0.010
0.5000	2.00	0.012
0.2000	5.00	0.025
0.1000	10.00	0.047
0.0400	25.00	0.119
0.0200	50.00	0.247
0.0100	100.00	0.522
0.0050	200.00	1.119

$1/2 Q_2 = 0.006$ cfs
$Q_{50} = 0.247$ cfs

1

Simulated - HOURLY FLOW SDW1A (PREDEV)
Observed - HOURLY FLOW SDW1A combined POC flow (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	278388	0.001	*	0.006	*	0.001	*
0.00	6342	0.026	2431.1	0.042	3839.0	0.026	2427.7
0.00	5011	0.022	1631.4	0.042	3208.5	0.021	1623.3
0.00	4522	0.015	873.4	0.032	1950.3	0.014	860.1
0.00	4616	0.013	602.1	0.030	1438.7	0.012	584.1
0.00	4122	0.012	445.2	0.028	1075.6	0.011	424.0
0.00	4644	0.011	345.7	0.026	788.7	0.010	316.5
0.00	5050	0.011	281.9	0.027	664.5	0.010	244.9
0.00	6192	0.011	222.9	0.026	512.7	0.009	183.3
0.01	6118	0.012	192.9	0.028	453.7	0.009	146.8
0.01	11650	0.013	165.5	0.028	358.0	0.008	103.3
0.01	17425	0.015	151.2	0.029	294.1	0.008	85.1
0.01	21477	0.016	135.6	0.031	260.1	0.007	59.2
0.01	28409	0.018	129.3	0.036	248.5	0.009	63.4
0.02	14100	0.026	146.9	0.051	290.5	0.013	74.5
0.02	285	0.034	152.3	0.080	358.8	0.011	48.6
0.03	362	0.039	138.5	0.079	278.2	0.007	22.8
0.03	1307	0.040	114.3	0.079	230.0	0.001	4.3
0.04	1758	0.042	96.6	0.078	177.9	-0.008	-17.7
0.05	1869	0.051	95.4	0.088	164.6	0.012	20.5
0.06	4	0.132	202.0	0.188	287.5	0.132	202.0
0.07	3	0.085	102.5	0.104	126.0	0.085	102.5
0.09	3	0.055	53.2	0.069	66.2	0.046	44.2
0.11	4	0.066	51.7	0.072	56.9	0.028	22.6
0.14	3	0.066	41.5	0.066	41.9	0.023	14.4
0.17	7	0.089	46.7	0.103	54.4	-0.014	-6.0
0.22	5	0.090	36.1	0.113	44.8	-0.086	-34.2
0.27	7	0.109	36.3	0.131	43.7	-0.096	-32.1
0.33	9	0.206	56.4	0.218	59.5	-0.206	-56.4
0.41	13	0.261	56.7	0.279	60.4	-0.261	-56.7
0.51	15	0.248	43.7	0.249	43.8	-0.248	-43.7
0.63	0	0.000	0.0	0.000	0.0	0.000	0.0
0.78	0	0.000	0.0	0.000	0.0	0.000	0.0
0.97	0	0.000	0.0	0.000	0.0	0.000	0.0
1.20	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.007	*	0.023	*	0.004	*

Standard error of estimate = 0.02
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDW1A (PREDEV)
Observed - HOURLY FLOW SDW1A combined POC flow (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	*****	*****	58.36	65.70	100.00	100.00	0.00	0.00
0.00	7354	6342	1.74	1.50	41.64	34.30	0.00	0.00
0.00	9161	5011	2.16	1.18	39.91	32.80	0.00	0.00
0.00	9784	4522	2.31	1.07	37.74	31.62	0.00	0.00
0.00	9997	4616	2.36	1.09	35.43	30.55	0.00	0.00
0.00	8294	4122	1.96	0.97	33.08	29.46	0.00	0.00
0.00	9920	4644	2.34	1.10	31.12	28.49	0.00	0.00
0.00	10120	5050	2.39	1.19	28.78	27.39	0.00	0.00
0.00	9745	6192	2.30	1.46	26.39	26.20	0.01	0.01
0.01	9385	6118	2.21	1.44	24.09	24.74	0.01	0.01
0.01	9724	11650	2.29	2.75	21.87	23.30	0.01	0.01
0.01	10669	17425	2.52	4.11	19.58	20.55	0.01	0.01
0.01	7221	21477	1.70	5.07	17.06	16.44	0.01	0.01
0.01	8646	28409	2.04	6.70	15.36	11.37	0.01	0.01
0.02	9092	14100	2.15	3.33	13.32	4.66	0.02	0.02
0.02	8742	285	2.06	0.07	11.17	1.33	0.02	0.02
0.03	7805	362	1.84	0.09	9.11	1.27	0.03	0.03
0.03	7254	1307	1.71	0.31	7.26	1.18	0.03	0.03
0.04	5727	1758	1.35	0.41	5.55	0.87	0.04	0.04
0.05	4662	1869	1.10	0.44	4.20	0.46	0.05	0.05
0.06	3881	4	0.92	0.00	3.10	0.02	0.07	0.07
0.07	3208	3	0.76	0.00	2.19	0.02	0.08	0.08
0.09	2094	3	0.49	0.00	1.43	0.02	0.10	0.10
0.11	1733	4	0.41	0.00	0.93	0.01	0.12	0.13
0.14	828	3	0.20	0.00	0.52	0.01	0.15	0.16
0.17	647	7	0.15	0.00	0.33	0.01	0.19	0.19
0.22	324	5	0.08	0.00	0.18	0.01	0.24	0.25
0.27	174	7	0.04	0.00	0.10	0.01	0.30	0.30
0.33	134	9	0.03	0.00	0.06	0.01	0.36	0.37
0.41	62	13	0.01	0.00	0.03	0.01	0.45	0.46
0.51	22	15	0.01	0.00	0.01	0.00	0.56	0.57
0.63	20	0	0.00	0.00	0.01	0.00	0.70	0.00
0.78	13	0	0.00	0.00	0.00	0.00	0.86	0.00
0.97	0	0	0.00	0.00	0.00	0.00	0.00	0.00
1.20	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720	423720	100.00	100.00			0.01	0.00

160669 Observed values are zero
68595 Simulated values are zero
68119 Observed values are zero when simulated are zero
92550 Observed values are zero when simulated are not
476 Observed values are not zero when simulated are

1

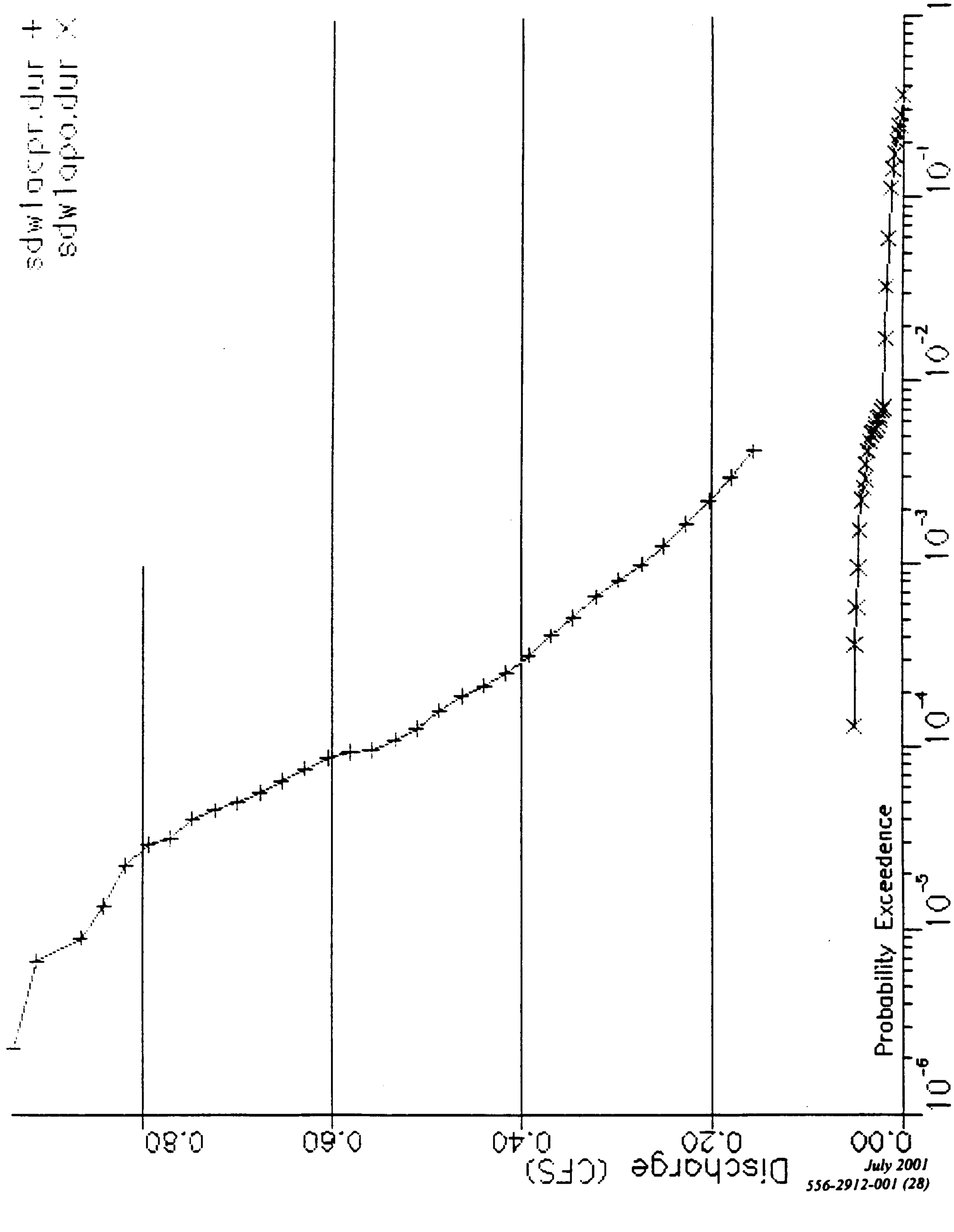
Simulated - HOURLY FLOW SDW1A (PREDEV)
Observed - HOURLY FLOW SDW1A combined POC flow (2006)

Number of occurrences between indicated deviations

Lower class limit		-60%	-30%	-10%	0%	10%	30%	60%
0.00	1282	440	229	160780	101	219	115337	0
0.00	90	52	46	41	40	61	6012	0
0.00	170	97	77	23	35	123	4486	0
0.00	253	156	72	39	61	156	3785	0
0.00	371	197	93	104	113	150	3588	0
0.00	390	180	132	162	65	176	3017	0
0.00	587	278	264	165	130	225	2995	0
0.00	840	356	340	192	162	295	2865	0

0.00	1129	459	379	281	201	395	3348	0
0.01	1262	560	367	307	249	413	2960	0
0.01	3188	1578	745	328	321	618	4872	0
0.01	5500	1879	1083	514	484	808	7157	0
0.01	7951	2420	1304	592	515	965	7730	0
0.01	8565	3766	2013	831	758	1358	11118	0
0.02	4942	1478	916	425	362	650	5327	0
0.02	159	27	0	0	0	12	87	0
0.03	216	51	5	2	1	0	87	0
0.03	734	154	77	28	18	47	249	0
0.04	985	259	129	49	41	41	254	0
0.05	595	396	177	62	47	80	512	0
0.06	0	0	0	0	0	1	3	0
0.07	0	0	0	0	1	0	2	0
0.09	0	0	1	0	0	0	2	0
0.11	0	1	1	0	0	0	2	0
0.14	0	1	0	0	0	0	2	0
0.17	0	4	0	0	0	2	1	0
0.22	1	2	0	1	1	0	0	0
0.27	3	0	2	1	0	1	0	0
0.33	6	2	1	0	0	0	0	0
0.41	7	4	2	0	0	0	0	0
0.51	0	15	0	0	0	0	0	0
0.63	0	0	0	0	0	0	0	0
0.78	0	0	0	0	0	0	0	0
0.97	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0

	39226	14812	8455	164927	3706	6796	185798	0



July 2001
556-2912-001 (28)

AR 046673

PREDEVELOPED CONDITIONS SUM THESE 2 TIME SERIES:

```
+-Land Use Summary-----------------------------------------------+
|Till Forest              19.00 acres                            |
|Till Pasture              0.00 acres                            |
|Till Grass                6.09 acres                            |
|Airport Fill              0.00 acres                            |
|Outwash Forest            8.86 acres                            |
|Outwash Pasture           0.00 acres                            |
|Outwash Grass             2.84 acres                            |
|Wetland                   0.33 acres                            |
|Impervious                0.35 acres                            |
|----------------------------------------------------------------|
|         Total Area :    37.47 acres                           |
|       Scale Factor :     1.00      Hourly      Historic       |
|----------------------------------------------------------------|
|                                                                |
|   Time Series: SWD1AIPR                                        |
|----------------------------------------------------------------|
|                    Compute Time Series                         |
|                     Modify User Input                          |
+----------------------------------------------------------------+
```

```
+-Land Use Summary-----------------------------------------------+
|Till Forest               0.00 acres                            |
|Till Pasture              0.00 acres                            |
|Till Grass                0.00 acres                            |
|Airport Fill              0.00 acres                            |
|Outwash Forest            9.54 acres                            |
|Outwash Pasture           0.00 acres                            |
|Outwash Grass             2.66 acres                            |
|Wetland                   2.63 acres                            |
|Impervious                0.52 acres                            |
|----------------------------------------------------------------|
|         Total Area :    15.35 acres                           |
|       Scale Factor :     1.00      Hourly      Historic       |
|----------------------------------------------------------------|
|                                                                |
|   Time Series: SDW1AOPR                                        |
|----------------------------------------------------------------|
|                    Compute Time Series                         |
|                     Modify User Input                          |
+----------------------------------------------------------------+
```

DEVELOPED AREA DRAINING TO POND = ALL AREA EXCEPT AIRFIELD IMPERVIOUS

```
+-Land Use Summary-------------------------------------------+
|Till Forest             0.00 acres                          |
|Till Pasture            0.00 acres                          |
|Till Grass              4.28 acres                          |
|Airport Fill           32.44 acres                          |
|Outwash Forest          0.00 acres                          |
|Outwash Pasture         0.00 acres                          |
|Outwash Grass           0.69 acres                          |
|Wetland                 0.00 acres                          |
|Impervious              1.64 acres                          |
|------------------------------------------------------------|
|        Total Area :   39.05 acres                          |
|      Scale Factor :    1.00      Hourly      Historic      |
|------------------------------------------------------------|
|                                                            |
|   Time Series: sdwlapdv                                    |
|------------------------------------------------------------|
|                    Compute Time Series                     |
|                     Modify User Input                      |
+------------------------------------------------------------+
```

DEVELOPED AREA DRAINING TO VAULT = AIRFIELD IMPERVIOUS

```
+-Land Use Summary-------------------------------------------+
|Till Forest             0.00 acres                          |
|Till Pasture            0.00 acres                          |
|Till Grass              0.00 acres                          |
|Airport Fill            0.00 acres                          |
|Outwash Forest          0.00 acres                          |
|Outwash Pasture         0.00 acres                          |
|Outwash Grass           0.00 acres                          |
|Wetland                 0.00 acres                          |
|Impervious             13.78 acres                          |
|------------------------------------------------------------|
|        Total Area :   13.78 acres                          |
|      Scale Factor :    1.00      Hourly      Historic      |
|------------------------------------------------------------|
|                                                            |
|   Time Series: sdwlavdv                                    |
|------------------------------------------------------------|
|                    Compute Time Series                     |
|                     Modify User Input                      |
+------------------------------------------------------------+
```

SDW1A VAULT

Two Outlet Reservoir Routing File

Stage (Ft)	Discharge (CFS) A	B	Storage (Cu-Ft)	Perm-Area (Sq-Ft)
0.00	0.000	0.000	0.	0.
0.01	0.140	0.000	300.	0.
1.00	0.141	0.000	30000.	0.
2.00	0.142	0.000	60000.	0.
4.00	0.143	0.000	120000.	0.
6.00	0.145	0.000	180000.	0.
8.00	0.146	0.000	240000.	0.
10.00	0.148	0.000	300000.	0.
12.00	0.149	0.000	360000.	0.
14.00	0.150	0.000	420000.	0.
16.00	0.152	0.000	480000.	0.
16.75	0.152	10.760	502500.	0.
16.90	0.152	13.960	507000.	0.
17.00	0.152	16.100	510000.	0.
17.10	0.152	18.570	513000.	0.
17.30	0.152	23.860	519000.	0.
18.00	0.152	45.540	540000.	0.

0.00 Ft : Base Reservoir Elevation
0.0 Minutes/Inch: Average Perm-Rate

Inflow/Outflow Analysis

Peak Inflow Discharge:	6.10 CFS at	0:00 on Oct 26 in 1986
Peak A-Outflow Discharge:	0.148 CFS at	2:00 on Jan 3 in 1997
Peak B-Outflow Discharge:	0.000 CFS at	2:00 on Jan 3 in 1997
Peak Reservoir Stage:	10.71 Ft	
Peak Reservoir Elev:	10.71 Ft	
Peak Reservoir Storage:	321220. Cu-Ft	
:	7.374 Ac-Ft	

SDW1A POND

Two Outlet Reservoir Routing File

Stage (Ft)	Discharge (CFS) A	B	Storage (Cu-Ft)	Perm-Area (Sq-Ft)
0.00	0.000	0.000	0.	0.
0.01	0.150	0.001	600.	0.
1.00	0.150	0.007	57500.	0.
2.00	0.150	0.010	115400.	0.
3.00	0.150	0.012	174200.	0.
4.00	0.150	0.013	233900.	0.
5.00	0.150	0.015	348400.	0.
6.00	0.150	0.017	466000.	0.
7.00	0.150	0.018	586600.	0.
8.00	0.150	0.019	710100.	0.
8.30	0.150	0.031	748100.	0.
9.00	0.150	0.041	836700.	0.
10.00	0.150	0.051	966200.	0.
11.00	0.150	0.058	1098800.	0.
11.10	0.150	0.675	1112350.	0.
11.30	0.150	3.260	1139450.	0.
12.00	0.150	15.190	1234300.	0.

0.00 Ft : Base Reservoir Elevation
0.0 Minutes/Inch: Average Perm-Rate

Inflow/Outflow Analysis

Peak Inflow Discharge: 8.56 CFS at 16:00 on Mar 3 in 1950
Peak A-Outflow Discharge: 0.150 CFS at 22:00 on Mar 14 in 1972
Peak B-Outflow Discharge: 0.052 CFS at 17:00 on Mar 14 in 1972
Peak Reservoir Stage: 10.09 Ft
Peak Reservoir Elev: 10.09 Ft
Peak Reservoir Storage: 977508. Cu-Ft
: 22.441 Ac-Ft

INFILTRATION VAULT DOES NOT OVERFLOW FOR MODELED PERIOD OF RECORD. COMPARE POND OUTFLOW TO OVERALL SDW1A PREDEVELOPED TIME SERIES.

Flow Frequency Analysis — LogPearson III Coefficients
Time Series File:sdw1acpr.tsf — Mean= -0.475 StdDev= 0.179
Project Location:Sea-Tac Miller — Skew= 1.165

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			1.22		100.00	0.990
Computed Peaks			0.985		50.00	0.980
Computed Peaks			0.791		25.00	0.960
Computed Peaks			0.583		10.00	0.900
Computed Peaks			0.548		8.00	0.875
Computed Peaks			0.454		5.00	0.800
Computed Peaks			0.310		2.00	0.500
Computed Peaks			0.243		1.30	0.231

Flow Frequency Analysis — LogPearson III Coefficients
Time Series File:sdw1apo.tsf — Mean= -1.821 StdDev= 0.190
Project Location:Sea-Tac Miller — Skew= 1.274

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			0.061	11.00		100.00	0.990
Computed Peaks			0.048	9.72		50.00	0.980
Computed Peaks			0.038	8.78		25.00	0.960
Computed Peaks			0.027	8.20		10.00	0.900
Computed Peaks			0.025	8.16		8.00	0.875
Computed Peaks			0.021	8.04		5.00	0.800
Computed Peaks			0.014	4.40		2.00	0.500
Computed Peaks			0.011	2.38		1.30	0.231

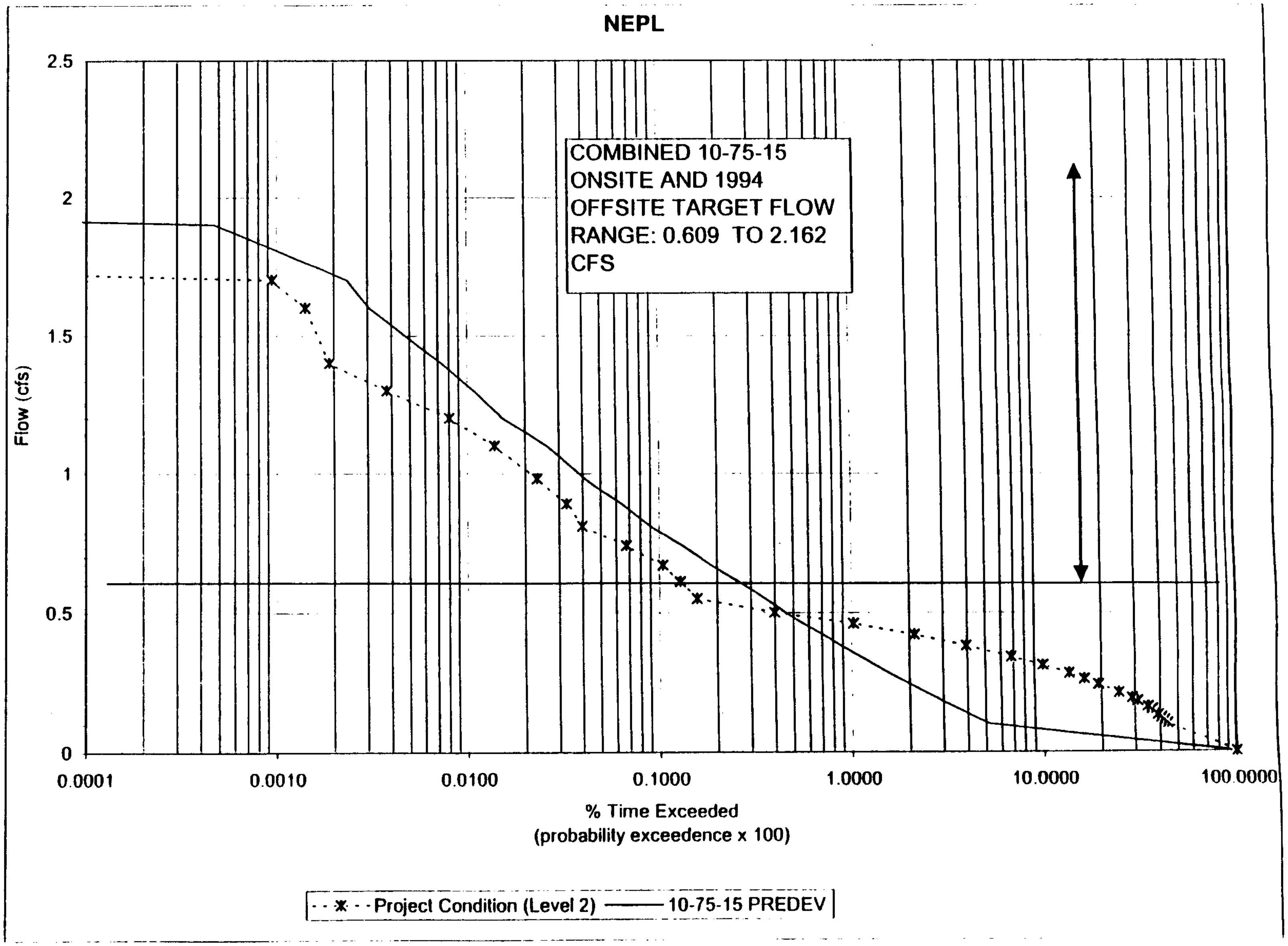
Duration Comparison Analysis
Base File: sdwlacpr.tsf
New File: sdwlapo.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.156	0.41E-02	0.00E+00	-100.0	0.41E-02	0.156	0.035	-77.5
0.182	0.29E-02	0.00E+00	-100.0	0.29E-02	0.182	0.039	-78.6
0.208	0.21E-02	0.00E+00	-100.0	0.21E-02	0.208	0.042	-79.7
0.234	0.15E-02	0.00E+00	-100.0	0.15E-02	0.234	0.043	-81.4
0.260	0.12E-02	0.00E+00	-100.0	0.12E-02	0.260	0.045	-82.9
0.286	0.90E-03	0.00E+00	-100.0	0.90E-03	0.286	0.045	-84.1
0.312	0.74E-03	0.00E+00	-100.0	0.74E-03	0.312	0.046	-85.2
0.338	0.55E-03	0.00E+00	-100.0	0.55E-03	0.338	0.047	-86.0
0.364	0.43E-03	0.00E+00	-100.0	0.43E-03	0.364	0.048	-86.8
0.390	0.33E-03	0.00E+00	-100.0	0.33E-03	0.390	0.049	-87.4
0.415	0.26E-03	0.00E+00	-100.0	0.26E-03	0.415	0.049	-88.1
0.441	0.22E-03	0.00E+00	-100.0	0.22E-03	0.441	0.050	-88.7
0.467	0.18E-03	0.00E+00	-100.0	0.18E-03	0.467	0.050	-89.3
0.493	0.15E-03	0.00E+00	-100.0	0.15E-03	0.493	0.050	-89.8
0.519	0.12E-03	0.00E+00	-100.0	0.12E-03	0.519	0.051	-90.3
0.545	0.11E-03	0.00E+00	-100.0	0.11E-03	0.545	0.051	-90.7
0.571	0.96E-04	0.00E+00	-100.0	0.96E-04	0.571	0.051	-91.1
0.597	0.94E-04	0.00E+00	-100.0	0.94E-04	0.597	0.051	-91.5
0.623	0.82E-04	0.00E+00	-100.0	0.82E-04	0.623	0.051	-91.8
0.649	0.66E-04	0.00E+00	-100.0	0.66E-04	0.649	0.051	-92.1
0.675	0.57E-04	0.00E+00	-100.0	0.57E-04	0.675	0.051	-92.4
0.701	0.50E-04	0.00E+00	-100.0	0.50E-04	0.701	0.051	-92.7
0.727	0.46E-04	0.00E+00	-100.0	0.46E-04	0.727	0.051	-92.9
0.753	0.41E-04	0.00E+00	-100.0	0.41E-04	0.753	0.051	-93.2
0.779	0.30E-04	0.00E+00	-100.0	0.30E-04	0.779	0.052	-93.4
0.805	0.27E-04	0.00E+00	-100.0	0.27E-04	0.805	0.052	-93.6
0.831	0.21E-04	0.00E+00	-100.0	0.21E-04	0.831	0.052	-93.8
0.857	0.11E-04	0.00E+00	-100.0	0.11E-04	0.857	0.052	-94.0
0.883	0.68E-05	0.00E+00	-100.0	0.68E-05	0.883	0.052	-94.1
0.909	0.68E-05	0.00E+00	-100.0	0.68E-05	0.909	0.052	-94.3
0.935	0.23E-05	0.00E+00	-100.0	0.23E-05	0.935	0.052	-94.4

There is no positive excursion

Maximum negative excursion = 0.907 cfs (-94.6%)
occurring at 0.959 cfs on the Base Data:sdwlacpr.tsf
and at 0.052 cfs on the New Data:sdwlapo.tsf

NEPL


NEPL
COMBINED 10-75-15 ONSITE AND 1994 OFFSITE TARGET FLOW RANGE: 0.609 TO 2.162 CFS
Flow (cfs)
2.5
2
1.5
1
0.5
0
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
100.0000
% Time Exceeded
(probability exceedence x 100)
Project Condition (Level 2)
10-75-15 PREDEV

:

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW NEPL (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

1.221	2.049	1.314	0.985	0.994
1.144	1.120	1.183	1.309	1.211
0.991	1.103	1.092	1.105	1.125
1.133	1.060	1.037	1.591	1.852
0.931	1.058	1.035	1.589	0.884
1.306	1.431	0.907	1.148	1.791
1.848	1.391	1.379	1.851	1.418
1.193	0.972	1.260	1.880	0.971
1.350	1.918	1.775	1.114	0.900
0.912	1.103	1.518		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.095
Variance (logs)	0.010
Standard Deviation (logs)	0.102
Skewness (logs)	0.580
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.203
Coefficient of Variation (logs)	1.073

1

HOURLY FLOW NEPL (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.798
0.9500	1.05	0.863
0.9000	1.11	0.938
0.8000	1.25	1.018
0.5000	2.00	1.217
0.2000	5.00	1.503
0.1000	10.00	1.700
0.0400	25.00	1.960
0.0200	50.00	2.162
0.0100	100.00	2.370
0.0050	200.00	2.587

$1/2 Q_2 = 0.609$
$Q_{50} = 2.162$

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III
distributions are for preliminary computations.
User is responsible for assessment and
interpretation.

HOURLY FLOW NEPL POC

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.408	0.496	1.354	0.364	0.520
0.430	0.403	0.775	0.437	0.449
0.421	0.525	0.477	0.355	0.468
0.511	0.516	0.447	0.476	0.430
0.434	0.475	0.442	1.119	0.513
0.453	0.415	0.416	0.350	0.453
0.335	0.924	0.428	0.520	0.440
0.357	0.364	0.462	0.513	0.398
0.359	0.566	0.639	0.462	0.347
0.322	0.486	1.215		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.318
Variance (logs)	0.019
Standard Deviation (logs)	0.136
Skewness (logs)	1.869
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.075
Coefficient of Variation (logs)	-0.428

1

HOURLY FLOW NEPL POC

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.346
0.9500	1.05	0.352
0.9000	1.11	0.360
0.8000	1.25	0.375
0.5000	2.00	0.439
0.2000	5.00	0.586
0.1000	10.00	0.726
0.0400	25.00	0.959
0.0200	50.00	1.182
0.0100	100.00	1.456
0.0050	200.00	1.793

$\frac{1}{2}Q_2 = 0.220$
$Q_{50} = 1.182$

1

Simulated - HOURLY FLOW NEPL (PREDEV)
Observed - HOURLY FLOW NEPL POC

Lower class limit	Number of cases	Mean absolute error(1) Average	Percent	Root mean square error(2) Average	Percent	Bias(3) Average	Percent
0.00	237042	0.027	102.7	0.042	139.5	-0.023	-91.3
0.10	7339	0.102	97.0	0.107	102.2	-0.091	-86.3
0.11	6707	0.111	96.2	0.115	100.4	-0.100	-86.7
0.12	6231	0.120	95.8	0.124	99.3	-0.108	-86.2
0.13	11418	0.133	94.9	0.139	99.5	-0.119	-84.7
0.15	7134	0.144	93.1	0.150	97.0	-0.132	-85.3
0.16	16649	0.159	93.2	0.165	96.8	-0.146	-85.6
0.18	8367	0.171	92.5	0.177	95.4	-0.158	-85.5
0.19	17914	0.184	91.9	0.189	94.7	-0.171	-85.7
0.21	22807	0.204	90.8	0.210	93.7	-0.191	-85.1
0.24	12437	0.225	90.0	0.231	92.6	-0.212	-84.9
0.26	11561	0.242	89.7	0.250	92.5	-0.227	-84.2
0.28	15924	0.262	88.8	0.269	91.4	-0.248	-84.2
0.31	13283	0.285	88.0	0.294	90.6	-0.271	-83.5
0.34	12160	0.311	86.9	0.320	89.4	-0.297	-82.9
0.38	7721	0.340	85.3	0.351	87.9	-0.325	-81.4
0.42	4685	0.369	84.3	0.381	87.0	-0.354	-80.8
0.46	2651	0.394	82.7	0.406	85.3	-0.375	-78.8
0.50	1026	0.401	77.5	0.417	80.6	-0.377	-72.8
0.55	121	0.425	73.6	0.443	76.7	-0.397	-68.8
0.61	100	0.493	76.8	0.506	78.8	-0.471	-73.3
0.67	156	0.520	73.9	0.539	76.6	-0.503	-71.5
0.74	118	0.549	71.6	0.565	73.6	-0.527	-68.7
0.81	30	0.629	73.9	0.647	76.1	-0.629	-73.9
0.89	41	0.648	69.8	0.666	71.9	-0.602	-64.8
0.98	39	0.658	63.7	0.689	66.6	-0.653	-63.2
1.10	25	0.712	62.2	0.749	65.3	-0.690	-60.2
1.20	18	0.840	67.2	0.870	69.5	-0.840	-67.2
1.30	8	0.851	64.0	0.878	66.1	-0.851	-64.0
1.40	2	1.247	85.8	1.247	85.8	-1.247	-85.8
1.60	2	0.974	60.5	1.056	65.8	-0.974	-60.5
1.70	4	1.399	77.7	1.404	78.1	-1.399	-77.7
1.90	0	0.000	0.0	0.000	0.0	0.000	0.0
2.10	0	0.000	0.0	0.000	0.0	0.000	0.0
2.30	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.110	97.4	0.160	121.6	-0.102	-88.3

Standard error of estimate = 0.12
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW NEPL (PREDEV)
Observed - HOURLY FLOW NEPL POC

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

AR 046684

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	*****	*****	94.81	55.94	100.00	100.00	0.01	0.03
0.10	1537	7339	0.36	1.73	5.19	44.06	0.10	0.10
0.11	1454	6707	0.34	1.58	4.83	42.32	0.11	0.11
0.12	1328	6231	0.31	1.47	4.48	40.74	0.12	0.12
0.13	2261	11418	0.53	2.69	4.17	39.27	0.14	0.14
0.15	1003	7134	0.24	1.68	3.64	36.56	0.15	0.16
0.16	1739	16649	0.41	3.93	3.40	34.89	0.17	0.17
0.18	793	8367	0.19	1.97	2.99	30.96	0.19	0.19
0.19	1433	17914	0.34	4.23	2.80	28.99	0.20	0.20
0.21	1820	22807	0.43	5.38	2.47	24.76	0.22	0.22
0.24	999	12437	0.24	2.94	2.04	19.38	0.25	0.25
0.26	896	11561	0.21	2.73	1.80	16.44	0.27	0.27
0.28	1093	15924	0.26	3.76	1.59	13.72	0.29	0.29
0.31	904	13283	0.21	3.13	1.33	9.96	0.32	0.32
0.34	993	12160	0.23	2.87	1.12	6.82	0.36	0.36
0.38	737	7721	0.17	1.82	0.88	3.95	0.40	0.40
0.42	619	4685	0.15	1.11	0.71	2.13	0.44	0.44
0.46	460	2651	0.11	0.63	0.56	1.02	0.48	0.48
0.50	415	1026	0.10	0.24	0.45	0.40	0.52	0.52
0.55	405	121	0.10	0.03	0.36	0.16	0.58	0.58
0.61	316	100	0.07	0.02	0.26	0.13	0.64	0.64
0.67	229	156	0.05	0.04	0.19	0.10	0.70	0.70
0.74	178	118	0.04	0.03	0.13	0.07	0.77	0.77
0.81	110	30	0.03	0.01	0.09	0.04	0.85	0.85
0.89	97	41	0.02	0.01	0.06	0.03	0.93	0.93
0.98	65	39	0.02	0.01	0.04	0.02	1.03	1.03
1.10	45	25	0.01	0.01	0.03	0.01	1.14	1.14
1.20	19	18	0.00	0.00	0.02	0.01	1.24	1.25
1.30	15	8	0.00	0.00	0.01	0.00	1.35	1.33
1.40	18	2	0.00	0.00	0.01	0.00	1.49	1.45
1.60	3	2	0.00	0.00	0.00	0.00	1.65	1.62
1.70	8	4	0.00	0.00	0.00	0.00	1.82	1.80
1.90	2	0	0.00	0.00	0.00	0.00	1.98	0.00
2.10	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.30	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720	423720	100.00	100.00			0.02	0.12

0 Observed values are zero
73109 Simulated values are zero
0 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
73109 Observed values are not zero when simulated are

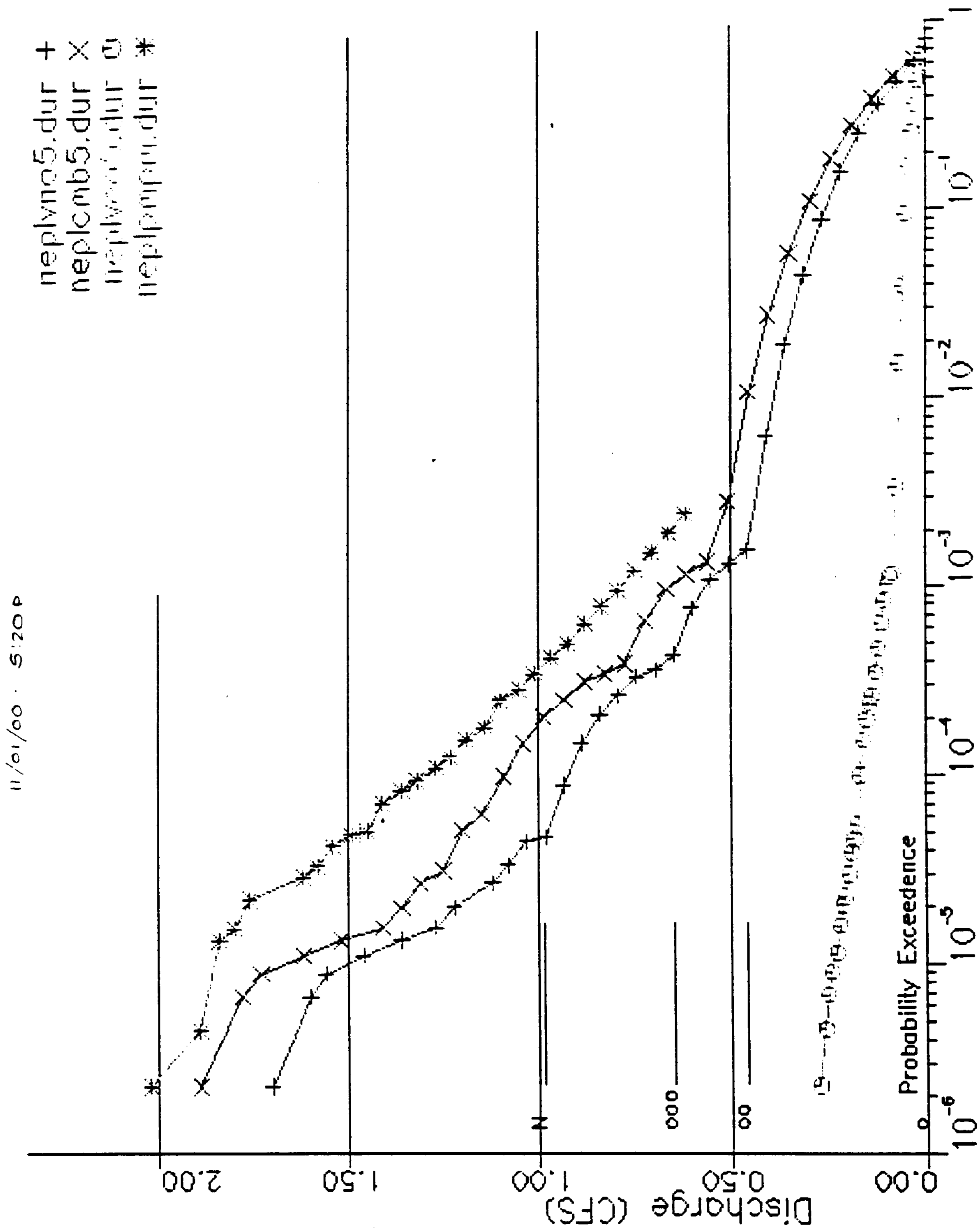
1

Simulated - HOURLY FLOW NEPL (PREDEV)
Observed - HOURLY FLOW NEPL POC

Lower class limit	Number of occurrences between indicated deviations	-60%	-30%	-10%	0%	10%	30%	60%
0.00	230743	1253	562	258	215	373	3638	0
0.10	6810	138	71	29	16	43	232	0
0.11	6200	145	72	23	21	36	210	0
0.12	5733	150	62	23	18	50	195	0
0.13	10387	307	130	57	51	84	402	0
0.15	6452	231	104	42	47	52	206	0
0.16	15117	504	228	98	73	138	491	0
0.18	7558	296	114	41	40	71	247	0
0.19	16216	603	253	113	93	166	470	0

AR 046685

0.21	20489	892	389	143	116	189	589	0
0.24	11122	519	212	92	75	108	309	0
0.26	10325	509	200	60	57	115	295	0
0.28	14206	725	298	91	95	142	367	0
0.31	11783	649	269	87	70	126	299	0
0.34	10767	629	251	78	68	113	254	0
0.38	6774	453	155	68	42	73	156	0
0.42	4095	301	97	38	27	35	92	0
0.46	2287	207	57	13	16	17	54	0
0.50	830	119	30	6	6	14	21	0
0.55	102	5	2	1	2	3	6	0
0.61	87	7	1	1	1	0	3	0
0.67	132	12	6	1	2	0	3	0
0.74	102	8	3	0	1	1	3	0
0.81	25	4	1	0	0	0	0	0
0.89	36	1	0	1	0	1	2	0
0.98	31	4	2	1	0	1	0	0
1.10	19	2	3	0	0	1	0	0
1.20	12	5	1	0	0	0	0	0
1.30	6	2	0	0	0	0	0	0
1.40	2	0	0	0	0	0	0	0
1.60	1	1	0	0	0	0	0	0
1.70	4	0	0	0	0	0	0	0
1.90	0	0	0	0	0	0	0	0
2.10	0	0	0	0	0	0	0	0
2.30	0	0	0	0	0	0	0	0
	398453	8681	3573	1365	1152	1952	8544	0



11/01/00 5:20 P
neplyno5.dur +
neplcmb5.dur ×
Discharge (CFS)
0.00
0.50
1.00
1.50
2.00
Probability Exceedence

NEPL NEW VAULT

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	180.00	ft
Facility Width:	180.00	ft
Facility Area:	32400.	sq. ft
Effective Storage Depth:	20.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	648000.	cu. ft
Riser Head:	20.00	ft
Riser Diameter:	24.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	2.13	0.548	
2	14.00	2.00	0.266	4.0
3	16.00	2.75	0.410	6.0

Top Notch Weir:	Rectangular	
Length:	3.50	in
Weir Height:	17.63	ft
Outflow Rating Curve:	None	

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.02	0.02	648.	0.015	0.018	0.00
0.04	0.04	1296.	0.030	0.026	0.00
0.07	0.07	2268.	0.052	0.032	0.00
0.09	0.09	2916.	0.067	0.036	0.00
0.11	0.11	3564.	0.082	0.041	0.00
0.13	0.13	4212.	0.097	0.045	0.00
0.15	0.15	4860.	0.112	0.048	0.00
0.18	0.18	5832.	0.134	0.052	0.00
0.64	0.64	20736.	0.476	0.098	0.00
1.11	1.11	35964.	0.826	0.129	0.00
1.57	1.57	50868.	1.168	0.154	0.00
2.04	2.04	66096.	1.517	0.175	0.00
2.50	2.50	81000.	1.860	0.194	0.00
2.97	2.97	96228.	2.209	0.211	0.00
3.43	3.43	111132.	2.551	0.227	0.00
3.90	3.90	126360.	2.901	0.242	0.00
4.36	4.36	141264.	3.243	0.256	0.00
4.83	4.83	156492.	3.593	0.269	0.00
5.29	5.29	171396.	3.935	0.282	0.00
5.76	5.76	186624.	4.284	0.294	0.00
6.22	6.22	201528.	4.626	0.306	0.00
6.69	6.69	216756.	4.976	0.317	0.00
7.15	7.15	231660.	5.318	0.328	0.00
7.62	7.62	246888.	5.668	0.338	0.00
8.08	8.08	261792.	6.010	0.348	0.00
8.55	8.55	277020.	6.360	0.358	0.00
9.01	9.01	291924.	6.702	0.368	0.00
9.48	9.48	307152.	7.051	0.377	0.00
9.94	9.94	322056.	7.393	0.386	0.00

NEPL NEW VAULT

10.41	10.41	337284.	7.743	0.395	0.00
10.87	10.87	352188.	8.085	0.404	0.00
11.34	11.34	367416.	8.435	0.412	0.00
11.80	11.80	382320.	8.777	0.421	0.00
12.27	12.27	397548.	9.126	0.429	0.00
12.74	12.74	412776.	9.476	0.437	0.00
13.20	13.20	427680.	9.818	0.445	0.00
13.67	13.67	442908.	10.168	0.453	0.00
14.00	14.00	453600.	10.413	0.458	0.00
14.02	14.02	454248.	10.428	0.459	0.00
14.04	14.04	454896.	10.443	0.462	0.00
14.06	14.06	455544.	10.458	0.467	0.00
14.08	14.08	456192.	10.473	0.473	0.00
14.10	14.10	456840.	10.488	0.480	0.00
14.12	14.12	457488.	10.502	0.489	0.00
14.15	14.15	458460.	10.525	0.499	0.00
14.17	14.17	459108.	10.540	0.505	0.00
14.19	14.19	459756.	10.555	0.508	0.00
14.65	14.65	474660.	10.897	0.557	0.00
15.12	15.12	489888.	11.246	0.591	0.00
15.58	15.58	504792.	11.588	0.620	0.00
16.00	16.00	518400.	11.901	0.643	0.00
16.03	16.03	519372.	11.923	0.647	0.00
16.06	16.06	520344.	11.945	0.654	0.00
16.09	16.09	521316.	11.968	0.665	0.00
16.11	16.11	521964.	11.983	0.680	0.00
16.14	16.14	522936.	12.005	0.698	0.00
16.17	16.17	523908.	12.027	0.719	0.00
16.20	16.20	524880.	12.050	0.744	0.00
16.23	16.23	525852.	12.072	0.754	0.00
16.69	16.69	540756.	12.414	0.849	0.00
17.16	17.16	555984.	12.764	0.921	0.00
17.62	17.62	570888.	13.106	0.982	0.00
17.63	17.63	571212.	13.113	0.982	0.00
17.92	17.92	580608.	13.329	1.140	0.00
18.22	18.22	590328.	13.552	1.310	0.00
18.52	18.52	600048.	13.775	1.570	0.00
18.81	18.81	609444.	13.991	1.860	0.00
19.11	19.11	619164.	14.214	2.190	0.00
19.41	19.41	628884.	14.437	2.550	0.00
19.70	19.70	638280.	14.653	2.940	0.00
20.00	20.00	648000.	14.876	3.350	0.00
20.10	20.10	651240.	14.950	3.980	0.00
20.20	20.20	654480.	15.025	5.110	0.00
20.30	20.30	657720.	15.099	6.580	0.00
20.40	20.40	660960.	15.174	8.310	0.00
20.50	20.50	664200.	15.248	10.280	0.00
20.60	20.60	667440.	15.322	12.460	0.00
20.70	20.70	670680.	15.397	14.820	0.00
20.80	20.80	673920.	15.471	16.950	0.00
20.90	20.90	677160.	15.545	17.780	0.00
21.00	21.00	680400.	15.620	18.560	0.00
21.10	21.10	683640.	15.694	19.310	0.00
21.20	21.20	686880.	15.769	20.020	0.00
21.30	21.30	690120.	15.843	20.710	0.00
21.40	21.40	693360.	15.917	21.370	0.00
21.50	21.50	696600.	15.992	22.000	0.00

21.60	21.60	699840.	16.066	22.620	0.00
21.70	21.70	703080.	16.140	23.210	0.00
21.80	21.80	706320.	16.215	23.790	0.00
21.90	21.90	709560.	16.289	24.360	0.00

NEPL NEW VAULT

```
Route Time Series through Facility
  Inflow Time Series File:nepl_dnm.tsf
 Outflow Time Series File:neplvno5
     POC Time Series File:neplcmb5

Inflow/Outflow Analysis
   Peak Inflow Discharge:       11.65 CFS at  0:00 on Oct 26 in 1986
  Peak Outflow Discharge:        1.71 CFS at 12:00 on Jan  2 in 1997
    Peak Reservoir Stage:       18.66  Ft
     Peak Reservoir Elev:       18.66  Ft
  Peak Reservoir Storage:  604564.     Cu-Ft
                        :       13.879 Ac-Ft
Add Time Series:neplveo5.tsf
   Peak Summed Discharge:        1.90 CFS at 12:00 on Jan  2 in 1997
Point of Compliance File:neplcmb5.tsf
```

Flow Frequency Analysis
Time Series File:neplpmpm.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= 0.098 StdDev= 0.101
Skew= 0.504

---Annual Peak Flow Rates---

Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis-------

- - Peaks - - (CFS)	Rank	Return Period	Prob
2.34		100.00	0.990
2.15		50.00	0.980
1.95		25.00	0.960
1.70		10.00	0.900
1.65		8.00	0.875
1.51		5.00	0.800
1.23		2.00	0.500
1.05		1.30	0.231

Flow Frequency Analysis
Time Series File:neplvno5.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.381 StdDev= 0.151
Skew= 2.216

---Annual Peak Flow Rates---

Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis-------

- - Peaks (CFS)	- - (ft)	Rank	Return Period	Prob
1.51	18.45		100.00	0.990
1.17	17.97		50.00	0.980
0.906	17.06		25.00	0.960
0.649	16.04		10.00	0.900
0.610	15.43		8.00	0.875
0.507	14.18		5.00	0.800
0.371	9.15		2.00	0.500
0.325	7.04		1.30	0.231

Flow Frequency Analysis
Time Series File:neplcmb5.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.313 StdDev= 0.153
Skew= 2.129

---Annual Peak Flow Rates---

Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis-------

- - Peaks - - (CFS)	Rank	Return Period	Prob
1.77		100.00	0.990
1.38		50.00	0.980
1.07		25.00	0.960
0.766		10.00	0.900
0.720		8.00	0.875
0.598		5.00	0.800
0.434		2.00	0.500
0.377		1.30	0.231

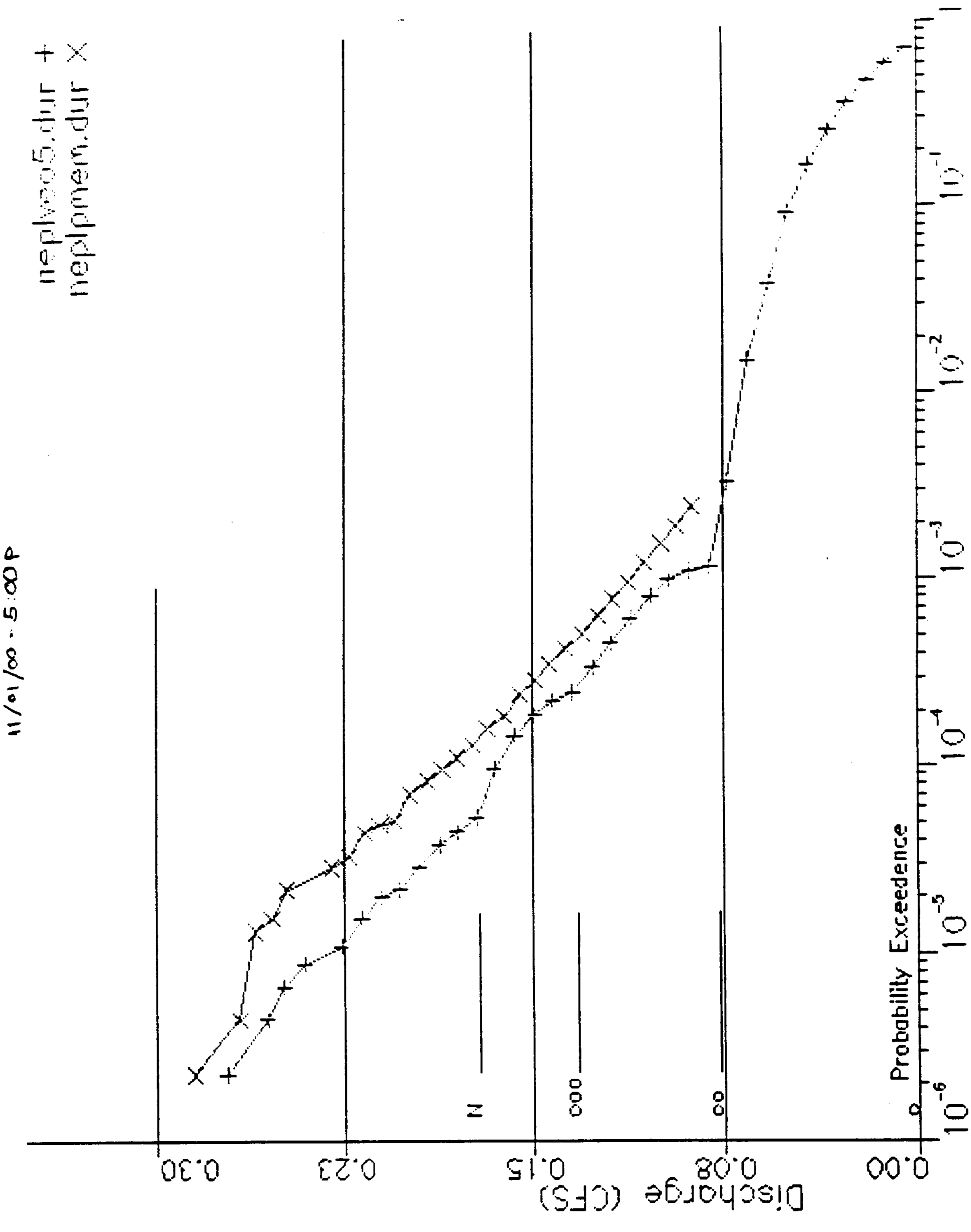
NEPL NEW VAULT

Duration Comparison Anaylsis
Base File: neplpmpm.tsf
New File: neplcmb5.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.615	0.25E-02	0.12E-02	-52.5	0.25E-02	0.615	0.513	-16.7
0.662	0.19E-02	0.10E-02	-48.0	0.19E-02	0.662	0.523	-21.0
0.708	0.15E-02	0.77E-03	-49.6	0.15E-02	0.708	0.531	-24.9
0.754	0.12E-02	0.47E-03	-61.4	0.12E-02	0.754	0.608	-19.4
0.800	0.94E-03	0.37E-03	-61.0	0.94E-03	0.800	0.676	-15.6
0.847	0.76E-03	0.34E-03	-54.5	0.76E-03	0.847	0.710	-16.2
0.893	0.62E-03	0.30E-03	-51.5	0.62E-03	0.893	0.727	-18.5
0.939	0.47E-03	0.26E-03	-46.2	0.47E-03	0.939	0.753	-19.8
0.985	0.39E-03	0.21E-03	-46.8	0.39E-03	0.985	0.777	-21.1
1.03	0.33E-03	0.16E-03	-52.4	0.33E-03	1.03	0.871	-15.5
1.08	0.27E-03	0.11E-03	-58.0	0.27E-03	1.08	0.912	-15.4
1.12	0.21E-03	0.78E-04	-63.4	0.21E-03	1.12	0.982	-12.6
1.17	0.18E-03	0.57E-04	-67.9	0.18E-03	1.17	1.01	-13.5
1.22	0.14E-03	0.43E-04	-69.4	0.14E-03	1.22	1.05	-13.8
1.26	0.12E-03	0.32E-04	-73.1	0.12E-03	1.26	1.07	-14.9
1.31	0.10E-03	0.27E-04	-73.3	0.10E-03	1.31	1.09	-16.6
1.35	0.87E-04	0.21E-04	-76.3	0.87E-04	1.35	1.11	-17.9
1.40	0.73E-04	0.18E-04	-75.0	0.73E-04	1.40	1.13	-19.2
1.45	0.53E-04	0.16E-04	-69.6	0.53E-04	1.45	1.20	-17.0
1.49	0.50E-04	0.14E-04	-72.7	0.50E-04	1.49	1.20	-19.3
1.54	0.43E-04	0.14E-04	-68.4	0.43E-04	1.54	1.22	-20.6
1.59	0.34E-04	0.11E-04	-66.7	0.34E-04	1.59	1.25	-21.1
1.63	0.30E-04	0.11E-04	-61.5	0.30E-04	1.63	1.28	-21.4
1.68	0.23E-04	0.91E-05	-60.0	0.23E-04	1.68	1.33	-20.8
1.72	0.23E-04	0.91E-05	-60.0	0.23E-04	1.72	1.33	-22.9
1.77	0.21E-04	0.68E-05	-66.7	0.21E-04	1.77	1.39	-21.4
1.82	0.16E-04	0.46E-05	-71.4	0.16E-04	1.82	1.46	-19.6
1.86	0.68E-05	0.23E-05	-66.7	0.68E-05	1.86	1.79	-3.7
1.91	0.46E-05	0.00E+00	-100.0	0.46E-05	1.91	1.82	-4.8
1.96	0.23E-05	0.00E+00	-100.0	0.23E-05	1.96	1.90	-3.0
2.00	0.23E-05	0.00E+00	-100.0	0.23E-05	2.00	1.90	-5.2

There is no positive excursion

Maximum negative excursion = 0.182 cfs (-25.4%)
occuring at 0.716 cfs on the Base Data:neplpmpm.tsf
and at 0.534 cfs on the New Data:neplcmb5.tsf



11/01/00 - 5:00 P
neplwao5.dur +
neplpmem.dur ×
Discharge (CFS)
0.00
0.08
0.15
0.23
0.30
Probability Exceedence

AR 046694

NEPL EXISTING VAULT

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	380.00	ft
Facility Width:	25.69	ft
Facility Area:	9762.	sq. ft
Effective Storage Depth:	18.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	175720.	cu. ft
Riser Head:	18.00	ft
Riser Diameter:	21.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.88	0.088	
2	13.50	1.25	0.090	4.0
3	15.00	1.13	0.059	4.0

Top Notch Weir:	Rectangular	
Length:	1.38	in
Weir Height:	15.63	ft
Outflow Rating Curve:	None	

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.01	0.01	98.	0.002	0.002	0.00
0.02	0.02	195.	0.004	0.003	0.00
0.03	0.03	293.	0.007	0.003	0.00
0.04	0.04	391.	0.009	0.004	0.00
0.05	0.05	488.	0.011	0.005	0.00
0.06	0.06	586.	0.013	0.005	0.00
0.07	0.07	683.	0.016	0.006	0.00
0.49	0.49	4784.	0.110	0.015	0.00
0.91	0.91	8884.	0.204	0.020	0.00
1.33	1.33	12984.	0.298	0.024	0.00
1.75	1.75	17084.	0.392	0.027	0.00
2.17	2.17	21184.	0.486	0.031	0.00
2.58	2.58	25186.	0.578	0.033	0.00
3.00	3.00	29287.	0.672	0.036	0.00
3.42	3.42	33387.	0.766	0.038	0.00
3.84	3.84	37487.	0.861	0.041	0.00
4.26	4.26	41587.	0.955	0.043	0.00
4.68	4.68	45687.	1.049	0.045	0.00
5.10	5.10	49787.	1.143	0.047	0.00
5.51	5.51	53790.	1.235	0.049	0.00
5.93	5.93	57890.	1.329	0.051	0.00
6.35	6.35	61990.	1.423	0.052	0.00
6.77	6.77	66090.	1.517	0.054	0.00
7.19	7.19	70190.	1.611	0.056	0.00
7.61	7.61	74290.	1.705	0.057	0.00
8.03	8.03	78390.	1.800	0.059	0.00
8.45	8.45	82491.	1.894	0.060	0.00
8.86	8.86	86493.	1.986	0.062	0.00
9.28	9.28	90593.	2.080	0.063	0.00

NEPL EXISTING VAULT

9.70	9.70	94693.	2.174	0.065	0.00
10.12	10.12	98793.	2.268	0.066	0.00
10.54	10.54	102894.	2.362	0.067	0.00
10.96	10.96	106994.	2.456	0.069	0.00
11.38	11.38	111094.	2.550	0.070	0.00
11.79	11.79	115096.	2.642	0.071	0.00
12.21	12.21	119196.	2.736	0.073	0.00
12.63	12.63	123297.	2.831	0.074	0.00
13.05	13.05	127397.	2.925	0.075	0.00
13.47	13.47	131497.	3.019	0.076	0.00
13.50	13.50	131790.	3.025	0.076	0.00
13.51	13.51	131887.	3.028	0.077	0.00
13.53	13.53	132083.	3.032	0.078	0.00
13.54	13.54	132180.	3.034	0.079	0.00
13.55	13.55	132278.	3.037	0.082	0.00
13.57	13.57	132473.	3.041	0.085	0.00
13.58	13.58	132571.	3.043	0.088	0.00
13.59	13.59	132668.	3.046	0.089	0.00
13.60	13.60	132766.	3.048	0.090	0.00
13.62	13.62	132961.	3.052	0.091	0.00
14.04	14.04	137061.	3.146	0.109	0.00
14.45	14.45	141064.	3.238	0.120	0.00
14.87	14.87	145164.	3.333	0.130	0.00
15.00	15.00	146433.	3.362	0.132	0.00
15.01	15.01	146531.	3.364	0.133	0.00
15.02	15.02	146628.	3.366	0.134	0.00
15.04	15.04	146823.	3.371	0.135	0.00
15.05	15.05	146921.	3.373	0.137	0.00
15.06	15.06	147019.	3.375	0.140	0.00
15.07	15.07	147116.	3.377	0.143	0.00
15.08	15.08	147214.	3.380	0.144	0.00
15.09	15.09	147312.	3.382	0.145	0.00
15.51	15.51	151412.	3.476	0.166	0.00
15.63	15.63	152583.	3.503	0.171	0.00
15.92	15.92	155414.	3.568	0.218	0.00
16.22	16.22	158343.	3.635	0.295	0.00
16.52	16.52	161272.	3.702	0.391	0.00
16.81	16.81	164103.	3.767	0.502	0.00
17.11	17.11	167031.	3.835	0.628	0.00
17.41	17.41	169960.	3.902	0.766	0.00
17.70	17.70	172791.	3.967	0.915	0.00
18.00	18.00	175720.	4.034	1.080	0.00
18.10	18.10	176696.	4.056	1.620	0.00
18.20	18.20	177672.	4.079	2.600	0.00
18.30	18.30	178648.	4.101	3.880	0.00
18.40	18.40	179624.	4.124	5.400	0.00
18.50	18.50	180601.	4.146	7.110	0.00
18.60	18.60	181577.	4.168	9.010	0.00
18.70	18.70	182553.	4.191	10.780	0.00
18.80	18.80	183529.	4.213	11.450	0.00
18.90	18.90	184506.	4.236	12.080	0.00
19.00	19.00	185482.	4.258	12.680	0.00
19.10	19.10	186458.	4.280	13.250	0.00
19.20	19.20	187434.	4.303	13.790	0.00
19.30	19.30	188410.	4.325	14.310	0.00
19.40	19.40	189387.	4.348	14.810	0.00
19.50	19.50	190363.	4.370	15.290	0.00

19.60	19.60	191339.	4.393	15.760	0.00
19.70	19.70	192315.	4.415	16.210	0.00
19.80	19.80	193292.	4.437	16.650	0.00
19.90	19.90	194268.	4.460	17.080	0.00

NEPL EXISTING VAULT

```
Route Time Series through Facility
  Inflow Time Series File:nepl_dem.tsf
 Outflow Time Series File:neplveo5

Inflow/Outflow Analysis
   Peak Inflow Discharge:       2.66 CFS at  0:00 on Oct 26 in 1986
  Peak Outflow Discharge:      0.273 CFS at 20:00 on Feb  9 in 1951
    Peak Reservoir Stage:      16.13  Ft
     Peak Reservoir Elev:      16.13  Ft
  Peak Reservoir Storage:  157493.    Cu-Ft
                        :       3.616 Ac-Ft
```

NEPL EXISTING VAULT

Flow Frequency Analysis
Time Series File:neplpmem.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.750 StdDev= 0.101
Skew= 0.503

---Annual Peak Flow Rates---

Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis-------

- - Peaks - - (CFS)	Rank	Return Period	Prob
0.332		100.00	0.990
0.304		50.00	0.980
0.277		25.00	0.960
0.242		10.00	0.900
0.235		8.00	0.875
0.214		5.00	0.800
0.174		2.00	0.500
0.148		1.30	0.231

Flow Frequency Analysis
Time Series File:neplveo5.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -1.154 StdDev= 0.169
Skew= 2.114

---Annual Peak Flow Rates---

Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis-------

- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.291	16.20		100.00	0.990
0.220	15.93		50.00	0.980
0.167	15.53		25.00	0.960
0.116	14.30		10.00	0.900
0.108	14.02		8.00	0.875
0.088	13.58		5.00	0.800
0.062	8.86		2.00	0.500
0.053	6.59		1.30	0.231

NEPL EXISTING VAULT

Duration Comparison Anaylsis
Base File: neplpmem.tsf
New File: neplveo5.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.088	0.24E-02	0.11E-02	-53.2	0.24E-02	0.088	0.074	-15.5
0.094	0.19E-02	0.10E-02	-45.7	0.19E-02	0.094	0.075	-20.1
0.100	0.16E-02	0.92E-03	-41.0	0.16E-02	0.100	0.076	-24.3
0.106	0.13E-02	0.77E-03	-39.1	0.13E-02	0.106	0.076	-28.1
0.112	0.99E-03	0.62E-03	-37.6	0.99E-03	0.112	0.097	-13.5
0.118	0.81E-03	0.48E-03	-40.7	0.81E-03	0.118	0.105	-11.3
0.124	0.66E-03	0.39E-03	-41.2	0.66E-03	0.124	0.110	-11.0
0.130	0.54E-03	0.30E-03	-43.9	0.54E-03	0.130	0.115	-11.4
0.136	0.45E-03	0.25E-03	-45.2	0.45E-03	0.136	0.120	-12.0
0.142	0.38E-03	0.24E-03	-37.3	0.38E-03	0.142	0.125	-12.2
0.148	0.31E-03	0.21E-03	-32.8	0.31E-03	0.148	0.129	-12.7
0.154	0.27E-03	0.17E-03	-35.9	0.27E-03	0.154	0.132	-14.4
0.160	0.21E-03	0.13E-03	-37.6	0.21E-03	0.160	0.147	-7.7
0.166	0.18E-03	0.87E-04	-51.3	0.18E-03	0.166	0.152	-8.4
0.172	0.14E-03	0.57E-04	-60.3	0.14E-03	0.172	0.159	-7.6
0.178	0.12E-03	0.53E-04	-57.4	0.12E-03	0.178	0.161	-9.7
0.184	0.11E-03	0.43E-04	-60.4	0.11E-03	0.184	0.163	-11.3
0.190	0.94E-04	0.37E-04	-61.0	0.94E-04	0.190	0.166	-12.8
0.196	0.82E-04	0.30E-04	-63.9	0.82E-04	0.196	0.166	-15.2
0.202	0.64E-04	0.23E-04	-64.3	0.64E-04	0.202	0.170	-15.6
0.208	0.50E-04	0.21E-04	-59.1	0.50E-04	0.208	0.179	-14.0
0.214	0.50E-04	0.18E-04	-63.6	0.50E-04	0.214	0.179	-16.4
0.220	0.43E-04	0.16E-04	-63.2	0.43E-04	0.220	0.185	-15.7
0.226	0.30E-04	0.11E-04	-61.5	0.30E-04	0.226	0.197	-12.8
0.232	0.30E-04	0.91E-05	-69.2	0.30E-04	0.232	0.197	-15.0
0.238	0.23E-04	0.91E-05	-60.0	0.23E-04	0.238	0.204	-14.2
0.244	0.23E-04	0.91E-05	-60.0	0.23E-04	0.244	0.204	-16.3
0.250	0.21E-04	0.68E-05	-66.7	0.21E-04	0.250	0.213	-14.7
0.256	0.16E-04	0.46E-05	-71.4	0.16E-04	0.256	0.220	-13.9
0.262	0.14E-04	0.46E-05	-66.7	0.14E-04	0.262	0.223	-14.9
0.268	0.46E-05	0.23E-05	-50.0	0.46E-05	0.268	0.262	-2.2

There is no positive excursion

Maximum negative excursion = 0.030 cfs (-28.2%)
occuring at 0.106 cfs on the Base Data:neplpmem.tsf
and at 0.076 cfs on the New Data:neplveo5.tsf

MILLER CREEK WATERSHED
ADDITIONAL POINTS OF COMPLIANCE PERFORMANCE DATA

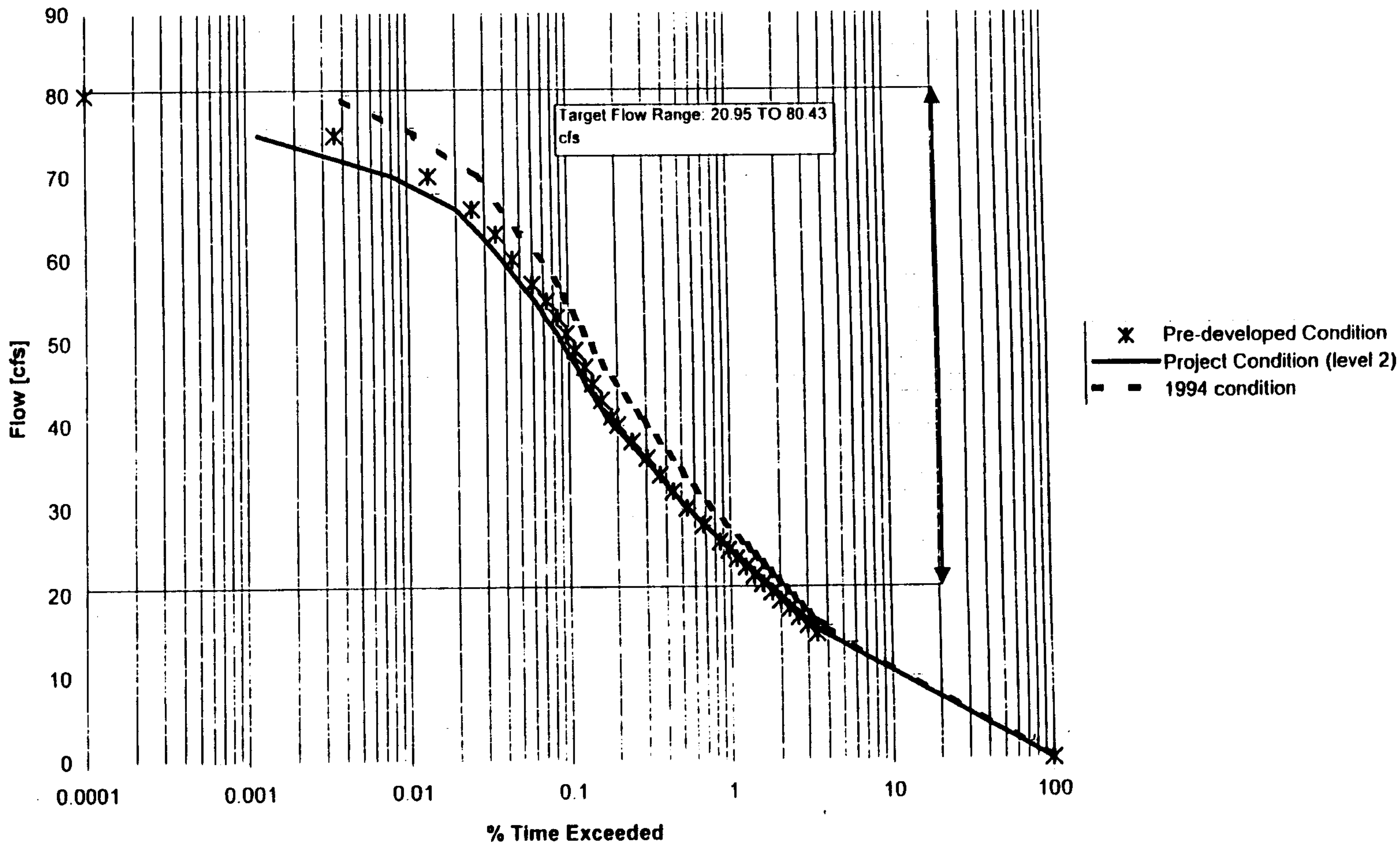
- SR509
- MCDF
- LAKE REBA

July 2001
556-2912-001 (28)

SR509

July 2001
556-2912-001 (28)

POC at SR-509



Target Flow Range: 20.95 TO 80.43 cfs
Flow [cfs]
% Time Exceeded
0
10
20
30
40
50
60
70
80
90
0.0001
0.001
0.01
0.1
1
10
100
Pre-developed Condition
Project Condition (level 2)
1994 condition

POC at SR-509

Percent cases equal or exceeding limit

Pre-developed Condition	1994 condition	Project Condition (level 2)	Flow [cfs]
100	100	100	0
3.4423676	4.242852789	3.839542502	15
2.9885302	3.735500829	3.30576348	16
2.6154064	3.296002133	2.857931928	17
2.2866516	2.912690703	2.482001029	18
2.0121779	2.592232825	2.167971354	19
1.7936373	2.315105803	1.906319639	20
1.5894931	2.078928823	1.688236863	21
1.4122534	1.863703026	1.496819229	22
1.2527141	1.68633221	1.32206731	23
1.0962428	1.521103556	1.1601718	24
0.9723402	1.363255433	1.01446584	25
0.8602379	1.221120698	0.887568329	26
0.6778061	0.971134983	0.686865512	28
0.5385632	0.781145839	0.54068339	30
0.4420372	0.640201512	0.435689389	32
0.3676956	0.532112451	0.357836695	34
0.3053904	0.447831552	0.28998343	36
0.2473331	0.371169267	0.235700817	38
0.2015482	0.309268042	0.187132164	40
0.1847918	0.283793307	0.170704531	41
0.1590673	0.24046245	0.147372531	43
0.1399509	0.201893225	0.125707102	45
0.1253186	0.169276041	0.112374531	47
0.1092703	0.145467878	0.09618498	49
0.096762	0.127135592	0.084757062	51
0.0847258	0.112612613	0.07142449	53
0.0733975	0.097137306	0.061901225	55
0.0599452	0.087852123	0.050711388	57
0.0448409	0.070234082	0.038093061	60
0.0351647	0.050711388	0.028093633	63
0.0252525	0.039045388	0.019998857	66
0.0134523	0.026665143	0.008094776	70
0.0035401	0.011189837	0.001190408	75
0.0001	0.003333143	0.0001	80
	0.0001		———

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III
distributions are for preliminary computations.
User is responsible for assessment and
interpretation.

HOURLY FLOW MILLER AT 509 (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

44.180	52.125	77.608	33.913	29.400
37.485	62.203	47.176	49.760	47.574
36.058	56.421	40.753	28.514	36.591
36.706	41.207	34.471	57.129	38.162
45.789	38.067	35.458	67.999	39.773
32.529	54.180	37.452	22.686	42.049
30.898	52.741	37.336	34.680	41.163
37.740	34.472	65.153	63.178	33.179
21.815	74.051	71.853	38.392	36.374
18.933	42.387	74.740		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.622
Variance (logs)	0.019
Standard Deviation (logs)	0.138
Skewness (logs)	-0.009
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.020
Coefficient of Variation (logs)	0.085

1

HOURLY FLOW MILLER AT 509 (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	19.926
0.9500	1.05	24.786
0.9000	1.11	27.840
0.8000	1.25	32.040
0.5000	2.00	41.901
0.2000	5.00	54.763
0.1000	10.00	62.971
0.0400	25.00	73.071
0.0200	50.00	80.433
0.0100	100.00	87.681
0.0050	200.00	94.879

1/2 Q_2 = 20.95 cfs
Q_{50} = 80.43 cfs

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW MILLER AT 509 (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

46.916	54.440	76.927	36.618	32.676
39.714	62.522	49.682	52.169	49.926
38.946	59.358	43.790	31.224	38.864
38.882	44.278	37.539	58.927	41.153
48.102	40.378	38.613	68.835	42.900
35.629	56.644	39.841	25.613	44.880
33.757	55.913	40.158	36.831	44.821
39.772	36.824	67.618	65.003	35.901
24.710	73.303	72.233	41.770	38.547
21.565	46.386	74.884		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.649
Variance (logs)	0.016
Standard Deviation (logs)	0.126
Skewness (logs)	-0.037
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.024
Coefficient of Variation (logs)	0.076

HOURLY FLOW MILLER AT 509 (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	22.555
0.9500	1.05	27.598
0.9000	1.11	30.711
0.8000	1.25	34.932
0.5000	2.00	44.604
0.2000	5.00	56.812
0.1000	10.00	64.406
0.0400	25.00	73.570
0.0200	50.00	80.140
0.0100	100.00	86.526
0.0050	200.00	92.794

$1/2 Q_2 \doteq 22.30$ cfs
$Q_{50} = 80.14$ cfs

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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III
distributions are for preliminary computations.
User is responsible for assessment and
interpretation.

HOURLY FLOW MILLER AT 509 (1994)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1995

Parameter is 1-day high value.

0 zero values in data

47 non-zero values in data

54.801	61.494	85.364	42.164	37.257
45.247	69.435	55.141	57.970	55.634
44.126	67.187	49.205	35.891	44.388
44.856	49.632	43.099	64.138	47.258
53.309	47.286	43.833	77.739	49.213
40.321	61.955	45.982	30.197	50.514
38.934	61.540	46.690	43.377	49.922
46.717	43.710	73.393	71.172	40.966
28.296	81.207	81.065	48.075	44.592
28.161	50.554			

The following 7 statistics are based on non-zero values.

Mean (logs)	1.700
Variance (logs)	0.013
Standard Deviation (logs)	0.113
Skewness (logs)	0.053
Standard Error of Skewness (logs)	0.347
Serial Correlation Coefficient (logs)	0.030
Coefficient of Variation (logs)	0.066

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HOURLY FLOW MILLER AT 509 (1994)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	27.614
0.9500	1.05	32.768
0.9000	1.11	35.928
0.8000	1.25	40.199
0.5000	2.00	49.957
0.2000	5.00	62.288
0.1000	10.00	69.993
0.0400	25.00	79.342
0.0200	50.00	86.083
0.0100	100.00	92.669
0.0050	200.00	99.168

$1/2 Q_2 = 24.98$ cfs
$Q_{50} = 86.08$ cfs

AR 046707

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Simulated - HOURLY FLOW MILLER AT 509 (1994)
Observed - HOURLY FLOW MILLER AT 509 (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	403897	0.462	15.5	0.696	21.8	-0.201	-0.5
15.00	2242	1.234	8.0	1.733	11.2	0.798	5.1
16.00	1881	1.267	7.7	1.819	11.0	0.898	5.4
17.00	1579	1.428	8.2	1.971	11.3	1.166	6.7
18.00	1319	1.556	8.4	2.155	11.6	1.336	7.2
19.00	1099	1.680	8.6	2.255	11.6	1.525	7.8
20.00	916	1.766	8.6	2.340	11.4	1.641	8.0
21.00	804	1.956	9.1	2.530	11.8	1.860	8.7
22.00	734	2.147	9.5	2.684	11.9	2.076	9.2
23.00	680	2.334	9.9	2.796	11.9	2.285	9.7
24.00	612	2.428	9.9	2.977	12.2	2.393	9.8
25.00	533	2.561	10.1	3.064	12.0	2.527	9.9
26.00	843	2.820	10.5	3.319	12.3	2.800	10.4
28.00	614	3.326	11.5	3.779	13.0	3.315	11.4
30.00	441	3.765	12.2	4.114	13.3	3.759	12.1
32.00	327	4.161	12.6	4.487	13.6	4.153	12.6
34.00	285	4.473	12.8	4.796	13.7	4.466	12.8
36.00	228	4.848	13.1	5.106	13.8	4.846	13.1
38.00	204	5.127	13.2	5.397	13.8	5.125	13.2
40.00	69	5.834	14.4	6.030	14.9	5.826	14.4
41.00	98	5.802	13.8	6.020	14.3	5.798	13.8
43.00	91	5.748	13.1	6.011	13.7	5.748	13.1
45.00	56	5.739	12.5	5.965	13.0	5.739	12.5
47.00	68	6.029	12.6	6.199	12.9	6.029	12.6
49.00	48	6.326	12.6	6.531	13.0	6.326	12.6
51.00	56	6.628	12.8	6.708	12.9	6.628	12.8
53.00	40	6.551	12.1	6.676	12.4	6.551	12.1
55.00	47	6.128	11.0	6.251	11.2	6.128	11.0
57.00	53	5.986	10.3	6.076	10.4	5.986	10.3
60.00	42	6.542	10.7	6.708	11.0	6.542	10.7
63.00	34	6.213	9.6	6.367	9.8	6.213	9.6
66.00	50	6.131	9.0	6.325	9.3	6.131	9.0
70.00	29	6.718	9.3	6.870	9.5	6.718	9.3
75.00	5	7.858	10.3	7.869	10.3	7.858	10.3
80.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420024	0.531	15.3	0.899	21.5	-0.114	-0.1

Standard error of estimate = 0.89
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

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Simulated - HOURLY FLOW MILLER AT 509 (1994)
Observed - HOURLY FLOW MILLER AT 509 (2006)

Lower class limit	Cases equal or exceeding lower limit & less then upper limit: Cases Sim	Cases Obs	Percent Simulated	Percent Observed	Percent cases equal or exceeding limit Simulated	Observed	Average of cases within class limits Simulated	Observed
0.00	*****	*****	95.76	96.16	100.00	100.00	3.01	3.27

15.00	2131	2242	0.51	0.53	4.24	3.84	15.49	15.49
16.00	1846	1881	0.44	0.45	3.74	3.31	16.48	16.49
17.00	1610	1579	0.38	0.38	3.30	2.86	17.50	17.48
18.00	1346	1319	0.32	0.31	2.91	2.48	18.50	18.50
19.00	1164	1099	0.28	0.26	2.59	2.17	19.51	19.48
20.00	992	916	0.24	0.22	2.32	1.91	20.49	20.49
21.00	904	804	0.22	0.19	2.08	1.69	21.48	21.47
22.00	745	734	0.18	0.17	1.86	1.50	22.48	22.49
23.00	694	680	0.17	0.16	1.69	1.32	23.49	23.51
24.00	663	612	0.16	0.15	1.52	1.16	24.52	24.48
25.00	597	533	0.14	0.13	1.36	1.01	25.49	25.48
26.00	1050	843	0.25	0.20	1.22	0.89	26.94	26.96
28.00	798	614	0.19	0.15	0.97	0.69	28.94	28.94
30.00	592	441	0.14	0.10	0.78	0.54	30.95	30.96
32.00	454	327	0.11	0.08	0.64	0.44	32.97	32.99
34.00	354	285	0.08	0.07	0.53	0.36	34.93	34.99
36.00	322	228	0.08	0.05	0.45	0.29	36.96	36.97
38.00	260	204	0.06	0.05	0.37	0.24	38.95	38.96
40.00	107	69	0.03	0.02	0.31	0.19	40.51	40.49
41.00	182	98	0.04	0.02	0.28	0.17	41.97	41.99
43.00	162	91	0.04	0.02	0.24	0.15	43.89	43.99
45.00	137	56	0.03	0.01	0.20	0.13	45.96	46.05
47.00	100	68	0.02	0.02	0.17	0.11	47.92	47.94
49.00	77	48	0.02	0.01	0.15	0.10	49.87	50.04
51.00	61	56	0.01	0.01	0.13	0.08	52.02	51.94
53.00	65	40	0.02	0.01	0.11	0.07	54.00	54.02
55.00	39	47	0.01	0.01	0.10	0.06	56.06	55.97
57.00	74	53	0.02	0.01	0.09	0.05	58.54	58.16
60.00	82	42	0.02	0.01	0.07	0.04	61.45	61.36
63.00	49	34	0.01	0.01	0.05	0.03	64.23	64.67
66.00	52	50	0.01	0.01	0.04	0.02	67.92	67.86
70.00	65	29	0.02	0.01	0.03	0.01	72.40	72.07
75.00	33	5	0.01	0.00	0.01	0.00	77.11	76.41
80.00	14	0	0.00	0.00	0.00	0.00	82.60	0.00
	420024	420024	100.00	100.00			3.91	4.02

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Simulated - HOURLY FLOW MILLER AT 509 (1994)
Observed - HOURLY FLOW MILLER AT 509 (2006)

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	2	11041	135049	69525	59577	118455	10248	0
15.00	0	0	8	849	768	563	54	0
16.00	0	0	1	678	705	459	38	0
17.00	0	0	0	433	650	465	31	0
18.00	0	0	0	337	537	421	24	0
19.00	0	0	0	206	492	381	20	0
20.00	0	0	0	143	434	330	9	0
21.00	0	0	0	96	384	309	15	0
22.00	0	0	0	67	355	301	11	0
23.00	0	0	0	47	314	316	3	0
24.00	0	0	0	34	319	250	9	0
25.00	0	0	0	21	269	239	4	0
26.00	0	0	0	26	407	405	5	0
28.00	0	0	0	13	273	323	5	0
30.00	0	0	0	7	159	274	1	0
32.00	0	0	0	6	93	228	0	0
34.00	0	0	0	3	83	198	1	0
36.00	0	0	0	1	45	182	0	0
38.00	0	0	0	1	38	165	0	0
40.00	0	0	0	1	5	63	0	0
41.00	0	0	0	1	10	87	0	0
43.00	0	0	0	0	17	74	0	0
45.00	0	0	0	0	17	39	0	0
47.00	0	0	0	0	9	59	0	0
49.00	0	0	0	0	5	43	0	0

51.00	0	0	0	0	5	51	0	0
53.00	0	0	0	0	9	31	0	0
55.00	0	0	0	0	18	29	0	0
57.00	0	0	0	0	25	26	0	0
60.00	0	0	0	0	17	25	0	0
63.00	0	0	0	0	21	13	0	0
66.00	0	0	0	0	34	16	0	0
70.00	0	0	0	0	20	9	0	0
75.00	0	0	0	0	3	2	0	0
80.00	0	0	0	0	0	0	0	0

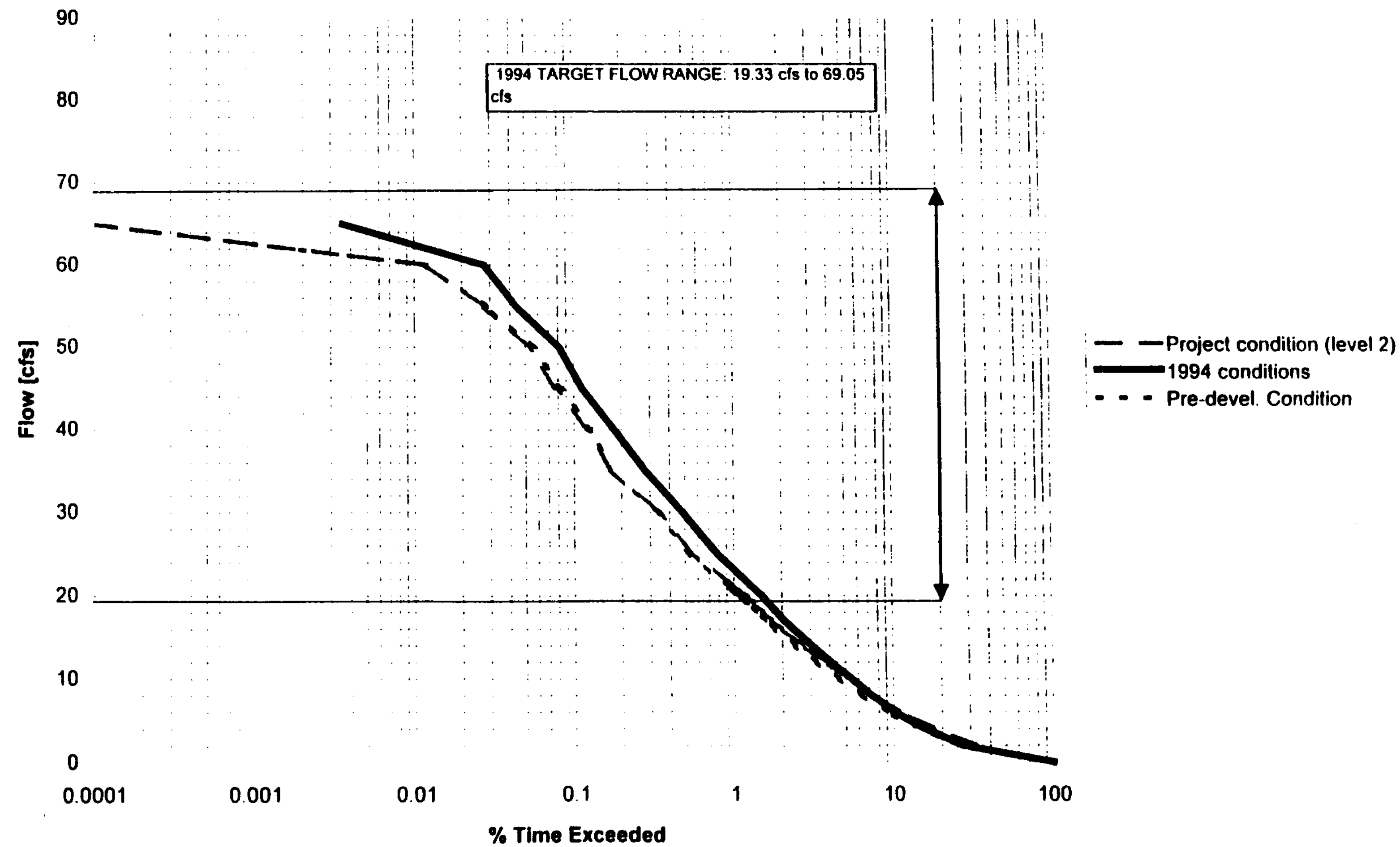
	2	11041	135058	72495	66117	124833	10478	0

MCDF

July 2001
556-2912-001 (28)

AR 046711

MILLER at RDF



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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
   Note -- Use of Log-Pearson Type III or Pearson-Type III
           distributions are for preliminary computations.
           User is responsible for assessment and
           interpretation.


HOURLY FLOW MILLER AT RDF (PREDEV)


Analysis for --  12 month period
                  starting October 1
                  ending   September 30
                  1949-1996


Parameter is  1-day high value.

   0 zero values in data

  48 non-zero values in data
        43.116      46.711      63.732      32.046      28.874
        32.819      54.419      43.174      47.522      43.266
        32.574      51.316      35.365      26.806      33.069
        32.820      37.983      31.966      51.384      35.331
        42.247      35.981      33.393      55.995      36.756
        30.604      50.650      34.627      24.925      40.871
        29.994      48.681      37.224      31.841      39.505
        34.350      33.662      58.946      57.141      31.290
        23.326      63.281      61.402      37.970      33.235
        21.460      40.271      61.260


The following 7 statistics are based on non-zero values.

Mean (logs)                                          1.590
Variance (logs)                                      0.014
Standard Deviation (logs)                            0.117
Skewness (logs)                                      0.136
Standard Error of Skewness (logs)                    0.343
Serial Correlation Coefficient (logs)                0.027
Coefficient of Variation (logs)                      0.074
```

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HOURLY FLOW MILLER AT RDF (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	21.324
0.9500	1.05	25.214
0.9000	1.11	27.632
0.8000	1.25	30.938
0.5000	2.00	38.655
0.2000	5.00	48.717
0.1000	10.00	55.173
0.0400	25.00	63.172
0.0200	50.00	69.048
0.0100	100.00	74.873
0.0050	200.00	80.701

$1/2 Q_2 = 19.33$ cfs
$Q_{50} = 69.05$ cfs

:

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW MILLER AT RDF (1994)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1995

Parameter is 1-day high value.

0 zero values in data

47 non-zero values in data

49.757	51.247	67.842	37.069	33.772
37.766	59.155	47.407	51.650	48.393
37.469	56.961	40.060	30.907	38.065
37.992	42.525	37.008	54.778	40.604
46.746	40.925	38.311	60.489	41.572
35.238	54.302	40.110	29.628	45.454
34.342	53.010	41.905	37.003	43.391
39.916	40.159	62.443	61.229	36.029
27.581	66.576	64.769	42.330	38.533
28.238	44.172			

The following 7 statistics are based on non-zero values.

Mean (logs)	1.638
Variance (logs)	0.010
Standard Deviation (logs)	0.099
Skewness (logs)	0.205
Standard Error of Skewness (logs)	0.347
Serial Correlation Coefficient (logs)	0.026
Coefficient of Variation (logs)	0.060

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HOURLY FLOW MILLER AT RDF (1994)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	26.468
0.9500	1.05	30.276
0.9000	1.11	32.617
0.8000	1.25	35.790
0.5000	2.00	43.102
0.2000	5.00	52.484
0.1000	10.00	58.435
0.0400	25.00	65.753
0.0200	50.00	71.096
0.0100	100.00	76.369
0.0050	200.00	81.626

$1/2Q_2 = 21.55$ cfs
$Q_{50} = 71.10$ cfs

:

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW MILLER AT RDF (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

43.301	46.788	64.300	32.369	28.979
33.494	54.636	43.635	47.694	43.849
33.375	51.992	36.322	27.375	33.944
33.095	38.706	32.682	51.524	35.935
42.511	36.336	34.248	56.856	37.251
31.153	50.838	35.073	25.391	40.843
30.117	49.339	37.264	32.189	40.030
34.573	33.610	59.659	57.817	31.672
23.985	63.558	61.798	38.328	33.833
21.644	40.865	61.698		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.595
Variance (logs)	0.013
Standard Deviation (logs)	0.116
Skewness (logs)	0.139
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.028
Coefficient of Variation (logs)	0.073

1

HOURLY FLOW MILLER AT RDF (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	21.729
0.9500	1.05	25.638
0.9000	1.11	28.065
0.8000	1.25	31.380
0.5000	2.00	39.109
0.2000	5.00	49.168
0.1000	10.00	55.613
0.0400	25.00	63.592
0.0200	50.00	69.448
0.0100	100.00	75.251
0.0050	200.00	81.053

$1/2 Q_2 = 19.55$ cfs
$Q_{50} = 69.45$ cfs

Miller Creek at RDF (New POC)
Percent cases equal or exceeding limit

Pre-devel. Condition	Project condition (level 2)	1994 conditions	Flow [cfs]
100	100	100	0
25.42363	32.42267	26.38992	2
14.13292	17.51519	15.32222	4
8.92901	10.80034	10.04657	6
6.297555	7.264585	7.216969	8
4.544747	5.21375	5.431594	10
3.262768	3.721454	4.061197	12
2.393326	2.674847	3.076253	14
1.800953	1.983934	2.340104	16
1.569905	1.727996	2.064644	17
1.379449	1.522056	1.85418	18
1.216841	1.347066	1.666571	19
1.184509	1.316115	1.635859	19.2
1.156424	1.281593	1.599194	19.4
1.134004	1.250405	1.569434	19.6
1.108987	1.218264	1.537769	19.8
1.083499	1.189694	1.510152	20
1.043614	1.145411	1.471344	20.2
1.006561	1.101128	1.428014	20.4
0.973284	1.066606	1.388254	20.6
0.912867	0.998276	1.315639	21
0.534315	0.564492	0.786146	25
0.325451	0.337124	0.480687	30
0.17488	0.173323	0.278794	35
0.128387	0.122136	0.180942	40
0.083546	0.077138	0.112375	45
0.056405	0.052378	0.081186	50
0.028557	0.027379	0.043569	55
0.0118	0.011904	0.027617	60
0.0001	0.0001	0.003571	65
0	0	0.0001	70
0	0	0	75
0	0	0	80
0	0	0	85
0	0	0	90

1

Simulated - HOURLY FLOW MILLER AT RDF (1994)
Observed - HOURLY FLOW MILLER AT RDF (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	283841	0.156	*	0.270	*	-0.126	*
2.00	62615	0.697	25.0	0.777	27.8	-0.576	-20.9
4.00	28204	0.796	16.5	0.943	19.5	-0.494	-10.4
6.00	14851	0.840	12.3	1.073	15.7	-0.276	-4.1
8.00	8614	0.870	9.8	1.177	13.2	0.054	0.5
10.00	6266	0.963	8.8	1.333	12.2	0.389	3.5
12.00	4396	1.125	8.7	1.564	12.1	0.714	5.5
14.00	2902	1.336	9.0	1.828	12.3	1.020	6.8
16.00	1075	1.572	9.5	2.080	12.6	1.327	8.0
17.00	865	1.653	9.5	2.078	11.9	1.451	8.3
18.00	735	1.822	9.9	2.163	11.7	1.666	9.0
19.00	130	1.922	10.1	2.257	11.8	1.789	9.4
19.20	145	1.865	9.7	2.201	11.4	1.695	8.8
19.40	131	1.798	9.2	2.199	11.3	1.591	8.2
19.60	135	1.838	9.3	2.213	11.2	1.729	8.8
19.80	120	1.838	9.2	2.135	10.7	1.614	8.1
20.00	186	1.928	9.6	2.267	11.3	1.832	9.1
20.20	186	1.962	9.7	2.352	11.6	1.884	9.3
20.40	145	2.081	10.2	2.516	12.3	1.984	9.7
20.60	287	2.085	10.0	2.518	12.1	1.998	9.6
21.00	1822	2.407	10.6	2.947	12.9	2.337	10.3
25.00	955	3.195	11.8	3.473	12.9	3.150	11.7
30.00	688	3.970	12.3	4.275	13.2	3.942	12.2
35.00	215	4.346	11.8	4.482	12.2	4.333	11.7
40.00	189	4.561	10.8	4.738	11.1	4.561	10.8
45.00	104	4.543	9.6	4.622	9.8	4.543	9.6
50.00	105	4.115	7.9	4.223	8.1	4.115	7.9
55.00	65	3.759	6.6	3.831	6.7	3.759	6.6
60.00	50	2.951	4.8	2.971	4.8	2.951	4.8
65.00	0	0.000	0.0	0.000	0.0	0.000	0.0
70.00	0	0.000	0.0	0.000	0.0	0.000	0.0
75.00	0	0.000	0.0	0.000	0.0	0.000	0.0
80.00	0	0.000	0.0	0.000	0.0	0.000	0.0
85.00	0	0.000	0.0	0.000	0.0	0.000	0.0
90.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420024	0.394	*	0.720	*	-0.146	*

Standard error of estimate = 0.71
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW MILLER AT RDF (1994)
Observed - HOURLY FLOW MILLER AT RDF (2006)

Lower class limit	Cases equal or exceeding lower limit & less then upper limit: Cases Sim	Cases Obs	Percent Simulated	Percent Observed	Percent cases equal or exceeding limit Simulated	Observed	Average of cases within class limits Simulated	Observed
0.00	*****	*****	73.61	67.58	100.00	100.00	0.59	0.63

2.00	46457	62615	11.07	14.91	26.39	32.42	2.85	2.85
4.00	22159	28204	5.28	6.71	15.32	17.52	4.91	4.90
6.00	11885	14851	2.83	3.54	10.05	10.80	6.91	6.89
8.00	7499	8614	1.79	2.05	7.22	7.26	8.94	8.93
10.00	5756	6268	1.37	1.49	5.43	5.21	10.95	10.93
12.00	4137	4396	0.98	1.05	4.06	3.72	12.95	12.93
14.00	3092	2902	0.74	0.69	3.08	2.67	14.95	14.94
16.00	1157	1075	0.28	0.26	2.34	1.98	16.48	16.48
17.00	884	865	0.21	0.21	2.06	1.73	17.48	17.48
18.00	788	735	0.19	0.17	1.85	1.52	18.49	18.47
19.00	129	130	0.03	0.03	1.67	1.35	19.10	19.10
19.20	154	145	0.04	0.03	1.64	1.32	19.30	19.30
19.40	125	131	0.03	0.03	1.60	1.28	19.50	19.50
19.60	133	135	0.03	0.03	1.57	1.25	19.69	19.70
19.80	116	120	0.03	0.03	1.54	1.22	19.91	19.90
20.00	163	186	0.04	0.04	1.51	1.19	20.10	20.09
20.20	182	186	0.04	0.04	1.47	1.15	20.30	20.30
20.40	167	145	0.04	0.03	1.43	1.10	20.50	20.50
20.60	305	287	0.07	0.07	1.39	1.07	20.80	20.79
21.00	2224	1822	0.53	0.43	1.32	1.00	22.74	22.73
25.00	1283	955	0.31	0.23	0.79	0.56	27.16	27.06
30.00	848	688	0.20	0.16	0.48	0.34	32.08	32.10
35.00	411	215	0.10	0.05	0.28	0.17	37.18	37.13
40.00	288	189	0.07	0.04	0.18	0.12	41.82	42.27
45.00	131	104	0.03	0.02	0.11	0.08	47.29	47.42
50.00	158	105	0.04	0.02	0.08	0.05	52.31	52.07
55.00	67	65	0.02	0.02	0.04	0.03	57.26	57.57
60.00	101	50	0.02	0.01	0.03	0.01	62.17	61.61
65.00	15	0	0.00	0.00	0.00	0.00	66.51	0.00
70.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
75.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
80.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
85.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
90.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420024	420024	100.00	100.00			2.33	2.48

1 Observed values are zero
1 Simulated values are zero
1 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
0 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW MILLER AT RDF (1994)
Observed - HOURLY FLOW MILLER AT RDF (2006)

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	16	62867	75981	44578	49599	43107	7693	0
2.00	2	18749	33648	4682	2157	1905	1472	0
4.00	0	782	17578	4868	2317	1776	883	0
6.00	0	0	6477	4304	2091	1413	566	0
8.00	0	0	1546	3601	1821	1346	300	0
10.00	0	0	265	2685	1829	1279	210	0
12.00	0	0	38	1607	1457	1161	133	0
14.00	0	0	6	945	979	889	83	0
16.00	0	0	1	276	370	405	23	0
17.00	0	0	0	178	331	348	8	0
18.00	0	0	1	109	270	350	5	0
19.00	0	0	0	19	46	65	0	0
19.20	0	0	1	20	58	64	2	0
19.40	0	0	0	27	48	54	2	0
19.60	0	0	1	13	61	59	1	0
19.80	0	0	0	21	49	50	0	0
20.00	0	0	0	21	72	93	0	0

20.20	0	0	0	18	82	85	1	0
20.40	0	0	0	16	59	70	0	0
20.60	0	0	0	31	116	140	0	0
21.00	0	0	0	142	794	876	10	0
25.00	0	0	0	28	314	613	0	0
30.00	0	0	0	12	206	469	1	0
35.00	0	0	0	2	59	154	0	0
40.00	0	0	0	0	79	110	0	0
45.00	0	0	0	0	60	44	0	0
50.00	0	0	0	0	88	17	0	0
55.00	0	0	0	0	64	1	0	0
60.00	0	0	0	0	50	0	0	0
65.00	0	0	0	0	0	0	0	0
70.00	0	0	0	0	0	0	0	0
75.00	0	0	0	0	0	0	0	0
80.00	0	0	0	0	0	0	0	0
85.00	0	0	0	0	0	0	0	0
90.00	0	0	0	0	0	0	0	0
	18	82398	135543	68203	65526	56943	11393	0

154th STREET RELOCATION INFORMATION

Table 1. Miller Creek effective impervious area (EIA) below the MCDF.

Basin	Basin Area (acres)	Pre-development EIA (acres)[a]		Post-development EIA (acres)	Difference (acres)	Total Impervious Area (acres)
		With 154th	Without 154th			
MC4	36.31	2.04	2.04	3.31	1.27	4.89
MC5	54.74	2.50	2.50	0.02	-2.48	8.20
MC6	15.35	0.80	0.80	0.26	-0.54	2.6[b]
MC7	46.29	3.05	3.05	0.03	-3.02	7.8[b]
Subtotal		8.39		3.62	-4.77	
SDN3A0	10.52	1.47	1.47	2.35	0.88	
SDN3A1	19.92	0.40	0.40	5.87	5.47	
SDW1A0	15.36	0.52	0.52	1.64	1.12	

[a] EIA was determined based on applying an effective impervious fraction to each designated land use cover.

[b] Prorated impervious area; actual for MC6 and MC7 (1994) are 4.4 and 9.2 acres, respectively.

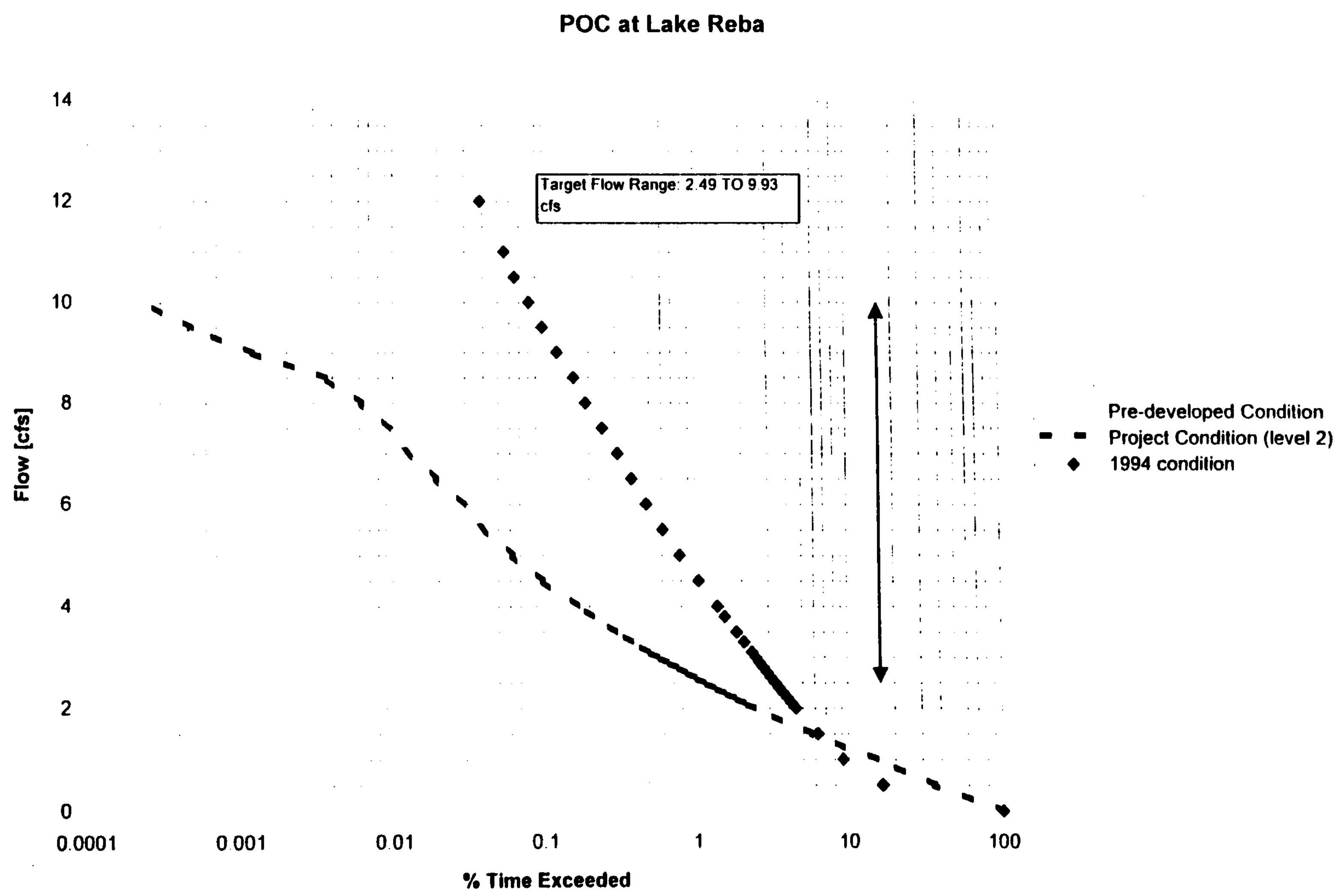
Table 2. Miller Creek effective impervious area (EIA) above the MCDF.

Basin	Basin Area (acres)	Pre-development EIA (acres)[a]		Post-development EIA (acres)	Difference (acres)
		With 154th	Without 154th		
SDN1-lwr	5.42	0.38	0.38	0.56	0.18
SDN2Xn	4.26	0	0	0	0
SDN3X	25.38	0	0	0	0
SDN4	30.32	2.63	2.63	12.26	9.63
SDN4X	15.18	1.05	1.05	4.21	3.16
MC1n	11.97	0.11	0.11	2.34	2.23
MC2	33.31	0.27	0.27	2.54	2.27
MC3	12.94	0.11	0.11	1.42	1.31
Subtotal					5.81

[a] EIA was determined based on applying an effective impervious fraction to each designated land use cover.

LAKE REBA

July 2001
556-2912-001 (28)



July 2001
556 2912 001 (28)

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW Lake Reba Flow (Predev)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

5.844	7.060	8.621	4.007	4.013
4.579	6.443	5.481	6.086	4.522
4.125	5.719	4.324	3.619	3.725
4.840	4.410	4.148	6.448	5.125
4.951	4.752	4.337	8.948	4.389
3.996	5.708	4.128	3.584	5.854
3.802	5.526	5.210	4.627	4.325
3.872	4.840	6.579	6.463	3.739
3.222	9.859	8.730	5.116	3.186
3.276	4.291	9.202		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.698
Variance (logs)	0.015
Standard Deviation (logs)	0.124
Skewness (logs)	0.725
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.132
Coefficient of Variation (logs)	0.177

1

HOURLY FLOW Lake Reba Flow (Predev)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	2.995
0.9500	1.05	3.331
0.9000	1.11	3.563
0.8000	1.25	3.905
0.5000	2.00	4.818
0.2000	5.00	6.240
0.1000	10.00	7.291
0.0400	25.00	8.749
0.0200	50.00	9.932
0.0100	100.00	11.202
0.0050	200.00	12.571

$1/2 Q_2 = 2.41$ cfs
$Q_{50} = 9.93$ cfs

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW Lake REba Flow (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

5.913	7.046	8.705	4.233	3.928
4.739	6.580	6.172	6.112	5.004
4.316	5.764	4.883	3.625	4.277
4.766	5.079	4.587	6.621	4.898
5.202	4.843	4.361	8.699	4.737
4.352	5.903	4.441	3.817	5.543
3.701	5.801	5.154	4.527	4.404
3.912	4.684	6.845	6.966	3.834
3.483	10.112	8.677	5.186	3.628
3.272	4.786	9.152		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.713
Variance (logs)	0.014
Standard Deviation (logs)	0.118
Skewness (logs)	0.701
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.150
Coefficient of Variation (logs)	0.165

1

HOURLY FLOW Lake REba Flow (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	3.162
0.9500	1.05	3.508
0.9000	1.11	3.743
0.8000	1.25	4.090
0.5000	2.00	5.000
0.2000	5.00	6.392
0.1000	10.00	7.405
0.0400	25.00	8.794
0.0200	50.00	9.908
0.0100	100.00	11.095
0.0050	200.00	12.363

$1/2 Q_2 = 2.50$ cfs
$Q_{50} = 9.91$ cfs

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW Lake Reba Flow (1994)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1995

Parameter is 1-day high value.

0 zero values in data

47 non-zero values in data

14.678	16.281	17.079	9.580	10.131
11.285	14.654	12.905	14.769	11.003
10.462	14.187	10.873	8.945	9.376
12.357	10.254	10.854	15.255	14.010
11.728	11.929	10.599	18.265	10.883
9.619	14.343	10.323	10.055	15.459
10.473	13.376	13.805	11.996	10.913
9.758	11.852	16.450	15.819	9.199
8.044	22.012	19.601	12.568	7.905
8.082	10.544			

The following 7 statistics are based on non-zero values.

Mean (logs)	1.082
Variance (logs)	0.011
Standard Deviation (logs)	0.104
Skewness (logs)	0.397
Standard Error of Skewness (logs)	0.347
Serial Correlation Coefficient (logs)	0.172
Coefficient of Variation (logs)	0.096

1

HOURLY FLOW Lake Reba Flow (1994)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	7.440
0.9500	1.05	8.398
0.9000	1.11	9.006
0.8000	1.25	9.853
0.5000	2.00	11.896
0.2000	5.00	14.687
0.1000	10.00	16.550
0.0400	25.00	18.931
0.0200	50.00	20.732
0.0100	100.00	22.558
0.0050	200.00	24.425

$1/2 Q_2 = 5.948$ cfs
$Q_{50} = 20.73$ cfs

POC at Lake Reba
Percent cases equal or exceeding limit

Pre-developed Condition	1994 condition	Project Condition (level 2)	Flow [cfs]
100	100	100	0
10.39011611	16.4831057	35.764147	0.5
4.19569527	9.16519056	14.934623	1
2.026810158	6.22750129	5.6908653	1.5
1.025441329	4.47022075	2.3317715	2
0.895638629	4.19761728	1.9925052	2.1
0.779996224	3.93691789	1.7220445	2.2
0.691730388	3.6995505	1.472773	2.3
0.614792788	3.48027732	1.2651658	2.4
0.551307467	3.28028875	1.0916043	2.5
0.489710186	3.08172866	0.9535169	2.6
0.43944114	2.90531017	0.8325715	2.7
0.393420183	2.74198617	0.7247205	2.8
0.350703295	2.58889968	0.627107	2.9
0.315066553	2.45033617	0.5447308	3
0.284385915	2.30796335	0.4752109	3.1
0.228216747	2.05083519	0.3721216	3.3
0.18219579	1.83632364	0.2926023	3.5
0.136410837	1.53967392	0.2061787	3.8
0.113754366	1.37777841	0.1659429	4
0.07646559	1.04470221	0.0980896	4.5
0.0528651	0.78590747	0.0619012	5
0.035164731	0.60806049	0.0411881	5.5
0.022892476	0.47640135	0.029046	6
0.016284339	0.3823591	0.0192846	6.5
0.011092231	0.30902996	0.0130945	7
0.007788162	0.24593833	0.0092852	7.5
0.004484093	0.19094147	0.0061901	8
0.002360049	0.15951469	0.0035712	8.5
0.001180025	0.12451669	0.0011904	9
0.00047201	0.09999429	0.0004762	9.5
0.0001	0.08142392	0.0002381	10
0	0.06523437	0.0001	10.5
0	0.05547302	0	11
0	0.03833114	0	12

Simulated - HOURLY FLOW Lake Reba Flow (1994)
Observed - HOURLY FLOW Lake REba Flow (2006)

Lower class limit	Number of cases	Mean absolute error (1) Average	Mean absolute error (1) Percent	Root mean square error (2) Average	Root mean square error (2) Percent	Bias (3) Average	Bias (3) Percent
0.00	269806	0.085	*	0.135	*	-0.067	*
0.50	87489	0.440	61.4	0.478	65.7	-0.346	-49.0
1.00	38826	0.623	51.7	0.714	58.8	-0.283	-24.4
1.50	14109	0.816	47.9	1.027	59.7	0.217	11.6
2.00	1425	1.109	54.1	1.416	69.1	0.840	41.0
2.10	1136	1.154	53.7	1.453	67.7	0.899	41.8
2.20	1047	1.329	59.1	1.642	72.9	1.152	51.2
2.30	872	1.380	58.8	1.702	72.5	1.221	52.0
2.40	729	1.514	61.8	1.840	75.0	1.399	57.1
2.50	580	1.699	66.7	1.996	78.3	1.596	62.6
2.60	508	1.871	70.7	2.203	83.2	1.763	66.6
2.70	453	2.004	72.9	2.338	85.0	1.901	69.1
2.80	410	2.120	74.4	2.403	84.3	2.024	71.0
2.90	346	2.364	80.2	2.652	90.0	2.278	77.2
3.00	292	2.454	80.4	2.767	90.7	2.369	77.6
3.10	433	2.755	86.3	3.085	96.5	2.677	83.6
3.30	334	3.054	89.9	3.357	98.8	2.977	87.7
3.50	363	3.436	94.4	3.742	102.8	3.372	92.7
3.80	169	3.722	95.6	4.016	103.1	3.640	93.5
4.00	285	4.076	96.0	4.442	104.4	3.946	92.9
4.50	152	4.778	100.9	5.159	108.8	4.678	98.6
5.00	87	5.299	101.2	5.718	109.1	5.253	100.3
5.50	51	6.278	109.3	6.717	117.0	6.278	109.3
6.00	41	6.138	98.4	6.639	106.6	6.138	98.4
6.50	26	6.587	97.4	6.913	102.4	6.587	97.4
7.00	16	7.079	98.3	7.376	102.6	7.079	98.3
7.50	13	7.262	93.6	7.688	98.9	7.262	93.6
8.00	11	7.220	87.2	7.476	90.5	7.220	87.2
8.50	10	8.218	94.8	8.525	98.2	8.218	94.8
9.00	3	9.737	106.1	9.812	106.8	9.737	106.1
9.50	1	11.663	117.9	11.663	117.9	11.663	117.9
10.00	1	11.900	117.7	11.900	117.7	11.900	117.7
10.50	0	0.000	0.0	0.000	0.0	0.000	0.0
11.00	0	0.000	0.0	0.000	0.0	0.000	0.0
12.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420024	0.278	*	0.544	*	-0.091	*

Standard error of estimate = 0.54
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW Lake Reba Flow (1994)
Observed - HOURLY FLOW Lake REba Flow (2006)

Lower class limit	Cases equal or exceeding lower limit & less then upper limit: Cases Sim	Cases Obs	Percent Simulated	Percent Observed	Percent cases equal or exceeding limit Simulated	Percent cases equal or exceeding limit Observed	Average of cases within class limits Simulated	Average of cases within class limits Observed
0.00	*********		83.52	64.24	100.00	100.00	0.14	0.18

0.503073787489			7.32	20.83	16.48	35.76	0.70	[illegible]
1.001233938626			2.94	9.24	9.17	14.93	1.22	[illegible]
1.50 738114109			1.76	3.36	6.23	5.69	1.73	[illegible]
2.00	1145	1425	0.27	0.34	4.47	2.33	2.05	2.05
2.10	1095	1136	0.26	0.27	4.20	1.99	2.15	2.15
2.20	997	1047	0.24	0.25	3.94	1.72	2.25	2.25
2.30	921	872	0.22	0.21	3.70	1.47	2.35	2.35
2.40	840	729	0.20	0.17	3.48	1.27	2.45	2.45
2.50	834	580	0.20	0.14	3.28	1.09	2.55	2.55
2.60	741	508	0.18	0.12	3.08	0.95	2.65	2.65
2.70	686	453	0.16	0.11	2.91	0.83	2.75	2.75
2.80	643	410	0.15	0.10	2.74	0.72	2.85	2.85
2.90	582	346	0.14	0.08	2.59	0.63	2.95	2.95
3.00	598	292	0.14	0.07	2.45	0.54	3.05	3.05
3.10	1080	433	0.26	0.10	2.31	0.48	3.20	3.19
3.30	901	334	0.21	0.08	2.05	0.37	3.40	3.40
3.50	1246	363	0.30	0.09	1.84	0.29	3.65	3.64
3.80	680	169	0.16	0.04	1.54	0.21	3.90	3.89
4.00	1399	285	0.33	0.07	1.38	0.17	4.24	4.25
4.50	1087	152	0.26	0.04	1.04	0.10	4.74	4.73
5.00	747	87	0.18	0.02	0.79	0.06	5.24	5.23
5.50	553	51	0.13	0.01	0.61	0.04	5.74	5.75
6.00	395	41	0.09	0.01	0.48	0.03	6.23	6.25
6.50	308	26	0.07	0.01	0.38	0.02	6.73	6.78
7.00	265	16	0.06	0.00	0.31	0.01	7.23	7.22
7.50	231	13	0.05	0.00	0.25	0.01	7.73	7.74
8.00	132	11	0.03	0.00	0.19	0.01	8.22	8.30
8.50	147	10	0.03	0.00	0.16	0.00	8.73	8.65
9.00	103	3	0.02	0.00	0.12	0.00	9.26	9.16
9.50	78	1	0.02	0.00	0.10	0.00	9.72	9.89
10.00	68	1	0.02	0.00	0.08	0.00	10.23	10.11
10.50	41	0	0.01	0.00	0.07	0.00	10.74	0.00
11.00	72	0	0.02	0.00	0.06	0.00	11.55	0.00
12.00	161	0	0.04	0.00	0.04	0.00	14.36	0.00
	420024420024		100.00	100.00			0.41	0.50

1 Observed values are zero
0 Simulated values are zero
0 Observed values are zero when simulated are zero
1 Observed values are zero when simulated are not
0 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW Lake Reba Flow (1994)
Observed - HOURLY FLOW Lake REba Flow (2006)

Number of occurrences between indicated deviations

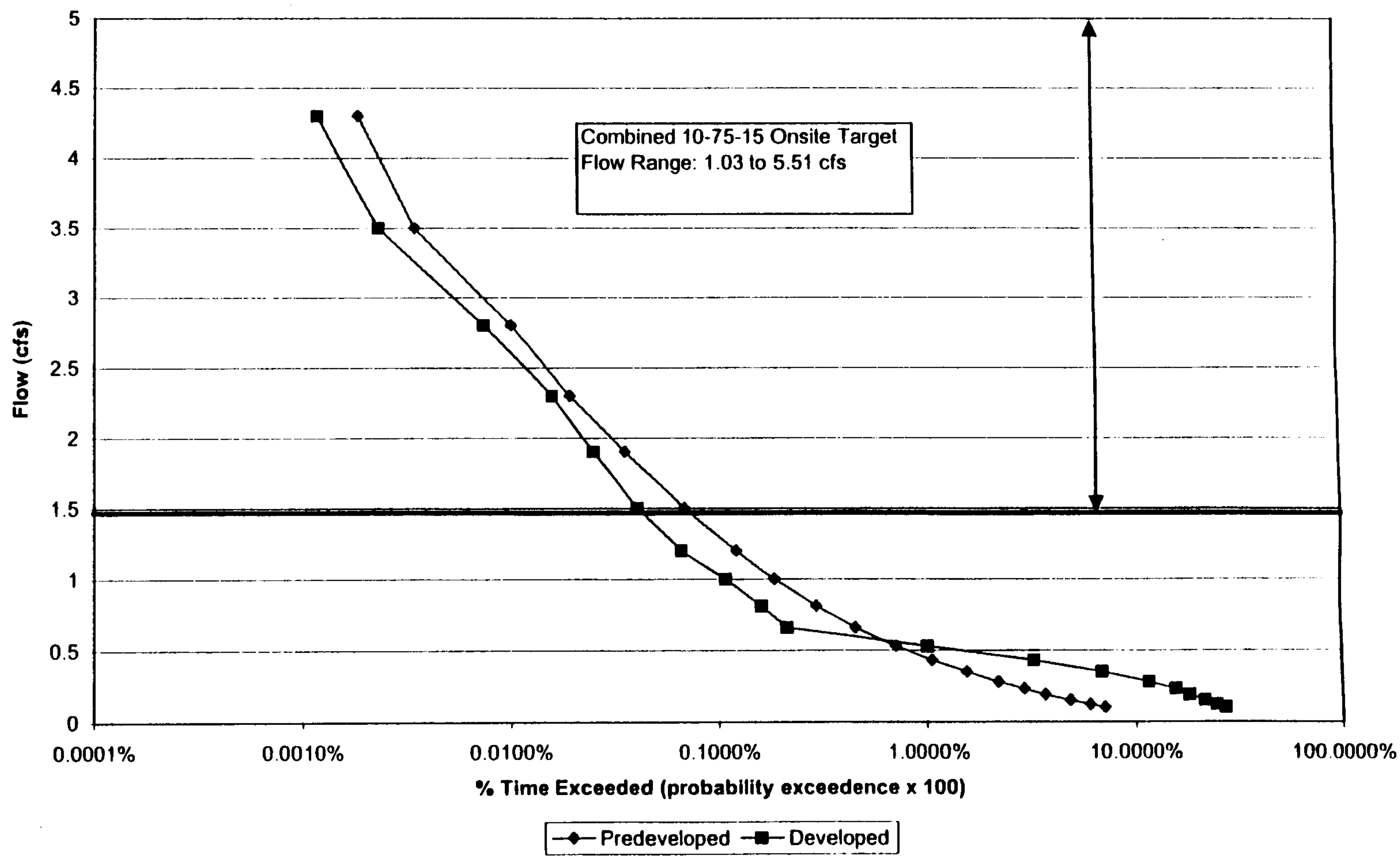
Lower class limit		-60%	-30%	-10%	0%	10%	30%	60%
0.00	47638	66088	38783	20926	23207	37581	35583	0
0.50	47926	24943	3887	1502	1214	2097	5920	0
1.00	10120	14857	3365	1324	1172	2032	5956	0
1.50	423	4125	1905	736	680	1367	4873	0
2.00	1	131	168	107	77	177	764	0
2.10	0	83	143	58	78	143	631	0
2.20	0	52	107	49	66	111	662	0
2.30	0	39	77	34	45	126	551	0
2.40	0	25	38	38	26	95	507	0
2.50	0	14	21	32	17	57	439	0
2.60	0	13	18	22	17	47	391	0
2.70	0	5	25	8	12	35	368	0
2.80	0	6	19	3	14	17	351	0
2.90	0	3	18	3	6	20	296	0
3.00	0	1	16	2	4	24	245	0
3.10	0	0	25	5	13	13	377	0
3.30	0	0	19	3	3	11	298	0

3.50	0	0	17	2	4	10	330	0
3.80	0	0	10	0	1	8	150	0
4.00	0	0	26	5	1	3	250	0
4.50	0	0	11	2	1	0	138	0
5.00	0	0	1	6	1	1	79	0
5.50	0	0	0	0	3	1	47	0
6.00	0	0	0	0	1	2	39	0
6.50	0	0	0	0	0	2	24	0
7.00	0	0	0	0	0	0	16	0
7.50	0	0	0	0	0	0	13	0
8.00	0	0	0	0	0	0	11	0
8.50	0	0	0	0	0	0	10	0
9.00	0	0	0	0	0	0	3	0
9.50	0	0	0	0	0	0	1	0
10.00	0	0	0	0	0	0	1	0
10.50	0	0	0	0	0	0	0	0
11.00	0	0	0	0	0	0	0	0
12.00	0	0	0	0	0	0	0	0

	106108	110385	48699	24867	26663	43980	59322	0

WALKER CREEK WATERSHED
DETENTION POND PERFORMANCE DATA
FOR SDW2 (SOUTH 12^{TH} STREET)
(HSPF AND KCRTS BACKUP)

SDW2



Combined 10-75-15 Onsite Target
Flow Range: 1.03 to 5.51 cfs
Flow (cfs)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0001%
0.0010%
0.0100%
0.1000%
1.0000%
10.0000%
100.0000%
% Time Exceeded (probability exceedence x 100)
Predeveloped
Developed

Computation of Basic Statistics. WALKER CREEK DETENTION FACILITIES

SDW-2 Data Set Number	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	Number Of data Values Used	Unused	
109	0.00	4.918	0.088	0.143	420024	0.00	flow
. 649	0.00	8.586	0.482	0.943	420024	0.00	stage
749	0.00	10.860	0.536	1.085	420024	0.00	volume

Flood Frequency For SDW-2

Pre and Post developed

Return Period

Walker Creek at South 12th Street

Return Period Peak	Pre-Project (cfs)	Project (cfs)
1/2 Q2	1.036	0.3105
Q2	2.072	0.621
Q10	3.827	1.801
Q25	4.778	3.114
Q50	5.512	4.657
Q100	6.264	6.914

Flow(cfs)	Predeveloped	Developed
0.1	7.1349%	27.3060%
0.12	6.0708%	24.7106%
0.15	4.8778%	21.5641%
0.19	3.7210%	18.2207%
0.23	2.9240%	15.7153%
0.28	2.2084%	11.5860%
0.35	1.5441%	6.9259%
0.43	1.0625%	3.2756%
0.53	0.7062%	1.0086%
0.66	0.4518%	0.2125%
0.81	0.2958%	0.1622%
1	0.1868%	0.1085%
1.2	0.1227%	0.0667%
1.5	0.0693%	0.0411%
1.9	0.0359%	0.0253%
2.3	0.0196%	0.0161%
2.8	0.0102%	0.0076%
3.5	0.0035%	0.0024%
4.3	0.0019%	0.0012%

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

0 RCHRES FLOWP.D64 SIMULATED YEARLY PEAKS

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

2.676	5.918	3.397	1.719	1.673
2.005	2.803	2.678	2.227	1.727
1.545	2.497	2.057	1.026	1.945
2.301	1.760	2.002	3.365	1.850
1.987	2.020	1.688	4.390	1.725
2.065	3.017	1.724	0.951	1.470
1.394	2.440	1.708	3.743	1.787
2.174	1.076	3.386	2.728	1.166
0.786	5.677	4.827	1.847	1.292
0.571	1.899	4.405		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.315
Variance (logs)	0.044
Standard Deviation (logs)	0.210
Skewness (logs)	-0.038
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.125
Coefficient of Variation (logs)	0.665

1

0 RCHRES FLOWP.D64 SIMULATED YEARLY PEAKS

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.663
0.9500	1.05	0.929
0.9000	1.11	1.111
0.8000	1.25	1.377

0.5000	2.00	2.072
0.2000	5.00	3.103
0.1000	10.00	3.827
0.0400	25.00	4.778
0.0200	50.00	5.512
0.0100	100.00	6.264
0.0050	200.00	7.040

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

0 RCHRES FLOWPOST.D64 SIMULATED YEARLY PEAKS

Analysis for -- 12 month period
starting October 1
ending September 30
1950-1997

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.495	0.954	4.918	0.433	0.504
0.554	0.586	1.087	0.554	0.583
0.511	1.795	0.558	0.385	0.562
0.554	0.935	0.516	0.574	0.527
0.508	0.554	0.565	2.707	0.745
0.582	0.546	0.556	0.314	0.555
0.403	2.023	0.514	1.403	0.575
0.444	0.405	1.197	1.481	0.464
0.380	2.888	3.001	0.578	0.482
0.378	0.665	4.653		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.137
Variance (logs)	0.086
Standard Deviation (logs)	0.294
Skewness (logs)	1.485
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.020
Coefficient of Variation (logs)	-2.150

1

0 RCHRES FLOWPOST.D64 SIMULATED YEARLY PEAKS

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.310
0.9500	1.05	0.338
0.9000	1.11	0.366
0.8000	1.25	0.417

0.5000	2.00	0.621
0.2000	5.00	1.167
0.1000	10.00	1.801
0.0400	25.00	3.114
0.0200	50.00	4.657
0.0100	100.00	6.914
0.0050	200.00	10.211

1

Flow Comparison: Predeveloped vs. Developed SDW2

MEASURED = Observed - HOURLY F SIMULATED = Simulated- HOURLY FL

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	329596	0.040	*	0.089	*	0.040	*
0.01	4797	0.173	1583.2	0.215	1969.4	0.173	1581.4
0.01	5923	0.177	1321.0	0.219	1636.2	0.176	1317.7
0.01	6311	0.182	1080.3	0.224	1329.7	0.182	1077.2
0.02	5263	0.183	877.4	0.226	1083.0	0.182	873.4
0.02	5515	0.189	745.2	0.231	911.8	0.188	740.4
0.03	6393	0.188	600.5	0.230	737.9	0.186	594.9
0.04	5846	0.190	490.8	0.233	602.7	0.187	484.1
0.04	5980	0.185	388.0	0.228	479.2	0.181	379.0
0.05	6014	0.184	312.0	0.228	386.6	0.178	300.8
0.07	5644	0.182	249.7	0.226	310.0	0.173	237.3
0.08	5515	0.177	197.3	0.220	246.3	0.164	182.5
0.10	4501	0.170	156.1	0.214	196.0	0.151	138.1
0.12	5046	0.166	124.6	0.209	156.9	0.140	105.0
0.15	4893	0.160	95.4	0.205	122.6	0.124	73.9
0.19	3371	0.148	71.1	0.192	92.8	0.098	47.1
0.23	3027	0.136	54.1	0.187	74.3	0.070	27.8
0.28	2810	0.126	40.7	0.185	59.3	0.032	10.4
0.35	2037	0.132	34.0	0.190	49.3	-0.023	-5.6
0.43	1507	0.169	35.5	0.248	52.2	-0.073	-15.2
0.53	1076	0.249	42.1	0.325	54.8	-0.153	-26.0
0.66	660	0.367	50.3	0.425	58.2	-0.256	-35.1
0.81	461	0.525	58.6	0.574	64.0	-0.368	-41.0
1.00	271	0.693	63.3	0.733	66.8	-0.525	-47.9
1.20	226	0.890	66.9	0.932	69.8	-0.668	-50.3
1.50	141	1.144	68.4	1.197	71.4	-0.939	-55.6
1.90	69	1.457	70.7	1.535	74.3	-1.120	-54.4
2.30	40	1.715	68.2	1.810	71.8	-1.493	-59.2
2.80	28	2.090	67.7	2.259	72.9	-1.819	-58.4
3.50	7	3.076	80.3	3.090	80.6	-3.076	-80.3
4.30	6	3.381	70.5	3.477	72.5	-3.381	-70.5
5.30	2	5.250	90.5	5.254	90.5	-5.250	-90.5
6.60	0	0.000	0.0	0.000	0.0	0.000	0.0
8.10	0	0.000	0.0	0.000	0.0	0.000	0.0
10.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	422976	0.072	*	0.142	*	0.061	*

STANDARD ERROR OF ESTIMATE = 0.12801
= (n/n-1)*square root((tot.col.5)**2 - (tot.col.7)**2)

(1) AVERAGE = sum (|S-M|/n)
PERCENT = 100.0 * (sum(|S-M|/M))/n for all M > 0.0

(2) AVERAGE = square root(sum((S-M)**2)/n)
PERCENT = 100.0 * square root(sum(((S-M)/M)**2)/n) for all M > 0

(3) AVERAGE = sum (S-M)/n
PERCENT = 100.0 * (sum ((S-M)/M)/n)   for all M > 0.0

S = Simulated value
M = Measured value
sum = Summation
n = Number of pairs of values
| | = Absolute value

note: Percents for the first class interval and the total should not be used if there are measured events that are zero.

1

Flow Comparison: Predeveloped vs. Developed SDW2

MEASURED = Observed - HOURLY F SIMULATED = Simulated- HOURLY FL

Lower class limit	Cases equal or exceeding lower limit & less than upper limit: Cases				Percent cases equal or exceeding limit		Average of cases within class limits	
	Cases		Percent					
	Meas	Sim	Measured	Simulated	Measured	Simulated	Measured	Simulated
0.00	*****	*****	77.92	43.72	100.00	100.00	0.00	0.00
0.01	4797	6898	1.13	1.63	22.08	56.28	0.01	0.01
0.01	5923	9390	1.40	2.22	20.94	54.65	0.01	0.01
0.01	6311	11041	1.49	2.61	19.54	52.43	0.02	0.02
0.02	5263	9392	1.24	2.22	18.05	49.82	0.02	0.02
0.02	5515	10081	1.30	2.38	16.81	47.60	0.03	0.03
0.03	6393	12297	1.51	2.91	15.50	45.21	0.03	0.03
0.04	5846	11820	1.38	2.79	13.99	42.31	0.04	0.04
0.04	5980	12377	1.41	2.93	12.61	39.51	0.05	0.05
0.05	6014	13487	1.42	3.19	11.19	36.58	0.06	0.06
0.07	5644	12682	1.33	3.00	9.77	33.40	0.07	0.07
0.08	5515	13078	1.30	3.09	8.44	30.40	0.09	0.09
0.10	4501	10978	1.06	2.60	7.13	27.31	0.11	0.11
0.12	5046	13309	1.19	3.15	6.07	24.71	0.13	0.13
0.15	4893	14142	1.16	3.34	4.88	21.56	0.17	0.17
0.19	3371	10597	0.80	2.51	3.72	18.22	0.21	0.21
0.23	3027	17466	0.72	4.13	2.92	15.72	0.25	0.26
0.28	2810	19711	0.66	4.66	2.21	11.59	0.31	0.31
0.35	2037	15440	0.48	3.65	1.54	6.93	0.39	0.38
0.43	1507	9589	0.36	2.27	1.06	3.28	0.48	0.47
0.53	1076	3367	0.25	0.80	0.71	1.01	0.59	0.56
0.66	660	213	0.16	0.05	0.45	0.21	0.73	0.73
0.81	461	227	0.11	0.05	0.30	0.16	0.89	0.90
1.00	271	177	0.06	0.04	0.19	0.11	1.09	1.10
1.20	226	108	0.05	0.03	0.12	0.07	1.33	1.36
1.50	141	67	0.03	0.02	0.07	0.04	1.67	1.70
1.90	69	39	0.02	0.01	0.04	0.03	2.06	2.08
2.30	40	36	0.01	0.01	0.02	0.02	2.52	2.57
2.80	28	22	0.01	0.01	0.01	0.01	3.09	2.98
3.50	7	5	0.00	0.00	0.00	0.00	3.84	4.00
4.30	6	5	0.00	0.00	0.00	0.00	4.80	4.63
5.30	2	0	0.00	0.00	0.00	0.00	5.80	0.00
6.60	0	0	0.00	0.00	0.00	0.00	0.00	0.00
8.10	0	0	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00

422976422976 100.00 100.00 0.03 0.09

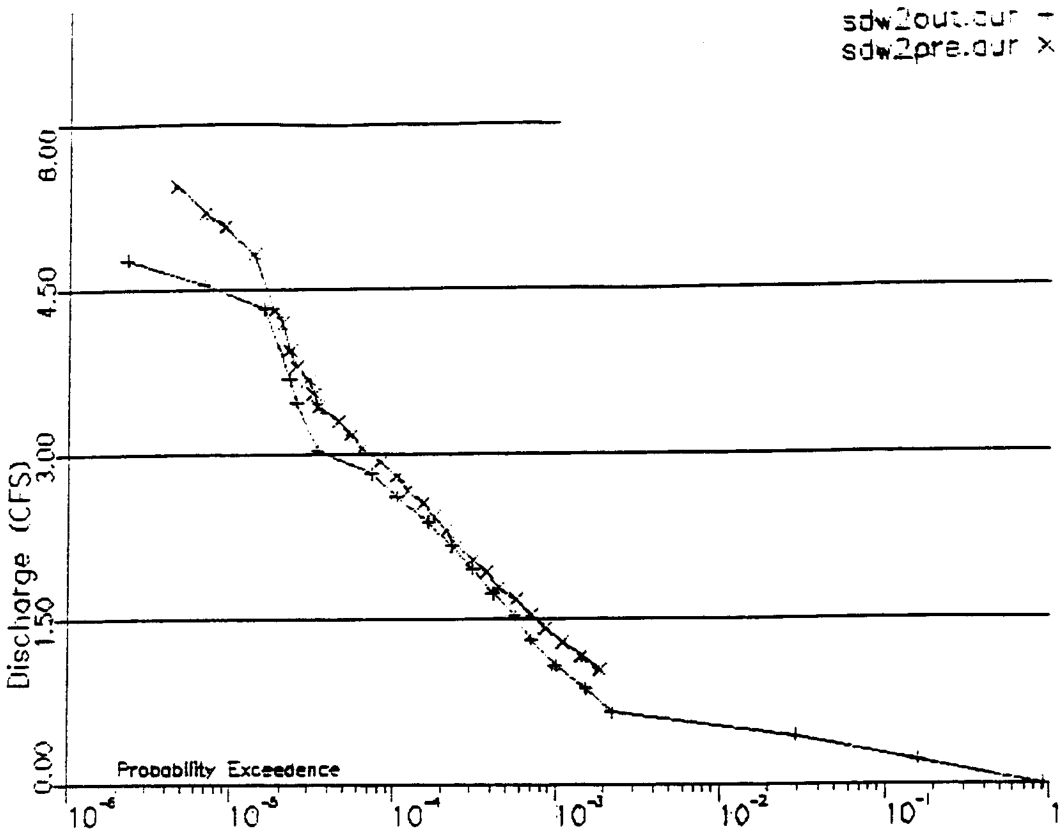
92917 Measured events are zero
***** Simulated events are zero
76691 Measured events are zero when simulated events are zero
16226 Measured events are zero when simulated events are not zero
49589 Measured events are not zero when simulated events are zero

zero is defined as less than 0.01

1

Flow Comparison: Predeveloped vs. Developed SDW2

Lower class limit	Number of deviations between indicated percentages							
		-60	-30	-10	0	10	30	60
0.00	126694	187	125	62	58	131	202339	0
0.01	37	19	24	7	8	32	4670	0
0.01	87	47	35	22	20	38	5674	0
0.01	82	66	36	20	36	46	6025	0
0.02	86	64	46	28	33	55	4951	0
0.02	102	97	64	22	25	69	5136	0
0.03	135	113	85	47	40	108	5865	0
0.04	154	129	94	53	55	106	5255	0
0.04	226	147	117	69	71	145	5205	0
0.05	266	226	132	96	71	157	5066	0
0.07	259	261	170	95	79	183	4597	0
0.08	289	315	201	101	97	207	4305	0
0.10	301	294	191	100	97	190	3328	0
0.12	357	384	223	115	115	247	3605	0
0.15	381	398	267	158	135	280	3274	0
0.19	285	314	203	130	108	357	1974	0
0.23	287	293	225	155	249	447	1371	0
0.28	248	332	427	258	241	458	846	0
0.35	209	352	453	205	185	323	310	0
0.43	161	436	369	157	142	156	86	0
0.53	118	503	290	68	31	9	57	0
0.66	127	367	114	3	3	7	39	0
0.81	156	254	7	1	1	6	36	0
1.00	142	99	3	1	2	4	20	0
1.20	154	44	1	3	2	4	18	0
1.50	115	5	4	1	2	4	10	0
1.90	54	2	1	0	2	2	8	0
2.30	28	6	2	1	1	0	2	0
2.80	21	0	2	1	1	0	3	0
3.50	7	0	0	0	0	0	0	0
4.30	5	1	0	0	0	0	0	0
5.30	2	0	0	0	0	0	0	0
6.60	0	0	0	0	0	0	0	0
8.10	0	0	0	0	0	0	0	0
10.00	0	0	0	0	0	0	0	0
	131575	5755	3911	1979	1910	3771	274075	0


sdw2out.cur +
sdw2pre.cur ×
Discharge (CFS)
0.00
1.50
3.00
4.50
6.00
Probability Exceedence
10⁻⁶
10⁻⁵
10⁻⁴
10⁻³
10⁻²
10⁻¹
1

One Outlet Reservoir Routing File

Stage (Ft)	Discharge (CFS)	Storage (Cu-Ft)	Perm-Area (Sq-Ft)
0.00	0.000	0.	0.
1.00	0.250	47146.	0.
2.00	0.350	96254.	0.
3.00	0.420	147358.	0.
4.00	0.490	200497.	0.
5.00	0.550	255812.	0.
6.00	0.600	313352.	0.
7.00	1.200	373070.	0.
8.00	2.690	434996.	0.
8.30	3.090	455400.	0.
9.00	7.570	499162.	0.
10.00	16.880	565746.	0.

0.00 Ft : Base Reservoir Elevation
0.0 Minutes/Inch: Average Perm-Rate

```
Reservoir Routing [Single Outlet]
Computing Series:sdw2out.tsf
  Years Complete: 50
                              Inflow/Outflow Analysis
                              -----------------------
  Peak Inflow Discharge:      16.14 CFS at  6:00 on Jan  9 in 1990
 Peak Outflow Discharge:       4.96 CFS at 19:00 on Feb  9 in 1951
   Peak Reservoir Stage:       8.59  Ft
    Peak Reservoir Elev:       8.59  Ft
 Peak Reservoir Storage:  473712.    Cu-Ft
                       :      10.875 Ac-Ft
```

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdw2pre.tsf Mean= 0.315 StdDev= 0.207
Project Location:Sea-Tac Walker Skew= -0.043

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			6.18		100.00	0.990
Computed Peaks			5.45		50.00	0.980
Computed Peaks			4.73		25.00	0.960
Computed Peaks			3.80		10.00	0.900
Computed Peaks			3.61		8.00	0.875
Computed Peaks			3.09		5.00	0.800
Computed Peaks			2.07		2.00	0.500
Computed Peaks			1.44		1.30	0.231

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdw2out.tsf Mean= -0.127 StdDev= 0.309
Project Location:Sea-Tac Walker Skew= 1.375

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks (CFS)	- - (ft)	Rank	Return Period	Prob
Computed Peaks			7.58	9.00		100.00	0.990
Computed Peaks			5.09	8.61		50.00	0.980
Computed Peaks			3.38	8.35		25.00	0.960
Computed Peaks			1.93	7.49		10.00	0.900
Computed Peaks			1.73	7.36		8.00	0.875
Computed Peaks			1.24	7.02		5.00	0.800
Computed Peaks			0.638	6.06		2.00	0.500
Computed Peaks			0.431	3.16		1.30	0.231

Duration Comparison Anaylsis
Base File: sdw2pre.tsf
New File: sdw2out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
1.03	0.19E-02	0.11E-02	-41.6	0.19E-02	1.03	0.759	-26.6
1.19	0.13E-02	0.79E-03	-40.7	0.13E-02	1.19	0.938	-21.2
1.35	0.96E-03	0.67E-03	-30.2	0.96E-03	1.35	1.10	-18.1
1.51	0.74E-03	0.56E-03	-23.9	0.74E-03	1.51	1.26	-16.2
1.66	0.57E-03	0.45E-03	-19.8	0.57E-03	1.66	1.50	-9.9
1.82	0.43E-03	0.36E-03	-16.5	0.43E-03	1.82	1.70	-6.7
1.98	0.34E-03	0.29E-03	-15.3	0.34E-03	1.98	1.87	-5.5
2.14	0.26E-03	0.24E-03	-9.6	0.26E-03	2.14	2.07	-3.2
2.29	0.21E-03	0.18E-03	-12.9	0.21E-03	2.29	2.19	-4.4
2.45	0.17E-03	0.14E-03	-20.0	0.17E-03	2.45	2.33	-4.8
2.61	0.13E-03	0.11E-03	-22.0	0.13E-03	2.61	2.46	-5.7
2.77	0.11E-03	0.80E-04	-25.5	0.11E-03	2.77	2.59	-6.4
2.92	0.82E-04	0.57E-04	-30.6	0.82E-04	2.92	2.74	-6.2
3.08	0.64E-04	0.27E-04	-57.1	0.64E-04	3.08	2.87	-6.7
3.24	0.53E-04	0.25E-04	-52.2	0.53E-04	3.24	2.95	-8.8
3.40	0.39E-04	0.25E-04	-35.3	0.39E-04	3.40	3.02	-11.0
3.55	0.34E-04	0.23E-04	-33.3	0.34E-04	3.55	3.03	-14.7
3.71	0.30E-04	0.21E-04	-30.8	0.30E-04	3.71	3.07	-17.2
3.87	0.25E-04	0.16E-04	-36.4	0.25E-04	3.87	3.47	-10.2
4.02	0.23E-04	0.16E-04	-30.0	0.23E-04	4.02	3.68	-8.6
4.18	0.21E-04	0.16E-04	-22.2	0.21E-04	4.18	3.77	-9.9
4.34	0.18E-04	0.16E-04	-12.5	0.18E-04	4.34	3.82	-12.0
4.50	0.14E-04	0.68E-05	-50.0	0.14E-04	4.50	4.47	-0.7
4.65	0.14E-04	0.46E-05	-66.7	0.14E-04	4.65	4.47	-4.0
4.81	0.14E-04	0.23E-05	-83.3	0.14E-04	4.81	4.47	-7.2
4.97	0.91E-05	0.00E+00	-100.0	0.91E-05	4.97	4.48	-9.8
5.13	0.68E-05	0.00E+00	-100.0	0.68E-05	5.13	4.61	-10.2
5.28	0.46E-05	0.00E+00	-100.0	0.46E-05	5.28	4.69	-11.2
5.44	0.46E-05	0.00E+00	-100.0	0.46E-05	5.44	4.69	-13.7
5.60	0.46E-05	0.00E+00	-100.0	0.46E-05	5.60	4.69	-16.2
5.76	0.23E-05	0.00E+00	-100.0	0.23E-05	5.76	4.96	-13.8
5.91	0.23E-05	0.00E+00	-100.0	0.23E-05	5.91	4.96	-16.1

Maximum positive excursion = 0.059 cfs (1.3%)
occuring at 4.39 cfs on the Base Data:sdw2pre.tsf
and at 4.45 cfs on the New Data:sdw2out.tsf

Maximum negative excursion = 0.275 cfs (-26.6%)
occuring at 1.03 cfs on the Base Data:sdw2pre.tsf
and at 0.759 cfs on the New Data:sdw2out.tsf

```
+-Land Use Summary------------------------------------------------+
|Till Forest           16.38 acres                                |
|Till Pasture           0.00 acres                                |
|Till Grass             4.37 acres                                |
|Airport Fill           0.00 acres                                |
|Outwash Forest        16.47 acres                                |
|Outwash Pasture        0.00 acres                                |
|Outwash Grass          4.39 acres                                |
|Wetland                1.05 acres                                |
|Impervious             2.20 acres                                |
|-----------------------------------------------------------------|
|         Total Area :  44.86 acres                                |
|       Scale Factor :   1.00      Hourly     Historic             |
|-----------------------------------------------------------------|
|                                                                 |
|   Time Series: sdw2pre                                          |
|-----------------------------------------------------------------|
|                    Compute Time Series                          |
|                     Modify User Input                           |
+-----------------------------------------------------------------+
```

```
+-Land Use Summary------------------------------------------------+
|Till Forest            0.00 acres                                |
|Till Pasture           0.00 acres                                |
|Till Grass            26.88 acres                                |
|Airport Fill           6.70 acres                                |
|Outwash Forest         0.00 acres                                |
|Outwash Pasture        0.00 acres                                |
|Outwash Grass          1.51 acres                                |
|Wetland                0.00 acres                                |
|Impervious             9.51 acres                                |
|-----------------------------------------------------------------|
|         Total Area :  44.60 acres                                |
|       Scale Factor :   1.00      Hourly     Historic             |
|-----------------------------------------------------------------|
|                                                                 |
|   Time Series: sdw2dev                                          |
|-----------------------------------------------------------------|
|                    Compute Time Series                          |
|                     Modify User Input                           |
+-----------------------------------------------------------------+
```

SDW2 Test Facility

USED ONLY TO STAGE-DISCHARGE CURVE FOR SDW2 KCRTS RESERVOIR FILE

Retention/Detention Facility

Type of Facility: Detention Vault
Effective Storage Depth: 9.00 ft
Stage 0 Elevation: 0.00 ft
Riser Head: 9.00 ft
Riser Diameter: 18.00 inches
Number of orifices: 3

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	3.00	0.732	
2	6.00	4.50	0.951	8.0
3	7.50	8.00	2.126	10.0

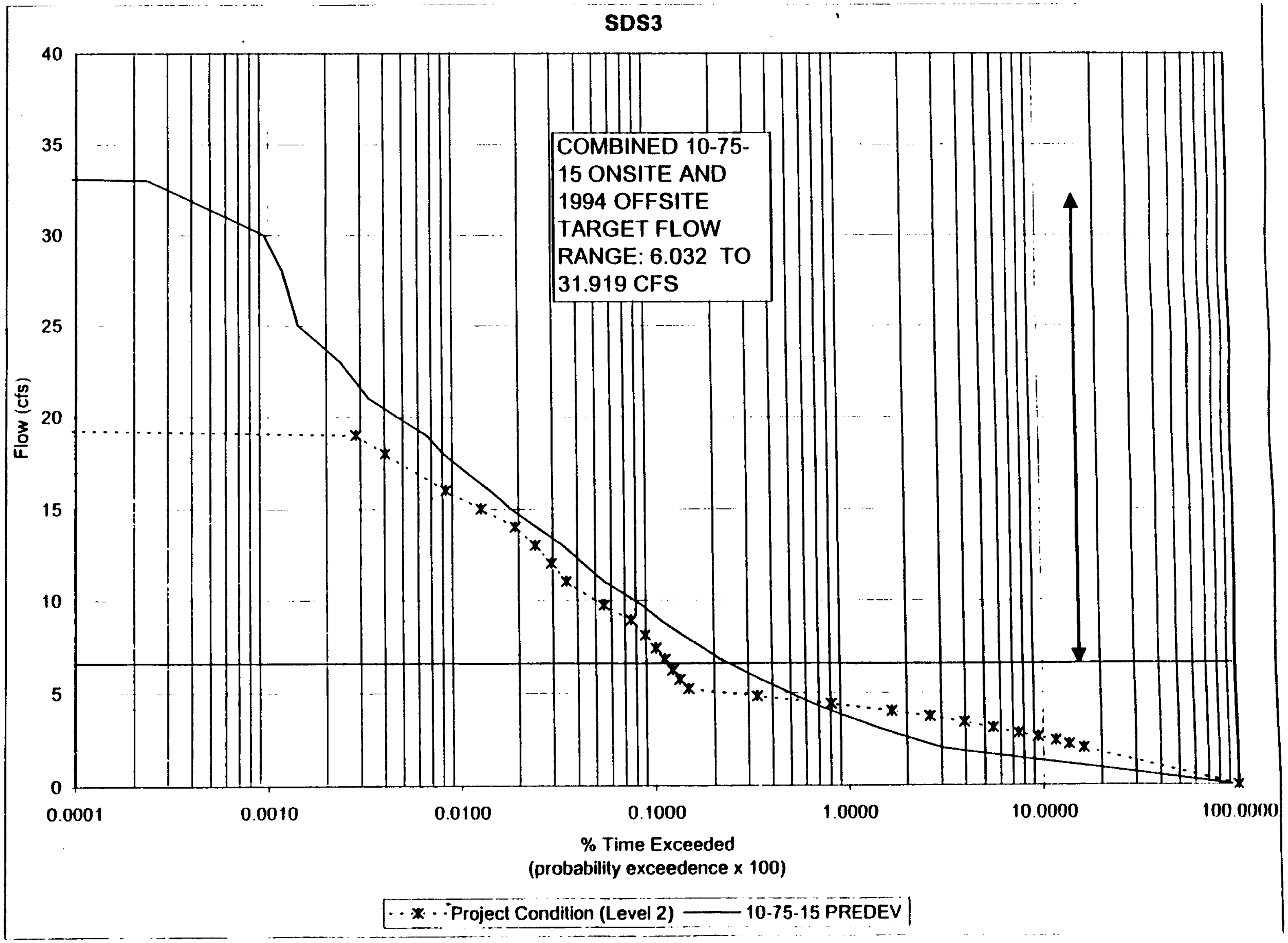
Top Notch Weir: Rectangular
Length: 25.00 in
Weir Height: 8.30 ft
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
1.09	1.09	10900.	0.250	0.255	0.00
1.92	1.92	19200.	0.441	0.339	0.00
2.97	2.97	29700.	0.682	0.421	0.00
4.02	4.02	40200.	0.923	0.489	0.00
5.06	5.06	50600.	1.162	0.549	0.00
7.00	7.00	70000.	1.607	1.200	0.00
8.00	8.00	80000.	1.837	2.690	0.00
8.30	8.30	83000.	1.905	3.090	0.00
9.00	9.00	90000.	2.066	7.570	0.00
10.00	10.00	100000.	2.296	16.880	0.00

DES MOINES CREEK WATERSHED
DETENTION POND PERFORMANCE DATA
(HSPF AND KCRTS BACKUP)

- SDS3
- SDS3A
- SDS4
- SDS7
- SASA

SDS3


SDS3
Flow (cfs)
40
35
30
25
20
15
10
5
0
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
100.0000
% Time Exceeded
(probability exceedence x 100)
COMBINED 10-75-15 ONSITE AND 1994 OFFSITE TARGET FLOW RANGE: 6.032 TO 31.919 CFS
Project Condition (Level 2)
10-75-15 PREDEV

:

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SDS-3

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

14.877	33.894	20.581	9.940	10.291
11.832	15.450	15.394	12.113	10.138
9.805	13.530	12.210	8.180	11.892
14.027	10.327	11.590	18.894	14.332
11.037	11.395	9.947	23.885	10.869
10.614	14.043	9.004	8.795	12.445
10.821	12.499	12.433	20.154	10.782
12.751	8.054	19.839	13.994	6.527
7.207	32.347	26.257	10.733	7.471
6.181	11.363	24.992		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.101
Variance (logs)	0.028
Standard Deviation (logs)	0.167
Skewness (logs)	0.721
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.171
Coefficient of Variation (logs)	0.151

1

PREDEV SDS-3

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	6.354
0.9500	1.05	7.336
0.9000	1.11	8.032
0.8000	1.25	9.091
0.5000	2.00	12.064
0.2000	5.00	17.087
0.1000	10.00	21.067
0.0400	25.00	26.916
0.0200	50.00	31.919
0.0100	100.00	37.521
0.0050	200.00	43.811

$\frac{1}{2}Q_2 = 6.032$
$Q_{50} = 31.919$

AR 046752

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III
distributions are for preliminary computations.
User is responsible for assessment and
interpretation.

2006 SDS-3

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

4.037	5.012	20.577	3.556	4.277
4.296	4.376	8.393	4.330	4.620
3.952	11.922	4.636	3.308	4.512
4.659	7.448	4.210	4.570	4.240
4.126	4.517	4.503	16.830	5.059
4.598	4.117	4.310	3.458	4.566
3.336	15.376	4.222	9.726	4.525
3.541	3.653	5.041	9.935	3.651
3.490	15.208	15.459	4.741	3.707
3.219	4.783	20.018		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.734
Variance (logs)	0.051
Standard Deviation (logs)	0.226
Skewness (logs)	1.470
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.062
Coefficient of Variation (logs)	0.308

1

2006 SDS-3

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	2.792
0.9500	1.05	2.991
0.9000	1.11	3.179
0.8000	1.25	3.524
0.5000	2.00	4.794
0.2000	5.00	7.781
0.1000	10.00	10.853
0.0400	25.00	16.509
0.0200	50.00	22.460
0.0100	100.00	30.385
0.0050	200.00	40.931

$\frac{1}{2} Q_2 = 2.397$

$Q_{50} = 22.460$

AR 046753

Simulated - PREDEV SDS-3
Observed - 2006 SDS-3

Lower class limit	Number of cases	Mean absolute error (1) Average	Mean absolute error (1) Percent	Root mean square error (2) Average	Root mean square error (2) Percent	Bias (3) Average	Bias (3) Percent
0.00	352393	0.389	*	0.670	*	-0.350	*
2.00	10731	1.680	80.1	1.775	84.6	-1.530	-73.0
2.20	8567	1.814	79.0	1.914	83.3	-1.658	-72.2
2.40	9445	1.946	77.9	2.057	82.3	-1.773	-71.0
2.60	8006	2.041	75.7	2.179	80.8	-1.837	-68.1
2.80	8435	2.215	75.4	2.367	80.5	-1.983	-67.5
3.10	6525	2.409	74.2	2.583	79.5	-2.144	-66.1
3.40	5592	2.544	71.8	2.769	78.1	-2.223	-62.7
3.70	4027	2.676	69.5	2.921	75.8	-2.292	-59.5
4.00	3644	2.814	67.3	3.079	73.7	-2.339	-56.1
4.40	1995	2.883	63.1	3.245	70.9	-2.343	-51.3
4.80	788	2.876	58.3	3.443	69.8	-1.948	-39.6
5.20	61	2.573	47.3	2.868	52.7	-2.109	-38.5
5.70	42	3.101	52.3	3.441	57.9	-2.349	-39.7
6.20	44	3.202	49.3	3.433	52.8	-2.988	-46.1
6.80	47	4.169	58.5	4.949	69.0	-2.242	-31.5
7.40	50	3.864	50.6	4.242	55.8	-3.073	-40.2
8.10	58	4.040	47.1	4.545	53.1	-2.954	-34.6
8.90	86	4.421	47.5	5.240	56.2	-3.146	-33.9
9.70	84	4.583	45.1	5.014	49.3	-3.792	-37.2
11.00	24	5.725	49.5	6.177	53.4	-4.467	-38.6
12.00	21	5.112	40.9	6.012	47.8	-2.997	-24.1
13.00	22	5.447	40.2	5.934	43.7	-4.485	-33.1
14.00	27	5.195	35.7	5.865	40.3	-3.809	-26.2
15.00	19	4.404	28.8	5.204	34.0	-4.325	-28.3
16.00	18	4.782	28.2	5.131	30.2	-3.602	-21.3
18.00	5	5.626	30.2	6.082	32.7	-5.626	-30.2
19.00	12	4.334	21.9	4.901	24.8	-4.099	-20.6
21.00	0	0.000	0.0	0.000	0.0	0.000	0.0
23.00	0	0.000	0.0	0.000	0.0	0.000	0.0
25.00	0	0.000	0.0	0.000	0.0	0.000	0.0
28.00	0	0.000	0.0	0.000	0.0	0.000	0.0
30.00	0	0.000	0.0	0.000	0.0	0.000	0.0
33.00	0	0.000	0.0	0.000	0.0	0.000	0.0
36.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.678	*	1.142	*	-0.605	*

Standard error of estimate = 0.97
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SDS-3
Observed - 2006 SDS-3

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

AR 046754

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	*****	*****	96.94	83.75	100.00	100.00	0.14	0.45
2.00	1781	10731	0.42	2.55	3.06	16.25	2.10	2.10
2.20	1472	8567	0.35	2.04	2.64	13.70	2.30	2.30
2.40	1288	9445	0.31	2.24	2.29	11.66	2.50	2.50
2.60	1107	8006	0.26	1.90	1.98	9.42	2.70	2.70
2.80	1239	8435	0.29	2.00	1.72	7.52	2.95	2.94
3.10	1010	6525	0.24	1.55	1.42	5.51	3.25	3.25
3.40	848	5592	0.20	1.33	1.18	3.96	3.54	3.55
3.70	701	4027	0.17	0.96	0.98	2.63	3.84	3.85
4.00	672	3644	0.16	0.87	0.82	1.67	4.19	4.18
4.40	499	1995	0.12	0.47	0.66	0.81	4.58	4.57
4.80	396	788	0.09	0.19	0.54	0.33	4.99	4.94
5.20	394	61	0.09	0.01	0.44	0.15	5.44	5.45
5.70	296	42	0.07	0.01	0.35	0.13	5.95	5.93
6.20	264	44	0.06	0.01	0.28	0.12	6.49	6.50
6.80	169	47	0.04	0.01	0.22	0.11	7.09	7.11
7.40	165	50	0.04	0.01	0.18	0.10	7.74	7.66
8.10	128	58	0.03	0.01	0.14	0.09	8.49	8.58
8.90	87	86	0.02	0.02	0.11	0.08	9.28	9.30
9.70	131	84	0.03	0.02	0.09	0.06	10.33	10.19
11.00	53	24	0.01	0.01	0.06	0.04	11.47	11.55
12.00	39	21	0.01	0.00	0.04	0.03	12.46	12.46
13.00	37	22	0.01	0.01	0.03	0.02	13.45	13.50
14.00	28	27	0.01	0.01	0.02	0.02	14.51	14.52
15.00	17	19	0.00	0.00	0.02	0.01	15.46	15.32
16.00	26	18	0.01	0.00	0.01	0.01	16.84	16.92
18.00	6	5	0.00	0.00	0.01	0.00	18.59	18.59
19.00	14	12	0.00	0.00	0.01	0.00	19.94	19.83
21.00	4	0	0.00	0.00	0.00	0.00	22.38	0.00
23.00	4	0	0.00	0.00	0.00	0.00	24.12	0.00
25.00	1	0	0.00	0.00	0.00	0.00	26.26	0.00
28.00	1	0	0.00	0.00	0.00	0.00	29.51	0.00
30.00	3	0	0.00	0.00	0.00	0.00	30.97	0.00
33.00	1	0	0.00	0.00	0.00	0.00	33.89	0.00
36.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768	420768	100.00	100.00			0.25	0.86

11795 Observed values are zero
118000 Simulated values are zero
11795 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
106205 Observed values are not zero when simulated are

1

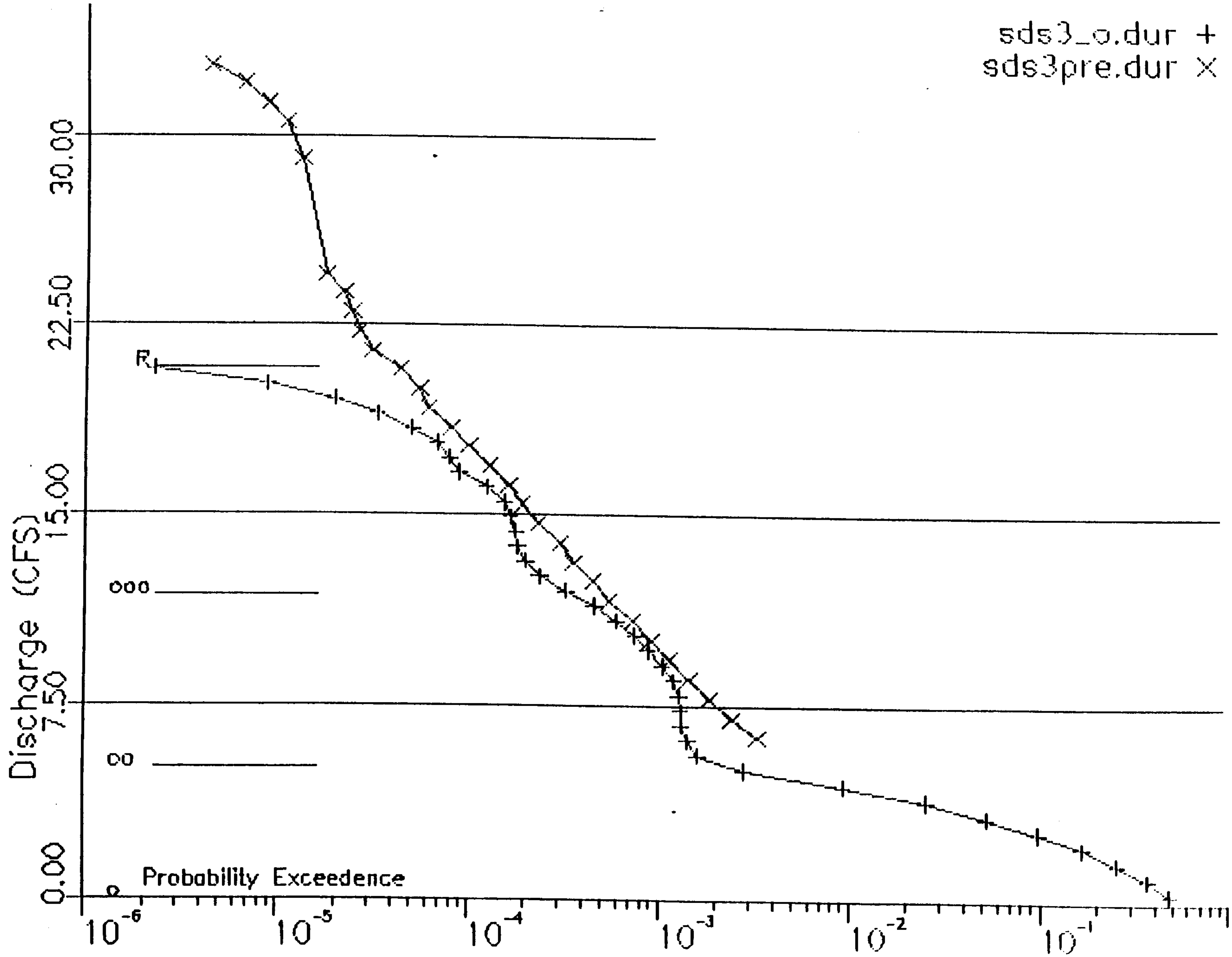
Simulated - PREDEV SDS-3
Observed - 2006 SDS-3

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	322350	7690	2872	9939	953	1512	7077	0
2.00	8645	1062	301	129	92	137	365	0
2.20	6816	859	285	100	89	135	283	0
2.40	7474	1008	331	111	74	128	319	0
2.60	6037	1018	350	114	85	116	286	0
2.80	6306	1144	348	119	76	128	314	0
3.10	4809	891	316	84	68	106	251	0
3.40	3913	921	265	81	82	108	222	0
3.70	2673	643	272	96	63	87	193	0

4.00	2306	675	251	85	53	70	204	0
4.40	1176	455	126	49	37	46	106	0
4.80	282	335	73	13	12	19	54	0
5.20	23	16	14	3	0	1	4	0
5.70	15	19	5	0	0	0	3	0
6.20	16	19	7	0	0	1	1	0
6.80	17	16	8	1	0	0	5	0
7.40	18	17	10	1	0	1	3	0
8.10	17	19	17	0	0	0	5	0
8.90	28	29	13	5	2	3	6	0
9.70	23	40	9	2	1	5	4	0
11.00	9	10	2	0	0	1	2	0
12.00	2	12	4	0	0	2	1	0
13.00	4	12	4	0	0	1	1	0
14.00	5	10	5	2	0	3	2	0
15.00	1	8	7	2	1	0	0	0
16.00	0	10	4	0	1	3	0	0
18.00	0	4	0	1	0	0	0	0
19.00	0	5	4	2	1	0	0	0
21.00	0	0	0	0	0	0	0	0
23.00	0	0	0	0	0	0	0	0
25.00	0	0	0	0	0	0	0	0
28.00	0	0	0	0	0	0	0	0
30.00	0	0	0	0	0	0	0	0
33.00	0	0	0	0	0	0	0	0
36.00	0	0	0	0	0	0	0	0
	372965	16947	5903	10939	1690	2613	9711	0

4.00	2306	675	251	85	53	70	204	0
4.40	1176	455	126	49	37	46	106	0
4.80	262	335	73	13	12	19	54	0
5.20	23	16	14	3	0	1	4	0
5.70	15	19	5	0	0	0	3	0
6.20	16	19	7	0	0	1	1	0
6.80	17	16	8	1	0	0	5	0
7.40	18	17	10	1	0	1	3	0
8.10	17	19	17	0	0	0	5	0
8.90	28	29	13	5	2	3	6	0
9.70	23	40	9	2	1	5	4	0
11.00	9	10	2	0	0	1	2	0
12.00	2	12	4	0	0	2	1	0
13.00	4	12	4	0	0	1	1	0
14.00	5	10	5	2	0	3	2	0
15.00	1	8	7	2	1	0	0	0
16.00	0	10	4	0	1	3	0	0
18.00	0	4	0	1	0	0	0	0
19.00	0	5	4	2	1	0	0	0
21.00	0	0	0	0	0	0	0	0
23.00	0	0	0	0	0	0	0	0
25.00	0	0	0	0	0	0	0	0
28.00	0	0	0	0	0	0	0	0
30.00	0	0	0	0	0	0	0	0
33.00	0	0	0	0	0	0	0	0
36.00	0	0	0	0	0	0	0	0

	372965	16947	5903	10939	1690	2613	9711	0



sds3_o.dur +
sds3pre.dur ×
Discharge (CFS)
30.00
22.50
15.00
7.50
0.00
R
ooo
oo
o
Probability Exceedence
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1

Retention/Detention Facility

Type of Facility:	Detention Vault
Facility Length:	700.00 ft
Facility Width:	275.00 ft
Facility Area:	192500. sq. ft
Effective Storage Depth:	20.00 ft
Stage 0 Elevation:	0.00 ft
Storage Volume:	3850000. cu. ft
Riser Head:	20.00 ft
Riser Diameter:	36.00 inches
Number of orifices:	3

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	7.00	5.942	
2	14.50	11.50	8.411	15.0
3	17.50	12.25	6.434	15.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.07	0.07	13475.	0.309	0.359	0.00
0.15	0.15	28875.	0.663	0.508	0.00
0.22	0.22	42350.	0.972	0.622	0.00
0.29	0.29	55825.	1.282	0.718	0.00
0.36	0.36	69300.	1.591	0.803	0.00
0.44	0.44	84700.	1.944	0.879	0.00
0.51	0.51	98175.	2.254	0.950	0.00
0.58	0.58	111650.	2.563	1.020	0.00
0.98	0.98	188650.	4.331	1.310	0.00
1.37	1.37	263725.	6.054	1.550	0.00
1.76	1.76	338800.	7.778	1.760	0.00
2.15	2.15	413875.	9.501	1.950	0.00
2.54	2.54	488950.	11.225	2.120	0.00
2.94	2.94	565950.	12.992	2.280	0.00
3.33	3.33	641025.	14.716	2.420	0.00
3.72	3.72	716100.	16.439	2.560	0.00
4.11	4.11	791175.	18.163	2.700	0.00
4.50	4.50	866250.	19.886	2.820	0.00
4.90	4.90	943250.	21.654	2.940	0.00
5.29	5.29	1018325.	23.378	3.060	0.00
5.68	5.68	1093400.	25.101	3.170	0.00
6.07	6.07	1168475.	26.824	3.280	0.00
6.47	6.47	1245475.	28.592	3.380	0.00
6.86	6.86	1320550.	30.316	3.480	0.00
7.25	7.25	1395625.	32.039	3.580	0.00
7.64	7.64	1470700.	33.763	3.670	0.00
8.03	8.03	1545775.	35.486	3.770	0.00
8.43	8.43	1622775.	37.254	3.860	0.00
8.82	8.82	1697850.	38.977	3.950	0.00
9.21	9.21	1772925.	40.701	4.030	0.00
9.60	9.60	1848000.	42.424	4.120	0.00
10.00	10.00	1925000.	44.192	4.200	0.00
10.39	10.39	2000075.	45.915	4.280	0.00

10.78	10.78	2075150.	47.639	4.360	0.00
11.17	11.17	2150225.	49.362	4.440	0.00
11.56	11.56	2225300.	51.086	4.520	0.00
11.96	11.96	2302300.	52.854	4.600	0.00
12.35	12.35	2377375.	54.577	4.670	0.00
12.74	12.74	2452450.	56.301	4.740	0.00
13.13	13.13	2527525.	58.024	4.820	0.00
13.52	13.52	2602600.	59.747	4.890	0.00
13.92	13.92	2679600.	61.515	4.960	0.00
14.31	14.31	2754675.	63.239	5.030	0.00
14.50	14.50	2791250.	64.078	5.060	0.00
14.62	14.62	2814350.	64.609	5.140	0.00
14.74	14.74	2837450.	65.139	5.320	0.00
14.86	14.86	2860550.	65.669	5.590	0.00
14.98	14.98	2883650.	66.199	5.960	0.00
15.10	15.10	2906750.	66.730	6.400	0.00
15.22	15.22	2929850.	67.260	8.230	0.00
15.34	15.34	2952950.	67.790	8.490	0.00
15.46	15.46	2976050.	68.321	8.740	0.00
15.85	15.85	3051125.	70.044	9.460	0.00
16.24	16.24	3126200.	71.768	10.090	0.00
16.63	16.63	3201275.	73.491	10.660	0.00
17.03	17.03	3278275.	75.259	11.190	0.00
17.42	17.42	3353350.	76.982	11.680	0.00
17.50	17.50	3368750.	77.336	11.770	0.00
17.63	17.63	3393775.	77.910	11.990	0.00
17.76	17.76	3418800.	78.485	12.320	0.00
17.88	17.88	3441900.	79.015	12.750	0.00
18.01	18.01	3466925.	79.590	13.280	0.00
18.14	18.14	3491950.	80.164	15.750	0.00
18.27	18.27	3516975.	80.739	16.200	0.00
18.39	18.39	3540075.	81.269	16.630	0.00
18.52	18.52	3565100.	81.843	17.030	0.00
18.65	18.65	3590125.	82.418	17.410	0.00
19.04	19.04	3665200.	84.141	18.500	0.00
19.43	19.43	3740275.	85.865	19.480	0.00
19.82	19.82	3815350.	87.588	20.400	0.00
20.00	20.00	3850000.	88.384	20.790	0.00
20.10	20.10	3869250.	88.826	21.930	0.00
20.20	20.20	3888500.	89.268	23.840	0.00
20.30	20.30	3907750.	89.710	26.240	0.00
20.40	20.40	3927000.	90.152	29.040	0.00
20.50	20.50	3946250.	90.593	32.180	0.00
20.60	20.60	3965500.	91.035	35.640	0.00
20.70	20.70	3984750.	91.477	39.370	0.00
20.80	20.80	4004000.	91.919	43.370	0.00
20.90	20.90	4023250.	92.361	47.600	0.00
21.00	21.00	4042500.	92.803	52.070	0.00
21.10	21.10	4061750.	93.245	56.750	0.00
21.20	21.20	4081000.	93.687	60.520	0.00
21.30	21.30	4100250.	94.129	62.230	0.00
21.40	21.40	4119500.	94.571	63.880	0.00
21.50	21.50	4138750.	95.013	65.480	0.00
21.60	21.60	4158000.	95.455	67.030	0.00
21.70	21.70	4177250.	95.896	68.540	0.00
21.80	21.80	4196500.	96.338	70.000	0.00
21.90	21.90	4215750.	96.780	71.430	0.00

```
Route Time Series through Facility
  Inflow Time Series File:sds3dev.tsf
 Outflow Time Series File:sds3_o

Inflow/Outflow Analysis
   Peak Inflow Discharge:      102.89 CFS at  6:00 on Jan  9 in 1990
  Peak Outflow Discharge:       20.76 CFS at 20:00 on Feb  9 in 1951
    Peak Reservoir Stage:       19.99  Ft
     Peak Reservoir Elev:       19.99  Ft
  Peak Reservoir Storage: 3847379.     Cu-Ft
                        :       88.324 Ac-Ft
```

Flow Frequency Analysis
Time Series File:sds3pre.tsf
Project Location:Sea-Tac DMoines

LogPearson III Coefficients
Mean= 1.122 StdDev= 0.169
Skew= 0.577

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			38.49		100.00	0.990
Computed Peaks			33.05		50.00	0.980
Computed Peaks			28.12		25.00	0.960
Computed Peaks			22.21		10.00	0.900
Computed Peaks			21.10		8.00	0.875
Computed Peaks			18.11		5.00	0.800
Computed Peaks			12.77		2.00	0.500
Computed Peaks			9.78		1.30	0.231

Flow Frequency Analysis
Time Series File:sds3_o.tsf
Project Location:Sea-Tac DMoines

LogPearson III Coefficients
Mean= 0.754 StdDev= 0.238
Skew= 1.313

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			33.22	20.53		100.00	0.990
Computed Peaks			24.61	20.23		50.00	0.980
Computed Peaks			18.09	18.89		25.00	0.960
Computed Peaks			11.84	17.54		10.00	0.900
Computed Peaks			10.87	16.79		8.00	0.875
Computed Peaks			8.42	15.31		5.00	0.800
Computed Peaks			5.06	14.48		2.00	0.500
Computed Peaks			3.72	7.82		1.30	0.231

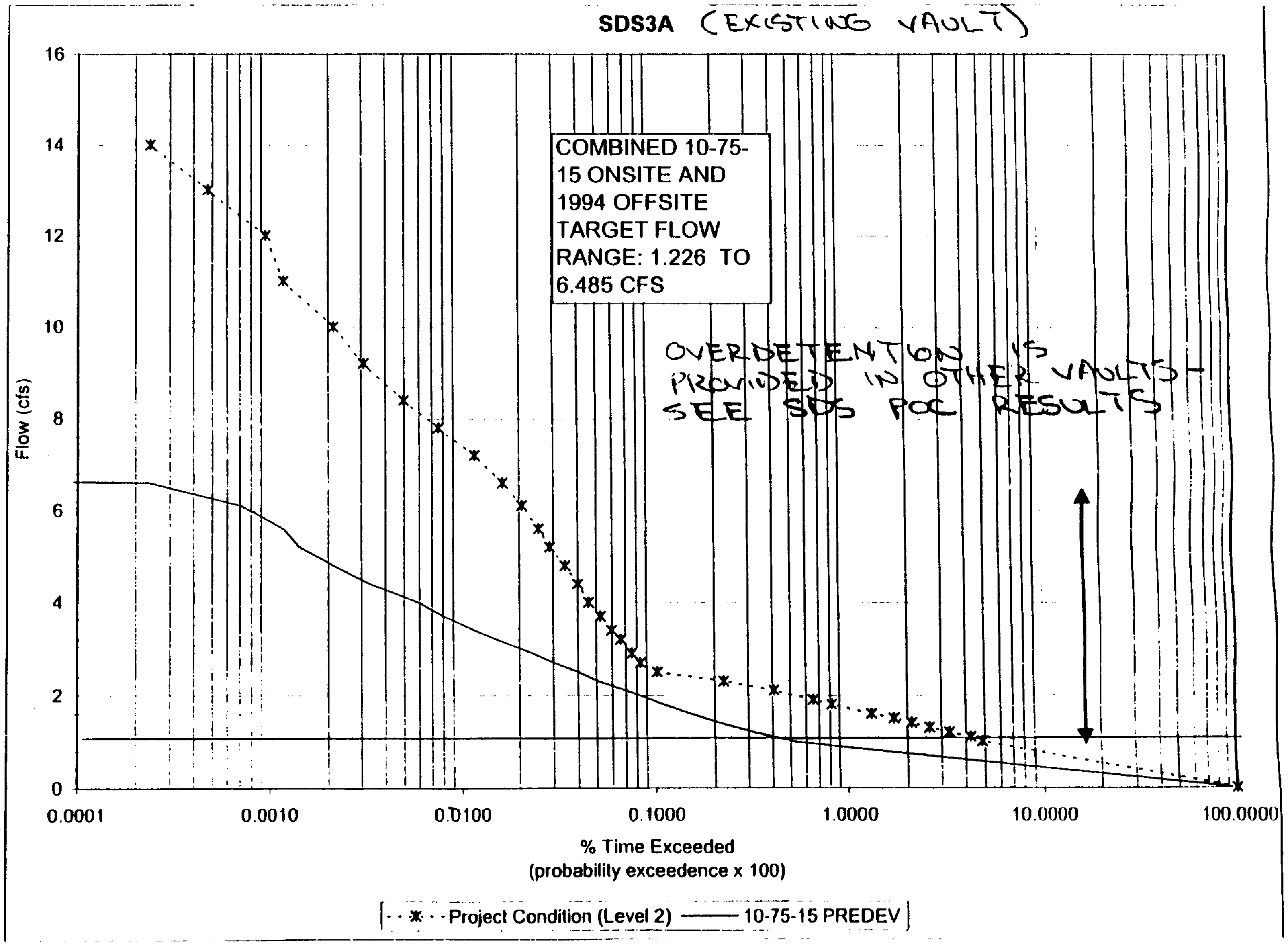
Duration Comparison Anaylsis
Base File: sds3pre.tsf
New File: sds3_o.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
2.52	0.23E-01	0.11E+00	379.1	0.23E-01	2.52	3.88	54.1
3.55	0.12E-01	0.36E-01	196.1	0.12E-01	3.55	4.27	20.3
4.58	0.69E-02	0.67E-02	-2.5	0.69E-02	4.58	4.56	-0.4
5.61	0.43E-02	0.16E-02	-62.9	0.43E-02	5.61	4.78	-14.8
6.65	0.28E-02	0.14E-02	-52.2	0.28E-02	6.65	4.96	-25.4
7.68	0.20E-02	0.13E-02	-33.3	0.20E-02	7.68	5.14	-33.1
8.71	0.14E-02	0.12E-02	-17.1	0.14E-02	8.71	6.27	-28.0
9.74	0.10E-02	0.88E-03	-14.0	0.10E-02	9.74	9.25	-5.0
10.77	0.76E-03	0.62E-03	-18.6	0.76E-03	10.77	10.30	-4.4
11.81	0.53E-03	0.37E-03	-31.3	0.53E-03	11.81	11.17	-5.4
12.84	0.40E-03	0.23E-03	-44.1	0.40E-03	12.84	11.65	-9.3
13.87	0.31E-03	0.19E-03	-39.0	0.31E-03	13.87	12.13	-12.6
14.90	0.24E-03	0.17E-03	-26.9	0.24E-03	14.90	12.67	-15.0
15.94	0.17E-03	0.14E-03	-19.7	0.17E-03	15.94	15.16	-4.9
16.97	0.13E-03	0.87E-04	-32.1	0.13E-03	16.97	16.10	-5.1
18.00	0.91E-04	0.64E-04	-30.0	0.91E-04	18.00	16.71	-7.2
19.03	0.71E-04	0.34E-04	-51.6	0.71E-04	19.03	17.81	-6.4
20.06	0.55E-04	0.91E-05	-83.3	0.55E-04	20.06	18.35	-8.5
21.10	0.37E-04	0.00E+00	-100.0	0.37E-04	21.10	18.90	-10.4
22.13	0.32E-04	0.00E+00	-100.0	0.32E-04	22.13	19.06	-13.8
23.16	0.25E-04	0.00E+00	-100.0	0.25E-04	23.16	19.35	-16.4
24.19	0.18E-04	0.00E+00	-100.0	0.18E-04	24.19	19.68	-18.7
25.23	0.14E-04	0.00E+00	-100.0	0.14E-04	25.23	19.90	-21.1
26.26	0.14E-04	0.00E+00	-100.0	0.14E-04	26.26	19.90	-24.2
27.29	0.14E-04	0.00E+00	-100.0	0.14E-04	27.29	19.90	-27.1
28.32	0.14E-04	0.00E+00	-100.0	0.14E-04	28.32	19.90	-29.7
29.35	0.11E-04	0.00E+00	-100.0	0.11E-04	29.35	19.94	-32.1
30.39	0.11E-04	0.00E+00	-100.0	0.11E-04	30.39	19.94	-34.4
31.42	0.91E-05	0.00E+00	-100.0	0.91E-05	31.42	20.32	-35.3
32.45	0.46E-05	0.00E+00	-100.0	0.46E-05	32.45	20.58	-36.6
33.48	0.46E-05	0.00E+00	-100.0	0.46E-05	33.48	20.58	-38.5
34.52	0.23E-05	0.00E+00	-100.0	0.23E-05	34.52	20.71	-40.0

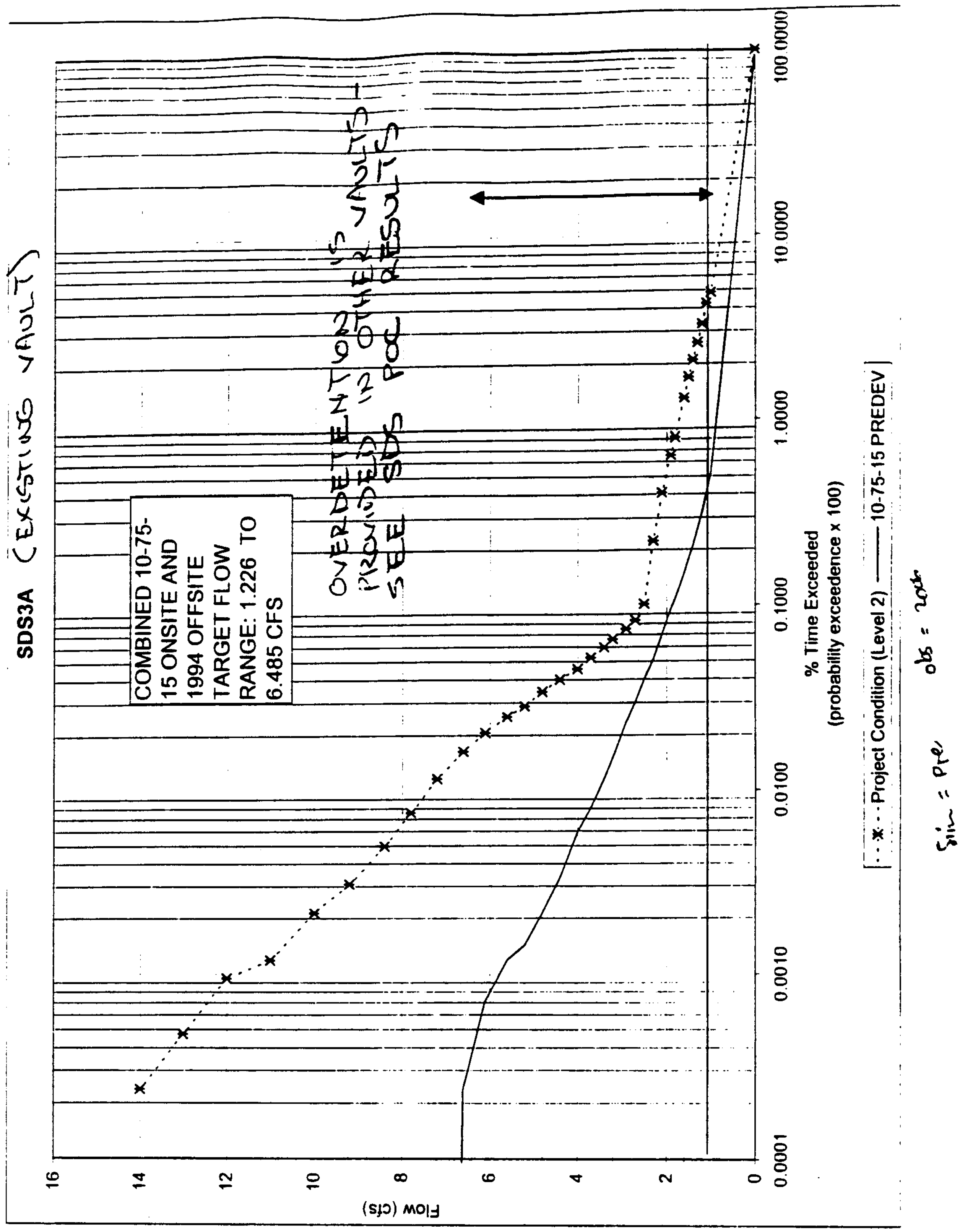
Maximum positive excursion = 1.36 cfs (54.1%)
occuring at 2.52 cfs on the Base Data:sds3pre.tsf
and at 3.88 cfs on the New Data:sds3_o.tsf

Maximum negative excursion = 13.87 cfs (-40.3%)
occuring at 34.45 cfs on the Base Data:sds3pre.tsf
and at 20.58 cfs on the New Data:sds3_o.tsf

SDS3A



Sim = Pre obs = 20th



SDS3A (EXISTING VAULT)
COMBINED 10-75-15 ONSITE AND 1994 OFFSITE TARGET FLOW RANGE: 1.226 TO 6.485 CFS
OVERDETENTION 2 OTHER VAULTS
(PROVIDED IN
SEE SDS POC RESULTS
Flow (cfs)
16
14
12
10
8
6
4
2
0
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
100.0000
% Time Exceeded
(probability exceedence x 100)
- - x - - Project Condition (Level 2)
——— 10-75-15 PREDEV

AR 046766

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SIMULATED FLOW @ SDS-3A

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

3.022	6.887	4.182	2.019	2.091
2.404	3.139	3.127	2.460	2.059
1.992	2.749	2.481	1.661	2.416
2.850	2.098	2.354	3.839	2.911
2.242	2.315	2.021	4.853	2.208
2.156	2.853	1.829	1.786	2.527
2.198	2.539	2.525	4.094	2.190
2.590	1.636	4.031	2.843	1.326
1.464	6.572	5.334	2.180	1.518
1.255	2.309	5.078		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.409
Variance (logs)	0.028
Standard Deviation (logs)	0.167
Skewness (logs)	0.721
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.171
Coefficient of Variation (logs)	0.407

1

PREDEV SIMULATED FLOW @ SDS-3A

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	1.290
0.9500	1.05	1.490
0.9000	1.11	1.631
0.8000	1.25	1.846
0.5000	2.00	2.451
0.2000	5.00	3.471
0.1000	10.00	4.280
0.0400	25.00	5.469
0.0200	50.00	6.485
0.0100	100.00	7.624
0.0050	200.00	8.902

$\frac{1}{2}Q_2 = 1.226$
$Q_{50} = 6.485$

:

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

2006 SIMULATED FLOW @ SDS-3A

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

2.456	3.973	8.106	2.096	2.128
2.285	6.881	3.291	3.472	2.505
2.228	7.456	2.408	1.897	2.444
2.366	3.253	2.022	6.232	2.198
2.450	2.315	2.499	7.851	2.201
2.161	6.195	2.308	1.880	2.376
1.928	5.400	2.172	12.521	3.855
2.139	2.400	9.105	9.744	2.155
1.637	14.657	12.111	2.207	2.332
1.581	3.887	10.415		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.528
Variance (logs)	0.074
Standard Deviation (logs)	0.272
Skewness (logs)	0.992
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.008
Coefficient of Variation (logs)	0.515

1

2006 SIMULATED FLOW @ SDS-3A

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	1.244
0.9500	1.05	1.477
0.9000	1.11	1.664
0.8000	1.25	1.979
0.5000	2.00	3.046
0.2000	5.00	5.419
0.1000	10.00	7.797
0.0400	25.00	12.085
0.0200	50.00	16.499
0.0100	100.00	22.261
0.0050	200.00	29.765

$\frac{1}{2}Q_2 = 1.523$
$Q_{50} = 16.499$

AR 046768

1

Simulated - PREDEV SIMULATED FLOW @ SDS-3A
Observed - 2006 SIMULATED FLOW @ SDS-3A

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	400309	0.066	*	0.155	*	-0.065	*
1.00	2600	0.754	71.5	0.781	74.0	-0.751	-71.2
1.10	4035	0.808	70.5	0.839	73.1	-0.803	-70.0
1.20	2897	0.874	70.0	0.908	72.7	-0.868	-69.6
1.30	2100	0.924	68.6	0.964	71.5	-0.916	-68.0
1.40	1653	0.992	68.5	1.034	71.4	-0.986	-68.1
1.50	1654	1.047	67.6	1.090	70.4	-1.035	-66.8
1.60	2074	1.122	66.4	1.169	69.2	-1.108	-65.6
1.80	696	1.208	65.3	1.260	68.1	-1.192	-64.4
1.90	1032	1.252	62.8	1.319	66.2	-1.228	-61.6
2.10	775	1.318	60.2	1.398	63.8	-1.277	-58.3
2.30	513	1.268	53.0	1.374	57.4	-1.235	-51.6
2.50	79	1.208	47.7	1.343	53.0	-1.190	-47.0
2.70	34	1.369	48.9	1.470	52.5	-1.354	-48.4
2.90	38	1.431	47.2	1.592	52.5	-1.397	-46.1
3.20	27	1.710	51.7	1.811	54.7	-1.710	-51.7
3.40	31	1.799	51.1	1.862	52.8	-1.769	-50.2
3.70	29	2.022	53.1	2.129	55.9	-2.022	-53.1
4.00	23	2.192	51.8	2.279	53.8	-2.192	-51.8
4.40	24	2.626	56.8	2.719	58.7	-2.458	-53.1
4.80	24	2.837	56.8	2.967	59.3	-2.837	-56.8
5.20	15	3.308	62.1	3.367	63.3	-3.308	-62.1
5.60	19	3.307	57.1	3.363	58.1	-3.307	-57.1
6.10	18	3.615	57.2	3.733	59.1	-3.615	-57.2
6.60	20	4.067	59.1	4.165	60.6	-4.067	-59.1
7.20	17	4.252	56.7	4.323	57.6	-4.252	-56.7
7.80	11	4.941	61.2	5.021	62.3	-4.941	-61.2
8.40	8	5.124	58.4	5.199	59.4	-5.124	-58.4
9.20	4	6.979	73.5	6.994	73.7	-6.979	-73.5
10.00	4	5.698	54.1	5.788	54.9	-5.698	-54.1
11.00	1	7.272	61.4	7.272	61.4	-7.272	-61.4
12.00	2	8.216	66.7	8.219	66.7	-8.216	-66.7
13.00	1	7.609	55.1	7.609	55.1	-7.609	-55.1
14.00	1	8.661	59.1	8.661	59.1	-8.661	-59.1
15.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.111	*	0.284	*	-0.109	*

Standard error of estimate = 0.26
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SIMULATED FLOW @ SDS-3A
Observed - 2006 SIMULATED FLOW @ SDS-3A

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

AR 046769

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00**********			99.49	95.14	100.00	100.00	0.04	0.09
1.00	436	2600	0.10	0.62	0.51	4.86	1.05	1.05
1.10	345	4035	0.08	0.96	0.40	4.24	1.15	1.15
1.20	265	2897	0.06	0.69	0.32	3.29	1.25	1.25
1.30	195	2100	0.05	0.50	0.26	2.60	1.35	1.35
1.40	138	1653	0.03	0.39	0.21	2.10	1.45	1.45
1.50	119	1654	0.03	0.39	0.18	1.70	1.55	1.55
1.60	174	2074	0.04	0.49	0.15	1.31	1.69	1.69
1.80	57	696	0.01	0.17	0.11	0.82	1.84	1.85
1.90	106	1032	0.03	0.25	0.10	0.65	2.00	1.99
2.10	81	775	0.02	0.18	0.07	0.41	2.19	2.19
2.30	46	513	0.01	0.12	0.05	0.22	2.39	2.40
2.50	42	79	0.01	0.02	0.04	0.10	2.60	2.53
2.70	28	34	0.01	0.01	0.03	0.08	2.80	2.80
2.90	35	38	0.01	0.01	0.02	0.08	3.03	3.03
3.20	15	27	0.00	0.01	0.02	0.07	3.29	3.30
3.40	15	31	0.00	0.01	0.01	0.06	3.50	3.52
3.70	9	29	0.00	0.01	0.01	0.05	3.82	3.81
4.00	11	23	0.00	0.01	0.01	0.05	4.09	4.22
4.40	5	24	0.00	0.01	0.00	0.04	4.57	4.62
4.80	3	24	0.00	0.01	0.00	0.03	4.97	4.99
5.20	1	15	0.00	0.00	0.00	0.03	5.33	5.33
5.60	2	19	0.00	0.00	0.00	0.03	6.05	5.79
6.10	2	18	0.00	0.00	0.00	0.02	6.39	6.32
6.60	1	20	0.00	0.00	0.00	0.02	6.89	6.88
7.20	0	17	0.00	0.00	0.00	0.01	0.00	7.50
7.80	0	11	0.00	0.00	0.00	0.01	0.00	8.08
8.40	0	8	0.00	0.00	0.00	0.00	0.00	8.80
9.20	0	4	0.00	0.00	0.00	0.00	0.00	9.50
10.00	0	4	0.00	0.00	0.00	0.00	0.00	10.51
11.00	0	1	0.00	0.00	0.00	0.00	0.00	11.85
12.00	0	2	0.00	0.00	0.00	0.00	0.00	12.32
13.00	0	1	0.00	0.00	0.00	0.00	0.00	13.82
14.00	0	1	0.00	0.00	0.00	0.00	0.00	14.66
15.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768420768		100.00	100.00			0.05	0.16

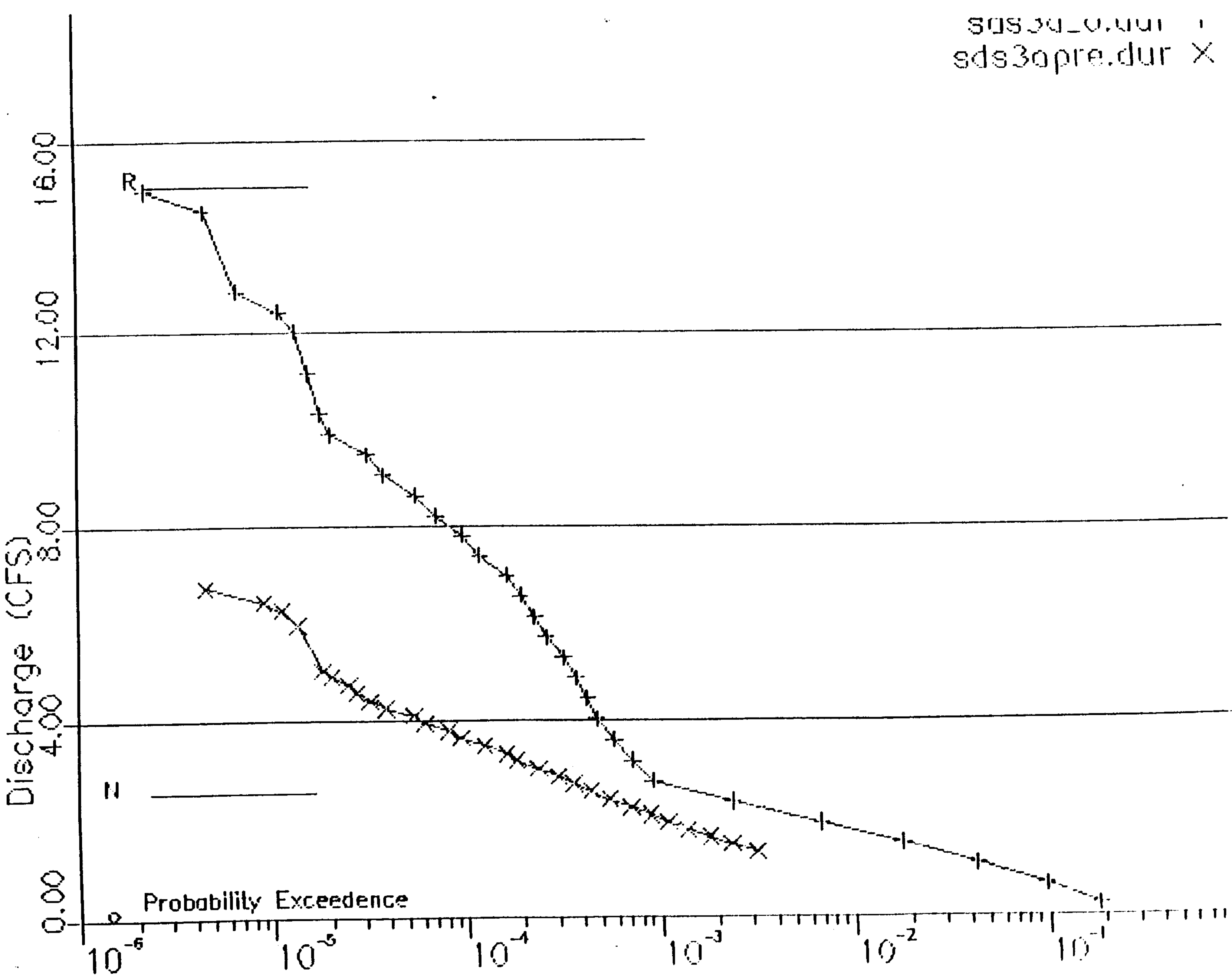
38133 Observed values are zero
118000 Simulated values are zero
38133 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
79867 Observed values are not zero when simulated are

1

Simulated - PREDEV SIMULATED FLOW @ SDS-3A
Observed - 2006 SIMULATED FLOW @ SDS-3A

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	276644	63094	15854	37973	1791	1890	3063	0
1.00	2025	463	80	17	5	5	5	0
1.10	3082	742	138	30	17	17	9	0
1.20	2197	550	92	21	19	13	5	0
1.30	1549	425	76	16	12	14	8	0
1.40	1219	326	79	8	10	9	2	0
1.50	1162	403	57	8	8	10	6	0
1.60	1455	483	78	17	17	17	7	0
1.80	465	183	31	5	1	7	4	0

1.90	621	328	50	4	11	10	8	0
2.10	424	270	47	11	10	4	9	0
2.30	208	215	61	8	11	8	2	0
2.50	29	29	17	3	0	1	0	0
2.70	13	15	5	0	1	0	0	0
2.90	14	14	7	0	2	1	0	0
3.20	9	14	4	0	0	0	0	0
3.40	8	21	1	0	0	1	0	0
3.70	9	17	3	0	0	0	0	0
4.00	5	17	1	0	0	0	0	0
4.40	8	15	0	0	0	0	1	0
4.80	11	12	1	0	0	0	0	0
5.20	7	8	0	0	0	0	0	0
5.60	6	13	0	0	0	0	0	0
6.10	8	9	1	0	0	0	0	0
6.60	8	12	0	0	0	0	0	0
7.20	7	10	0	0	0	0	0	0
7.80	5	6	0	0	0	0	0	0
8.40	4	4	0	0	0	0	0	0
9.20	4	0	0	0	0	0	0	0
10.00	1	3	0	0	0	0	0	0
11.00	1	0	0	0	0	0	0	0
12.00	2	0	0	0	0	0	0	0
13.00	0	1	0	0	0	0	0	0
14.00	0	1	0	0	0	0	0	0
15.00	0	0	0	0	0	0	0	0
	291210	67703	16683	38121	1915	2007	3129	0


sds3apre.dur X
16.00
12.00
8.00
4.00
0.00
Discharge (CFS)
R
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Probability Exceedence
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	375.00	ft
Facility Width:	80.00	ft
Facility Area:	30000.	sq. ft
Effective Storage Depth:	7.94	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	238200.	cu. ft
Riser Head:	7.94	ft
Riser Diameter:	36.00	inches
Number of orifices:	1	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	6.25	2.985	

Top Notch Weir:	Rectangular	
Length:	18.00	in
Weir Height:	5.70	ft
Outflow Rating Curve:	None	

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.07	0.07	2100.	0.048	0.270	0.00
0.13	0.13	3900.	0.090	0.382	0.00
0.20	0.20	6000.	0.138	0.468	0.00
0.26	0.26	7800.	0.179	0.541	0.00
0.33	0.33	9900.	0.227	0.605	0.00
0.39	0.39	11700.	0.269	0.662	0.00
0.46	0.46	13800.	0.317	0.715	0.00
0.52	0.52	15600.	0.358	0.765	0.00
0.66	0.66	19800.	0.455	0.858	0.00
0.79	0.79	23700.	0.544	0.942	0.00
0.92	0.92	27600.	0.634	1.020	0.00
1.06	1.06	31800.	0.730	1.090	0.00
1.19	1.19	35700.	0.820	1.160	0.00
1.33	1.33	39900.	0.916	1.220	0.00
1.46	1.46	43800.	1.006	1.280	0.00
1.60	1.60	48000.	1.102	1.340	0.00
1.73	1.73	51900.	1.191	1.390	0.00
1.87	1.87	56100.	1.288	1.450	0.00
2.00	2.00	60000.	1.377	1.500	0.00
2.14	2.14	64200.	1.474	1.550	0.00
2.27	2.27	68100.	1.563	1.600	0.00
2.40	2.40	72000.	1.653	1.640	0.00
2.54	2.54	76200.	1.749	1.690	0.00
2.67	2.67	80100.	1.839	1.730	0.00
2.81	2.81	84300.	1.935	1.780	0.00
2.94	2.94	88200.	2.025	1.820	0.00
3.08	3.08	92400.	2.121	1.860	0.00
3.21	3.21	96300.	2.211	1.900	0.00
3.35	3.35	100500.	2.307	1.940	0.00
3.48	3.48	104400.	2.397	1.980	0.00

3.62	3.62	108600.	2.493	2.010	0.00
3.75	3.75	112500.	2.583	2.050	0.00
3.89	3.89	116700.	2.679	2.090	0.00
4.02	4.02	120600.	2.769	2.120	0.00
4.15	4.15	124500.	2.858	2.160	0.00
4.29	4.29	128700.	2.955	2.190	0.00
4.42	4.42	132600.	3.044	2.230	0.00
4.56	4.56	136800.	3.140	2.260	0.00
4.69	4.69	140700.	3.230	2.300	0.00
4.83	4.83	144900.	3.326	2.330	0.00
4.96	4.96	148800.	3.416	2.360	0.00
5.10	5.10	153000.	3.512	2.390	0.00
5.23	5.23	156900.	3.602	2.420	0.00
5.37	5.37	161100.	3.698	2.450	0.00
5.50	5.50	165000.	3.788	2.480	0.00
5.63	5.63	168900.	3.877	2.520	0.00
5.70	5.70	171000.	3.926	2.530	0.00
5.83	5.83	174900.	4.015	2.800	0.00
5.97	5.97	179100.	4.112	3.250	0.00
6.10	6.10	183000.	4.201	3.820	0.00
6.24	6.24	187200.	4.298	4.470	0.00
6.37	6.37	191100.	4.387	5.170	0.00
6.51	6.51	195300.	4.483	5.930	0.00
6.64	6.64	199200.	4.573	6.730	0.00
6.78	6.78	203400.	4.669	7.560	0.00
6.91	6.91	207300.	4.759	8.410	0.00
7.05	7.05	211500.	4.855	9.280	0.00
7.18	7.18	215400.	4.945	10.160	0.00
7.31	7.31	219300.	5.034	11.040	0.00
7.45	7.45	223500.	5.131	11.920	0.00
7.58	7.58	227400.	5.220	12.800	0.00
7.72	7.72	231600.	5.317	13.670	0.00
7.85	7.85	235500.	5.406	14.530	0.00
7.94	7.94	238200.	5.468	15.070	0.00
8.04	8.04	241200.	5.537	16.020	0.00
8.14	8.14	244200.	5.606	17.720	0.00
8.24	8.24	247200.	5.675	19.930	0.00
8.34	8.34	250200.	5.744	22.540	0.00
8.44	8.44	253200.	5.813	25.500	0.00
8.54	8.54	256200.	5.882	28.760	0.00
8.64	8.64	259200.	5.950	32.310	0.00
8.74	8.74	262200.	6.019	36.130	0.00
8.84	8.84	265200.	6.088	40.180	0.00
8.94	8.94	268200.	6.157	44.470	0.00
9.04	9.04	271200.	6.226	48.980	0.00
9.14	9.14	274200.	6.295	52.580	0.00
9.24	9.24	277200.	6.364	54.120	0.00
9.34	9.34	280200.	6.433	55.600	0.00
9.44	9.44	283200.	6.501	57.030	0.00
9.54	9.54	286200.	6.570	58.410	0.00
9.64	9.64	289200.	6.639	59.760	0.00
9.74	9.74	292200.	6.708	61.060	0.00
9.84	9.84	295200.	6.777	62.330	0.00

SDS3A

```
Route Time Series through Facility
  Inflow Time Series File:sds3adev.tsf
 Outflow Time Series File:sds3a_o

Inflow/Outflow Analysis
   Peak Inflow Discharge:      19.60 CFS at  6:00 on Jan  9 in 1990
  Peak Outflow Discharge:      14.99 CFS at  9:00 on Jan  9 in 1990
    Peak Reservoir Stage:       7.93  Ft
     Peak Reservoir Elev:       7.93  Ft
  Peak Reservoir Storage:  237794.    Cu-Ft
                        :       5.459 Ac-Ft
```

Flow Frequency Analysis
Time Series File:sds3apre.tsf
Project Location:Sea-Tac DMoines

LogPearson III Coefficients
Mean= 0.430 StdDev= 0.169
Skew= 0.578

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			7.82		100.00	0.990
Computed Peaks			6.72		50.00	0.980
Computed Peaks			5.71		25.00	0.960
Computed Peaks			4.51		10.00	0.900
Computed Peaks			4.29		8.00	0.875
Computed Peaks			3.68		5.00	0.800
Computed Peaks			2.59		2.00	0.500
Computed Peaks			1.99		1.30	0.231

Flow Frequency Analysis
Time Series File:sds3a_o.tsf
Project Location:Sea-Tac DMoines

LogPearson III Coefficients
Mean= 0.540 StdDev= 0.278
Skew= 0.928

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			23.27	8.36		100.00	0.990
Computed Peaks			17.28	8.11		50.00	0.980
Computed Peaks			12.67	7.56		25.00	0.960
Computed Peaks			8.17	6.87		10.00	0.900
Computed Peaks			7.45	6.76		8.00	0.875
Computed Peaks			5.66	6.46		5.00	0.800
Computed Peaks			3.15	5.94		2.00	0.500
Computed Peaks			2.10	3.95		1.30	0.231

Duration Comparison Anaylsis

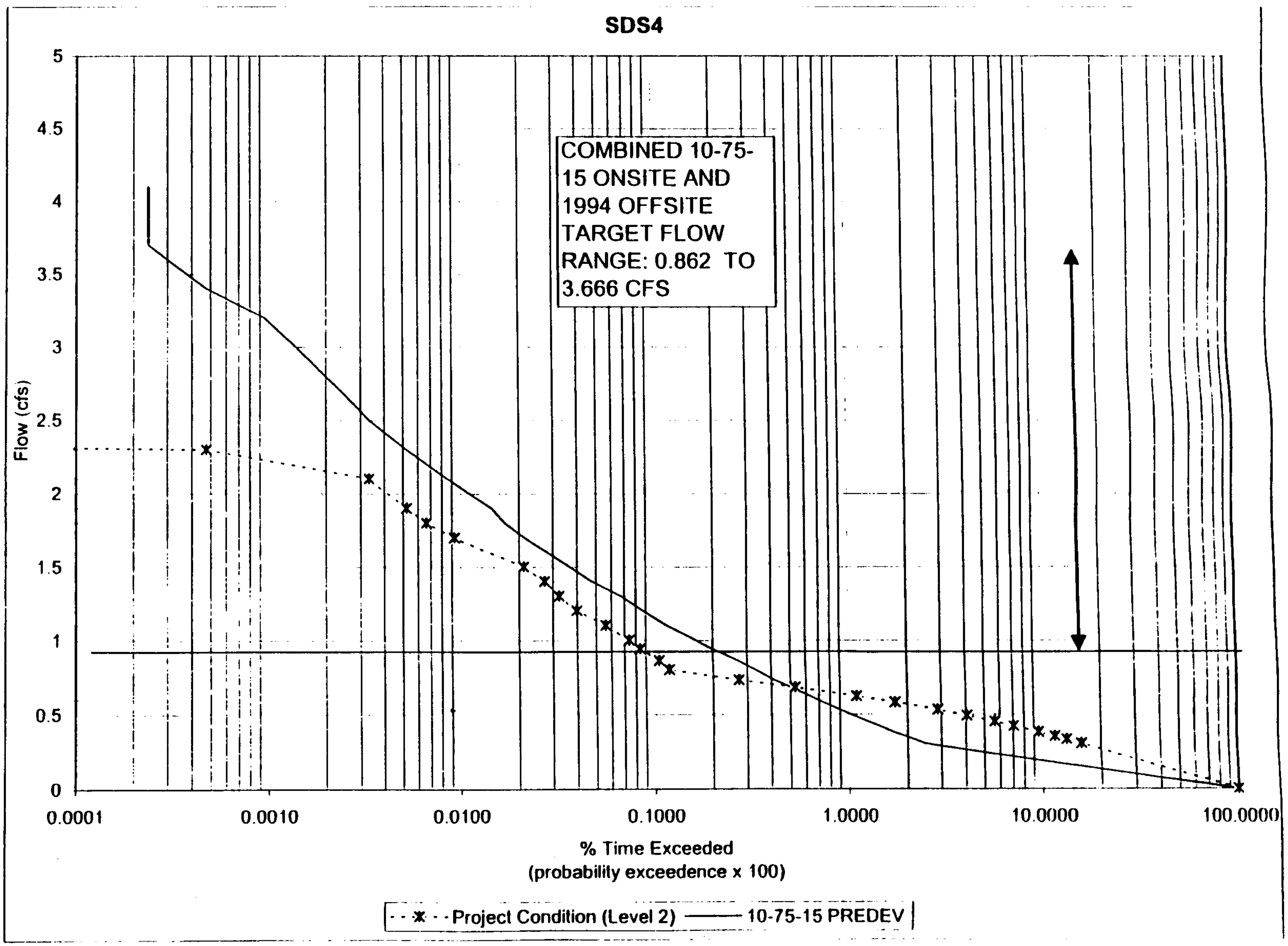
Base File: sds3apre.tsf
New File: sds3a_o.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
4.23	0.46E-04	0.46E-03	910.0	0.46E-04	4.23	8.92	110.9
4.41	0.32E-04	0.43E-03	1250.0	0.32E-04	4.41	9.56	116.8
4.60	0.25E-04	0.41E-03	1518.2	0.25E-04	4.60	9.86	114.6
4.78	0.23E-04	0.39E-03	1600.0	0.23E-04	4.78	9.89	106.8
4.97	0.18E-04	0.37E-03	1950.0	0.18E-04	4.97	10.49	111.2
5.15	0.14E-04	0.34E-03	2416.7	0.14E-04	5.15	12.38	140.4
5.34	0.14E-04	0.32E-03	2233.3	0.14E-04	5.34	12.38	132.0
5.52	0.14E-04	0.29E-03	2000.0	0.14E-04	5.52	12.38	124.3
5.71	0.14E-04	0.27E-03	1850.0	0.14E-04	5.71	12.38	117.0
5.89	0.14E-04	0.25E-03	1750.0	0.14E-04	5.89	12.38	110.2
6.08	0.11E-04	0.24E-03	2000.0	0.11E-04	6.08	12.52	106.1
6.26	0.11E-04	0.22E-03	1860.0	0.11E-04	6.26	12.52	100.0
6.45	0.91E-05	0.21E-03	2150.0	0.91E-05	6.45	12.82	98.9
6.63	0.46E-05	0.20E-03	4200.0	0.46E-05	6.63	14.62	120.6
6.82	0.46E-05	0.18E-03	3900.0	0.46E-05	6.82	14.62	114.6
7.00	0.46E-05	0.17E-03	3600.0	0.46E-05	7.00	14.62	105.9
1.27	0.34E-02	0.28E-01	733.1	0.34E-02	1.27	2.21	73.7
1.46	0.23E-02	0.19E-01	713.5	0.23E-02	1.46	2.33	59.8
1.64	0.17E-02	0.12E-01	620.8	0.17E-02	1.64	2.42	47.3
1.83	0.13E-02	0.82E-02	526.6	0.13E-02	1.83	2.49	36.3
2.01	0.98E-03	0.53E-02	441.9	0.98E-03	2.01	2.68	33.4
2.19	0.76E-03	0.35E-02	356.0	0.76E-03	2.19	3.11	41.5
2.38	0.55E-03	0.20E-02	256.2	0.55E-03	2.38	3.74	57.3
2.56	0.43E-03	0.10E-02	143.6	0.43E-03	2.56	4.44	73.0
2.75	0.34E-03	0.94E-03	175.8	0.34E-03	2.75	5.20	89.1
2.93	0.25E-03	0.83E-03	231.8	0.25E-03	2.93	5.90	101.2
3.12	0.20E-03	0.75E-03	272.7	0.20E-03	3.12	6.54	109.6
3.30	0.17E-03	0.68E-03	306.8	0.17E-03	3.30	7.01	112.1
3.49	0.12E-03	0.61E-03	398.1	0.12E-03	3.49	7.55	116.6
3.67	0.91E-04	0.57E-03	522.5	0.91E-04	3.67	7.90	115.1
3.86	0.73E-04	0.51E-03	603.1	0.73E-04	3.86	8.22	113.2
4.04	0.59E-04	0.47E-03	700.0	0.59E-04	4.04	8.55	111.4

Maximum positive excursion = 7.25 cfs (141.4%)
occuring at 5.13 cfs on the Base Data:sds3apre.tsf
and at 12.38 cfs on the New Data:sds3a_o.tsf

Maximum negative excursion = -0.593 cfs (30.2%)
occuring at 1.96 cfs on the Base Data:sds3apre.tsf
and at 2.56 cfs on the New Data:sds3a_o.tsf

SDS4


SDS4
Flow (cfs)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
100.0000
% Time Exceeded
(probability exceedence x 100)
COMBINED 10-75-15 ONSITE AND 1994 OFFSITE TARGET FLOW RANGE: 0.862 TO 3.666 CFS
Project Condition (Level 2)
10-75-15 PREDEV

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SDS-4

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

1.914	4.165	2.362	1.405	1.452
1.658	1.833	1.802	1.880	1.646
1.300	1.787	1.677	1.401	1.530
1.857	1.523	1.565	2.222	2.401
1.453	1.549	1.374	2.965	1.460
1.482	1.999	1.355	1.597	2.096
1.981	1.822	2.001	2.814	1.941
1.661	1.416	2.163	2.363	1.144
1.354	3.463	3.031	1.545	1.020
1.161	1.504	2.787		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.253
Variance (logs)	0.016
Standard Deviation (logs)	0.127
Skewness (logs)	0.792
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.183
Coefficient of Variation (logs)	0.503

1

PREDEV SDS-4

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	1.076
0.9500	1.05	1.191
0.9000	1.11	1.272
0.8000	1.25	1.393
0.5000	2.00	1.723
0.2000	5.00	2.249
0.1000	10.00	2.647
0.0400	25.00	3.206
0.0200	50.00	3.666
0.0100	100.00	4.165
0.0050	200.00	4.710

$\frac{1}{2}Q_2 = 0.862$
$Q_{50} = 3.666$

:

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III
distributions are for preliminary computations.
User is responsible for assessment and
interpretation.

2006 SDS-4

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.591	0.747	2.297	0.519	0.632
0.663	0.682	0.770	0.663	0.700
0.600	1.436	0.705	0.498	0.679
0.695	0.781	0.623	0.699	0.640
0.591	0.651	0.695	1.632	0.746
0.695	0.650	0.669	0.571	0.691
0.515	1.695	0.621	1.112	0.686
0.551	0.595	0.784	1.157	0.570
0.568	1.560	1.798	0.706	0.574
0.505	0.720	2.312		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.117
Variance (logs)	0.029
Standard Deviation (logs)	0.172
Skewness (logs)	1.612
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.044
Coefficient of Variation (logs)	-1.468

1

2006 SDS-4

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.478
0.9500	1.05	0.497
0.9000	1.11	0.517
0.8000	1.25	0.554
0.5000	2.00	0.691
0.2000	5.00	0.997
0.1000	10.00	1.291
0.0400	25.00	1.797
0.0200	50.00	2.294
0.0100	100.00	2.921
0.0050	200.00	3.709

$\frac{1}{2}Q_2 = 0.346$

$Q_{50} = 2.294$

AR 046781

1

Simulated - PREDEV SDS-4
Observed - 2006 SDS-4

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	354193	0.058	*	0.102	*	-0.051	*
0.30	10259	0.270	85.6	0.282	89.4	-0.243	-76.9
0.33	7420	0.286	84.3	0.300	88.3	-0.260	-76.5
0.35	8716	0.309	84.6	0.323	88.6	-0.279	-76.5
0.38	10379	0.333	83.2	0.349	87.2	-0.303	-75.7
0.42	5985	0.360	82.8	0.377	86.7	-0.328	-75.5
0.45	6760	0.386	82.2	0.406	86.4	-0.350	-74.5
0.49	4908	0.416	81.8	0.435	85.5	-0.380	-74.7
0.53	4800	0.444	80.0	0.469	84.6	-0.404	-72.9
0.58	2721	0.472	78.8	0.497	83.0	-0.431	-72.0
0.62	2401	0.503	77.6	0.528	81.4	-0.457	-70.5
0.68	1079	0.531	75.8	0.557	79.5	-0.480	-68.5
0.73	648	0.592	78.1	0.634	83.7	-0.492	-64.9
0.80	54	0.635	76.4	0.656	78.9	-0.563	-68.0
0.86	91	0.641	71.1	0.663	73.4	-0.584	-64.8
0.94	42	0.766	78.8	0.861	88.7	-0.440	-45.3
1.00	76	0.730	69.4	0.768	73.0	-0.696	-66.2
1.10	68	0.748	65.5	0.792	69.4	-0.717	-62.8
1.20	32	0.859	68.9	0.921	73.8	-0.728	-58.6
1.30	22	0.900	66.5	0.951	70.2	-0.798	-58.9
1.40	25	0.916	63.5	0.972	67.4	-0.911	-63.2
1.50	50	0.991	62.0	1.032	64.5	-0.925	-58.0
1.70	11	0.997	56.8	1.053	60.0	-0.997	-56.8
1.80	6	0.978	52.8	1.096	59.0	-0.969	-52.3
1.90	8	1.204	60.0	1.311	65.4	-1.204	-60.0
2.10	12	1.231	55.6	1.315	59.4	-1.231	-55.6
2.30	2	1.116	48.3	1.135	49.2	-1.116	-48.3
2.50	0	0.000	0.0	0.000	0.0	0.000	0.0
2.70	0	0.000	0.0	0.000	0.0	0.000	0.0
2.90	0	0.000	0.0	0.000	0.0	0.000	0.0
3.20	0	0.000	0.0	0.000	0.0	0.000	0.0
3.40	0	0.000	0.0	0.000	0.0	0.000	0.0
3.70	0	0.000	0.0	0.000	0.0	0.000	0.0
4.10	0	0.000	0.0	0.000	0.0	0.000	0.0
4.40	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.105	*	0.180	*	-0.094	*

Standard error of estimate = 0.15
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SDS-4
Observed - 2006 SDS-4

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		97.53	84.16	100.00	100.00	0.02	0.06
0.30	135910259		0.32	2.44	2.47	15.82	0.31	0.32
0.33	779	7420	0.19	1.76	2.15	13.38	0.34	0.34
0.35	1057	8716	0.25	2.07	1.96	11.62	0.36	0.36
0.38	112710379		0.27	2.47	1.71	9.55	0.40	0.40
0.42	805	5985	0.19	1.42	1.44	7.08	0.43	0.43
0.45	814	6760	0.19	1.61	1.25	5.66	0.47	0.47
0.49	678	4908	0.16	1.17	1.06	4.05	0.51	0.51
0.53	680	4800	0.16	1.14	0.90	2.89	0.55	0.55
0.58	437	2721	0.10	0.65	0.74	1.75	0.60	0.60
0.62	528	2401	0.13	0.57	0.63	1.10	0.65	0.65
0.68	379	1079	0.09	0.26	0.51	0.53	0.70	0.70
0.73	358	648	0.09	0.15	0.42	0.27	0.76	0.76
0.80	253	54	0.06	0.01	0.33	0.12	0.83	0.83
0.86	296	91	0.07	0.02	0.27	0.11	0.90	0.90
0.94	155	42	0.04	0.01	0.20	0.08	0.97	0.97
1.00	202	76	0.05	0.02	0.16	0.07	1.05	1.05
1.10	118	68	0.03	0.02	0.12	0.06	1.14	1.14
1.20	83	32	0.02	0.01	0.09	0.04	1.25	1.24
1.30	85	22	0.02	0.01	0.07	0.03	1.35	1.36
1.40	45	25	0.01	0.01	0.05	0.03	1.44	1.44
1.50	64	50	0.02	0.01	0.04	0.02	1.60	1.60
1.70	19	11	0.00	0.00	0.02	0.01	1.76	1.76
1.80	10	6	0.00	0.00	0.02	0.01	1.84	1.86
1.90	25	8	0.01	0.00	0.01	0.01	1.99	2.01
2.10	14	12	0.00	0.00	0.01	0.00	2.19	2.22
2.30	8	2	0.00	0.00	0.01	0.00	2.37	2.31
2.50	4	0	0.00	0.00	0.00	0.00	2.62	0.00
2.70	3	0	0.00	0.00	0.00	0.00	2.80	0.00
2.90	3	0	0.00	0.00	0.00	0.00	3.02	0.00
3.20	2	0	0.00	0.00	0.00	0.00	3.22	0.00
3.40	1	0	0.00	0.00	0.00	0.00	3.46	0.00
3.70	0	0	0.00	0.00	0.00	0.00	0.00	0.00
4.10	1	0	0.00	0.00	0.00	0.00	4.17	0.00
4.40	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768420768		100.00	100.00			0.03	0.12

13083 Observed values are zero
118000 Simulated values are zero
13083 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
104917 Observed values are not zero when simulated are

1

Simulated - PREDEV SDS-4
Observed - 2006 SDS-4

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	325068	6279	2541	9848	931	1529	7997	0
0.30	8614	634	265	84	98	149	415	0
0.33	6185	529	189	69	70	103	275	0
0.35	7306	543	228	78	87	126	348	0
0.38	8622	760	304	100	77	141	375	0
0.42	4958	443	154	73	56	82	219	0
0.45	5553	521	206	74	58	98	250	0
0.49	4036	389	167	46	38	56	176	0
0.53	3879	426	153	58	52	78	154	0

0.58	2182	240	91	40	26	50	92	0
0.62	1888	263	82	26	20	30	92	0
0.68	831	137	35	7	9	17	43	0
0.73	522	54	20	7	7	9	29	0
0.80	46	3	1	1	0	1	2	0
0.86	68	15	1	1	1	2	3	0
0.94	31	3	0	1	2	0	5	0
1.00	59	8	3	2	0	3	1	0
1.10	52	8	1	3	1	2	1	0
1.20	25	2	1	1	1	1	1	0
1.30	17	1	1	1	0	1	1	0
1.40	19	4	0	1	1	0	0	0
1.50	33	12	1	0	0	2	2	0
1.70	6	3	2	0	0	0	0	0
1.80	3	2	0	0	1	0	0	0
1.90	6	1	0	1	0	0	0	0
2.10	8	2	2	0	0	0	0	0
2.30	0	2	0	0	0	0	0	0
2.50	0	0	0	0	0	0	0	0
2.70	0	0	0	0	0	0	0	0
2.90	0	0	0	0	0	0	0	0
3.20	0	0	0	0	0	0	0	0
3.40	0	0	0	0	0	0	0	0
3.70	0	0	0	0	0	0	0	0
4.10	0	0	0	0	0	0	0	0
4.40	0	0	0	0	0	0	0	0
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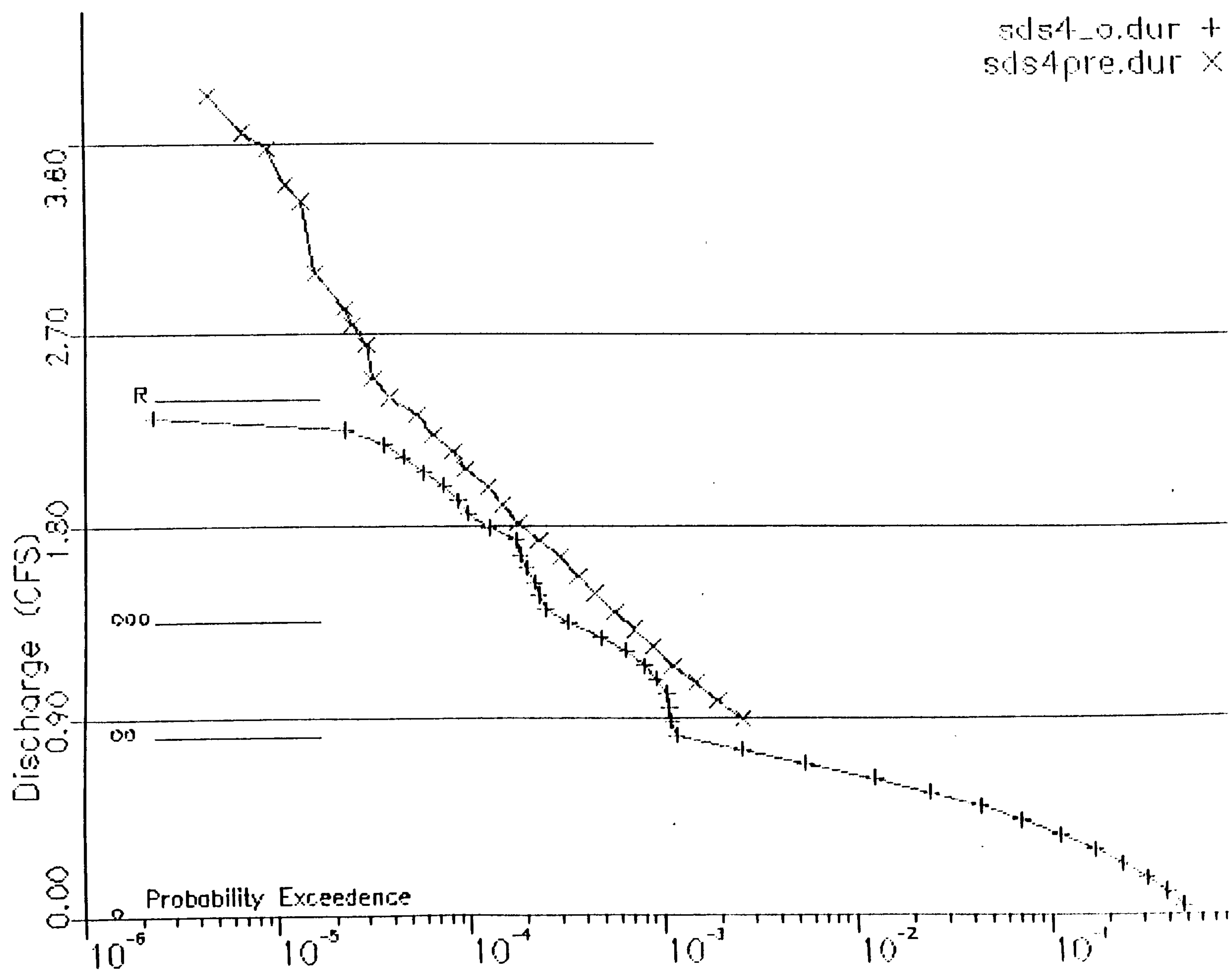
	380017	11284	4448	10522	1536	2480	10481	0


sds4_o.dur +
sds4pre.dur ×
Discharge (CFS)
3.60
2.70
1.80
0.90
0.00
R
ooo
oo
Probability Exceedence
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1

Retention/Detention Facility

Type of Facility:	Detention Vault
Facility Length:	195.00 ft
Facility Width:	195.00 ft
Facility Area:	38025. sq. ft
Effective Storage Depth:	15.00 ft
Stage 0 Elevation:	0.00 ft
Storage Volume:	570375. cu. ft
Riser Head:	15.00 ft
Riser Diameter:	10.00 inches
Number of orifices:	3

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	3.00	0.945	
2	11.00	3.50	0.664	6.0
3	13.00	4.50	0.777	8.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.03	0.03	1141.	0.026	0.043	0.00
0.06	0.06	2282.	0.052	0.061	0.00
0.09	0.09	3422.	0.079	0.075	0.00
0.13	0.13	4943.	0.113	0.086	0.00
0.16	0.16	6084.	0.140	0.096	0.00
0.19	0.19	7225.	0.166	0.106	0.00
0.22	0.22	8366.	0.192	0.114	0.00
0.25	0.25	9506.	0.218	0.122	0.00
0.54	0.54	20534.	0.471	0.180	0.00
0.84	0.84	31941.	0.733	0.224	0.00
1.13	1.13	42968.	0.986	0.260	0.00
1.43	1.43	54376.	1.248	0.292	0.00
1.72	1.72	65403.	1.501	0.320	0.00
2.01	2.01	76430.	1.755	0.347	0.00
2.31	2.31	87838.	2.016	0.371	0.00
2.60	2.60	98865.	2.270	0.394	0.00
2.90	2.90	110273.	2.532	0.416	0.00
3.19	3.19	121300.	2.785	0.436	0.00
3.49	3.49	132707.	3.047	0.456	0.00
3.78	3.78	143735.	3.300	0.475	0.00
4.07	4.07	154762.	3.553	0.493	0.00
4.37	4.37	166169.	3.815	0.510	0.00
4.66	4.66	177197.	4.068	0.527	0.00
4.96	4.96	188604.	4.330	0.543	0.00
5.25	5.25	199631.	4.583	0.559	0.00
5.54	5.54	210659.	4.836	0.575	0.00
5.84	5.84	222066.	5.098	0.590	0.00
6.13	6.13	233093.	5.351	0.605	0.00
6.43	6.43	244501.	5.613	0.619	0.00
6.72	6.72	255528.	5.866	0.633	0.00
7.01	7.01	266555.	6.119	0.647	0.00

7.31	7.31	277963.	6.381	0.660	0.00
7.60	7.60	288990.	6.634	0.673	0.00
7.90	7.90	300398.	6.896	0.686	0.00
8.19	8.19	311425.	7.149	0.699	0.00
8.49	8.49	322832.	7.411	0.711	0.00
8.78	8.78	333860.	7.664	0.723	0.00
9.07	9.07	344887.	7.918	0.735	0.00
9.37	9.37	356294.	8.179	0.747	0.00
9.66	9.66	367322.	8.433	0.759	0.00
9.96	9.96	378729.	8.694	0.770	0.00
10.25	10.25	389756.	8.948	0.782	0.00
10.54	10.54	400784.	9.201	0.793	0.00
10.84	10.84	412191.	9.463	0.804	0.00
11.00	11.00	418275.	9.602	0.810	0.00
11.04	11.04	419796.	9.637	0.814	0.00
11.07	11.07	420937.	9.663	0.825	0.00
11.11	11.11	422458.	9.698	0.842	0.00
11.15	11.15	423979.	9.733	0.863	0.00
11.18	11.18	425120.	9.759	0.891	0.00
11.22	11.22	426641.	9.794	0.922	0.00
11.26	11.26	428162.	9.829	0.987	0.00
11.29	11.29	429302.	9.855	1.000	0.00
11.33	11.33	430823.	9.890	1.010	0.00
11.62	11.62	441851.	10.143	1.090	0.00
11.92	11.92	453258.	10.405	1.160	0.00
12.21	12.21	464285.	10.659	1.220	0.00
12.50	12.50	475313.	10.912	1.270	0.00
12.80	12.80	486720.	11.174	1.320	0.00
13.00	13.00	494325.	11.348	1.350	0.00
13.05	13.05	496226.	11.392	1.360	0.00
13.09	13.09	497747.	11.427	1.390	0.00
13.14	13.14	499649.	11.470	1.420	0.00
13.19	13.19	501550.	11.514	1.470	0.00
13.23	13.23	503071.	11.549	1.530	0.00
13.28	13.28	504972.	11.593	1.590	0.00
13.33	13.33	506873.	11.636	1.670	0.00
13.38	13.38	508775.	11.680	1.740	0.00
13.67	13.67	519802.	11.933	1.890	0.00
13.96	13.96	530829.	12.186	2.020	0.00
14.26	14.26	542237.	12.448	2.140	0.00
14.55	14.55	553264.	12.701	2.240	0.00
14.85	14.85	564671.	12.963	2.340	0.00
15.00	15.00	570375.	13.094	2.390	0.00
15.10	15.10	574178.	13.181	2.670	0.00
15.20	15.20	577980.	13.269	3.170	0.00
15.30	15.30	581783.	13.356	3.810	0.00
15.40	15.40	585585.	13.443	4.170	0.00
15.50	15.50	589388.	13.530	4.390	0.00
15.60	15.60	593190.	13.618	4.600	0.00
15.70	15.70	596993.	13.705	4.790	0.00
15.80	15.80	600795.	13.792	4.970	0.00
15.90	15.90	604598.	13.880	5.140	0.00
16.00	16.00	608400.	13.967	5.300	0.00
16.10	16.10	612203.	14.054	5.450	0.00
16.20	16.20	616005.	14.142	5.600	0.00
16.30	16.30	619808.	14.229	5.740	0.00
16.40	16.40	623610.	14.316	5.880	0.00

16.50	16.50	627413.	14.403	6.020	0.00
16.60	16.60	631215.	14.491	6.150	0.00
16.70	16.70	635018.	14.578	6.270	0.00
16.80	16.80	638820.	14.665	6.400	0.00
16.90	16.90	642623.	14.753	6.520	0.00

```
Route Time Series through Facility
  Inflow Time Series File:sds4dev.tsf
 Outflow Time Series File:sds4_o

Inflow/Outflow Analysis
   Peak Inflow Discharge:       15.82 CFS at 16:00 on Mar  3 in 1950
  Peak Outflow Discharge:        2.32 CFS at 20:00 on Feb  9 in 1951
    Peak Reservoir Stage:       14.80  Ft
     Peak Reservoir Elev:       14.80  Ft
  Peak Reservoir Storage:   562952.    Cu-Ft
                        :       12.924 Ac-Ft
```

Flow Frequency Analysis
Time Series File:sds4pre.tsf
Project Location:Sea-Tac DMoines

LogPearson III Coefficients
Mean= 0.266 StdDev= 0.129
Skew= 0.787

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			4.36		100.00	0.990
Computed Peaks			3.83		50.00	0.980
Computed Peaks			3.34		25.00	0.960
Computed Peaks			2.75		10.00	0.900
Computed Peaks			2.64		8.00	0.875
Computed Peaks			2.33		5.00	0.800
Computed Peaks			1.78		2.00	0.500
Computed Peaks			1.46		1.30	0.231

Flow Frequency Analysis
Time Series File:sds4_o.tsf
Project Location:Sea-Tac DMoines

LogPearson III Coefficients
Mean= -0.105 StdDev= 0.180
Skew= 1.552

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks (CFS)	- - (ft)	Rank	Return Period	Prob
Computed Peaks			3.15	15.20		100.00	0.990
Computed Peaks			2.46	15.03		50.00	0.980
Computed Peaks			1.92	13.73		25.00	0.960
Computed Peaks			1.36	13.05		10.00	0.900
Computed Peaks			1.27	12.52		8.00	0.875
Computed Peaks			1.04	11.44		5.00	0.800
Computed Peaks			0.709	8.45		2.00	0.500
Computed Peaks			0.573	5.51		1.30	0.231

Duration Comparison Anaylsis
Base File: sds4pre.tsf
New File: sds4_o.tsf
Cutoff Units: Discharge in CFS

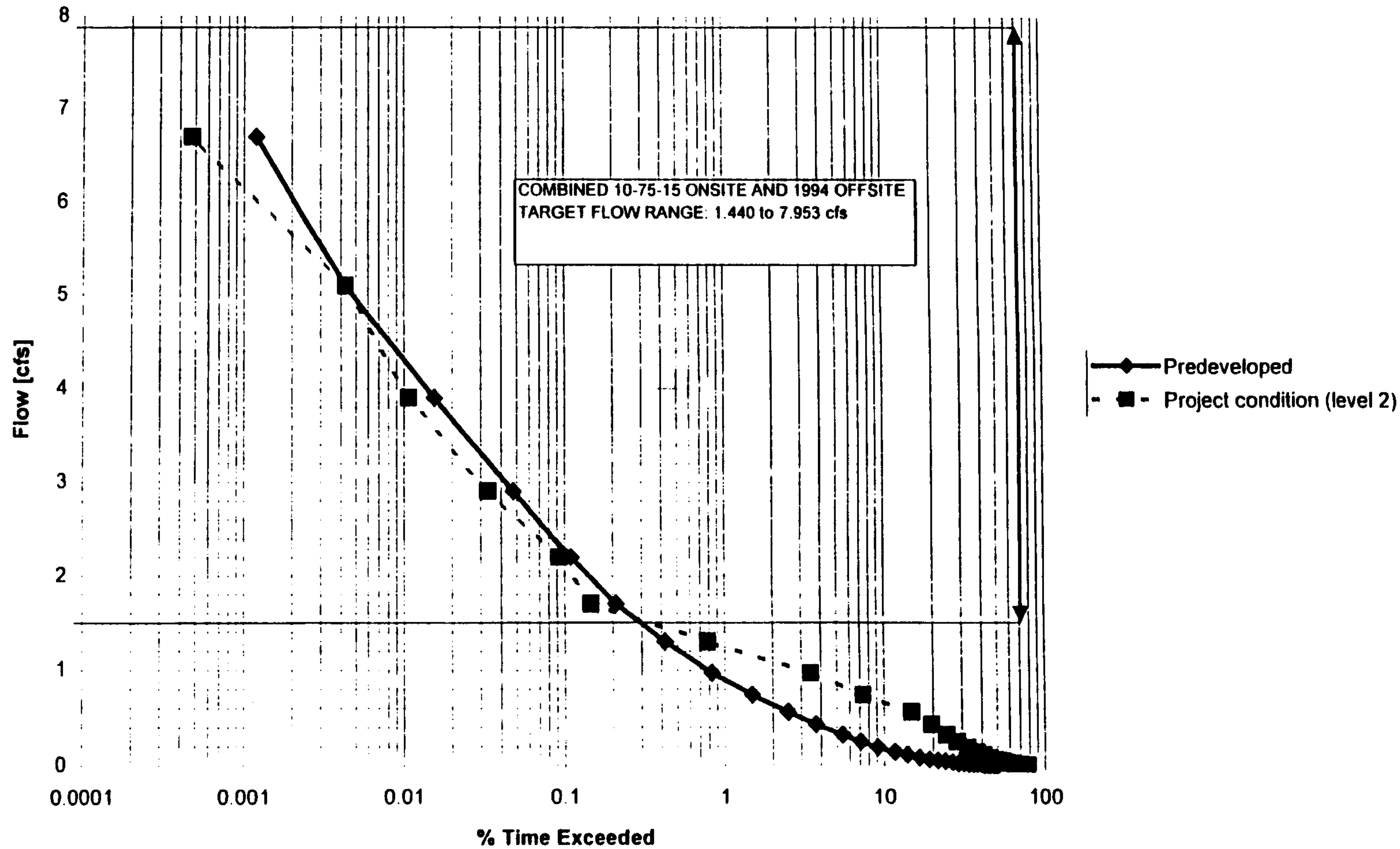
	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.890	0.26E-02	0.11E-02	-57.5	0.26E-02	0.890	0.750	-15.7
1.00	0.18E-02	0.11E-02	-41.6	0.18E-02	1.00	0.779	-22.1
1.11	0.13E-02	0.86E-03	-32.1	0.13E-02	1.11	0.805	-27.5
1.22	0.92E-03	0.61E-03	-33.8	0.92E-03	1.22	1.08	-11.3
1.33	0.69E-03	0.34E-03	-50.2	0.69E-03	1.33	1.19	-10.5
1.44	0.50E-03	0.24E-03	-52.9	0.50E-03	1.44	1.26	-12.6
1.55	0.37E-03	0.21E-03	-42.7	0.37E-03	1.55	1.32	-14.9
1.66	0.29E-03	0.19E-03	-34.4	0.29E-03	1.66	1.35	-18.5
1.77	0.21E-03	0.15E-03	-29.3	0.21E-03	1.77	1.57	-11.5
1.88	0.15E-03	0.94E-04	-38.8	0.15E-03	1.88	1.77	-6.2
1.99	0.12E-03	0.73E-04	-40.7	0.12E-03	1.99	1.81	-9.2
2.10	0.96E-04	0.48E-04	-50.0	0.96E-04	2.10	1.88	-10.8
2.21	0.73E-04	0.30E-04	-59.4	0.73E-04	2.21	2.01	-9.3
2.32	0.55E-04	0.00E+00	-100.0	0.55E-04	2.32	2.08	-10.7
2.43	0.39E-04	0.00E+00	-100.0	0.39E-04	2.43	2.17	-10.8
2.55	0.30E-04	0.00E+00	-100.0	0.30E-04	2.55	2.22	-12.7
2.66	0.30E-04	0.00E+00	-100.0	0.30E-04	2.66	2.22	-16.4
2.77	0.23E-04	0.00E+00	-100.0	0.23E-04	2.77	2.25	-18.7
2.88	0.16E-04	0.00E+00	-100.0	0.16E-04	2.88	2.27	-21.1
2.99	0.16E-04	0.00E+00	-100.0	0.16E-04	2.99	2.27	-24.0
3.10	0.14E-04	0.00E+00	-100.0	0.14E-04	3.10	2.27	-26.6
3.21	0.14E-04	0.00E+00	-100.0	0.14E-04	3.21	2.27	-29.1
3.32	0.14E-04	0.00E+00	-100.0	0.14E-04	3.32	2.27	-31.5
3.43	0.91E-05	0.00E+00	-100.0	0.91E-05	3.43	2.28	-33.5
3.54	0.91E-05	0.00E+00	-100.0	0.91E-05	3.54	2.28	-35.6
3.65	0.91E-05	0.00E+00	-100.0	0.91E-05	3.65	2.28	-37.5
3.76	0.46E-05	0.00E+00	-100.0	0.46E-05	3.76	2.30	-38.7
3.87	0.46E-05	0.00E+00	-100.0	0.46E-05	3.87	2.30	-40.5
3.98	0.23E-05	0.00E+00	-100.0	0.23E-05	3.98	2.32	-41.8
4.09	0.23E-05	0.00E+00	-100.0	0.23E-05	4.09	2.32	-43.3
4.20	0.23E-05	0.00E+00	-100.0	0.23E-05	4.20	2.32	-44.8
4.31	0.23E-05	0.00E+00	-100.0	0.23E-05	4.31	2.32	-46.2

There is no positive excursion

Maximum negative excursion = 1.99 cfs (-46.2%)
occuring at 4.31 cfs on the Base Data:sds4pre.tsf
and at 2.32 cfs on the New Data:sds4_o.tsf

SDS7

SDS7


COMBINED 10-75-15 ONSITE AND 1994 OFFSITE
TARGET FLOW RANGE: 1.440 to 7.953 cfs
Flow [cfs]
8
7
6
5
4
3
2
1
0
0.0001
0.001
0.01
0.1
1
10
100
% Time Exceeded
Predeveloped
Project condition (level 2)

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SIMULATED FLOW @ SDS-7

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

46 non-zero values in data

3.633	8.587	5.187	2.416	2.500
2.872	3.801	3.803	2.931	2.450
2.399	3.336	3.001	1.946	2.915
3.424	2.498	2.820	4.711	3.424
2.690	2.771	2.432	6.006	2.643
2.588	3.427	2.176	2.068	2.971
2.542	3.042	2.991	2.562	2.611
3.129	1.906	4.905	3.430	1.577
1.683	8.035	6.483	2.619	1.928
1.444	2.791	6.299		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.482
Variance (logs)	0.029
Standard Deviation (logs)	0.170
Skewness (logs)	0.803
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.187
Coefficient of Variation (logs)	0.354

1

PREDEV SIMULATED FLOW @ SDS-7

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	1.538
0.9500	1.05	1.760
0.9000	1.11	1.920
0.8000	1.25	2.168
0.5000	2.00	2.880
0.2000	5.00	4.121
0.1000	10.00	5.128
0.0400	25.00	6.638
0.0200	50.00	7.953
0.0100	100.00	9.447
0.0050	200.00	11.150

$1/2\,Q_2 = 1.440$
$Q_{50} = 7.953$

```
Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1966)
   Note -- Use of Log-Pearson Type III or Pearson-Type III
           distributions are for preliminary computations.
           User is responsible for assessment and
           interpretation.


2006 SIMULATED FLOW @ SDS-7


Analysis for --  12 month period
                  starting October 1
                  ending   September 30
                  1949-1996


Parameter is  1-day high value.

   0 zero values in data

  48 non-zero values in data
          1.156       1.540       6.504       1.023       1.159
          1.272       1.352       1.543       1.275       1.358
          1.160       2.359       1.295       0.865       1.319
          1.280       1.503       1.184       1.340       1.207
          1.176       1.261       1.328       3.671       1.438
          1.381       1.233       1.275       0.856       1.310
          0.900       3.503       1.197       1.378       1.350
          1.017       0.962       1.709       2.119       1.076
          0.886       3.264       4.067       1.379       1.103
          0.854       1.424       7.379


The following 7 statistics are based on non-zero values.

Mean (logs)                                       0.167
Variance (logs)                                   0.044
Standard Deviation (logs)                         0.210
Skewness (logs)                                   1.877
Standard Error of Skewness (logs)                 0.343
Serial Correlation Coefficient (logs)             0.001
Coefficient of Variation (logs)                   1.261
1
2006 SIMULATED FLOW @ SDS-7

        Exceedence        Recurrence        Parameter
        Probability        Interval           Value
        -----------       ----------        ---------
             0.9900             1.01            0.883
             0.9500             1.05            0.908
             0.9000             1.11            0.938
             0.8000             1.25            1.001
             0.5000             2.00            1.275
             0.2000             5.00            1.993
             0.1000            10.00            2.773
             0.0400            25.00            4.271
             0.0200            50.00            5.908
             0.0100           100.00            8.162
             0.0050           200.00           11.266
```

SDS7 - Percent cases equal or exceeding limit

Predeveloped	Project condition (level 2)	Flow [cfs]
100	100	0
50.6272	78.1148	0
48.9241	77.0508	0
47.0704	75.8691	0
45.0196	74.4241	0
43.1896	73.079	0
41.1956	71.5085	0
39.3359	69.9564	0.01
37.2659	68.1551	0.01
35.2852	66.3247	0.01
33.0617	64.1855	0.01
30.7542	61.9108	0.02
28.4805	59.6215	0.02
26.3231	57.3207	0.03
23.7528	54.4041	0.04
21.36	51.5106	0.05
18.8524	48.3136	0.06
16.2983	44.7681	0.08
13.6724	40.7481	0.11
11.5817	37.2148	0.14
9.12807	32.4533	0.19
7.06993	28.0903	0.25
5.41177	24.1946	0.32
3.72533	19.5143	0.43
2.47595	14.69	0.56
1.49108	7.37247	0.74
0.83062	3.46224	0.97
0.41923	0.77905	1.3
0.2089	0.14569	1.7
0.10861	0.09269	2.2
0.04753	0.03327	2.9
0.01545	0.01069	3.9
0.00428	0.00428	5.1
0.00119	0.00048	6.7
0	0	8.8

1

Simulated - PREDEV SIMULATED FLOW @ SDS-7
Observed - 2006 SIMULATED FLOW @ SDS-7

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	92086	0.000	*	0.000	*	0.000	*
0.00	4477	0.001	100.5	0.001	104.4	-0.001	-96.7
0.00	4972	0.002	102.4	0.002	111.3	-0.001	-93.4
0.00	6080	0.002	102.2	0.002	111.2	-0.002	-93.2
0.00	5660	0.003	102.4	0.003	112.1	-0.002	-92.6
0.00	6608	0.004	102.0	0.004	110.8	-0.003	-92.3
0.00	6531	0.005	101.7	0.005	110.5	-0.004	-91.9
0.01	7579	0.006	102.7	0.007	114.2	-0.005	-89.5
0.01	7702	0.008	103.0	0.009	115.9	-0.007	-88.2
0.01	9001	0.011	102.8	0.012	116.4	-0.009	-87.4
0.01	9571	0.014	102.6	0.016	115.4	-0.012	-87.3
0.02	9633	0.019	103.2	0.022	116.6	-0.016	-84.8
0.02	9681	0.024	101.9	0.027	114.6	-0.020	-84.9
0.03	12272	0.032	100.8	0.035	112.7	-0.026	-83.6
0.04	12175	0.041	100.3	0.046	111.4	-0.034	-82.4
0.05	13452	0.054	99.5	0.060	110.1	-0.044	-81.4
0.06	14918	0.069	96.6	0.076	105.5	-0.058	-80.5
0.08	16915	0.091	95.4	0.099	103.5	-0.076	-79.7
0.11	14867	0.117	94.1	0.127	101.8	-0.097	-77.9
0.14	20035	0.148	90.5	0.159	96.6	-0.126	-77.1
0.19	18358	0.191	87.6	0.202	92.7	-0.167	-76.3
0.25	16392	0.241	84.9	0.253	88.9	-0.214	-75.3
0.32	19693	0.304	81.8	0.319	85.6	-0.277	-74.6
0.43	20299	0.401	79.7	0.421	83.4	-0.371	-73.6
0.56	30790	0.493	77.2	0.521	81.4	-0.455	-71.3
0.74	16453	0.619	74.0	0.660	78.6	-0.562	-67.2
0.97	11290	0.775	69.8	0.834	74.9	-0.696	-62.8
1.30	2665	0.898	63.8	0.993	70.4	-0.751	-53.6
1.70	223	1.169	58.9	1.275	63.9	-0.956	-48.4
2.20	250	1.299	53.3	1.379	56.7	-1.060	-43.6
2.90	95	1.298	39.3	1.411	42.8	-1.096	-33.0
3.90	27	1.361	31.7	1.464	33.8	-1.280	-29.7
5.10	16	2.067	35.6	2.203	37.9	-2.067	-35.6
6.70	2	3.041	42.6	3.041	42.7	-3.041	-42.6
8.80	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.163	*	0.291	*	-0.146	*

Standard error of estimate = 0.25
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SIMULATED FLOW @ SDS-7
Observed - 2006 SIMULATED FLOW @ SDS-7

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	*****	92086	49.37	21.89	100.00	100.00	0.00	0.00
0.00	7166	4477	1.70	1.06	50.63	78.11	0.00	0.00
0.00	7800	4972	1.85	1.18	48.92	77.05	0.00	0.00
0.00	8629	6080	2.05	1.44	47.07	75.87	0.00	0.00
0.00	7700	5660	1.83	1.35	45.02	74.42	0.00	0.00
0.00	8390	6608	1.99	1.57	43.19	73.08	0.00	0.00
0.00	7825	6531	1.86	1.55	41.20	71.51	0.00	0.00
0.01	8710	7579	2.07	1.80	39.34	69.96	0.01	0.01
0.01	8334	7702	1.98	1.83	37.27	68.16	0.01	0.01
0.01	9356	9001	2.22	2.14	35.29	66.32	0.01	0.01
0.01	9709	9571	2.31	2.27	33.06	64.19	0.01	0.01
0.02	9567	9633	2.27	2.29	30.75	61.91	0.02	0.02
0.02	9078	9681	2.16	2.30	28.48	59.62	0.02	0.02
0.03	10815	12272	2.57	2.92	26.32	57.32	0.03	0.03
0.04	10068	12175	2.39	2.89	23.75	54.40	0.04	0.04
0.05	10551	13452	2.51	3.20	21.36	51.51	0.05	0.05
0.06	10747	14918	2.55	3.55	18.85	48.31	0.07	0.07
0.08	11049	16915	2.63	4.02	16.30	44.77	0.10	0.10
0.11	8797	14867	2.09	3.53	13.67	40.75	0.12	0.12
0.14	10324	20035	2.45	4.76	11.58	37.21	0.16	0.16
0.19	8660	18358	2.06	4.36	9.13	32.45	0.22	0.22
0.25	6977	16392	1.66	3.90	7.07	28.09	0.28	0.28
0.32	7096	19693	1.69	4.68	5.41	24.19	0.37	0.37
0.43	5257	20299	1.25	4.82	3.73	19.51	0.49	0.50
0.56	4144	30790	0.98	7.32	2.48	14.69	0.64	0.64
0.74	2779	16453	0.66	3.91	1.49	7.37	0.84	0.84
0.97	1731	11290	0.41	2.68	0.83	3.46	1.11	1.11
1.30	885	2665	0.21	0.63	0.42	0.78	1.47	1.41
1.70	422	223	0.10	0.05	0.21	0.15	1.91	1.98
2.20	257	250	0.06	0.06	0.11	0.09	2.50	2.45
2.90	135	95	0.03	0.02	0.05	0.03	3.31	3.32
3.90	47	27	0.01	0.01	0.02	0.01	4.38	4.27
5.10	13	16	0.00	0.00	0.00	0.00	5.69	5.81
6.70	5	2	0.00	0.00	0.00	0.00	7.80	7.14
8.80	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768420768		100.00	100.00			0.06	0.21

6831 Observed values are zero
96528 Simulated values are zero
6831 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
89697 Observed values are not zero when simulated are

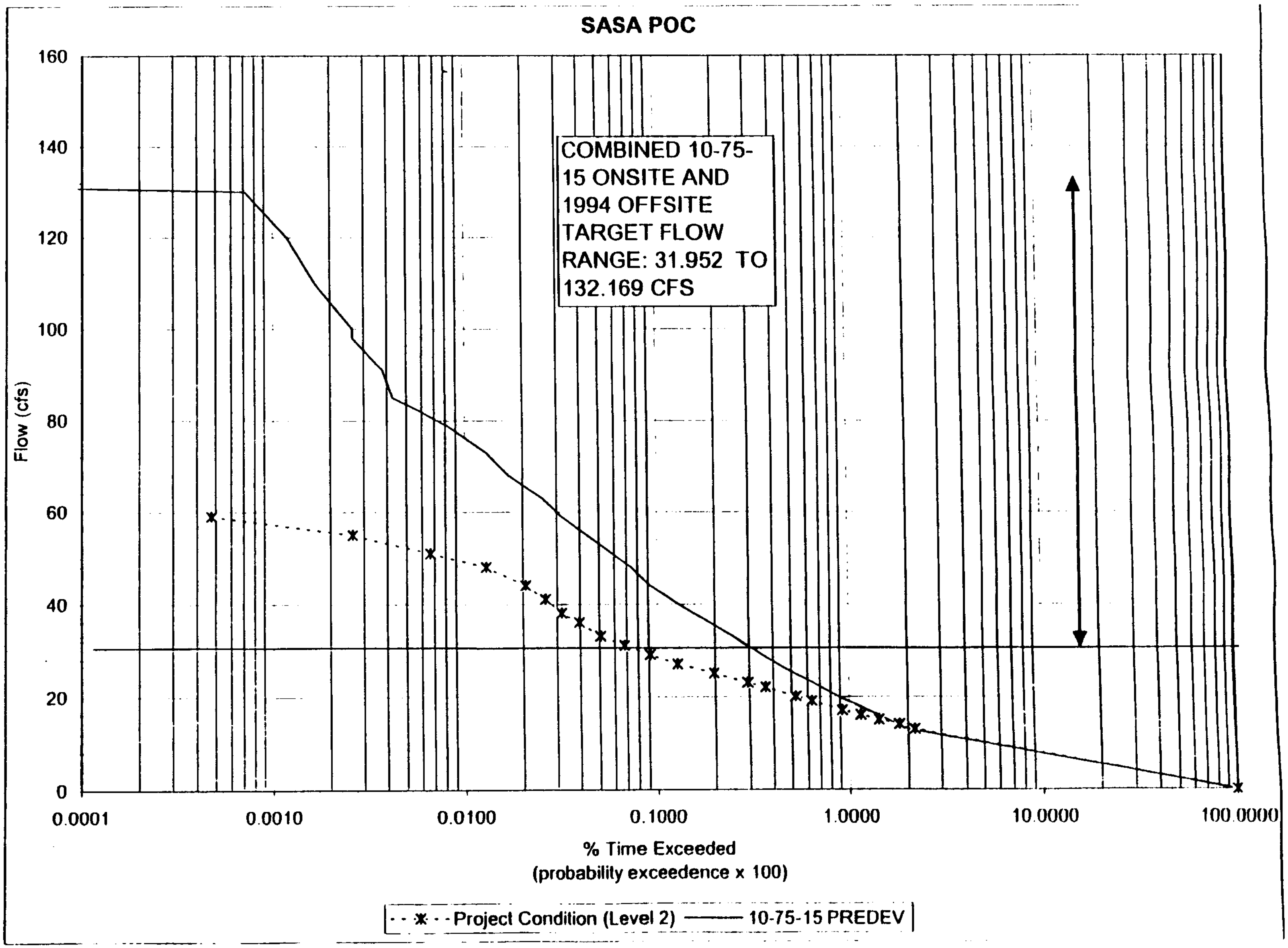
1

Simulated - PREDEV SIMULATED FLOW @ SDS-7
Observed - 2006 SIMULATED FLOW @ SDS-7

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	87662	12	7	4260	3	5	137	0
0.00	4434	9	2	1	1	4	26	0
0.00	4891	9	5	7	2	7	51	0
0.00	5973	20	14	5	2	3	63	0
0.00	5552	32	7	0	3	1	65	0
0.00	6464	39	10	2	3	6	84	0
0.00	6399	21	8	7	3	7	86	0
0.01	7374	27	17	5	7	13	136	0

0.01	7477	33	16	5	8	11	152	0
0.01	8700	56	26	10	7	15	187	0
0.01	9249	61	25	11	13	9	203	0
0.02	9227	73	35	12	7	21	258	0
0.02	9240	98	43	13	10	17	260	0
0.03	11587	158	61	21	18	57	370	0
0.04	11430	157	76	29	18	49	416	0
0.05	12546	199	88	38	39	52	490	0
0.06	13675	350	125	63	54	93	558	0
0.08	15418	407	171	70	58	124	667	0
0.11	13380	421	162	73	79	93	659	0
0.14	17667	785	321	105	111	177	869	0
0.19	15972	880	325	134	110	175	762	0
0.25	14014	884	366	127	143	173	685	0
0.32	16550	1436	487	189	148	235	648	0
0.43	16511	1906	618	212	162	263	627	0
0.56	24416	3308	1076	345	302	427	916	0
0.74	12312	2352	661	197	161	234	536	0
0.97	7847	1920	625	196	116	198	388	0
1.30	1587	657	160	58	37	46	120	0
1.70	126	56	17	3	1	8	12	0
2.20	69	143	11	3	3	4	17	0
2.90	14	58	12	2	4	1	4	0
3.90	0	15	9	2	0	1	0	0
5.10	0	12	3	1	0	0	0	0
6.70	0	2	0	0	0	0	0	0
8.80	0	0	0	0	0	0	0	0
	377763	16596	5589	6206	1633	2529	10452	0

SASA


SASA POC
160
140
120
100
80
60
40
20
0
Flow (cfs)
COMBINED 10-75-15 ONSITE AND 1994 OFFSITE TARGET FLOW RANGE: 31.952 TO 132.169 CFS
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
100.0000
% Time Exceeded
(probability exceedence x 100)
Project Condition (Level 2)
10-75-15 PREDEV

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

STIA FLOW PREDEV SD34 SDS1 SASA

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

73.632	135.722	84.919	51.285	53.338
62.586	71.288	67.897	70.916	61.171
47.655	64.416	59.859	50.581	56.395
70.826	56.892	59.352	83.054	84.648
55.287	60.174	52.688	101.459	55.615
55.186	75.445	52.450	56.742	76.187
64.717	72.045	74.751	110.667	67.736
60.880	51.160	83.737	79.136	40.694
44.999	136.619	119.201	59.882	36.964
40.195	55.036	100.612		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.819
Variance (logs)	0.016
Standard Deviation (logs)	0.128
Skewness (logs)	0.624
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.210
Coefficient of Variation (logs)	0.070

1

STIA FLOW PREDEV SD34 SDS1 SASA

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	38.122
0.9500	1.05	43.038
0.9000	1.11	46.360
0.8000	1.25	51.214
0.5000	2.00	63.904
0.2000	5.00	83.254
0.1000	10.00	97.345
0.0400	25.00	116.654
0.0200	50.00	132.169
0.0100	100.00	148.687
0.0050	200.00	166.367

$\frac{1}{2}Q_2$ = 31.952
Q_{50} = 132.169

:

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

STIA FLOW SDE4/SDS1/SASA INTO E.BRANCH

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

27.039	29.179	59.112	21.741	23.364
23.110	36.235	27.551	29.154	27.556
25.123	47.716	26.062	18.846	25.436
23.531	27.889	21.173	31.730	23.799
26.255	24.636	25.661	38.612	24.308
21.864	32.190	24.410	20.050	25.865
20.499	37.410	23.981	54.795	28.337
22.778	26.038	49.952	50.531	22.894
18.201	59.943	56.266	24.205	24.265
17.888	27.699	53.919		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.457
Variance (logs)	0.020
Standard Deviation (logs)	0.143
Skewness (logs)	1.026
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.012
Coefficient of Variation (logs)	0.098

1

STIA FLOW SDE4/SDS1/SASA INTO E.BRANCH

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	17.112
0.9500	1.05	18.656
0.9000	1.11	19.826
0.8000	1.25	21.677
0.5000	2.00	27.129
0.2000	5.00	36.734
0.1000	10.00	44.536
0.0400	25.00	56.203
0.0200	50.00	66.335
0.0100	100.00	77.821
0.0050	200.00	90.876

$\frac{1}{2}Q_2 = 13.565$
$Q_{50} = 66.335$

AR 046803

1

Simulated - STIA FLOW PREDEV SD34 SDS1 SASA
Observed - STIA FLOW SDE4/SDS1/SASA INTO E.BRANCH

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	411654	0.715	1375.6	1.671	2943.0	-0.335	1318.2
13.00	1457	6.547	48.2	6.081	59.5	-0.886	-6.5
14.00	1669	7.503	51.8	9.430	65.1	-0.889	-6.1
15.00	1185	8.172	52.8	10.128	65.4	-0.678	-4.3
16.00	916	8.789	53.3	11.156	67.7	-0.331	-2.0
17.00	1227	9.342	52.0	11.661	64.9	-0.956	-5.3
19.00	451	10.948	56.2	13.697	70.3	-1.190	-6.1
20.00	680	11.012	52.6	13.780	65.8	-1.981	-9.4
22.00	287	12.095	53.8	14.798	65.8	-1.928	-8.5
23.00	413	12.614	52.7	16.280	68.0	-1.692	-7.1
25.00	287	13.240	51.1	16.843	65.0	-2.168	-8.4
27.00	156	13.696	49.2	17.147	61.6	-0.667	-2.3
29.00	99	15.105	50.7	20.798	69.9	-0.370	-1.2
31.00	73	15.687	49.2	20.546	64.2	-0.417	-1.2
33.00	47	17.097	49.8	20.117	58.7	-3.787	-10.9
36.00	33	18.018	48.9	25.069	68.1	0.368	1.0
38.00	24	18.379	46.6	22.382	56.6	-5.943	-15.3
41.00	23	17.633	41.7	21.667	51.6	-4.900	-11.5
44.00	33	22.229	48.1	27.363	59.1	-0.508	-1.4
48.00	26	12.108	24.4	14.423	29.1	-3.763	-7.6
51.00	17	17.828	33.6	21.259	40.0	-0.704	-1.5
55.00	9	16.703	29.8	24.643	43.8	4.808	8.5
59.00	2	6.419	10.8	6.859	11.6	6.419	10.8
63.00	0	0.000	0.0	0.000	0.0	0.000	0.0
68.00	0	0.000	0.0	0.000	0.0	0.000	0.0
73.00	0	0.000	0.0	0.000	0.0	0.000	0.0
79.00	0	0.000	0.0	0.000	0.0	0.000	0.0
85.00	0	0.000	0.0	0.000	0.0	0.000	0.0
91.00	0	0.000	0.0	0.000	0.0	0.000	0.0
98.00	0	0.000	0.0	0.000	0.0	0.000	0.0
100.00	0	0.000	0.0	0.000	0.0	0.000	0.0
110.00	0	0.000	0.0	0.000	0.0	0.000	0.0
120.00	0	0.000	0.0	0.000	0.0	0.000	0.0
130.00	0	0.000	0.0	0.000	0.0	0.000	0.0
140.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.901	1346.9	2.432	2911.0	-0.350	1289.5

Standard error of estimate = 2.41
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - STIA FLOW PREDEV SD34 SDS1 SASA
Observed - STIA FLOW SDE4/SDS1/SASA INTO E.BRANCH

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	*****	*****	97.97	97.83	100.00	100.00	0.78	1.20
13.00	1020	1457	0.24	0.35	2.03	2.17	13.48	13.57
14.00	870	1669	0.21	0.40	1.78	1.82	14.50	14.47
15.00	737	1185	0.18	0.28	1.58	1.42	15.48	15.49
16.00	688	916	0.16	0.22	1.40	1.14	16.47	16.49
17.00	1050	1227	0.25	0.29	1.24	0.92	17.91	17.95
19.00	451	451	0.11	0.11	0.99	0.63	19.49	19.48
20.00	723	680	0.17	0.16	0.88	0.52	20.94	20.91
22.00	299	287	0.07	0.07	0.71	0.36	22.47	22.51
23.00	522	413	0.12	0.10	0.64	0.30	23.92	23.94
25.00	389	287	0.09	0.07	0.52	0.20	25.92	25.94
27.00	315	156	0.07	0.04	0.42	0.13	27.98	27.81
29.00	231	99	0.05	0.02	0.35	0.09	30.03	29.83
31.00	188	73	0.04	0.02	0.29	0.07	32.03	31.90
33.00	259	47	0.06	0.01	0.25	0.05	34.39	34.32
36.00	133	33	0.03	0.01	0.19	0.04	36.94	36.86
38.00	152	24	0.04	0.01	0.16	0.03	39.43	39.29
41.00	117	23	0.03	0.01	0.12	0.03	42.39	42.33
44.00	74	33	0.02	0.01	0.09	0.02	45.84	46.33
48.00	66	26	0.02	0.01	0.07	0.01	49.46	49.40
51.00	62	17	0.01	0.00	0.06	0.01	52.53	53.24
55.00	50	9	0.01	0.00	0.04	0.00	56.74	56.21
59.00	28	2	0.01	0.00	0.03	0.00	60.82	59.53
63.00	35	0	0.01	0.00	0.03	0.00	65.36	0.00
68.00	17	0	0.00	0.00	0.02	0.00	70.74	0.00
73.00	20	0	0.00	0.00	0.01	0.00	76.32	0.00
79.00	16	0	0.00	0.00	0.01	0.00	81.55	0.00
85.00	2	0	0.00	0.00	0.00	0.00	88.22	0.00
91.00	5	0	0.00	0.00	0.00	0.00	94.00	0.00
98.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
100.00	4	0	0.00	0.00	0.00	0.00	103.54	0.00
110.00	2	0	0.00	0.00	0.00	0.00	114.93	0.00
120.00	2	0	0.00	0.00	0.00	0.00	123.83	0.00
130.00	3	0	0.00	0.00	0.00	0.00	134.47	0.00
140.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768	420768	100.00	100.00			1.22	1.57

1

Simulated - STIA FLOW PREDEV SD34 SDS1 SASA
Observed - STIA FLOW SDE4/SDS1/SASA INTO E.BRANCH

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	94991	83137	31739	13618	12647	18079	157443	0
13.00	245	386	175	81	76	146	348	0
14.00	308	462	170	99	93	127	410	0
15.00	209	338	135	65	64	72	302	0
16.00	155	259	105	43	40	69	245	0
17.00	226	339	139	71	54	97	301	0
19.00	93	131	54	17	16	34	106	0
20.00	130	219	61	36	27	58	149	0
22.00	50	102	32	8	13	13	69	0
23.00	64	146	45	25	12	29	92	0
25.00	37	116	31	12	9	16	66	0
27.00	19	52	20	8	4	17	36	0
29.00	14	31	13	5	3	10	23	0
31.00	7	29	7	4	1	8	17	0
33.00	8	21	1	2	3	1	11	0
36.00	4	9	6	2	3	1	8	0
38.00	2	13	1	3	0	1	4	0

41.00	4	7	2	0	3	4	3	0
44.00	2	13	4	2	0	5	1	0
48.00	1	7	4	2	5	5	2	0
51.00	0	5	4	1	2	1	4	0
55.00	0	1	2	1	2	1	2	0
59.00	0	0	0	0	1	1	0	0
63.00	0	0	0	0	0	0	0	0
68.00	0	0	0	0	0	0	0	0
73.00	0	0	0	0	0	0	0	0
79.00	0	0	0	0	0	0	0	0
85.00	0	0	0	0	0	0	0	0
91.00	0	0	0	0	0	0	0	0
98.00	0	0	0	0	0	0	0	0
100.00	0	0	0	0	0	0	0	0
110.00	0	0	0	0	0	0	0	0
120.00	0	0	0	0	0	0	0	0
130.00	0	0	0	0	0	0	0	0
140.00	0	0	0	0	0	0	0	0
	96569	85823	32750	14105	13078	18795	159648	0

Retention/Detention Facility SASA

KCRTS DATA USED IN HSPF MODEL FOR SASA RETROFIT INCLUDING INLINE TRIBUTARY AREA

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	484.77	ft
Pond Bottom Width:	242.38	ft
Pond Bottom Area:	117500.	sq. ft
Top Area at 1 ft. FB:	191044.	sq. ft
	4.386	acres
Effective Storage Depth:	14.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	2105493.	cu. ft
	48.335	ac-ft
Riser Head:	14.00	ft
Riser Diameter:	48.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	21.00	44.746	
2	6.50	12.00	10.694	15.0

Top Notch Weir:	Rectangular	
Length:	36.00	in
Weir Height:	9.00	ft
Outflow Rating Curve:	None	

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	0.00	0.	0.000	0.000	0.00	117500.
0.22	0.22	25956.	0.596	5.590	0.00	118462.
0.44	0.44	52123.	1.197	7.910	0.00	119427.
0.66	0.66	78504.	1.802	9.690	0.00	120395.
0.88	0.88	105097.	2.413	11.190	0.00	121367.
1.09	1.09	130682.	3.000	12.510	0.00	122298.
1.31	1.31	157696.	3.620	13.700	0.00	123277.
1.53	1.53	184925.	4.245	14.800	0.00	124260.
1.75	1.75	212370.	4.875	15.820	0.00	125245.
2.02	2.02	246350.	5.655	17.020	0.00	126460.
2.30	2.30	281936.	6.472	18.140	0.00	127725.
2.57	2.57	316587.	7.268	19.190	0.00	128950.
2.85	2.85	352872.	8.101	20.190	0.00	130227.
3.12	3.12	388200.	8.912	21.140	0.00	131463.
3.40	3.40	425189.	9.761	22.050	0.00	132750.
3.67	3.67	461200.	10.588	22.920	0.00	133997.
3.95	3.95	498901.	11.453	23.760	0.00	135295.
4.22	4.22	535600.	12.296	24.570	0.00	136553.
4.50	4.50	574018.	13.178	25.360	0.00	137862.
4.77	4.77	611412.	14.036	26.120	0.00	139130.
5.04	5.04	649149.	14.902	26.870	0.00	140404.
5.32	5.32	688647.	15.809	27.590	0.00	141730.
5.59	5.59	727088.	16.692	28.290	0.00	143014.
5.87	5.87	767318.	17.615	28.980	0.00	144351.
6.14	6.14	806468.	18.514	29.650	0.00	145645.
6.42	6.42	847437.	19.454	30.300	0.00	146994.

6.50	6.50	859212.	19.725	30.500	0.00	147380.
6.63	6.63	878412.	20.166	30.850	0.00	148009.
6.75	6.75	896208.	20.574	31.310	0.00	148590.
6.88	6.88	915566.	21.018	31.870	0.00	149221.
7.00	7.00	933507.	21.430	32.530	0.00	149804.
7.13	7.13	953023.	21.878	33.260	0.00	150438.
7.25	7.25	971111.	22.294	35.590	0.00	151023.
7.38	7.38	990785.	22.745	36.140	0.00	151659.
7.50	7.50	1009019.	23.164	36.660	0.00	152247.
7.77	7.77	1050305.	24.112	37.760	0.00	153573.
8.05	8.05	1093499.	25.103	38.800	0.00	154954.
8.32	8.32	1135517.	26.068	39.790	0.00	156291.
8.60	8.60	1179473.	27.077	40.730	0.00	157684.
8.87	8.87	1222230.	28.059	41.650	0.00	159031.
9.00	9.00	1242946.	28.534	42.060	0.00	159682.
9.27	9.27	1286243.	29.528	44.320	0.00	161038.
9.55	9.55	1331531.	30.568	47.660	0.00	162449.
9.82	9.82	1375577.	31.579	51.620	0.00	163815.
10.10	10.10	1421644.	32.636	56.040	0.00	165238.
10.37	10.37	1466444.	33.665	60.810	0.00	166615.
10.65	10.65	1513297.	34.741	65.860	0.00	168048.
10.92	10.92	1558857.	35.786	71.120	0.00	169436.
11.20	11.20	1606501.	36.880	76.550	0.00	170880.
11.47	11.47	1652827.	37.944	82.110	0.00	172279.
11.75	11.75	1701269.	39.056	87.750	0.00	173734.
12.02	12.02	1748368.	40.137	93.450	0.00	175144.
12.29	12.29	1795847.	41.227	99.160	0.00	176558.
12.57	12.57	1845489.	42.367	104.870	0.00	178030.
12.84	12.84	1893750.	43.475	110.550	0.00	179455.
13.12	13.12	1944204.	44.633	116.170	0.00	180938.
13.39	13.39	1993252.	45.759	121.700	0.00	182374.
13.67	13.67	2044525.	46.936	127.130	0.00	183868.
13.94	13.94	2094365.	48.080	132.430	0.00	185315.
14.00	14.00	2105493.	48.335	133.540	0.00	185637.
14.10	14.10	2124084.	48.762	135.000	0.00	186174.
14.20	14.20	2142728.	49.190	137.490	0.00	186712.
14.30	14.30	2161427.	49.620	140.630	0.00	187251.
14.40	14.40	2180178.	50.050	144.310	0.00	187791.
14.50	14.50	2198985.	50.482	148.460	0.00	188331.
14.60	14.60	2217845.	50.915	153.020	0.00	188872.
14.70	14.70	2236759.	51.349	157.950	0.00	189414.
14.80	14.80	2255728.	51.784	163.230	0.00	189957.
14.90	14.90	2274750.	52.221	168.840	0.00	190500.
15.00	15.00	2293828.	52.659	174.760	0.00	191044.
15.10	15.10	2312959.	53.098	180.970	0.00	191588.
15.20	15.20	2332145.	53.539	187.450	0.00	192134.
15.30	15.30	2351386.	53.980	194.210	0.00	192680.
15.40	15.40	2370681.	54.423	201.210	0.00	193227.
15.50	15.50	2390031.	54.868	208.470	0.00	193774.
15.60	15.60	2409436.	55.313	213.660	0.00	194322.
15.70	15.70	2428896.	55.760	216.230	0.00	194871.
15.80	15.80	2448410.	56.208	218.730	0.00	195421.
15.90	15.90	2467980.	56.657	221.170	0.00	195971.

Hyd	Inflow	Outflow		Peak		Storage	
		Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	184.48	*******	128.47	13.74	13.74	2057151.	47.226

DES MOINES CREEK WATERSHED
ADDITIONAL POINTS OF COMPLIANCE PERFORMANCE DATA

- **SDS POC-1**
- **SDS POC-2**
- **SASA INLINE FACILITY ANALYSIS**
- **SOUTH 200TH STREET**

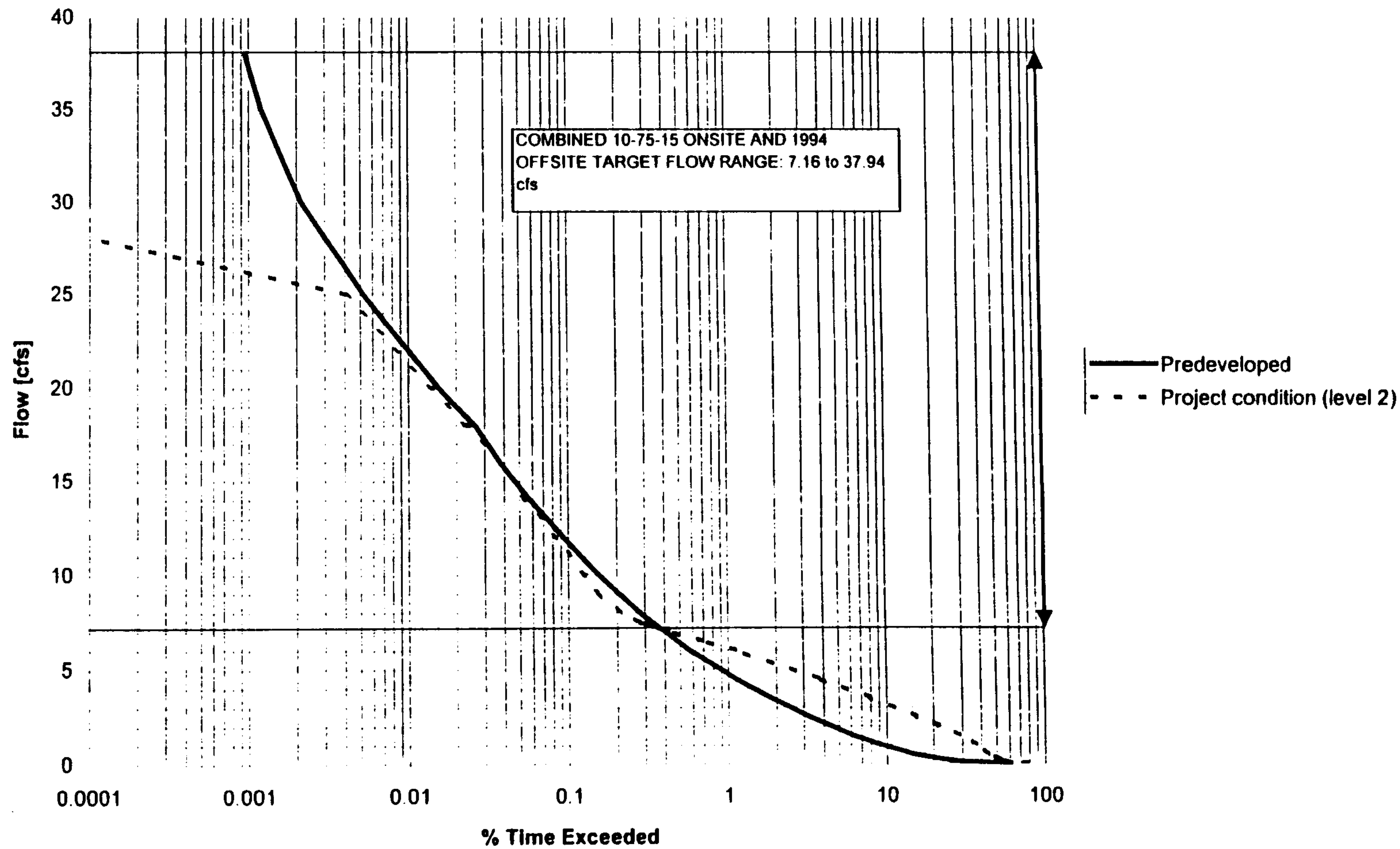
July 2001
556-2912-001 (28)

SDS POC-1

July 2001
556-2912-001 (28)

AR 046810

SDS POC-1



40
35
30
25
20
15
10
5
0
Flow [cfs]
0.0001
0.001
0.01
0.1
1
10
100
% Time Exceeded
COMBINED 10-75-15 ONSITE AND 1994
OFFSITE TARGET FLOW RANGE: 7.16 to 37.94
cfs
Predeveloped
Project condition (level 2)

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III
distributions are for preliminary computations.
User is responsible for assessment and
interpretation.

PREDEV SDS POC-1 (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

18.765	37.704	26.767	12.075	12.852
13.810	19.464	18.045	14.404	12.938
10.946	16.067	14.014	9.464	13.085
17.860	12.157	13.746	23.709	15.884
13.804	14.807	12.211	27.283	13.772
12.237	15.963	11.295	10.664	15.058
11.511	16.125	14.966	13.554	13.079
13.979	10.336	24.189	18.052	8.459
8.069	39.666	31.663	13.153	9.467
7.434	14.051	30.988		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.177
Variance (logs)	0.027
Standard Deviation (logs)	0.164
Skewness (logs)	0.790
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.195
Coefficient of Variation (logs)	0.139

1

PREDEV SDS POC (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	7.795
0.9500	1.05	8.890
0.9000	1.11	9.677
0.8000	1.25	10.885
0.5000	2.00	14.320
0.2000	5.00	20.205
0.1000	10.00	24.920
0.0400	25.00	31.910
0.0200	50.00	37.936
0.0100	100.00	44.728
0.0050	200.00	52.403

$1/2\ Q_2 = 7.16$

$Q_{50} = 37.94$

:

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

2006 SDS POC-1 (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

7.883	11.281	29.424	6.231	6.954
7.382	12.771	11.446	8.160	8.063
6.996	17.973	7.857	5.417	7.747
7.335	10.338	7.149	11.515	7.153
7.287	7.022	8.025	24.787	7.947
7.432	11.081	7.296	5.669	7.224
5.470	19.700	7.058	7.148	9.127
6.048	6.676	15.298	19.045	6.512
5.616	29.632	23.650	7.164	6.744
5.053	9.574	29.178		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.968
Variance (logs)	0.044
Standard Deviation (logs)	0.211
Skewness (logs)	1.221
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.020
Coefficient of Variation (logs)	0.218

1

2006 SDS POC (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	4.631
0.9500	1.05	5.103
0.9000	1.11	5.499
0.8000	1.25	6.176
0.5000	2.00	8.444
0.2000	5.00	13.251
0.1000	10.00	17.822
0.0400	25.00	25.672
0.0200	50.00	33.413
0.0100	100.00	43.168
0.0050	200.00	55.458

POC - 1 - Percent cases equal or exceeding limit

Predeveloped	Project condition (level 2)	Flow [cfs]
100	100	0
60.33	77.7497	0.01
29.1046	56.9832	0.1
23.0621	51.9032	0.2
14.8462	44.0518	0.5
9.10407	37.0149	1
6.16563	28.6944	1.5
4.40718	21.4166	2
3.24882	15.5863	2.5
1.84306	7.90792	3.5
1.11487	3.69586	4.5
0.57348	1.10964	6
0.48103	0.68327	6.5
0.39951	0.42137	7
0.38667	0.38644	7.1
0.37099	0.35554	7.2
0.35697	0.32464	7.3
0.3458	0.29779	7.4
0.33177	0.27379	7.5
0.27901	0.21033	8
0.20558	0.15686	9
0.15591	0.12786	10
0.09364	0.08508	12
0.05775	0.05442	14
0.03755	0.03874	16
0.02614	0.02305	18
0.01545	0.01402	20
0.00523	0.00404	25
0.00214	0.00001	30
0.00119	0	35
0.00095	0	38
0	0	40
0	0	42
0	0	45
0	0	48

1

Simulated - PREDEV SDS POC-1 (PREDEV)
Observed - 2006 SDS POC-1 (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	93622	0.000	*	0.000	*	0.000	*
0.00	87379	0.026	96.6	0.038	97.5	-0.025	-93.1
0.10	21375	0.139	95.4	0.144	97.1	-0.128	-88.2
0.20	33036	0.309	93.4	0.325	95.4	-0.283	-85.6
0.50	29609	0.661	90.5	0.691	92.7	-0.611	-83.5
1.00	35010	1.106	89.3	1.133	91.0	-1.065	-86.0
1.50	30623	1.489	85.2	1.534	87.5	-1.431	-81.8
2.00	24532	1.796	80.5	1.861	83.2	-1.727	-77.4
2.50	32308	2.235	75.9	2.341	79.2	-2.141	-72.7
3.50	17723	2.694	68.4	2.857	72.5	-2.536	-64.5
4.50	10882	2.984	58.6	3.228	63.4	-2.675	-52.6
6.00	1794	3.026	48.6	3.371	54.2	-2.504	-40.2
6.50	1102	2.953	43.9	3.389	50.4	-2.080	-31.0
7.00	147	2.747	39.0	3.240	46.0	-1.429	-20.3
7.10	130	3.251	45.5	3.760	52.6	-1.570	-22.0
7.20	130	3.177	43.8	3.640	50.2	-1.653	-22.8
7.30	113	2.704	36.8	3.263	44.4	-1.163	-15.9
7.40	101	2.830	38.0	3.557	47.8	-1.352	-18.2
7.50	267	2.873	37.2	3.678	47.6	-0.807	-10.5
8.00	225	3.317	39.3	4.124	48.7	0.046	0.4
9.00	122	4.933	51.9	5.661	59.6	-1.020	-10.4
10.00	180	5.068	46.0	5.910	53.6	-2.889	-26.1
12.00	129	5.960	46.3	6.839	52.8	-4.493	-35.0
14.00	66	5.929	39.7	6.924	46.3	-2.108	-14.1
16.00	66	6.428	37.8	7.576	44.4	-4.327	-25.5
18.00	38	6.657	35.2	7.575	40.1	-4.490	-23.9
20.00	42	5.566	25.0	6.263	28.0	-3.990	-18.1
25.00	17	5.843	21.2	6.457	23.6	-4.802	-17.7
30.00	0	0.000	0.0	0.000	0.0	0.000	0.0
35.00	0	0.000	0.0	0.000	0.0	0.000	0.0
38.00	0	0.000	0.0	0.000	0.0	0.000	0.0
40.00	0	0.000	0.0	0.000	0.0	0.000	0.0
42.00	0	0.000	0.0	0.000	0.0	0.000	0.0
45.00	0	0.000	0.0	0.000	0.0	0.000	0.0
48.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.788	*	1.318	*	-0.734	*

Standard error of estimate = 1.09
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SDS POC-1 (PREDEV)
Observed - 2006 SDS POC-1(2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

AR 046815

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	*****	93622	39.67	22.25	100.00	100.00	0.00	0.00
0.00	*****	87379	31.22	20.77	60.33	77.75	0.02	0.03
0.10	25425	21375	6.04	5.08	29.10	56.98	0.14	0.15
0.20	34570	33036	8.22	7.85	23.06	51.90	0.33	0.33
0.50	24161	29609	5.74	7.04	14.85	44.05	0.71	0.73
1.00	12364	35010	2.94	8.32	9.10	37.01	1.23	1.24
1.50	7399	30623	1.76	7.28	6.17	28.69	1.73	1.75
2.00	4874	24532	1.16	5.83	4.41	21.42	2.24	2.24
2.50	5915	32308	1.41	7.68	3.25	15.59	2.94	2.96
3.50	3064	17723	0.73	4.21	1.84	7.91	3.95	3.94
4.50	2278	10882	0.54	2.59	1.11	3.70	5.14	5.12
6.00	389	1794	0.09	0.43	0.57	1.11	6.25	6.23
6.50	343	1102	0.08	0.26	0.48	0.68	6.74	6.73
7.00	54	147	0.01	0.03	0.40	0.42	7.04	7.05
7.10	66	130	0.02	0.03	0.39	0.39	7.16	7.15
7.20	59	130	0.01	0.03	0.37	0.36	7.25	7.25
7.30	47	113	0.01	0.03	0.36	0.32	7.34	7.35
7.40	59	101	0.01	0.02	0.35	0.30	7.45	7.45
7.50	222	267	0.05	0.06	0.33	0.27	7.74	7.73
8.00	309	225	0.07	0.05	0.28	0.21	8.47	8.42
9.00	209	122	0.05	0.03	0.21	0.16	9.49	9.48
10.00	262	180	0.06	0.04	0.16	0.13	10.88	11.03
12.00	151	129	0.04	0.03	0.09	0.09	13.01	12.87
14.00	85	66	0.02	0.02	0.06	0.05	14.84	14.93
16.00	48	66	0.01	0.02	0.04	0.04	16.83	17.00
18.00	45	38	0.01	0.01	0.03	0.02	18.92	18.88
20.00	43	42	0.01	0.01	0.02	0.01	22.38	22.37
25.00	13	17	0.00	0.00	0.01	0.00	26.61	27.69
30.00	4	0	0.00	0.00	0.00	0.00	30.89	0.00
35.00	1	0	0.00	0.00	0.00	0.00	37.70	0.00
38.00	4	0	0.00	0.00	0.00	0.00	39.26	0.00
40.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
42.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
45.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
48.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768	420768	100.00	100.00			0.33	1.06

10350 Observed values are zero
117496 Simulated values are zero
10350 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
107146 Observed values are not zero when simulated are

1

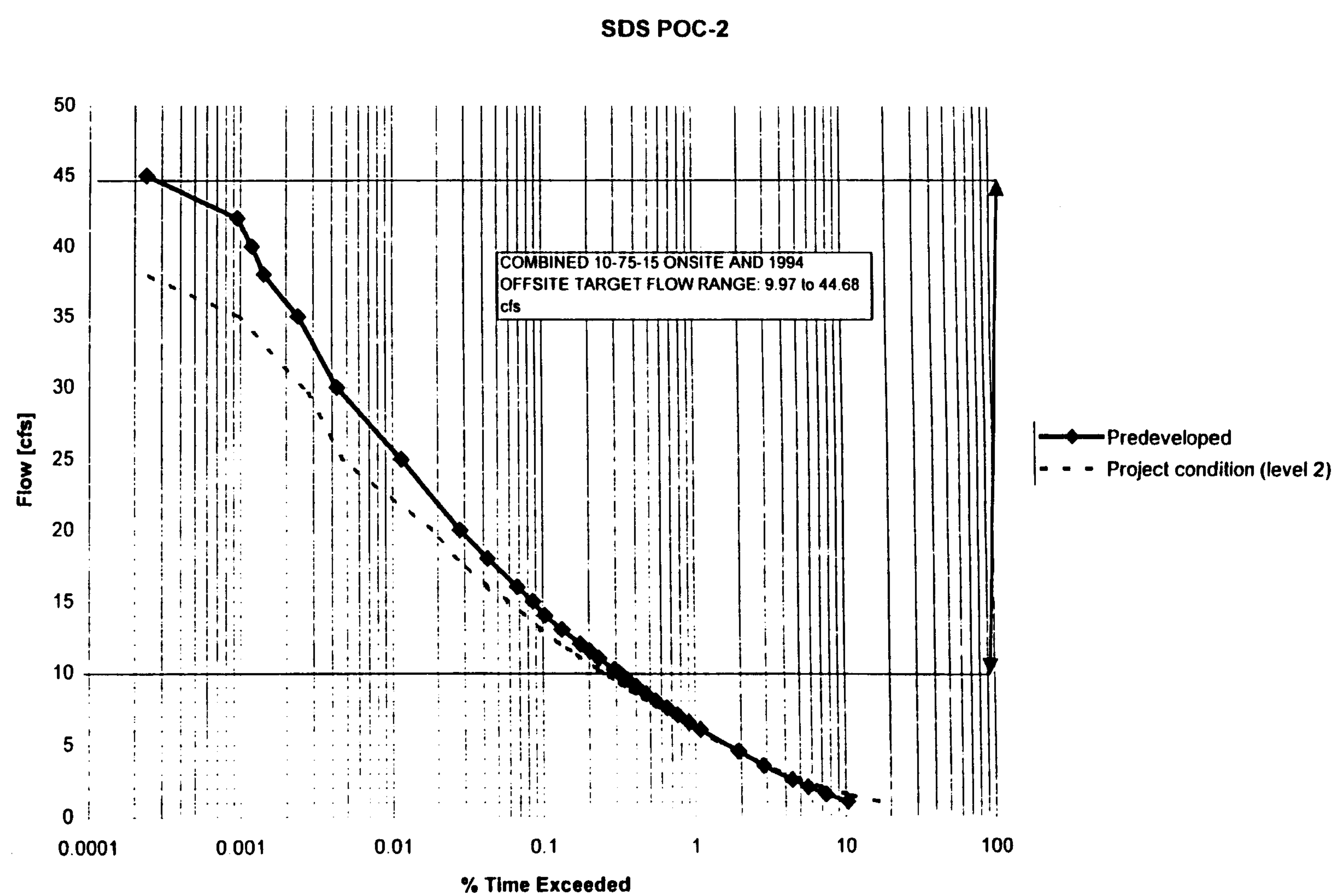
Simulated - PREDEV SDS POC-1 (PREDEV)
Observed - 2006 SDS POC-1 (2006)

Lower class limit	Number of occurrences between indicated deviations	-60%	-30%	-10%	0%	10%	30%	60%
0.00	84895	1	0	8712	0	0	14	0
0.00	85869	343	131	45	46	65	880	0
0.10	20469	200	83	35	40	61	487	0
0.20	30979	566	228	86	81	166	930	0
0.50	26922	916	395	147	111	214	904	0
1.00	32422	1131	400	148	121	194	594	0
1.50	27406	1545	512	202	170	269	519	0
2.00	20924	1985	585	199	158	245	436	0

2.50	25808	3734	1070	369	297	414	616	0
3.50	12262	3362	862	274	225	311	427	0
4.50	5667	3214	842	253	214	283	409	0
6.00	529	780	229	59	49	63	85	0
6.50	259	414	203	47	35	55	89	0
7.00	25	42	34	7	9	14	16	0
7.10	26	52	14	5	8	9	16	0
7.20	22	51	21	6	5	7	18	0
7.30	9	39	24	10	10	7	14	0
7.40	13	33	17	13	6	8	11	0
7.50	28	83	46	28	17	26	39	0
8.00	29	45	26	15	16	38	56	0
9.00	36	27	6	3	3	13	34	0
10.00	42	76	22	6	2	11	21	0
12.00	40	50	21	2	3	4	9	0
14.00	10	20	11	5	2	6	12	0
16.00	12	28	8	3	5	6	4	0
18.00	6	15	8	1	2	3	3	0
20.00	0	18	12	5	3	3	1	0
25.00	0	4	9	3	0	1	0	0
30.00	0	0	0	0	0	0	0	0
35.00	0	0	0	0	0	0	0	0
38.00	0	0	0	0	0	0	0	0
40.00	0	0	0	0	0	0	0	0
42.00	0	0	0	0	0	0	0	0
45.00	0	0	0	0	0	0	0	0
48.00	0	0	0	0	0	0	0	0
	374709	18774	5819	10688	1638	2496	6644	0

SDS POC-2

July 2001
556-2912-001 (28)


SDS POC-2
50
45
40
35
30
25
20
15
10
5
0
Flow [cfs]
0.0001
0.001
0.01
0.1
1
10
100
% Time Exceeded
COMBINED 10-75-15 ONSITE AND 1994
OFFSITE TARGET FLOW RANGE: 9.97 to 44.68
cfs
Predeveloped
Project condition (level 2)

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SDS POC-2 (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

24.049	48.542	29.929	16.294	16.958
19.267	23.386	21.733	23.022	18.742
15.503	21.425	19.066	15.268	16.913
23.240	17.724	18.709	28.794	26.430
17.863	19.786	16.469	36.154	18.208
17.077	24.088	16.893	17.572	24.797
19.014	23.237	24.069	19.785	17.797
18.448	16.775	27.247	23.533	13.448
12.987	44.210	38.579	19.670	12.090
12.334	17.134	36.423		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.318
Variance (logs)	0.018
Standard Deviation (logs)	0.135
Skewness (logs)	0.823
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.189
Coefficient of Variation (logs)	0.102

PREDEV SDS POC (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	12.209
0.9500	1.05	13.550
0.9000	1.11	14.502
0.8000	1.25	15.946
0.5000	2.00	19.939
0.2000	5.00	26.473
0.1000	10.00	31.496
0.0400	25.00	38.683
0.0200	50.00	44.682
0.0100	100.00	51.269
0.0050	200.00	58.529

$1/2 Q_2 = 9.97$ cfs
$Q_{50} = 44.68$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

2006 SDS POC-2 (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

20.712	40.089	25.637	14.241	14.772
16.589	19.950	18.714	20.594	16.625
14.183	18.691	16.490	13.594	14.318
19.868	15.411	16.329	24.495	23.088
15.611	17.396	15.095	30.348	15.914
14.875	21.186	15.286	15.924	22.047
16.345	20.985	21.383	17.546	15.604
15.423	15.324	22.773	21.068	12.187
12.134	36.318	32.252	17.643	11.005
11.153	15.293	30.832		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.260
Variance (logs)	0.016
Standard Deviation (logs)	0.126
Skewness (logs)	0.817
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.198
Coefficient of Variation (logs)	0.100

1

2006 SDS POC (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	11.060
0.9500	1.05	12.198
0.9000	1.11	13.000
0.8000	1.25	14.208
0.5000	2.00	17.508
0.2000	5.00	22.806
0.1000	10.00	26.812
0.0400	25.00	32.464
0.0200	50.00	37.124
0.0100	100.00	42.189
0.0050	200.00	47.716

POC - 2 - Percent cases equal or exceeding limit

Predeveloped	Project condition (level 2)	Flow [cfs]
100	100	0
10.3813	16.5466	1
7.42832	10.1895	1.5
5.63446	6.91474	2
4.43023	5.04387	2.5
2.85098	2.9893	3.5
1.91911	1.89178	4.5
1.08658	0.9977	6
0.90525	0.81779	6.5
0.76146	0.67163	7
0.65	0.55993	7.5
0.54638	0.46296	8
0.46653	0.38596	8.5
0.40212	0.33177	9
0.34912	0.28377	9.5
0.31514	0.25121	9.9
0.30872	0.2417	10
0.29256	0.22768	10.2
0.23219	0.17468	11
0.20201	0.15068	11.5
0.17468	0.12691	12
0.13261	0.09649	13
0.10291	0.07581	14
0.08603	0.05846	15
0.06773	0.0423	16
0.04254	0.02733	18
0.02804	0.01806	20
0.01141	0.00475	25
0.00428	0.00261	30
0.00238	0.00095	35
0.00143	0.00024	38
0.00119	0.00024	40
0.00095	0	42
0.00024	0	45
0.00024	0	48

Simulated - PREDEV SDS POC-2 (PREDEV)
Observed - 2006 SDS POC-2 (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	351145	0.098	26.8	0.181	37.0	-0.096	-24.6
1.00	26749	0.512	42.4	0.572	47.3	-0.502	-41.6
1.50	13779	0.520	30.4	0.613	36.1	-0.497	-29.1
2.00	7872	0.443	20.0	0.543	24.7	-0.397	-17.9
2.50	8645	0.329	11.4	0.420	14.7	-0.231	-8.1
3.50	4618	0.287	7.3	0.398	10.1	-0.077	-2.0
4.50	3762	0.313	6.1	0.412	8.0	0.089	1.6
6.00	757	0.382	6.1	0.465	7.4	0.250	4.0
6.50	615	0.418	6.2	0.503	7.5	0.304	4.5
7.00	470	0.499	6.9	0.581	8.0	0.398	5.5
7.50	408	0.584	7.5	0.677	8.7	0.481	6.2
8.00	324	0.614	7.4	0.706	8.6	0.500	6.1
8.50	228	0.734	8.4	0.810	9.3	0.651	7.5
9.00	202	0.799	8.6	0.873	9.4	0.736	8.0
9.50	137	0.828	8.5	0.896	9.2	0.759	7.8
9.90	40	0.950	9.5	1.017	10.2	0.875	8.8
10.00	59	0.994	9.9	1.052	10.4	0.938	9.3
10.20	223	1.021	9.6	1.093	10.3	0.963	9.1
11.00	101	1.109	9.9	1.182	10.5	1.013	9.0
11.50	100	1.188	10.1	1.259	10.7	1.152	9.8
12.00	128	1.283	10.3	1.371	11.0	1.158	9.3
13.00	87	1.513	11.2	1.584	11.7	1.461	10.8
14.00	73	1.805	12.5	1.874	13.0	1.737	12.0
15.00	68	1.884	12.2	1.983	12.8	1.809	11.7
16.00	63	2.175	12.9	2.244	13.4	2.094	12.5
18.00	39	2.579	13.6	2.690	14.2	2.579	13.6
20.00	56	3.050	13.8	3.176	14.3	2.933	13.2
25.00	9	4.147	15.1	4.433	16.2	4.129	15.1
30.00	7	5.347	17.0	5.409	17.1	5.347	17.0
35.00	3	7.316	20.3	7.328	20.3	7.316	20.3
38.00	0	0.000	0.0	0.000	0.0	0.000	0.0
40.00	1	8.453	21.1	8.453	21.1	8.453	21.1
42.00	0	0.000	0.0	0.000	0.0	0.000	0.0
45.00	0	0.000	0.0	0.000	0.0	0.000	0.0
48.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.160	26.8	0.290	36.7	-0.133	-24.6

Standard error of estimate = 0.26
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SDS POC-2(PREDEV)
Observed - 2006 SDS POC-2 (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Percent	Percent cases equal or exceeding limit	Average of cases within class limits

AR 046823

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	*****	*****	89.62	83.45	100.00	100.00	0.16	0.22
1.00	12425	26749	2.95	6.36	10.36	16.55	1.22	1.22
1.50	7548	13779	1.79	3.27	7.43	10.19	1.73	1.72
2.00	5067	7872	1.20	1.87	5.63	6.91	2.24	2.23
2.50	6645	8645	1.58	2.05	4.43	5.04	2.96	2.94
3.50	3921	4618	0.93	1.10	2.85	2.99	3.96	3.96
4.50	3503	3762	0.83	0.89	1.92	1.89	5.17	5.17
6.00	763	757	0.18	0.18	1.09	1.00	6.24	6.23
6.50	605	615	0.14	0.15	0.91	0.82	6.75	6.74
7.00	469	470	0.11	0.11	0.76	0.67	7.25	7.24
7.50	436	408	0.10	0.10	0.65	0.56	7.74	7.73
8.00	336	324	0.08	0.08	0.55	0.46	8.26	8.24
8.50	271	228	0.06	0.05	0.47	0.39	8.73	8.74
9.00	223	202	0.05	0.05	0.40	0.33	9.25	9.25
9.50	143	137	0.03	0.03	0.35	0.28	9.70	9.70
9.90	27	40	0.01	0.01	0.32	0.25	9.95	9.95
10.00	68	59	0.02	0.01	0.31	0.24	10.10	10.09
10.20	254	223	0.06	0.05	0.29	0.23	10.59	10.58
11.00	127	101	0.03	0.02	0.23	0.17	11.26	11.22
11.50	115	100	0.03	0.02	0.20	0.15	11.74	11.73
12.00	177	128	0.04	0.03	0.17	0.13	12.53	12.45
13.00	125	87	0.03	0.02	0.13	0.10	13.49	13.51
14.00	71	73	0.02	0.02	0.10	0.08	14.50	14.43
15.00	77	68	0.02	0.02	0.09	0.06	15.48	15.45
16.00	106	63	0.03	0.01	0.07	0.04	17.02	16.81
18.00	61	39	0.01	0.01	0.04	0.03	18.92	18.98
20.00	70	56	0.02	0.01	0.03	0.02	22.29	22.14
25.00	30	9	0.01	0.00	0.01	0.00	26.83	27.29
30.00	8	7	0.00	0.00	0.00	0.00	32.58	31.44
35.00	4	3	0.00	0.00	0.00	0.00	35.87	36.12
38.00	1	0	0.00	0.00	0.00	0.00	38.58	0.00
40.00	1	1	0.00	0.00	0.00	0.00	40.88	40.09
42.00	3	0	0.00	0.00	0.00	0.00	43.43	0.00
45.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
48.00	1	0	0.00	0.00	0.00	0.00	48.54	0.00
	420768	420768	100.00	100.00			0.47	0.60

1

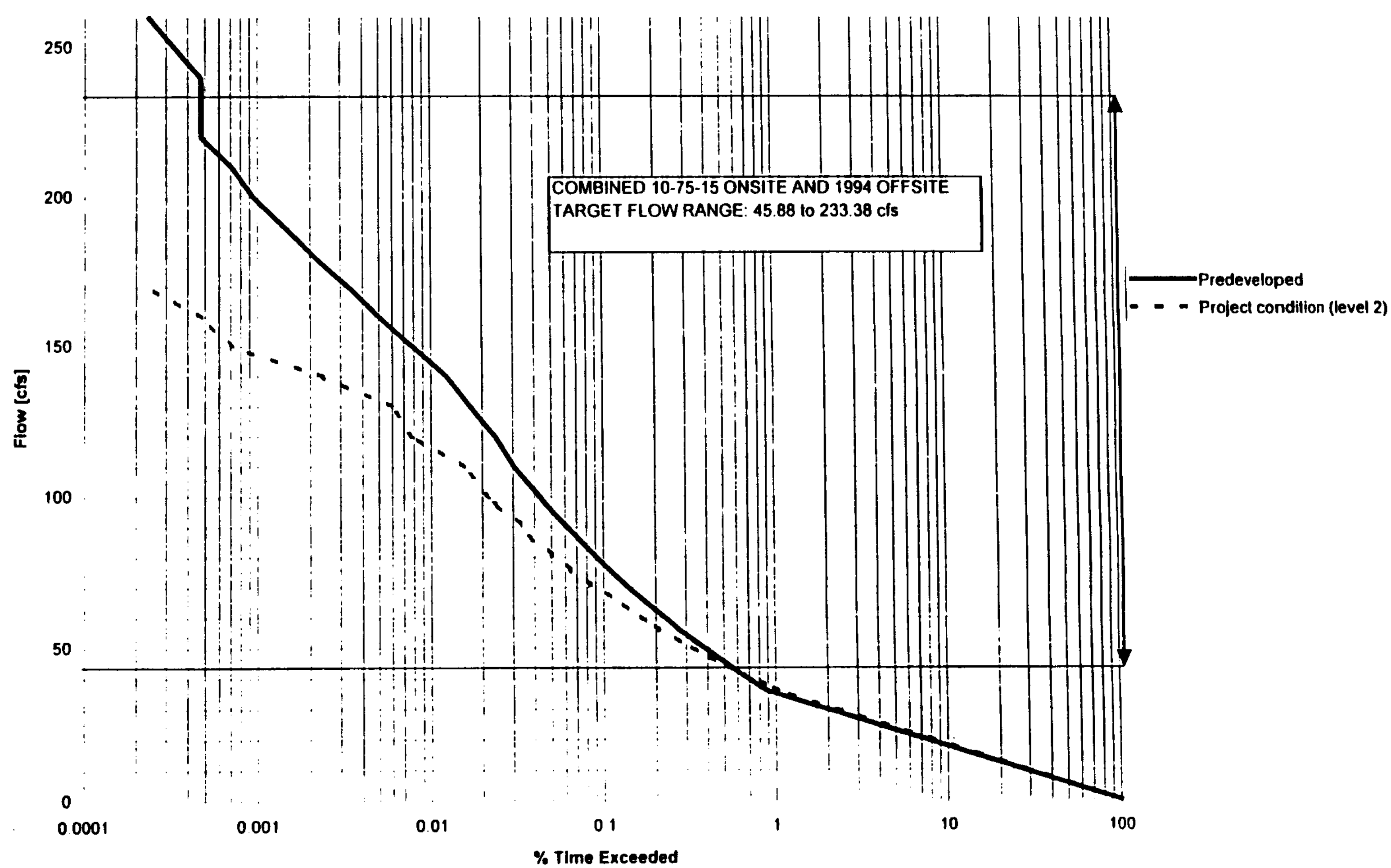
Simulated - PREDEV SDS POC (PREDEV)
Observed - 2006 SDS POC (2006)

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	51970	89887	54773	41080	112396	1039	0	0
1.00	6008	13231	4610	1424	1055	421	0	0
1.50	1205	5230	4593	1430	955	366	0	0
2.00	33	1922	3273	1420	944	280	0	0
2.50	0	470	2955	2927	1803	490	0	0
3.50	0	88	677	1762	1707	384	0	0
4.50	0	27	234	1053	2041	407	0	0
6.00	0	0	23	141	489	104	0	0
6.50	0	1	14	97	426	77	0	0
7.00	0	0	14	45	331	80	0	0
7.50	0	0	10	32	283	83	0	0
8.00	0	0	8	18	234	64	0	0
8.50	0	0	5	5	150	68	0	0
9.00	0	0	3	5	123	71	0	0
9.50	0	0	2	4	91	40	0	0
9.90	0	0	1	0	24	15	0	0

10.00	0	0	1	0	30	28	0	0
10.20	0	0	3	2	123	95	0	0
11.00	0	0	2	2	53	44	0	0
11.50	0	0	1	3	40	56	0	0
12.00	0	0	2	6	54	66	0	0
13.00	0	0	1	1	30	55	0	0
14.00	0	0	1	0	22	50	0	0
15.00	0	0	1	2	14	51	0	0
16.00	0	0	1	0	12	50	0	0
18.00	0	0	0	0	8	31	0	0
20.00	0	0	0	3	5	48	0	0
25.00	0	0	0	1	0	8	0	0
30.00	0	0	0	0	0	7	0	0
35.00	0	0	0	0	0	3	0	0
38.00	0	0	0	0	0	0	0	0
40.00	0	0	0	0	0	1	0	0
42.00	0	0	0	0	0	0	0	0
45.00	0	0	0	0	0	0	0	0
48.00	0	0	0	0	0	0	0	0
	59216	110856	71208	51463	123443	4582	0	0

SOUTH 200TH STREET

Des Moines Creek at South 200th Street



1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SIM SOUTH 200TH STREET

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

122.981	166.733	167.003	79.350	70.532
86.954	138.000	103.731	114.550	89.858
76.011	106.940	79.298	60.528	75.784
90.482	77.645	81.295	151.266	91.617
96.550	90.882	77.699	178.019	85.062
77.479	110.259	82.537	70.834	94.611
66.897	109.739	91.995	81.573	84.913
70.945	69.289	159.147	141.139	69.556
63.317	262.423	199.243	96.596	69.986
51.129	91.202	189.139		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.985
Variance (logs)	0.023
Standard Deviation (logs)	0.153
Skewness (logs)	0.904
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.189
Coefficient of Variation (logs)	0.077

1

PREDEV SIM SOUTH 200TH STREET

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	53.911
0.9500	1.05	60.044
0.9000	1.11	64.549
0.8000	1.25	71.553
0.5000	2.00	91.754
0.2000	5.00	126.778
0.1000	10.00	155.009
0.0400	25.00	197.025
0.0200	50.00	233.378
0.0100	100.00	274.464
0.0050	200.00	321.030

$1/2\,Q_2 = 45.88$ cfs
$Q_{50} = 233.38$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

2006 SIM SOUTH 200TH STREET

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

81.855	99.826	145.239	59.304	57.039
61.320	92.578	80.005	85.909	72.696
62.534	102.963	64.817	50.957	64.552
58.732	67.396	64.213	95.642	67.725
72.218	68.963	69.340	118.691	65.077
59.914	87.423	66.786	56.232	71.542
52.043	83.429	72.338	57.980	72.099
53.602	57.276	111.874	122.616	59.511
49.143	174.423	142.678	70.465	59.845
40.351	72.530	141.935		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.872
Variance (logs)	0.019
Standard Deviation (logs)	0.137
Skewness (logs)	0.892
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.131
Coefficient of Variation (logs)	0.073

1

2006 SIM SOUTH 200TH STREET

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	43.986
0.9500	1.05	48.504
0.9000	1.11	51.780
0.8000	1.25	56.816
0.5000	2.00	71.025
0.2000	5.00	94.842
0.1000	10.00	113.483
0.0400	25.00	140.538
0.0200	50.00	163.415
0.0100	100.00	188.792
0.0050	200.00	217.039

South 200th Street - Percent cases equal or exceeding limit

Predeveloped	Project condition (level 2)	1994 conditions	Flow [cfs]
100	100	100	0
0.88006	1.0305	1.6645753	36
0.77382	0.85819	1.491083	38
0.64763	0.65689	1.2617404	41
0.57514	0.55232	1.1300764	43
0.48625	0.43421	0.9663282	46
0.40426	0.34271	0.8265838	49
0.34294	0.2745	0.7184482	52
0.27283	0.20867	0.6012815	56
0.23647	0.17278	0.5204768	59
0.19441	0.13713	0.4330177	63
0.1609	0.10932	0.3576793	67
0.1338	0.08413	0.3061069	71
0.1079	0.06441	0.2552475	76
0.08793	0.05038	0.2131816	81
0.07225	0.03921	0.1801468	86
0.05918	0.03303	0.1549547	91
0.04729	0.02448	0.13309	97
0.04302	0.02186	0.1207316	100
0.03042	0.01569	0.0929253	110
0.02353	0.00784	0.0703476	120
0.01711	0.00594	0.0541866	130
0.01236	0.00238	0.0423036	140
0.00784	0.00071	0.0327972	150
0.00499	0.00048	0.026618	160
0.00333	0.00024	0.0209141	170
0.00214	0	0.0142596	180
0.00143	0	0.0090311	190
0.00095	0	0.0068922	200
0.00071	0	0.0045156	210
0.00048	0	0.0028519	220
0.00048	0	0.0026143	230
0.00048	0	0.0019013	240
0.00024	0	0.001426	260
0	0	0.000713	280

1

Simulated - PREDEV SIM SOUTH 200TH STREET
Observed - 2006 SIM SOUTH 200TH STREET

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	416432	1.586	32.0	2.893	38.3	-1.329	-18.3
36.00	725	8.856	24.0	10.562	28.6	-4.646	-12.6
38.00	847	9.009	22.9	10.857	27.6	-3.374	-8.6
41.00	440	9.741	23.2	11.664	27.8	-3.712	-8.9
43.00	497	10.229	23.0	12.006	27.0	-2.651	-6.0
46.00	385	9.954	21.0	11.830	25.0	-1.506	-3.2
49.00	267	10.533	20.9	12.631	25.1	-0.343	-0.7
52.00	277	11.215	20.8	13.357	24.7	0.632	1.1
56.00	151	11.317	19.7	13.505	23.5	2.767	4.8
59.00	150	13.994	23.0	16.323	26.8	4.421	7.3
63.00	117	14.581	22.5	16.860	26.0	4.762	7.3
67.00	106	17.504	25.4	19.476	28.2	8.190	11.9
71.00	83	19.016	25.9	21.707	29.5	8.498	11.5
76.00	59	21.603	27.6	25.121	32.2	10.824	13.9
81.00	47	23.422	28.0	25.970	31.1	7.195	8.6
86.00	26	25.124	28.4	29.665	33.5	6.504	7.3
91.00	36	30.038	32.1	34.827	37.2	11.557	12.4
97.00	11	25.964	26.2	31.790	32.0	10.173	10.2
100.00	26	21.538	20.6	28.080	26.7	7.970	7.5
110.00	33	24.174	21.1	30.184	26.4	19.297	16.9
120.00	8	17.423	14.0	21.154	16.8	17.423	14.0
130.00	15	26.677	19.9	33.035	24.7	23.659	17.6
140.00	7	24.159	17.0	36.677	25.7	22.913	16.1
150.00	1	49.347	31.1	49.347	31.1	49.347	31.1
160.00	1	94.361	57.9	94.361	57.9	94.361	57.9
170.00	1	88.000	50.5	88.000	50.5	88.000	50.5
180.00	0	0.000	0.0	0.000	0.0	0.000	0.0
190.00	0	0.000	0.0	0.000	0.0	0.000	0.0
200.00	0	0.000	0.0	0.000	0.0	0.000	0.0
210.00	0	0.000	0.0	0.000	0.0	0.000	0.0
220.00	0	0.000	0.0	0.000	0.0	0.000	0.0
230.00	0	0.000	0.0	0.000	0.0	0.000	0.0
240.00	0	0.000	0.0	0.000	0.0	0.000	0.0
260.00	0	0.000	0.0	0.000	0.0	0.000	0.0
280.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	1.686	31.9	3.224	38.2	-1.323	-18.1

Standard error of estimate = 2.94
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SIM SOUTH 200TH STREET
Observed - 2006 SIM SOUTH 200TH STREET

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00**********			99.12	98.97	100.00	100.00	2.65	3.97
36.00	447	725	0.11	0.17	0.88	1.03	36.93	36.95
38.00	531	847	0.13	0.20	0.77	0.86	39.42	39.42
41.00	305	440	0.07	0.10	0.65	0.66	41.98	41.96
43.00	374	497	0.09	0.12	0.58	0.55	44.46	44.39
46.00	345	385	0.08	0.09	0.49	0.43	47.46	47.43
49.00	258	287	0.06	0.07	0.40	0.34	50.42	50.44
52.00	295	277	0.07	0.07	0.34	0.27	53.89	53.96
56.00	153	151	0.04	0.04	0.27	0.21	57.48	57.40
59.00	177	150	0.04	0.04	0.24	0.17	60.95	60.73
63.00	141	117	0.03	0.03	0.19	0.14	64.85	64.76
67.00	114	106	0.03	0.03	0.16	0.11	69.00	68.80
71.00	109	83	0.03	0.02	0.13	0.08	73.41	73.31
76.00	84	59	0.02	0.01	0.11	0.06	78.42	78.29
81.00	66	47	0.02	0.01	0.09	0.05	83.56	83.59
86.00	55	26	0.01	0.01	0.07	0.04	88.30	88.23
91.00	50	36	0.01	0.01	0.06	0.03	94.05	93.58
97.00	18	11	0.00	0.00	0.05	0.02	98.64	98.85
100.00	53	26	0.01	0.01	0.04	0.02	104.44	103.90
110.00	29	33	0.01	0.01	0.03	0.02	114.61	114.66
120.00	27	8	0.01	0.00	0.02	0.01	124.31	124.34
130.00	20	15	0.00	0.00	0.02	0.01	135.30	134.24
140.00	19	7	0.00	0.00	0.01	0.00	143.87	142.52
150.00	12	1	0.00	0.00	0.01	0.00	155.23	158.79
160.00	7	1	0.00	0.00	0.00	0.00	164.43	163.11
170.00	5	1	0.00	0.00	0.00	0.00	176.49	174.42
180.00	3	0	0.00	0.00	0.00	0.00	187.47	0.00
190.00	2	0	0.00	0.00	0.00	0.00	199.15	0.00
200.00	1	0	0.00	0.00	0.00	0.00	208.13	0.00
210.00	1	0	0.00	0.00	0.00	0.00	218.80	0.00
220.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
230.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
240.00	1	0	0.00	0.00	0.00	0.00	257.47	0.00
260.00	1	0	0.00	0.00	0.00	0.00	262.42	0.00
280.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768	420768	100.00	100.00			3.11	4.43

1

Simulated - PREDEV SIM SOUTH 200TH STREET
Observed - 2006 SIM SOUTH 200TH STREET

Lower class limit	Number of occurrences between indicated deviations	-60%	-30%	-10%	0%	10%	30%	60%
0.00	49156	121110	73931	39285	38926	55566	38458	0
36.00	20	162	221	104	67	108	43	0
38.00	16	170	223	98	98	184	58	0
41.00	7	90	123	45	57	87	31	0
43.00	6	92	130	52	51	125	41	0
46.00	4	52	103	42	46	107	31	0
49.00	4	36	63	33	31	101	19	0
52.00	5	26	64	30	29	95	28	0
56.00	1	10	30	18	19	55	18	0
59.00	2	13	25	9	18	55	28	0
63.00	1	11	15	9	15	45	21	0
67.00	1	8	14	2	10	43	28	0
71.00	0	6	13	8	4	29	23	0
76.00	0	6	6	2	6	18	19	0
81.00	0	4	14	2	1	11	15	0
86.00	0	4	4	3	2	6	7	0

91.00	0	5	6	3	3	5	14	0
97.00	0	0	4	0	2	2	3	0
100.00	0	0	9	1	5	7	4	0
110.00	0	0	3	4	6	11	9	0
120.00	0	0	0	0	2	5	1	0
130.00	0	0	1	1	4	4	5	0
140.00	0	0	0	1	3	1	2	0
150.00	0	0	0	0	0	0	1	0
160.00	0	0	0	0	0	0	1	0
170.00	0	0	0	0	0	0	1	0
180.00	0	0	0	0	0	0	0	0
190.00	0	0	0	0	0	0	0	0
200.00	0	0	0	0	0	0	0	0
210.00	0	0	0	0	0	0	0	0
220.00	0	0	0	0	0	0	0	0
230.00	0	0	0	0	0	0	0	0
240.00	0	0	0	0	0	0	0	0
260.00	0	0	0	0	0	0	0	0
280.00	0	0	0	0	0	0	0	0

	49223	121805	75002	39752	39407	56670	38909	0

ATTACHMENT D

HSPF Input Files for Miller, Walker, and Des Moines Creeks

Miller Creek Watershed

- Predevelopment Conditions
- 2006 Conditions

Walker Creek Watershed

- Predevelopment Conditions
- 2006 Conditions

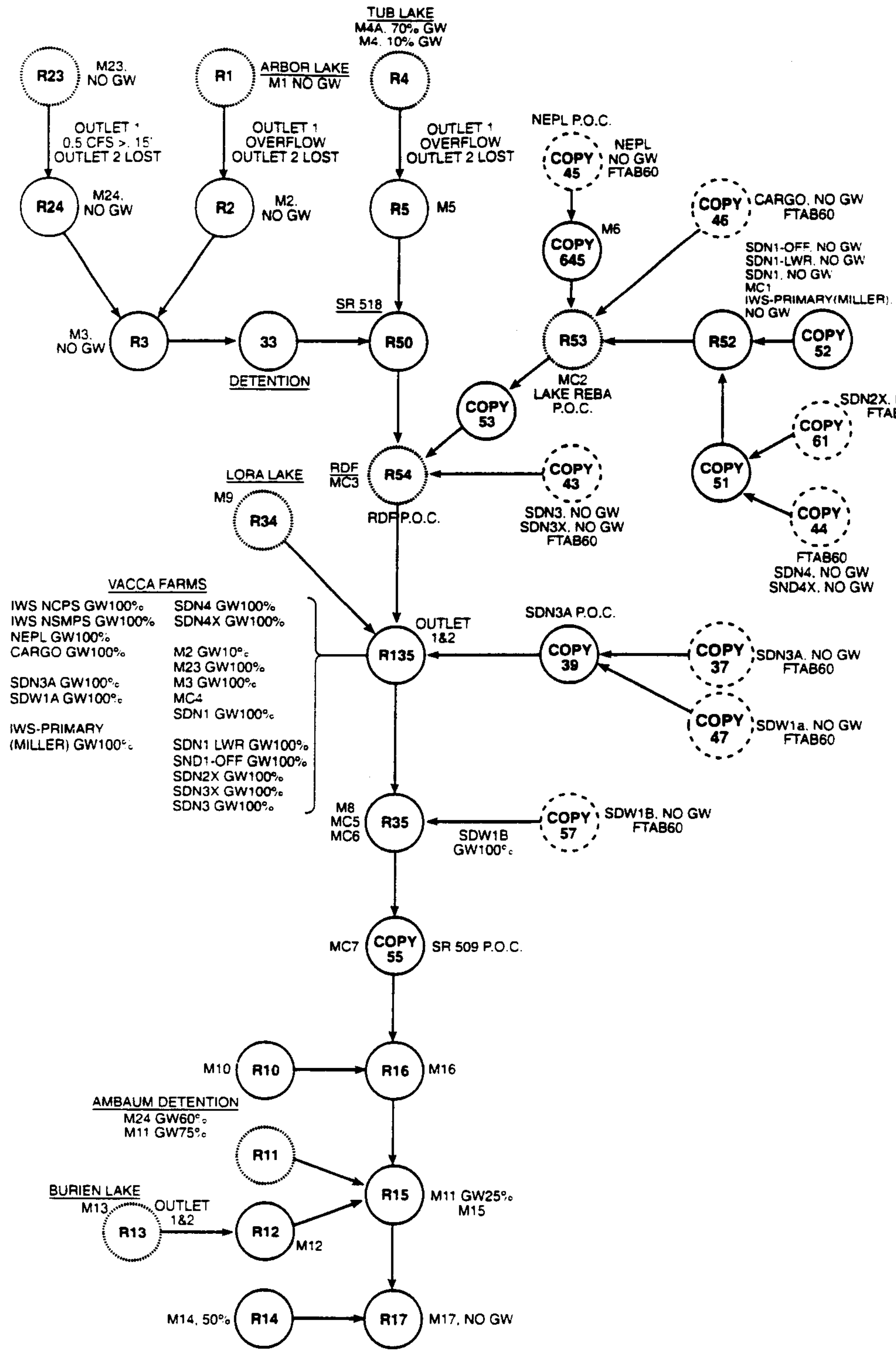
Des Moines Creek Watershed

- Predevelopment Conditions
- 2006 Conditions

MILLER CREEK WATERSHED
HSPF INPUT FILES

- PREDEVELOPMENT CONDITIONS
- 2006 CONDITIONS

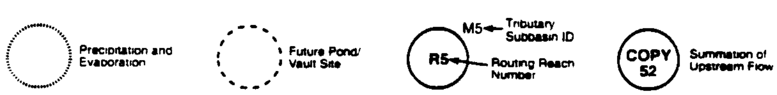
PREDEVELOPMENT CONDITIONS



Notes: GW routed to reach unless otherwise noted
Reaches have one outlet unless otherwise noted
Reach table # is the same as reach # unless otherwise noted

Parametrix, Inc. Port of Seattle/556-2912-001 01(28) 6/01 (K)

July 2001
556-2912-001 (28)



Miller Creek
Predevelopment HSPF
Model Routing Schematic

AR 046837

```
RUN
GLOBAL
  ***   SEATAC AIRPORT HSPF BASIN MODEL OF MILLER CREEK
  ***   FILE: MCPRED10.INP - predevelopment condition
  ***
  ***   BASED ON MILL64.INP FILE
  ***   - UPDATED LAND USE, revised MC-1 and SDN-2X land uses (FK, June 2001)
  MILLER CREEK BASIN HSPF MODEL
  START        1948 10  1  0  0  END    1997  1 31 24  0
  RUN INTERP OUTPUT LEVEL    6
  RESUME     0 RUN     1
END GLOBAL

FILES
<type>  <fun>***<------------fname---------------------------------------------->
MESSU      24   MILL.MES
WDM        25   MCPOND22.WDM
           61   PER.L61
           62   RCH.L62
END FILES

OPN SEQUENCE
    INGRP              INDELT 01:00
      PERLND      16
      PERLND      26
      PERLND      34
      PERLND      44
      PERLND      54
      IMPLND      14
      RCHRES       1
      RCHRES      23
      RCHRES      24
      RCHRES       2
      RCHRES       3
      RCHRES      33
      RCHRES       4
      RCHRES       5
      RCHRES      50
*** OUTPUT AT NODES 242, 240, 61, 43, 44, 45 & 46 FOR DETENTION PONDS:
*** NOte: 240 and 242 removed from analysis
***   COPY       242
***   COPY       240
      COPY        61
      COPY        43
      COPY        44
      COPY        51
      COPY        45
      COPY       645
      COPY        46
      COPY        52
      RCHRES      52
      RCHRES      53
      COPY        53
      RCHRES      54
*** OUTPUT AT NODES 37 & 47 FOR DETENTION PONDS:
      COPY        37
      COPY        47
      COPY        39
      RCHRES      34
      RCHRES     135
*** OUTPUT AT NODE 57 FOR DETENTION PONDS:
      COPY        57
      RCHRES      35
*** OUTPUT AT NODE 55 FOR SR509 COMPARISON
      COPY        55
      RCHRES      10
      RCHRES      16
```

```
      RCHRES       11
      RCHRES       13
      RCHRES       12
      RCHRES       15
      RCHRES       14
      RCHRES       17
    END INGRP
END OPN SEQUENCE                                                                  ***

PERLND
  GEN-INFO                                                                        ***
    <PLS >       Name             NBLKS   Unit-systems   Printer                  ***
    # -  #                               User  t-series Engl Metr                 ***
                                                in  out
   16      TFM- TILL FOR MOD         1     1     1    1   61    0
   26      TGM- TILL GR MOD          1     1     1    1   61    0
   34      OF - OUTWASH FOR          1     1     1    1   61    0
   44      OG - OUTWASH GR           1     1     1    1   61    0
 ***PERLND FOR NEW AIRPORT FILL; NONE IN PREDEV
   45      AIRPORT FILL              1     1     1    1   61    0
   54      SA - WETLANDS             1     1     1    1   61    0
  END GEN-INFO
  ACTIVITY
    <PLS > ************* Active Sections ***************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC            ***
   14  200    0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    <PLS > ********************* Print-flags ************************ PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
   14  200    0    0    0    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  PWAT-PARM1
    <PLS > **************** Flags *******************
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                           ***
   14  200    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1
  PWAT-PARM2
    <PLS > ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16                   9.0000    0.3200    400.00    0.1000    0.5000    0.9960
   26                   9.0000    0.1200    400.00    0.1000    0.5000    0.9960
   34                  10.0000    2.0000    400.00    0.0500    0.3000    0.9960
   44                  10.0000    0.8000    400.00    0.0500    0.3000    0.9960
   54                   8.0000    2.0000    100.00    0.0010    0.5000    0.9960
  END PWAT-PARM2
  PWAT-PARM3
    <PLS >***
    # -  #*** PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16                             2.0000    2.0000      0.33      0.00       0.0
   26                             2.0000    2.0000      0.33        0.        0.
   34                             2.0000    2.0000      0.33      0.00       0.0
   44                             2.0000    2.0000      0.33        0.        0.
   54                             10.000    2.0000      0.33        0.       0.7
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >                                                          ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP***
   16         0.2000    0.7500    0.3500     9.000    0.7000    0.7000
   26         0.1000    0.3750    0.2500     9.000    0.7000    0.2500
   34         0.2000    0.7500    0.3500     0.000    0.7000    0.7000
   44         0.1000    0.7500    0.2500     0.000    0.7000    0.2500
   54         0.1000    2.2500    0.5000     1.000    0.7000    0.8000
  END PWAT-PARM4
  PWAT-STATE1
    <PLS >  PWATER state variables***
    # -  #***   CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
```

```
  16          0.078        0.    0.2500     0.10     2.000     2.000     0.000
  26          0.051        0.    0.2500     0.10     2.000     2.000     0.000
  34          0.078        0.    0.2500     0.10     2.000     2.000     0.000
  44          0.051        0.    0.2500     0.10     2.000     2.000     0.000
  54          0.051        0.    0.2500     0.10     2.000     2.000     0.000
  END PWAT-STATE1
END PERLND

IMPLND
  GEN-INFO                                                                  ***
    <ILS >       Name                 Unit-systems   Printer                ***
    # -  #                         User  t-series Engl Metr                 ***
                                          in  out
  14      IMPERVIOUS                 1    1    1   60    0
  END GEN-INFO
  ACTIVITY
    <ILS > ************* Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL  ***
  14         0    0    1    0    0    0
  END ACTIVITY
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
  14         0    0    0    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1                                                                ***
    <ILS >          Flags              ***                                  ***
    # -  # CSNO RTOP  VRS  VNN RTLI    ***
  14         0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2                                                                ***
    <ILS >                                                                  ***
    # -  #       LSUR     SLSUR      NSUR     RETSC
  14           100.00    0.0100    0.1000    0.1000
  END IWAT-PARM2
  IWAT-PARM3                                                                ***
    <ILS >                                                                  ***
    # -  #     PETMAX    PETMIN
  14
  END IWAT-PARM3
  IWAT-STATE1                                                               ***
    <ILS >  IWATER state variables                                          ***
    # -  #        RETS      SURS
  14        1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND                                                                  ***

EXT SOURCES                                                                 ***

*** NOTE: The only RCHRES that precip and PET are applied to are lakes.     ***

<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
*** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
WDM    1002 PREC      ENGLZERO  1.00          PERLND  14 200 EXTNL  PREC
WDM    1002 PREC      ENGLZERO  1.00          IMPLND  14     EXTNL  PREC
WDM       1 EVAP      ENGLZERO  0.8           PERLND  14  18 EXTNL  PETINP
WDM       1 EVAP      ENGLZERO  0.8           PERLND  24  28 EXTNL  PETINP
WDM       1 EVAP      ENGLZERO  0.8           PERLND  34  54 EXTNL  PETINP
WDM       1 EVAP      ENGLZERO  0.8           PERLND  64     EXTNL  PETINP
WDM       1 EVAP      ENGLZERO  0.8           IMPLND  14     EXTNL  PETINP
*** PRECIP/EVAP TO LAKES
WDM    1002 PREC      ENGLZERO                RCHRES   1     EXTNL  PREC
WDM       1 EVAP      ENGLZERO    0.8         RCHRES   1     EXTNL  POTEV
WDM    1002 PREC      ENGLZERO                RCHRES   4     EXTNL  PREC
WDM       1 EVAP      ENGLZERO    0.8         RCHRES   4     EXTNL  POTEV
WDM    1002 PREC      ENGLZERO                RCHRES  11     EXTNL  PREC
```

```
WDM      1 EVAP      ENGLZERO    0.8          RCHRES  11       EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                 RCHRES  13       EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8          RCHRES  13       EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                 RCHRES  23       EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8          RCHRES  23       EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                 RCHRES  34       EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8          RCHRES  34       EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                 RCHRES  53       EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8          RCHRES  53       EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                 RCHRES  54       EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8          RCHRES  54       EXTNL  POTEV
END EXT SOURCES

EXT TARGETS
***
*** NOTE: MFACTOR 12.1 CONVERTS ACRE-FEET OF RUNOFF TO AVERAGE CFS PER HOUR.
***
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
***PREDEVELOPMENT CONDITION FLOWS
*** 54=MCDF       47=SDW1A       43=SDN3X
*** 17=MOUTH      49=SDW2        44=SDN4X
*** 61=SDN2X      57=SDW1B       39=MILLER POC FOR SDN3A/SDW1A
*** 45=NEPL       55=SR509       645=NEPL+M6 (M6X)
*** 46=CARGO      37=SDN3A
*** 53=LAKE REBA
***
*** GAUGE POINTS (17=MOUTH, 54=MILLER RDF, 55=SR509)
RCHRES  17 HYDR   RO      1 1                 WDM      93 FLOW     ENGL       REPL
COPY    55 OUTPUT MEAN    1 1 12.1            WDM      98 FLOW     ENGL       REPL
RCHRES  54 HYDR   RO      1 1                 WDM      94 FLOW     ENGL       REPL
*** DETENTION POND POC LOCATIONS
COPY    61 OUTPUT MEAN    1 1 12.1            WDM      81 FLOW     ENGL       REPL
COPY    52 OUTPUT MEAN    1 1 12.1            WDM      82 FLOW     ENGL       REPL
COPY    45 OUTPUT MEAN    1 1 12.1            WDM      85 FLOW     ENGL       REPL
COPY    46 OUTPUT MEAN    1 1 12.1            WDM      86 FLOW     ENGL       REPL
COPY    47 OUTPUT MEAN    1 1 12.1            WDM      87 FLOW     ENGL       REPL
COPY    57 OUTPUT MEAN    1 1 12.1            WDM      90 FLOW     ENGL       REPL
COPY    37 OUTPUT MEAN    1 1 12.1            WDM      91 FLOW     ENGL       REPL
COPY    43 OUTPUT MEAN    1 1 12.1            WDM      83 FLOW     ENGL       REPL
COPY    44 OUTPUT MEAN    1 1 12.1            WDM      84 FLOW     ENGL       REPL
COPY    51 OUTPUT MEAN    1 1 12.1            WDM      39 FLOW     ENGL       REPL
*** OTHER POC LOCATIONS
***COPY    645 OUTPUT MEAN    1 1 12.1    ***      WDM      99 FLOW     ENGL
REPL
COPY    39 OUTPUT MEAN    1 1 12.1            WDM      95 FLOW     ENGL       REPL
COPY    53 OUTPUT MEAN    1 1 12.1            WDM     499 FLOW     ENGL       REPL
END EXT TARGETS
                                                                              ***

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK    ***
<Name>   #                  <-factor->     <Name>   #   Tbl#    ***
  *** SUB-CATCHMENT 1 all agwo goes to sound
PERLND  16                        3.41     RCHRES   1      6
PERLND  26                      232.36     RCHRES   1      6
PERLND  34                        3.07     RCHRES   1      6
PERLND  44                       38.03     RCHRES   1      6
PERLND  54                        3.87     RCHRES   1      6
IMPLND  14                       56.14     RCHRES   1      2
 *** SUB-CATCHMENT 2 10% of area GW goes to vaca 90% goes to sound
PERLND  16                        5.56     RCHRES   2      6
PERLND  26                      200.05     RCHRES   2      6
PERLND  34                        0.46     RCHRES   2      6
PERLND  44                       38.71     RCHRES   2      6
PERLND  16                        0.56     RCHRES 135      7
PERLND  26                       20.01     RCHRES 135      7
PERLND  34                        0.05     RCHRES 135      7
```

```
PERLND  44                          3.87     RCHRES 135         7
IMPLND  14                         42.22     RCHRES   2         2
 *** SUB-CATCHMENT 23 New subbasin 15 % OF GW GOES TO VACCA 85% TO SOUND
PERLND  16                          3.09     RCHRES  23         6
PERLND  26                        156.15     RCHRES  23         6
PERLND  34                          2.25     RCHRES  23         6
PERLND  44                         45.84     RCHRES  23         6
PERLND  16                          0.46     RCHRES 135         7
PERLND  26                         23.42     RCHRES 135         7
PERLND  34                          0.34     RCHRES 135         7
PERLND  44                          6.88     RCHRES 135         7
IMPLND  14                         58.44     RCHRES  23         2
 *** SUB-CATCHMENT 24 New subbasin 60 % OF GW GOES TO 11 40% TO SOUND
PERLND  16                          ****     RCHRES  24         6
PERLND  26                        135.43     RCHRES  24         6
PERLND . 34                         2.02     RCHRES  24         6
PERLND  44                         69.29     RCHRES  24         6
PERLND  16                          ****     RCHRES  11         7
PERLND  26                         81.26     RCHRES  11         7
PERLND  34                          1.21     RCHRES  11         7
PERLND  44                         41.57     RCHRES  11         7
IMPLND  14                         79.98     RCHRES  24         2
  *** SUB-CATCHMENT 3 agwo goes to vaca(135)
PERLND  16                          8.26     RCHRES   3         6
PERLND  26                        108.38     RCHRES   3         6
PERLND  34                         16.02     RCHRES   3         6
PERLND  44                        102.89     RCHRES   3         6
PERLND  54                          0.04     RCHRES   3         6
PERLND  16                          8.26     RCHRES 135         7
PERLND  26                        108.38     RCHRES 135         7
PERLND  34                         16.02     RCHRES 135         7
PERLND  44                        102.89     RCHRES 135         7
PERLND  54                          0.04     RCHRES 135         7
IMPLND  14                         27.30     RCHRES   3         2
  *** SUB-CATCHMENT 4 10% of agwo goes to rchres 90% goes to sound
PERLND  16                          2.95     RCHRES   4         6
PERLND  26                         85.95     RCHRES   4         6
PERLND  34                          3.75     RCHRES   4         6
PERLND  44                         92.06     RCHRES   4         6
PERLND  16                          0.30     RCHRES   4         7
PERLND  26                          8.60     RCHRES   4         7
PERLND  34                          0.38     RCHRES   4         7
PERLND  44                          9.21     RCHRES   4         7
IMPLND  14                         16.43     RCHRES   4         2
  *** SUB-CATCHMENT 4a 70% of agwo goes to rchres 30% goes to sound
PERLND  16                          8.66     RCHRES   4         6
PERLND  26                         61.64     RCHRES   4         6
PERLND  34                         22.06     RCHRES   4         6
PERLND  44                         78.09     RCHRES   4         6
PERLND  54                         12.50     RCHRES   4         6
PERLND  16                          6.06     RCHRES   4         7
PERLND  26                         43.15     RCHRES   4         7
PERLND  34                         15.44     RCHRES   4         7
PERLND  44                         54.66     RCHRES   4         7
PERLND  54                          8.75     RCHRES   4         7
IMPLND  14                         29.14     RCHRES   4         2
  *** SUB-CATCHMENT 5
PERLND  26                         10.29     RCHRES   5         1
PERLND  44                         50.05     RCHRES   5         1
PERLND  54                         10.74     RCHRES   5         1
IMPLND  14                         16.31     RCHRES   5         2
  *** SUB-CATCHMENT 6
PERLND  16                          1.43     COPY   645        21
PERLND  26                         20.37     COPY   645        21
PERLND  34                         13.43     COPY   645        21
PERLND  44                         11.79     COPY   645        21
PERLND  54                          0.82     COPY   645        21
```

```
IMPLND  14                         6.23      COPY   645       22
  *** SUB-CATCHMENT 8
PERLND  44                        22.21      RCHRES  35        1
IMPLND  14                         6.60      RCHRES  35        2
  *** SUB-CATCHMENT 9
PERLND  16                         4.98      RCHRES  34        1
PERLND  26                        14.38      RCHRES  34        1
PERLND  34                         0.05      RCHRES  34        1
PERLND  44                        56.71      RCHRES  34        1
PERLND  54                         0.01      RCHRES  34        1
IMPLND  14                        22.47      RCHRES  34        2
  *** SUB-CATCHMENT 10
PERLND  16                         4.15      RCHRES  10        1
PERLND  26                        31.94      RCHRES  10        1
PERLND  44                        95.23      RCHRES  10        1
IMPLND  14                        71.98      RCHRES  10        2
  *** SUB-CATCHMENT 11 25% OF AGWO GOES TO 15
PERLND  16                         0.89      RCHRES  11        6
PERLND  26                       217.92      RCHRES  11        6
PERLND  34                         1.32      RCHRES  11        6
PERLND  44                        65.65      RCHRES  11        6
PERLND  16                         0.67      RCHRES  11        7
PERLND  26                       163.44      RCHRES  11        7
PERLND  34                         0.99      RCHRES  11        7
PERLND  44                        49.24      RCHRES  11        7
PERLND  16                         0.22      RCHRES  15        7
PERLND  26                        54.48      RCHRES  15        7
PERLND  34                         0.33      RCHRES  15        7
PERLND  44                        16.41      RCHRES  15        7
IMPLND  14                       230.80      RCHRES  11        2
  *** SUB-CATCHMENT 12
PERLND  16                         0.39      RCHRES  12        1
PERLND  26                       101.18      RCHRES  12        1
PERLND  34                         5.64      RCHRES  12        1
PERLND  44                        54.98      RCHRES  12        1
PERLND  54                         0.64      RCHRES  12        1
IMPLND  14                        79.83      RCHRES  12        2
  *** SUB-CATCHMENT 13
PERLND  16                         0.79      RCHRES  13        1
PERLND  26                       197.68      RCHRES  13        1
IMPLND  14                        27.66      RCHRES  13        2
  *** SUB-CATCHMENT 14 50% OF AGWO GOES TO SOUND
PERLND  16                         0.24      RCHRES  14        6
PERLND  26                       118.67      RCHRES  14        6
PERLND  34                        13.46      RCHRES  14        6
PERLND  44                        41.91      RCHRES  14        6
PERLND  16                         0.12      RCHRES  14        7
PERLND  26                        59.34      RCHRES  14        7
PERLND  34                         6.73      RCHRES  14        7
PERLND  44                        20.96      RCHRES  14        7
IMPLND  14                        20.66      RCHRES  14        2
  *** SUB-CATCHMENT 15
PERLND  16                         6.59      RCHRES  15        1
PERLND  26                        49.55      RCHRES  15        1
PERLND  34                        50.09      RCHRES  15        1
PERLND  44                        86.52      RCHRES  15        1
IMPLND  14                        19.47      RCHRES  15        2
  *** SUB-CATCHMENT 16
PERLND  16                        10.93      RCHRES  16        1
PERLND  26                        30.30      RCHRES  16        1
PERLND  34                        20.03      RCHRES  16        1
PERLND  44                        31.43      RCHRES  16        1
IMPLND  14                        15.62      RCHRES  16        2
  *** SUB-CATCHMENT 17 AGWO GOES TO SOUND
PERLND  16                         0.90      RCHRES  17        6
PERLND  26                        16.31      RCHRES  17        6
PERLND  34                        34.82      RCHRES  17        6
```

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PERLND  44                          82.11     RCHRES  17        6
PERLND  54                           1.19     RCHRES  17        6
IMPLND  14                          10.49     RCHRES  17        2
  *** SUB-CATCHMENT MC-1 (revised by FK, 06/04/01)
PERLND  26                           0.17     RCHRES  52        1
PERLND  44                          11.15     RCHRES  52        1
PERLND  54                           0.27     RCHRES  52        1
IMPLND  14                           0.37     RCHRES  52        2
  *** SUB-CATCHMENT MC-2
PERLND  16                           0.08     RCHRES  53        1
PERLND  26                           0.64     RCHRES  53        1
PERLND  34                           6.66     RCHRES  53        1
PERLND  44                          10.41     RCHRES  53        1
PERLND  54                          15.25     RCHRES  53        1
IMPLND  14                           0.27     RCHRES  53        2
  *** SUB-CATCHMENT MC-3
PERLND  34                           5.53     RCHRES  54        1
PERLND  44                           5.03     RCHRES  54        1
PERLND  54                           1.27     RCHRES  54        1
IMPLND  14                           0.11     RCHRES  54        2
  *** SUB-CATCHMENT MC-4
PERLND  34                           0.05     RCHRES 135        1
PERLND  44                          19.47     RCHRES 135        1
PERLND  54                          14.72     RCHRES 135        1
IMPLND  14                           2.04     RCHRES 135        2
  *** SUB-CATCHMENT MC-5
PERLND  26                          13.49     RCHRES  35        1
PERLND  44                          31.13     RCHRES  35        1
PERLND  54                           7.60     RCHRES  35        1
IMPLND  14                           2.50     RCHRES  35        2
  *** SUB-CATCHMENT MC-6
PERLND  44                          13.56     RCHRES  35        1
PERLND  54                           0.99     RCHRES  35        1
IMPLND  14                           0.80     RCHRES  35        2
  *** SUB-CATCHMENT MC-7
PERLND  26                           9.23     COPY    55       21
PERLND  44                          30.54     COPY    55       21
PERLND  54                           3.47     COPY    55       21
IMPLND  14                           3.05     COPY    55       22

*** NOTE: SDN AGWO TO VACA FARMS (135), no AGWO to ponds

  *** SUB-CATCHMENT SDN-1
PERLND  16                           7.27     COPY    52       26
PERLND  26                           1.45     COPY    52       26
PERLND  34                           4.69     COPY    52       26
PERLND  44                           0.94     COPY    52       26
PERLND  54                           0.20     COPY    52       26
PERLND  16                           7.27     RCHRES 135        7
PERLND  26                           1.45     RCHRES 135        7
PERLND  34                           4.69     RCHRES 135        7
PERLND  44                           0.94     RCHRES 135        7
PERLND  54                           0.20     RCHRES 135        7
IMPLND  14                           1.59     COPY    52       22

  *** SUB-CATCHMENT SDN-1-LWR
PERLND  34                           4.01     COPY    52       26
PERLND  44                           0.96     COPY    52       26
PERLND  54                           0.07     COPY    52       26
PERLND  34                           4.01     RCHRES 135        7
PERLND  44                           0.96     RCHRES 135        7
PERLND  54                           0.07     RCHRES 135        7
IMPLND  14                           0.38     COPY    52       22

  *** SUB-CATCHMENT SDN-1-OFF
PERLND  16                          21.99     RCHRES  52        6
PERLND  26                           4.40     RCHRES  52        6
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PERLND  34                             3.96      RCHRES  52        6
PERLND  44                             0.79      RCHRES  52        6
PERLND  54                             1.67      RCHRES  52        6
PERLND  16                            21.99      RCHRES 135        7
PERLND  26                             4.40      RCHRES 135        7
PERLND  34                             3.96      RCHRES 135        7
PERLND  44                             0.79      RCHRES 135        7
PERLND  54                             1.67      RCHRES 135        7
IMPLND  14                             3.46      RCHRES  52        2

  *** SUB-CATCHMENT SDN-2X (TO POND)(revised by FK 06/02/01)
PERLND  16                             0.85      COPY    61       26
PERLND  26                             0.28      COPY    61       26
PERLND  34                             2.34      COPY    61       26
PERLND  44                             0.78      COPY    61       26
PERLND  16                             0.85      RCHRES 135        7
PERLND  26                             0.28      RCHRES 135        7
PERLND  34                             2.34      RCHRES 135        7
PERLND  44                             0.78      RCHRES 135        7
IMPLND  14                             ****      COPY    61       22

  *** SUB-CATCHMENT SDN-3 (TO POND)
PERLND  16                            35.89      COPY    43       26
PERLND  26                             7.18      COPY    43       26
PERLND  16                            35.89      RCHRES 135        7
PERLND  26                             7.18      RCHRES 135        7
IMPLND  14                             4.79      COPY    43       22

  *** SUB-CATCHMENT SDN-3X (TO POND)
PERLND  16                             4.71      COPY    43       26
PERLND  26                             1.57      COPY    43       26
PERLND  34                            13.89      COPY    43       26
PERLND  44                             4.63      COPY    43       26
PERLND  54                             0.57      COPY    43       26
PERLND  16                             4.71      RCHRES 135        7
PERLND  26                             1.57      RCHRES 135        7
PERLND  34                            13.89      RCHRES 135        7
PERLND  44                             4.63      RCHRES 135        7
PERLND  54                             0.57      RCHRES 135        7

  *** SUB-CATCHMENT SDN-4 (TO POND)
PERLND  16                            20.23      COPY    44       26
PERLND  26                             4.41      COPY    44       26
PERLND  34                             2.50      COPY    44       26
PERLND  44                             0.55      COPY    44       26
PERLND  16                            20.23      RCHRES 135        7
PERLND  26                             4.41      RCHRES 135        7
PERLND  34                             2.50      RCHRES 135        7
PERLND  44                             0.55      RCHRES 135        7
IMPLND  14                             2.63      COPY    44       22

  *** SUB-CATCHMENT SDN-4X (TO POND)
PERLND  16                             2.43      COPY    44       26
PERLND  26                             0.59      COPY    44       26
PERLND  34                             8.96      COPY    44       26
PERLND  44                             2.16      COPY    44       26
PERLND  16                             2.43      RCHRES 135        7
PERLND  26                             0.59      RCHRES 135        7
PERLND  34                             8.96      RCHRES 135        7
PERLND  44                             2.16      RCHRES 135        7
IMPLND  14                             1.05      COPY    44       22

*** EXTRA POND TRIBUTARY FLOWS:

  *** SUB-CATCHMENT IWS-NCPS (TO POND)
PERLND  16                            26.79      COPY   242       26
PERLND  26                             5.36      COPY   242       26
```

PERLND	16	26.79	RCHRES	135	7
PERLND	26	5.36	RCHRES	135	7
IMPLND	14	3.57	COPY	242	22

*** SUB-CATCHMENT IWS-NSMPS (TO POND)

PERLND	16	2.80	COPY	240	26
PERLND	26	0.91	COPY	240	26
PERLND	34	2.17	COPY	240	26
PERLND	44	0.70	COPY	240	26
PERLND	16	2.80	RCHRES	135	7
PERLND	26	0.91	RCHRES	135	7
PERLND	34	2.17	RCHRES	135	7
PERLND	44	0.70	RCHRES	135	7
IMPLND	14	0.04	COPY	240	22

*** SUB-CATCHMENT NEPL (TO POND)

PERLND	16	23.15	COPY	45	26
PERLND	26	4.63	COPY	45	26
PERLND	34	8.57	COPY	45	26
PERLND	44	1.71	COPY	45	26
PERLND	16	23.15	RCHRES	135	7
PERLND	26	4.63	RCHRES	135	7
PERLND	34	8.57	RCHRES	135	7
PERLND	44	1.71	RCHRES	135	7
IMPLND	14	4.23	COPY	45	22

*** SUB-CATCHMENT CARGO (TO POND)

PERLND	16	6.09	COPY	46	26
PERLND	26	1.22	COPY	46	26
PERLND	16	6.09	RCHRES	135	7
PERLND	26	1.22	RCHRES	135	7
IMPLND	14	0.81	COPY	46	22

*** SUB-CATCHMENT SDN3A (TO POND)

PERLND	16	4.26	COPY	37	26
PERLND	26	1.07	COPY	37	26
PERLND	34	18.43	COPY	37	26
PERLND	44	4.63	COPY	37	26
PERLND	54	0.19	COPY	37	26
PERLND	16	4.26	RCHRES	135	7
PERLND	26	1.07	RCHRES	135	7
PERLND	34	18.43	RCHRES	135	7
PERLND	44	4.63	RCHRES	135	7
PERLND	54	0.19	RCHRES	135	7
IMPLND	14	1.87	COPY	37	22

*** SUB-CATCHMENT SDW1A (TO POND)

PERLND	16	19.29	COPY	47	26
PERLND	26	5.98	COPY	47	26
PERLND	34	18.40	COPY	47	26
PERLND	44	5.50	COPY	47	26
PERLND	54	2.96	COPY	47	26
PERLND	16	19.29	RCHRES	135	7
PERLND	26	5.98	RCHRES	135	7
PERLND	34	18.40	RCHRES	135	7
PERLND	44	5.50	RCHRES	135	7
PERLND	54	2.96	RCHRES	135	7
IMPLND	14	0.87	COPY	47	22

*** SUB-CATCHMENT SDW1B (TO POND)

PERLND	16	45.57	COPY	57	26
PERLND	26	12.23	COPY	57	26
PERLND	34	21.27	COPY	57	26
PERLND	44	5.71	COPY	57	26
PERLND	54	7.74	COPY	57	26
PERLND	16	45.57	RCHRES	135	7
PERLND	26	12.23	RCHRES	135	7

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PERLND  34                                   21.27      RCHRES 135        7
PERLND  44                                    5.71      RCHRES 135        7
PERLND  54                                    7.74      RCHRES 135        7
IMPLND  14                                    4.34      COPY    57       22

  *** ADD SUB-CATCHMENT IWS-PRIMARY TO PREDEVELOPEMENT ONLY
PERLND  16                                   26.61      RCHRES  52        6
PERLND  26                                    5.32      RCHRES  52        6
PERLND  34                                    6.22      RCHRES  52        6
PERLND  44                                    1.24      RCHRES  52        6
PERLND  16                                   26.61      RCHRES 135        7
PERLND  26                                    5.32      RCHRES 135        7
PERLND  34                                    6.22      RCHRES 135        7
PERLND  44                                    1.24      RCHRES 135        7
IMPLND  14                                    4.38      RCHRES  52        2

***ROUTING FOR MILLER CREEK
*** M1 TO M2 TO M3 TO STORAGE 50.  M4 TO M5 TO STORAGE 50
RCHRES   1                                              RCHRES   2        4
RCHRES  23                                              RCHRES  24        4
RCHRES  24                                              RCHRES   3        3
RCHRES   2                                              RCHRES   3        3
RCHRES   3                                              RCHRES  33        3
RCHRES  33                                              RCHRES  50        3
RCHRES   4                                              RCHRES   5        4
RCHRES   5                                              RCHRES  50        3
*** PONDS TO 52, 53 & 54
COPY   242                                              COPY   240       10
COPY   240                                              COPY    61       10
COPY    61                                              COPY    51       10
COPY    43                                              RCHRES  54       12
COPY    44                                              COPY    51       10
COPY    51                                              RCHRES  52       12
COPY    52                                              RCHRES  52       12
COPY    45                                              COPY   645       10
COPY   645                                              RCHRES  53       12
COPY    46                                              RCHRES  53       12
*** NEW STREAM REACH 52 TO LAKE REBA 53 TO RDF 54 (Revised by FK)
RCHRES  52                                              RCHRES  53        3
RCHRES  53                                              COPY    53       11
COPY    53                                              RCHRES  54       12
RCHRES  50                                              RCHRES  54        3
*** RDF 54 TO 35
RCHRES  54                                              RCHRES 135        3
*** PONDS TO 34
COPY    37                                              COPY    39       10
COPY    47                                              COPY    39       10
COPY    39                                              RCHRES 135       12
RCHRES  34                                              RCHRES 135        4
RCHRES  34                                              RCHRES 135        5
RCHRES 135                                              RCHRES  35        3
RCHRES  10                                              RCHRES  16        3
*** PONDS TO 35
COPY    57                                              RCHRES  35       12
RCHRES  35                                              COPY    55       11
COPY    55                                              RCHRES  16       12
RCHRES  11                                              RCHRES  15        3
RCHRES  13                                              RCHRES  12        4
RCHRES  13                                              RCHRES  12        5
RCHRES  12                                              RCHRES  15        3
RCHRES  16                                              RCHRES  15        3
RCHRES  14                                              RCHRES  17        3
RCHRES  15                                              RCHRES  17        3
END SCHEMATIC

NETWORK
***         <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>        <-MEMBER->
```

```
<NAME>    # <NAME>    TEM STRG<-FACTOR->STRG <NAME>    #    # <-GRP> <NAME> # # ***
END NETWORK                                                                    ***

RCHRES
  GEN-INFO                                                                     ***
    RCHRES          Name          Nexits  Unit Systems   Printer               ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG               ***
                                               in   out
    1       Arbor Lake  M 1          2     1    1    1    62    0    0
    2       Arbor Ck -03710 M 2      1     1    1    1    62    0    0
    3       Arbor Ck    M 3          1     1    1    1    62    0    0
    4       Tub Lake    M 4          2     1    1    1    62    0    0
    5       Miller Ck SR518 M5       1     1    1    1    62    0    0
   10       Trib (0371G)    M 10     1     1    1    1    62    0    0
   11       Mil Ambaum Detention     1     1    1    1    62    0    0
   12       Trib(0354)   M 12        1     1    1    1    62    0    0
   13       Burien Lake M 13         2     1    1    1    62    0    0
   14       Trib (0353) M 14         1     1    1    1    62    0    0
   15       M/S U/S OF 17            1     1    1    1    62    0    0
   16       U/S OF 15 M/S            1     1    1    1    62    0    0
   17       GAGE                     1     1    1    1    62    0    0
   23       BASIN M23                2     1    1    1    62    0    0
   24       BASIN M24                1     1    1    1    62    0    0
   33       detention m3             1     1    1    1    62    0    0
   34       LORA LAKE                2     1    1    1    62    0    0
   35       D/S OF VACA FARM         1     1    1    1    62    0    0
***37       sdn3a pond               1     1    1    1    62    0    0
   38       MC basins                1     1    1    1    62    0    0
***39       sdn3a/sdw1a              1     1    1    1    62    0    0
***43       sdn3 pond                1     1    1    1    62    0    0
***44       sdn4 pond                1     1    1    1    62    0    0
***45       nepl pond                1     1    1    1    62    0    0
***46       cargo pond               1     1    1    1    62    0    0
***47       sdw1a pond               1     1    1    1    62    0    0
   50       sr 518                   1     1    1    1    62    0    0
***51       sdn4x/2x basins          1     1    1    1    62    0    0
   52       U/S OF LAKE REBA         1     1    1    1    62    0    0
   53       Reba outflow             1     1    1    1    62    0    0
   54       Miller RDF outflow       1     1    1    1    62    0    0
***55       MC7                      1     1    1    1    62    0    0
***57       sdw1b pond               1     1    1    1    62    0    0
***61       sdn2x pond               1     1    1    1    62    0    0
  135       VACA FARMS               1     1    1    1    62    0    0
***240       iws-nsmps pond           1     1    1    1    62    0    0
***242       iws-nsmps                1     1    1    1    62    0    0
***645       nepl poc                 1     1    1    1    62    0    0
  END GEN-INFO

  ACTIVITY
    RCHRES *************** Active Sections ****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG                   ***
    1  200    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    RCHRES *************** Printout Flags ***************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
    1  200    5    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                        ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each      FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit       possible  exit
             *  *  *  *    *   *   *   *   *     *   *   *   *   *         ***
    1        0  1  0  0    4   5   0   0   0     0   0   0   0   0       2   2   2   2   2
    2        0  0  0  0    4   0   0   0   0     0   0   0   0   0       2   2   2   2   2
```

```
  3            0  0  0  0     4  0  0  0  0     0  0  0  0  0     [illegible]
  4            0  1  0  0     4  5  0  0  0     0  0  0  0  0     [illegible]
  5    10      0  0  0  0     4  0  0  0  0     0  0  0  0  0     [illegible]
 13            0  1  0  0     4  5  0  0  0     0  0  0  0  0     [illegible]
 14    21      0  0  0  0     4  0  0  0  0     0  0  0  0  0     [illegible]
 23            0  1  0  0     4  5  0  0  0     0  0  0  0  0     [illegible]
 24    33      0  0  0  0     4  0  0  0  0     0  0  0  0  0     [illegible]
 34            0  1  0  0     4  5  0  0  0     0  0  0  0  0     [illegible]
 35   200      0  0  0  0     4  0  0  0  0     0  0  0  0  0     [illegible]
END HYDR-PARM1

HYDR-PARM2
  RCHRES                                                                  ***
  #  -  #     FTABNO        LEN     DELTH     STCOR        KS      DB50   ***
<------><--------><--------><--------><--------><--------><-------->      ***
  1              1   0.010                                0.3
  2              2   0.776                                0.3
  3              3   0.980                                0.3
  4              4   0.010                                0.3
  5              5   0.380                                0.3
 10             10   0.380                                0.3
 11             11   0.010                                0.3
 12             12   1.000                                0.3
 13             13   0.015                                0.3
 14             14   0.450                                0.3
 15             15   0.735                                0.3
 16             16   0.587                                0.3
 17             17   0.379                                0.3
 23             23   0.379              300.0             0.3
 24             24   0.379                                0.3
 33             33   0.200                                0.3
 34             34   0.852                                0.3
 35             35   0.663                                0.3
 38             38   0.010                                0.3
 50             50   0.010                                0.3
 52             52   0.010                                0.3
 53             53   0.010                                0.3
 54             54   0.010                                0.3
135            135   0.350                                0.3
END HYDR-PARM2

HYDR-INIT
  RCHRES  Initial conditions for each HYDR section                        ***
  #  -  # ***   VOL     Initial  value  of COLIND    Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
<------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  1     2.0              4.0  5.0
  2     0.0              4.0
  3     0.0              4.0
  4     2.0              4.0  5.0
  5     0.0              4.0
 10     0.0              4.0
 11     0.0              4.0
 12     0.0              4.0
 13    10.0              4.0  5.0
 14     0.0              4.0
 15     0.0              4.0
 16     0.0              4.0
 17     0.0              4.0
 23     6.0              4.0  5.0
 24     0.0              4.0
 33     0.0              4.0
 34     9.0              4.0  5.0
 35     0.1              4.0
 38     0.1              4.0
 50     0.0              4.0
 52     0.0              4.0
```

```
  53      0.1                 4.0
  54      2.25                4.0
 135      0.00                4.0
  END HYDR-INIT
END RCHRES

FTABLES
***UPPER BASIN
***===========

  FTABLE      1
 ROWS COLS ***
  11    5
     DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.00        3.00      0.00       0.00     0.00
     2.50        3.00      7.50       0.00     0.11
     3.00        3.00      9.00       1.80     0.11
     3.50        3.30     10.58       5.00     0.11
     4.00        3.60     12.30      10.90     0.11
     4.50        3.90     14.18      17.50     0.11
     5.00        4.10     16.18      26.20     0.11
     5.50        4.30     18.28      32.50     0.11
     6.00        4.50     20.48      35.90     0.11
     7.00        5.00     25.23      38.10     0.11
     8.00        5.50     30.48      46.40     0.11
  END FTABLE  1

  FTABLE      2
 ROWS COLS ***
   9    4
     DEPTH       AREA     VOLUME    OUTFLOW     ***
     0.000     0.0000     0.0000       0.00
     0.100     0.2571     0.0129       0.16
     0.500     0.3873     0.1417       6.53
     1.000     0.5501     0.3761      25.95
     1.500     0.7128     0.6918      59.86
     2.000     0.8756     1.0889     110.67
     3.000     1.2011     2.1273     272.24
     3.500     1.3639     2.7685     387.38
     4.000     1.5266     3.4912     528.19
  END FTABLE  2

  FTABLE      3
 ROWS COLS ***
  12    4
     DEPTH       AREA     VOLUME    OUTFLOW     ***
     0.000     0.0000     0.0000       0.00
     0.100     0.9669     0.0483       0.13
     0.500     1.0637     0.4545       4.92
     1.000     1.1846     1.0165      17.12
     1.500     1.3055     1.6390      34.92
     2.000     1.4264     2.3220      57.95
     2.500     1.5473     3.0654      86.14
     3.000     1.6682     3.8693     119.53
     3.500     1.7891     4.7336     158.24
     4.000     1.9100     5.6584     202.41
     4.500     2.0294     6.6310     251.52
     5.000     2.1488     7.6624     306.28
  END FTABLE  3

  FTABLE      4
 ROWS COLS ***
   7    5
     DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
      0.00     3.00     0.00       0.00       0.00
      2.50     4.50     9.38       0.00       0.11
      3.00     6.00     12.00      6.00       0.11
```

```
     4.00      10.00      20.00      13.00      0.11
     5.00      15.00      32.50      20.00      0.11
     6.00      20.00      50.00      26.00      0.11
     7.00      25.00      72.50     168.00      0.11
 END FTABLE  4

 FTABLE      5
ROWS COLS ***
  10    4
   DEPTH      AREA     VOLUME    OUTFLOW    ***
   0.000    0.0000     0.0000       0.00
   0.100    0.1010     0.0051       0.03
   0.500    0.1754     0.0603       1.46
   1.000    0.2684     0.1713       6.16
   1.500    0.3614     0.3288      14.89
   2.000    0.4544     0.5327      28.48
   2.500    0.5474     0.7832      47.70
   3.000    0.6404     1.0801      73.29
   3.500    0.7334     1.4236     105.94
   4.000    0.8264     1.8136     146.33
 END FTABLE  5

 FTABLE     10
ROWS COLS ***
   9    4
   DEPTH      AREA     VOLUME    OUTFLOW    ***
   0.000    0.0000     0.0000       0.00
   0.100    0.1010     0.0051       0.06
   0.500    0.1660     0.0585       2.27
   1.000    0.2472     0.1618       9.32
   1.500    0.3285     0.3057      22.08
   2.000    0.4097     0.4902      41.66
   2.500    0.4909     0.7154      69.09
   3.000    0.5722     0.9811     105.37
   4.000    0.6887     1.6116     209.70
 END FTABLE 10

 POST AMBAUM DETENTION ***
 FTABLE     11
ROWS COLS ***
  11    4
   DEPTH      AREA     VOLUME    OUTFLOW    ***
   0.000    0.0000     0.0000       0.00
   1.000    0.1000     0.2300       3.90
   2.000    0.2000     0.6000       6.30
   3.000    0.3000     0.9700       8.10
   4.000    0.4000     1.3400      11.10
   5.000    0.5000     1.8200      16.00
   6.000    0.6000     2.2700      19.10
   7.000    0.7000     2.8300      21.60
   8.000    0.8000     3.3700      30.80
   9.000    0.9000     4.0000      38.10
  10.000    1.0000     4.6500      74.10
  10.500    1.1000     5.2000     133.00
  11.000    1.1500     5.3000     500.00
 END FTABLE 11

 FTABLE     12
ROWS COLS ***
   6    4
   DEPTH      AREA     VOLUME    OUTFLOW    ***
   0.000    0.0000     0.0000       0.00
   0.100    0.6327     0.0316       0.15
   0.500    0.7960     0.3174       5.87
   1.000    1.0002     0.7664      21.53
   1.500    1.2043     1.3176      46.43
   2.000    1.4085     1.9708      81.20
```

```
     3.000    1.8168     3.5834     183.79
     4.000    2.2251     5.6044     336.22
     5.000    2.6335     8.0337     545.30
     6.000    3.0418    10.8713     817.51
 END FTABLE 12

 FTABLE     13
ROWS COLS ***
   7    5
    DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
    0.000     40.000     0.0000       0.00     0.00
    1.000     41.400     40.000       0.00     0.11
    1.500     42.000     60.000      10.00     0.11
    2.000     42.700     80.000      16.00     0.11
    2.500     43.300     100.00      20.00     0.11
    3.000     44.000     120.00      28.00     0.11
    5.000     45.000     210.00      45.00     0.11
 END FTABLE 13

 FTABLE     14
ROWS COLS ***
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000     0.0000     0.0000       0.00
    0.100     0.3361     0.0168       0.24
    0.500     0.3809     0.1602       9.04
    1.000     0.4370     0.3647      31.61
    1.500     0.4930     0.5972      65.00
    2.000     0.5491     0.8577     108.85
    2.500     0.6051     1.1462     163.33
    3.000     0.6612     1.4628     228.78
 END FTABLE 14

 FTABLE     15
ROWS COLS ***
   4    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.00       0.10       0.00       0.00
     1.00       1.00       0.55      91.00
     2.00       1.10       1.60     268.00
     3.00       1.20       2.75     493.00
 END FTABLE 15

 FTABLE     16
ROWS COLS ***
   4    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.00       0.10       0.00       0.00
     1.00       1.00       0.55      74.00
     2.00       1.10       1.60     219.00
     3.00       1.20       2.75     403.00
 END FTABLE 16

 FTABLE     17
ROWS COLS ***
   5    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.00       0.10       0.00       0.00
     1.00       1.00       0.55      59.00
     2.00       1.10       1.60     173.00
     3.00       1.20       2.75     318.00
     4.00       1.30       4.00     484.00
 END FTABLE 17

 FTABLE     23
ROWS COLS ***   HERMES
   9    5
```

```
    DEPTH      AREA     VOLUME   OUTFLOW OUTFLOW   ***
     0.00      0.00      0.00      0.00    0.00           0.00
     5.00      0.50      1.91      0.00    0.00         305.00
    11.00      0.79      5.79      0.00    0.00         311.00
    15.00      1.13      9.64      0.50    0.01         315.00
    19.00      1.72     15.34      0.50    0.05         319.00
    29.00      2.86     38.25      0.50    0.10         329.00
    39.00      4.40     74.55      0.50    0.20         339.00
    50.00      6.22    132.98      0.50    0.30         350.00
    60.00     10.00   1212.98      0.50    0.40         360.00
 END FTABLE 23

 FTABLE      24
ROWS COLS ***
  9    4
    DEPTH      AREA     VOLUME   OUTFLOW   ***
    0.000    0.0000    0.0000      0.00
    0.100    0.2571    0.0129      0.16
    0.500    0.3673    0.1417      6.53
    1.000    0.5501    0.3761     25.95
    1.500    0.7128    0.6918     59.86
    2.000    0.8756    1.0889    110.67
    3.000    1.2011    2.1273    272.24
    3.500    1.3639    2.7685    387.38
    4.000    1.5266    3.4912    528.19
 END FTABLE 24

 FTABLE      33
ROWS COLS ***
 11    4
    DEPTH      AREA     VOLUME   OUTFLOW   ***
     0.00      1.00      0.00      0.00
     0.50      1.20      0.55      2.00
     1.00      1.40      1.20      6.00
     1.50      1.60      1.95      9.00
     2.00      1.80      2.80     13.00
     2.50      2.00      3.75     16.50
     3.00      2.20      4.80     20.00
     3.50      2.40      5.95     23.00
     4.00      2.60      7.20     26.00
     5.00      2.80      9.90    104.00
     6.00      3.00     12.80    246.00
 END FTABLE 33

 FTABLE      34
ROWS COLS *** REVISED 11/19/97 BASED ON HEC-RAS MODEL
  6    5
    DEPTH      AREA     VOLUME   OUTFLOW OUTFLOW2***
     0.00      3.00      0.00      0.00    0.00
     3.00      3.05      9.08      0.00    0.11
     4.00      3.10     12.15      0.00    0.11
     5.00      3.15     15.28      0.00    0.11
     6.00      3.20     18.45      72.0    0.11
     7.00      3.25     21.66     225.0    0.11
 END FTABLE 34

 FTABLE      35
ROWS COLS *** REVISED 11/19/97 BASED ON HECRAS MODEL
  5    4
    DEPTH      AREA     VOLUME   OUTFLOW   ***
     0.00      0.10      0.00      0.00
     1.00      1.10      0.60     38.00
     2.00      1.20      1.75    108.00
     3.00      1.30      3.00    194.00
     4.00      1.40      4.35    290.00
 END FTABLE 35
```

```
 FTABLE     38
ROWS COLS ***
   7    4
   DEPTH       AREA     VOLUME   OUTFLOW  ***
   0.000    0.0000    0.0000      0.00
   1.000    0.4000    0.4000      2.00
   1.500    0.5000    1.0000      4.00
   2.000    0.9000    1.3000     11.00
   2.500    1.3000    1.6000     15.00
   3.000    1.6000    2.0000     18.00
   3.500    1.9000    2.5000     20.80
 END FTABLE 38

 FTABLE     45
ROWS COLS ***
NORTH EMPLOYEE PARKING LOT VAULT (AS-BUILT)*** not used in predev run
  12    4
   DEPTH       AREA     VOLUME   OUTFLOW  ***
   0.000    0.2200    0.0000      0.00
   2.000    0.2200    0.4500      1.20
   4.000    0.2200    0.9000      1.70
   6.000    0.2200    1.3400      2.10
   8.000    0.2200    1.7900      2.40
  10.000    0.2200    2.2400      2.70
  12.240    0.2200    2.7400      3.00
  14.000    0.2200    3.1400      6.90
  15.440    0.2200    3.4600      8.30
  16.000    0.2200    3.5800     10.30
  18.000    0.2200    4.0300     13.60
  20.000    0.2200    4.4800     30.79
 END FTABLE 45

 FTABLE     50
ROWS COLS ***
  10    4
   DEPTH       AREA     VOLUME   OUTFLOW  ***
     0.00      1.00      0.00      0.00
     0.50      1.10      0.53      5.00
     1.00      1.20      1.10     15.00
     1.50      1.30      1.73     25.00
     2.00      1.40      2.40     35.00
     2.50      1.50      3.13     52.00
     3.00      1.60      3.90     70.00
     3.50      1.70      4.73     87.00
     4.00      1.80      5.60    105.00
     6.00      1.90      9.30    165.00
 END FTABLE 50

 FTABLE     52
ROWS COLS ***
   6    4
   DEPTH       AREA     VOLUME   OUTFLOW  ***
   0.000    0.0000    0.0000      0.00
   0.100    0.3680    0.0184      0.25
   0.500    0.3717    0.1664      9.39
   1.000    0.3763    0.3534     31.06
   2.000    0.3819    0.7325     94.37
   3.000    0.3874    1.1171    174.33
 END FTABLE 52

 FTABLE     53
OLD LAKE REBA                                ***
MAX DEPTH = 4.9 FEET                         ***
30" CMP, 40 CFS DISCHARGE AT MAX DEPTH       ***
ROWS COLS ***
   7    4
   DEPTH       AREA     VOLUME   OUTFLOW  ***
```

```
      0.000     2.4000     0.0000       0.00
      1.000     2.5800     2.5000      18.00
      2.000     2.9400     5.3000      26.00
      3.000     3.4100     8.4000      31.00
      4.000     3.8800     12.100      36.00
      4.900     4.3000     15.800      40.00
      6.000     4.3000     15.810     500.00
  END FTABLE 53

  FTABLE     54
 EXISTING MILLER CREEK DETENTION FACILITY*** REVISED STORAGE/Q DATA
 GATE SETTING: 2.0 FEET***
 ROWS COLS ***
   12    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.000       0.00       0.00       0.00
     1.300       0.01       0.01      10.00
     2.000       0.01       0.02      20.00
     2.900       0.70       0.40      30.00
     4.000       1.50       1.50      40.00
     5.400       3.50       4.90      50.00
     7.000       8.60      13.30      60.00
     8.800      15.60      34.80      70.00
    10.000      19.90      57.30      76.00
    10.500      21.50      68.00      92.00
    11.000      23.10      78.80     179.00
    11.500      24.70      88.60     303.00
  END FTABLE 54

  FTABLE     69
 PRE-MILLER CREEK DETENTION FACILITY***
 ROWS COLS ***
   12    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.000     0.0000     0.0000       0.00
     0.100     0.1860     0.0093       0.12
     0.500     0.2552     0.0975       4.84
     1.000     0.3417     0.2467      18.49
     1.500     0.4282     0.4392      41.30
     2.000     0.5148     0.6750      74.40
     2.500     0.6013     0.9540     119.01
     3.000     0.6878     1.2763     176.30
     3.500     0.7744     1.6418     247.41
     4.000     0.8609     2.0506     333.43
     4.500     0.9470     2.4992     434.59
     5.000     1.0331     2.9905     552.33
  END FTABLE 69

  PRE AMBAUM DETENTION ***
  FTABLE    111
 ROWS COLS ***
   12    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.000     0.0000     0.0000       0.00
     0.500     0.2160     0.0750       5.30
     1.000     0.2730     0.1990      21.10
     1.500     0.2890     0.3410      43.90
     2.000     0.2900     0.4830      68.80
     2.500     0.2910     0.6070      89.10
     3.000     0.2950     0.6820      90.00
     3.500     0.3000     2.1000     100.00
     4.000     0.3050     2.5000     105.00
     4.500     0.3100     3.0000     110.00
     5.000     0.3200     3.5000     120.00
     5.500     0.3300     4.0000     130.00
  END FTABLE111
```

```
  FTABLE     135
 ROWS COLS *** VACA FARM
    6    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
      0.00       0.10      0.00       0.00
      1.00       0.10      0.10       4.00
      2.00       0.11      0.21       8.00
      2.50       1.00      0.48      13.00
      3.50       6.50      4.23      86.00
      4.50      13.00     13.98     235.00
  END FTABLE135
END FTABLES

MASS-LINK
***
*** NOTE: MFACTOR 0.083 CONVERTS ACRE-INCHES TO ACRE-FT (1/12)
***
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>        <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                 <Name> # #***
  MASS-LINK        1
PERLND     PWATER PERO        0.0833333    RCHRES          INFLOW IVOL
  END MASS-LINK    1

  MASS-LINK        2
IMPLND     IWATER SURO        0.0833333    RCHRES          INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
RCHRES     ROFLOW                          RCHRES          INFLOW
  END MASS-LINK    3

  MASS-LINK        4
RCHRES     OFLOW  OVOL   1                 RCHRES          INFLOW IVOL
  END MASS-LINK    4

  MASS-LINK        5
RCHRES     OFLOW  OVOL   2                 RCHRES          INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
PERLND     PWATER SURO        0.0833333    RCHRES          INFLOW IVOL
PERLND     PWATER IFWO        0.0833333    RCHRES          INFLOW IVOL
  END MASS-LINK    6

  MASS-LINK        7
PERLND     PWATER AGWO        0.0833333    RCHRES          INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK       10
COPY       OUTPUT MEAN                     COPY            INPUT  MEAN
  END MASS-LINK   10

  MASS-LINK       11
RCHRES     ROFLOW                          COPY            INPUT  MEAN
  END MASS-LINK   11

  MASS-LINK       12
COPY       OUTPUT MEAN                     RCHRES          INFLOW IVOL
  END MASS-LINK   12

  MASS-LINK       21
PERLND     PWATER PERO        0.0833333    COPY            INPUT  MEAN
  END MASS-LINK   21

  MASS-LINK       22
IMPLND     IWATER SURO        0.0833333    COPY            INPUT  MEAN
  END MASS-LINK   22
```

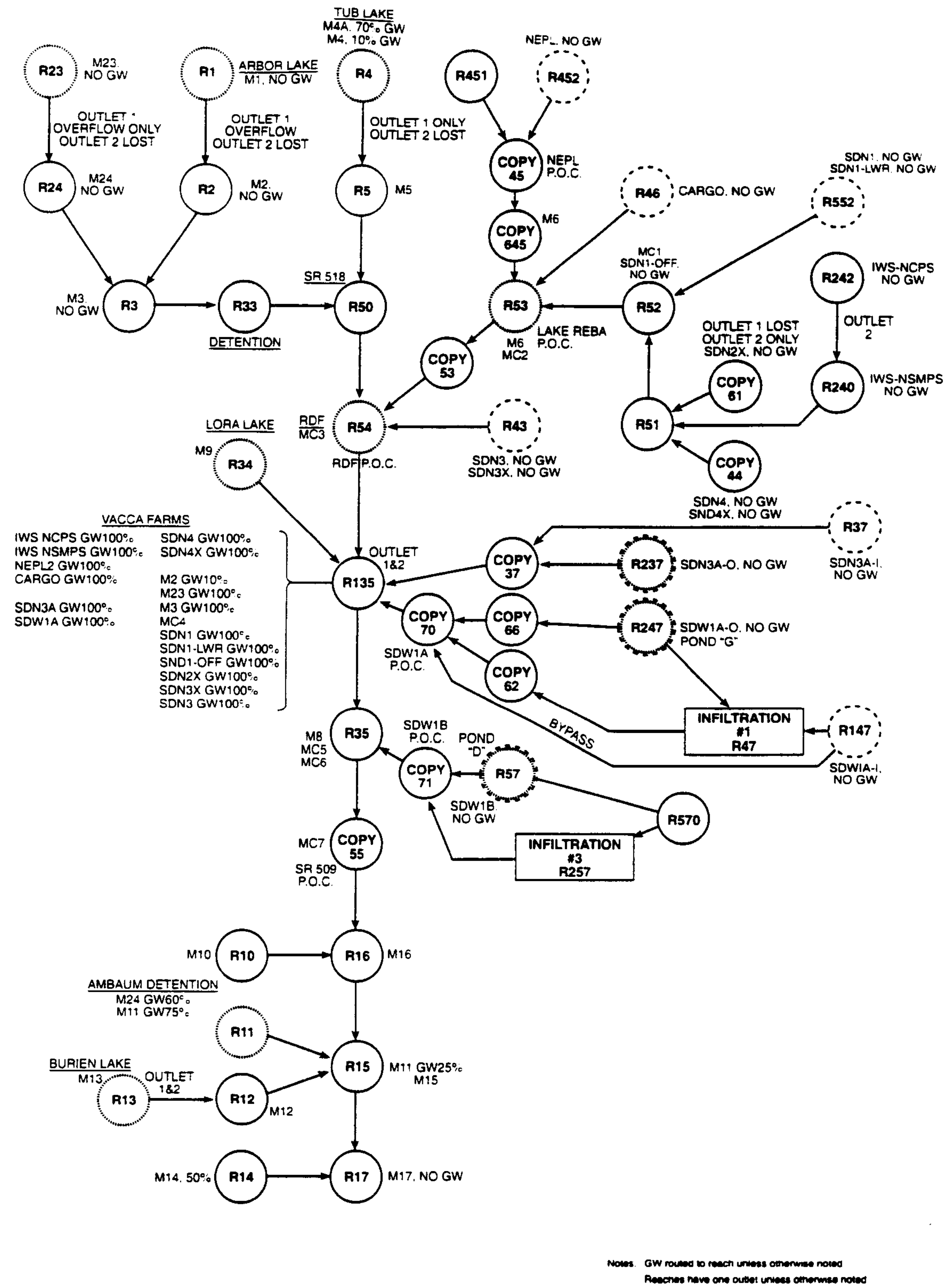
```
  MASS-LINK        26
PERLND      PWATER SURC          0.0833333      COPY              INPUT  MEAN
PERLND      PWATER IFWO          0.0833333      COPY              INPUT  MEAN
  END MASS-LINK    26

  MASS-LINK        27
PERLND      PWATER AGWO          0.0833333      COPY              INPUT  MEAN
  END MASS-LINK    27
END MASS-LINK

COPY
  TIMESERIES
  Copy-opn
    # -  #  NPT  NMN
   37   61         1
  240  242         1
  645  645         1
  END TIMESERIES
END COPY

END RUN
```

2006 CONDITIONS

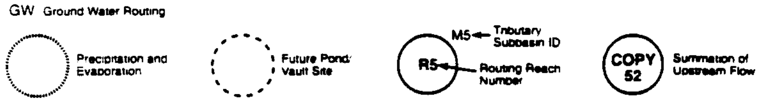


Notes: GW routed to reach unless otherwise noted
Reaches have one outlet unless otherwise noted
Reach table # is the same as reach # unless otherwise noted

Parametrix, Inc.

July 2001
556-2912-001 (28)

GW Ground Water Routing



Miller Creek
Project Condition HSPF
Model Routing Schematic

AR 046859

```
RUN
GLOBAL
  ***  SEATAC AIRPORT HSPF BASIN MODEL OF MILLER CREEK
  ***  FILE: MC23inif.INP - 2006 future condition
  ***
  ***  BASED ON MILL64.INP FILE FROM AQUA TERRA
  ***  MC22WDM:
  ***  ADDED PERLND 47,57,
  ***  ADDED GROUND WATER INFILTRATION TO WDM FOR USE WITH MCAGWO.INP
  ***  FK revised SDW1A and SDW1B with flow splitters, storages at SDN3/3X, SDN2X/4X;
  ***  FK revised MC-1 and SDN-2X land uses, added POC at Lake Reba, removed run-of-river
tables
  ***  FK added POC downstream of facilities SDW1A and SDW1B
  MILLER CREEK BASIN HSPF MODEL
*** START       1994  1  1  0  0  END    1996  8 30 24  0
  START       1948 10  1  0  0  END    1997  1 31 24  0
  RUN INTERP OUTPUT LEVEL    6
  RESUME     0 RUN     1
END GLOBAL

FILES
<type>  <fun>***<------------fname--------------------------------------------->
MESSU      24   MILL.MES
WDM        25   MCPOND23.WDM
           61   PER.L61
           62   RCH.L62
END FILES

OPN SEQUENCE
    INGRP              INDELT 01:00
      PERLND      16
      PERLND      26
      PERLND      34
      PERLND      44
      PERLND      45
      PERLND      47 ***
      PERLND      54
      PERLND      57 ***
      IMPLND      14
      RCHRES       1
      RCHRES      23
      RCHRES      24
      RCHRES       2
      RCHRES       3
      RCHRES      33
      RCHRES       4
      RCHRES       5
      RCHRES      50
      RCHRES     242
      RCHRES     240
      COPY        61
      COPY        44
      RCHRES      51
      RCHRES      43
      RCHRES     451
      RCHRES     452
      COPY        45
      COPY       645
      RCHRES      46
      RCHRES     552
      RCHRES      52
      RCHRES      53
      COPY        53
      RCHRES      54
      RCHRES      37
      RCHRES     237
      COPY        37
      RCHRES     147
      RCHRES     247
      COPY        66
      COPY        69
```

```
      RCHRES      47
      COPY        62
      COPY        63
      COPY        67
      COPY        68
*** --> output SDW1A infiltration discharge to WDM dataset 5 in in/ac <--
      COPY        47
      COPY        70
      RCHRES      34
      RCHRES     135
      RCHRES     570
      RCHRES      57
      RCHRES     257
      COPY        64
      COPY        65
      COPY       357
*** --> output SDW1B infiltration discharge to WDM dataset 6 in in/ac <--
      COPY        56
      COPY        57
      COPY        71
      RCHRES      35
      COPY        55
      RCHRES      10
      RCHRES      16
      RCHRES      11
      RCHRES      13
      RCHRES      12
      RCHRES      15
      RCHRES      14
      RCHRES      17
    END INGRP
END OPN SEQUENCE
                                                                            ***
PERLND
  GEN-INFO
    <PLS >      Name              NBLKS   Unit-systems   Printer            ***
    # -  #                              User  t-series Engl Metr            ***
                                              in  out                       ***
   16      TFM- TILL FOR MOD       1     1     1    1    61    0
   26      TGM- TILL GR MOD        1     1     1    1    61    0
   34      OF - OUTWASH FOR        1     1     1    1    61    0
   44      OG - OUTWASH GR         1     1     1    1    61    0
 ***PERLND FOR NEW AIRPORT FILL; NONE IN CALIBRATION
   45      AIRPORT FILL            1     1     1    1    61    0
   47      OG - INFILTRATION 1     1     1     1    1    61    0
   54      SA - WETLANDS           1     1     1    1    61    0
   57      OG - INFILTRATION 3     1     1     1    1    61    0
  END GEN-INFO
  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC      ***
   14  200    0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    <PLS > ******************** Print-flags *********************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
   14  200    0    0    5    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  PWAT-PARM1
    <PLS > **************** Flags *******************
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                    ***
   14  200    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1
  PWAT-PARM2
    <PLS > ***
    # -  # ***FOREST       LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16                    9.0000    0.3200    400.00    0.1000    0.5000    0.9960
   26                    9.0000    0.1200    400.00    0.1000    0.5000    0.9960
   34                   10.0000    2.0000    400.00    0.0500    0.3000    0.9960
   44                   10.0000    0.8000    400.00    0.0500    0.3000    0.9960
   45                    7.5000    0.0200    300.00    0.0700    0.0000    0.9960
```

```
  47                10.0000      0.8000      400.00     0.0500     0.3000     0.9960
  54                 8.0000      2.0000      100.00     0.0010     0.5000     0.9960
  57                10.0000      0.8000      400.00     0.0500     0.3000     0.9960
 END PWAT-PARM2
 PWAT-PARM3
   <PLS >***
   # -  #*** PETMAX     PETMIN     INFEXP     INFILD     DEEPFR     BASETP     AGWETP
  16                               2.0000     2.0000       0.33       0.00        0.0
  26                               2.0000     2.0000       0.33       0.           0.
  34                               2.0000     2.0000       0.33       0.00        0.0
  44                               2.0000     2.0000       0.33       0.           0.
  47                               2.0000     2.0000       0.33       0.           0.
  45                               2.0000     2.0000       0.33       0.           0.
  54                               10.000     2.0000       0.33       0.          0.7
  57                               2.0000     2.0000       0.33       0.           0.
 END PWAT-PARM3
 PWAT-PARM4
   <PLS >                                                            ***
   # -  #      CEPSC       UZSN       NSUR      INTFW        IRC     LZETP***
  16          0.2000     0.7500     0.3500      9.000     0.7000     0.7000
  26          0.1000     0.3750     0.2500      9.000     0.7000     0.2500
  34          0.2000     0.7500     0.3500      0.000     0.7000     0.7000
  44          0.1000     0.7500     0.2500      0.000     0.7000     0.2500
  47          0.1000     0.7500     0.2500      0.000     0.7000     0.2500
  45          0.1000     0.2800     0.2500      6.000     0.1500     0.6000
  54          0.1000     2.2500     0.5000      1.000     0.7000     0.8000
  57          0.1000     0.7500     0.2500      0.000     0.7000     0.2500

 END PWAT-PARM4
 PWAT-STATE1
   <PLS >  PWATER state variables***
   # -  #***    CEPS       SURS        UZS       IFWS        LZS       AGWS       GWVS
  16           0.078         0.     0.2500       0.10      2.000      2.000      0.000
  26           0.051         0.     0.2500       0.10      2.000      2.000      0.000
  34           0.078         0.     0.2500       0.10      2.000      2.000      0.000
  44           0.051         0.     0.2500       0.10      2.000      2.000      0.000
  47           0.051         0.     0.2500       0.10      2.000      2.000      0.000
  45           0.051         0.     0.2500       0.10      2.000      2.000      0.000
  54           0.051         0.     0.2500       0.10      2.000      2.000      0.000
  57           0.051         0.     0.2500       0.10      2.000      2.000      0.000
 END PWAT-STATE1
END PERLND

IMPLND
 GEN-INFO
   <ILS >       Name              Unit-systems   Printer                             ***
   # -  #                       User  t-series Engl Metr                             ***
                                       in  out                                       ***
  14       IMPERVIOUS              1    1    1   60    0
 END GEN-INFO
 ACTIVITY
   <ILS > ************* Active Sections ****
   # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  14         0    0    1    0    0    0
 END ACTIVITY
 PRINT-INFO
   <ILS > ******** Print-flags ******** PIVL  PYR
   # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
  14         0    0    6    0    0    0    1    9
 END PRINT-INFO
 IWAT-PARM1
   <ILS >         Flags           ***                                                ***
   # -  # CSNO RTOP  VRS  VNN RTLI    ***                                            ***
  14         0    0    0    0    0
 END IWAT-PARM1
 IWAT-PARM2
   <ILS >                                                                            ***
   # -  #       LSUR      SLSUR       NSUR      RETSC                              ***
  14          100.00     0.0100     0.1000     0.1000
 END IWAT-PARM2
 IWAT-PARM3
```

```
    <ILS >                                                                 ***
    # - #      PETMAX     PETMIN                                           ***
   14
  END IWAT-PARM3
  IWAT-STATE1
    <ILS >  IWATER state variables                                         ***
    # - #          RETS       SURS                                         ***
   14       1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND
                                                                           ***
EXT SOURCES
                                                                           ***
*** NOTE: The only RCHRES that precip and PET are applied to are lakes and ponds
*** FOLLOWING RCHRES ARE PONDS: 57, 247, 237
                                                                           ***
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
*** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
WDM   1002 PREC      ENGLZERO  1.00         PERLND  14 200 EXTNL  PREC
WDM   1002 PREC      ENGLZERO  1.00         IMPLND  14     EXTNL  PREC
WDM      1 EVAP      ENGLZERO  0.8          PERLND  14 200 EXTNL  PETINP
WDM      1 EVAP      ENGLZERO  0.8          IMPLND  14     EXTNL  PETINP
*** PRECIP/EVAP TO LAKES
WDM   1002 PREC      ENGLZERO               RCHRES   1     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8        RCHRES   1     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO               RCHRES   4     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8        RCHRES   4     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO               RCHRES  11     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8        RCHRES  11     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO               RCHRES  13     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8        RCHRES  13     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO               RCHRES  23     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8        RCHRES  23     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO               RCHRES  34     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8        RCHRES  34     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO               RCHRES  53     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8        RCHRES  53     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO               RCHRES  54     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8        RCHRES  54     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO               RCHRES 237     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8        RCHRES 237     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO               RCHRES 247     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8        RCHRES 247     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO               RCHRES  57     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8        RCHRES  57     EXTNL  POTEV
END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
***PROJECT CONDITION FLOWS
*** RCHRES=LOCATION:
*** 54=MCDF       47=SDW1A INFILTRATION TANK      43=SDN3X      247=SDW1A POND G
*** 17=MOUTH      49=SDW2          44=SDN4X       52=SDN1       451= EXISTING NEPL
*** 61=SDN2X      57=SDW1B         51=SDN2X+SDN4X 53=Lake Reba 452=NEW NEPL
*** 45=NEPL POC   55=SR509         39=SDN3A/SDW1A POC
*** 46=CARGO      37=SDN3AI VAULT 237=SDN3AO POND
*** GAUGE POINTS (17=MOUTH, 54=MILLER RDF, 55=SR509)
RCHRES  17 HYDR   RO       1 1                 WDM    113 FLOW     ENGL      REPL
COPY     55 OUTPUT MEAN    1 1 12.1            WDM    118 FLOW     ENGL      REPL
RCHRES  54 HYDR   RO       1 1                 WDM    114 FLOW     ENGL      REPL
*** DETENTION POND FLOWS
COPY     61 OUTPUT MEAN    1 1 12.1            WDM    101 FLOW     ENGL      REPL
RCHRES 552 HYDR   RO       1 1                 WDM    102 FLOW     ENGL      REPL
RCHRES 451 HYDR   RO       1 1                 WDM    105 FLOW     ENGL      REPL
RCHRES 452 HYDR   RO       1 1                 WDM    119 FLOW     ENGL      REPL
RCHRES  46 HYDR   RO       1 1                 WDM    106 FLOW     ENGL      REPL
*** write SDW1A Inf.Tank # 1 outlets to WDM 107 and 108 like so:
COPY     62 OUTPUT MEAN    1 1 12.1            WDM    107 FLOW     ENGL      REPL
COPY     63 OUTPUT MEAN    1 1 12.1            WDM    108 FLOW     ENGL      REPL
```

```
*** write SDW1A det. pond G outlets to WDM files:
COPY     66 OUTPUT MEAN    1 1 12.1          WDM    112 FLOW     ENGL       REPL
COPY     69 OUTPUT MEAN    1 1 12.1          WDM   1120 FLOW     ENGL       REPL
*** write SDW1A det. vault G1 to WDM files:
COPY     67 OUTPUT MEAN    1 1 12.1          WDM    109 FLOW     ENGL       REPL
COPY     68 OUTPUT MEAN    1 1 12.1          WDM   1090 FLOW     ENGL       REPL
*** write flow splitter outlets to WDM files:
RCHRES 570 HYDR    RO      1 1               WDM    210 FLOW     ENGL       REPL
COPY     64 OUTPUT MEAN    1 1 12.1          WDM    110 FLOW     ENGL       REPL
COPY     65 OUTPUT MEAN    1 1 12.1          WDM    115 FLOW     ENGL       REPL
*** write SDW1B inf. tank outlets to WDM files:
COPY     56 OUTPUT MEAN    1 1 12.1          WDM    121 FLOW     ENGL       REPL
COPY     57 OUTPUT MEAN    1 1 12.1          WDM    120 FLOW     ENGL       REPL
*** write SDW1B pond D outlet to WDM file:
COPY    357 OUTPUT MEAN    1 1 12.1          WDM    211 FLOW     ENGL       REPL
*** write SDN3A vaults to WDM files:
RCHRES  37 HYDR    RO      1 1               WDM    111 FLOW     ENGL       REPL
RCHRES 237 HYDR    RO      1 1               WDM    122 FLOW     ENGL       REPL
*** write SDN3/3X, SDN4/4X, and SDN4X/2X vaults to WDM files:
RCHRES  43 HYDR    RO      1 1               WDM    103 FLOW     ENGL       REPL
COPY     44 OUTPUT MEAN    1 1 12.1          WDM    104 FLOW     ENGL       REPL
RCHRES  51 HYDR    RO      1 1               WDM    139 FLOW     ENGL       REPL
*** DETENTION STAGES
RCHRES  47 HYDR    STAGE                     WDM    652 STAG     ENGL       REPL
RCHRES 147 HYDR    STAGE                     WDM    657 STAG     ENGL       REPL
RCHRES 247 HYDR    STAGE                     WDM    654 STAG     ENGL       REPL
RCHRES 552 HYDR    STAGE                     WDM    601 STAG     ENGL       REPL
RCHRES  57 HYDR    STAGE                     WDM    651 STAG     ENGL       REPL
RCHRES 257 HYDR    STAGE                     WDM    655 STAG     ENGL       REPL
RCHRES 237 HYDR    STAGE                     WDM    656 STAG     ENGL       REPL
RCHRES  37 HYDR    STAGE                     WDM    650 STAG     ENGL       REPL
RCHRES  54 HYDR    STAGE                     WDM     61 STAG     ENGL       REPL
RCHRES 451 HYDR    STAGE                     WDM    662 STAG     ENGL       REPL
RCHRES 452 HYDR    STAGE                     WDM    667 STAG     ENGL       REPL
RCHRES  46 HYDR    STAGE                     WDM    663 STAG     ENGL       REPL
RCHRES  43 HYDR    STAGE                     WDM    664 STAG     ENGL       REPL
***RCHRES  44 HYDR    STAGE                     WDM    665 STAG     ENGL       REPL
RCHRES  51 HYDR    STAGE                     WDM    666 STAG     ENGL       REPL
*** DETENTION VOLUMES
RCHRES  47 HYDR    VOL                       WDM    752 VOL      ENGL       REPL
RCHRES 147 HYDR    VOL                       WDM    757 VOL      ENGL       REPL
RCHRES 247 HYDR    VOL                       WDM    754 VOL      ENGL       REPL
RCHRES 552 HYDR    VOL                       WDM    602 VOL      ENGL       REPL
RCHRES  57 HYDR    VOL                       WDM    751 VOL      ENGL       REPL
RCHRES 257 HYDR    VOL                       WDM    755 VOL      ENGL       REPL
RCHRES 237 HYDR    VOL                       WDM    756 VOL      ENGL       REPL
RCHRES  37 HYDR    VOL                       WDM    750 VOL      ENGL       REPL
RCHRES  54 HYDR    VOL                       WDM     62 VOL      ENGL       REPL
RCHRES 451 HYDR    VOL                       WDM    762 VOL      ENGL       REPL
RCHRES 452 HYDR    VOL                       WDM    767 VOL      ENGL       REPL
RCHRES  46 HYDR    VOL                       WDM    763 VOL      ENGL       REPL
RCHRES  43 HYDR    VOL                       WDM    764 VOL      ENGL       REPL
***RCHRES  44 HYDR    VOL                       WDM    765 VOL      ENGL       REPL
RCHRES  51 HYDR    VOL                       WDM    766 VOL      ENGL       REPL
*** POINT OF COMPLIANCE (POC)FLOWS
COPY     37 OUTPUT MEAN    1 1 12.1          WDM    125 FLOW     ENGL       REPL
COPY     45 OUTPUT MEAN    1 1 12.1          WDM    199 FLOW     ENGL       REPL
COPY     53 OUTPUT MEAN    1 1 12.1          WDM    399 FLOW     ENGL       REPL
COPY     70 OUTPUT MEAN    1 1 12.1          WDM   7000 FLOW     ENGL       REPL
COPY     71 OUTPUT MEAN    1 1 12.1          WDM   7001 FLOW     ENGL       REPL
***INFILTRATION FLOW
  ***  --> output SDW1A infiltration discharge to WDM dataset 5 <--
  ***  --> convert acft to in/ac, assuming reinfiltrate to 2 ac <--
COPY     47 OUTPUT MEAN    1 1   6           WDM      5 FLOW     ENGL       REPL
  ***  --> output SDW1B infiltration discharge to WDM dataset 6 <--
  ***  --> convert acft to in/ac, assuming reinfiltrate to 2 ac <--
COPY     57 OUTPUT MEAN    1 1   6           WDM      6 FLOW     ENGL       REPL
END EXT TARGETS

SCHEMATIC
<-Source->                   <--Area-->     <-Target->   MBLK    ***
```

```
<Name>   #                  <-factor->    <Name>   #    Tbl#    ***
 *** SUB-CATCHMENT 1 all agwo goes to sound
PERLND  16                      3.41     RCHRES   1      6
PERLND  26                    232.36     RCHRES   1      6
PERLND  34                      3.07     RCHRES   1      6
PERLND  44                     38.03     RCHRES   1      6
PERLND  54                      3.87     RCHRES   1      6
IMPLND  14                     56.14     RCHRES   1      2
 *** SUB-CATCHMENT 2 10% of area GW goes to vaca 90% goes to sound
PERLND  16                      5.56     RCHRES   2      6
PERLND  26                    200.05     RCHRES   2      6
PERLND  34                      0.46     RCHRES   2      6
PERLND  44                     38.71     RCHRES   2      6
PERLND  16                      0.56     RCHRES 135      7
PERLND  26                     20.00     RCHRES 135      7
PERLND  34                      0.05     RCHRES 135      7
PERLND  44                      3.87     RCHRES 135      7
IMPLND  14                     42.22     RCHRES   2      2
 *** SUB-CATCHMENT 23 New subbasin 15 % OF GW GOES TO VACCA 85% TO SOUND
PERLND  16                      3.09     RCHRES  23      6
PERLND  26                    156.15     RCHRES  23      6
PERLND  34                      2.25     RCHRES  23      6
PERLND  44                     45.84     RCHRES  23      6
PERLND  16                      0.46     RCHRES 135      7
PERLND  26                     23.42     RCHRES 135      7
PERLND  34                      0.34     RCHRES 135      7
PERLND  44                      6.88     RCHRES 135      7
IMPLND  14                     58.44     RCHRES  23      2
 *** SUB-CATCHMENT 24 New subbasin 60 % OF GW GOES TO 11 40% TO SOUND
PERLND  26                    135.43     RCHRES  24      6
PERLND  34                      2.02     RCHRES  24      6
PERLND  44                     69.29     RCHRES  24      6
PERLND  26                     81.26     RCHRES  11      7
PERLND  34                      1.21     RCHRES  11      7
PERLND  44                     41.57     RCHRES  11      7
IMPLND  14                     79.98     RCHRES  24      2
  *** SUB-CATCHMENT 3 agwo goes to vaca(135)
PERLND  16                      8.26     RCHRES   3      6
PERLND  26                    108.38     RCHRES   3      6
PERLND  34                     16.02     RCHRES   3      6
PERLND  44                    102.89     RCHRES   3      6
PERLND  54                      0.04     RCHRES   3      6
PERLND  16                      8.26     RCHRES 135      7
PERLND  26                    108.38     RCHRES 135      7
PERLND  34                     16.02     RCHRES 135      7
PERLND  44                    102.89     RCHRES 135      7
PERLND  54                      0.04     RCHRES 135      7
IMPLND  14                     27.30     RCHRES   3      2
  *** SUB-CATCHMENT 4 10% of agwo goes to rchres 90% goes to sound
PERLND  16                      2.95     RCHRES   4      6
PERLND  26                     85.95     RCHRES   4      6
PERLND  34                      3.75     RCHRES   4      6
PERLND  44                     92.06     RCHRES   4      6
PERLND  16                      0.30     RCHRES   4      7
PERLND  26                      8.59     RCHRES   4      7
PERLND  34                      0.38     RCHRES   4      7
PERLND  44                      9.21     RCHRES   4      7
IMPLND  14                     18.43     RCHRES   4      2
  *** SUB-CATCHMENT 4a 70% of agwo goes to rchres 30% goes to sound
PERLND  16                      8.66     RCHRES   4      6
PERLND  26                     61.64     RCHRES   4      6
PERLND  34                     22.06     RCHRES   4      6
PERLND  44                     76.09     RCHRES   4      6
PERLND  54                     12.50     RCHRES   4      6
PERLND  16                      6.06     RCHRES   4      7
PERLND  26                     43.15     RCHRES   4      7
PERLND  34                     15.44     RCHRES   4      7
PERLND  44                     54.66     RCHRES   4      7
PERLND  54                      8.75     RCHRES   4      7
IMPLND  14                     29.14     RCHRES   4      2
  *** SUB-CATCHMENT 5
```

```
PERLND  26                  10.29     RCHRES    5       1
PERLND  44                  50.05     RCHRES    5       1
PERLND  54                  10.74     RCHRES    5       1
IMPLND  14                  16.31     RCHRES    5       2
  *** SUB-CATCHMENT 6
PERLND  16                   1.42     COPY    645      26
PERLND  26                  20.38     COPY    645      26
PERLND  34                  13.44     COPY    645      26
PERLND  44                  11.79     COPY    645      26
PERLND  54                   0.82     COPY    645      26
PERLND  16                   1.42     RCHRES   53       7
PERLND  26                  20.38     RCHRES   53       7
PERLND  34                  13.44     RCHRES   53       7
PERLND  44                  11.79     RCHRES   53       7
PERLND  54                   0.82     RCHRES   53       7
IMPLND  14                   6.23     COPY    645      22
  *** SUB-CATCHMENT 8
PERLND  44                  22.21     RCHRES   35       1
IMPLND  14                   6.60     RCHRES   35       2
  *** SUB-CATCHMENT 9
PERLND  16                   4.98     RCHRES   34       1
PERLND  26                  14.38     RCHRES   34       1
PERLND  34                   0.05     RCHRES   34       1
PERLND  44                  56.71     RCHRES   34       1
PERLND  54                   0.01     RCHRES   34       1
IMPLND  14                  22.47     RCHRES   34       2
  *** SUB-CATCHMENT 10
PERLND  16                   4.15     RCHRES   10       1
PERLND  26                  31.94     RCHRES   10       1
PERLND  44                  95.22     RCHRES   10       1
IMPLND  14                  71.98     RCHRES   10       2
  *** SUB-CATCHMENT 11 25% OF AGWO GOES TO 15
PERLND  16                   0.89     RCHRES   11       6
PERLND  26                 217.92     RCHRES   11       6
PERLND  34                   1.32     RCHRES   11       6
PERLND  44                  65.65     RCHRES   11       6
PERLND  16                   0.67     RCHRES   11       7
PERLND  26                 163.44     RCHRES   11       7
PERLND  34                   0.99     RCHRES   11       7
PERLND  44                  49.24     RCHRES   11       7
PERLND  16                   0.22     RCHRES   15       7
PERLND  26                  54.48     RCHRES   15       7
PERLND  34                   0.33     RCHRES   15       7
PERLND  44                  16.41     RCHRES   15       7
IMPLND  14                 230.80     RCHRES   11       2
  *** SUB-CATCHMENT 12
PERLND  16                   0.39     RCHRES   12       1
PERLND  26                 101.18     RCHRES   12       1
PERLND  34                   5.64     RCHRES   12       1
PERLND  44                  54.98     RCHRES   12       1
PERLND  54                   0.64     RCHRES   12       1
IMPLND  14                  79.83     RCHRES   12       2
  *** SUB-CATCHMENT 13
PERLND  16                   0.79     RCHRES   13       1
PERLND  26                 197.68     RCHRES   13       1
IMPLND  14                  27.66     RCHRES   13       2
  *** SUB-CATCHMENT 14 50% OF AGWO GOES TO SOUND
PERLND  16                   0.24     RCHRES   14       6
PERLND  26                 118.67     RCHRES   14       6
PERLND  34                  13.46     RCHRES   14       6
PERLND  44                  41.91     RCHRES   14       6
PERLND  16                   0.12     RCHRES   14       7
PERLND  26                  59.34     RCHRES   14       7
PERLND  34                   6.73     RCHRES   14       7
PERLND  44                  20.95     RCHRES   14       7
IMPLND  14                  20.66     RCHRES   14       2
  *** SUB-CATCHMENT 15
PERLND  16                   6.59     RCHRES   15       1
PERLND  26                  49.55     RCHRES   15       1
PERLND  34                  50.09     RCHRES   15       1
PERLND  44                  86.52     RCHRES   15       1
```

```
IMPLND  14                          19.47     RCHRES  15        2
  *** SUB-CATCHMENT 16
PERLND  16                          10.93     RCHRES  16        1
PERLND  26                          29.93     RCHRES  16        1
PERLND  34                          20.03     RCHRES  16        1
PERLND  44                          31.83     RCHRES  16        1
IMPLND  14                          15.58     RCHRES  16        2
  *** SUB-CATCHMENT 17 AGWO GOES TO SOUND
PERLND  16                           0.90     RCHRES  17        6
PERLND  26                          16.31     RCHRES  17        6
PERLND  34                          34.82     RCHRES  17        6
PERLND  44                          82.11     RCHRES  17        6
PERLND  54                           2.19     RCHRES  17        6
IMPLND  14                          10.49     RCHRES  17        2
  *** SUB-CATCHMENT MC-1
PERLND  26                           0.14     RCHRES  52        1
PERLND  44                           9.44     RCHRES  52        1
PERLND  45                           0.14     RCHRES  52        1
PERLND  54                           0.27     RCHRES  52        1
IMPLND  14                           1.98     RCHRES  52        2
  *** SUB-CATCHMENT MC-2
PERLND  16                           0.08     RCHRES  53        1
PERLND  26                           0.53     RCHRES  53        1
PERLND  34                           3.60     RCHRES  53        1
PERLND  44                           9.20     RCHRES  53        1
PERLND  45                           2.22     RCHRES  53        1
PERLND  54                          15.14     RCHRES  53        1
IMPLND  14                           2.54     RCHRES  53        2
  *** SUB-CATCHMENT MC-3
PERLND  34                           3.70     RCHRES  54        1
PERLND  44                           4.91     RCHRES  54        1
PERLND  45                           1.07     RCHRES  54        1
PERLND  54                           1.84     RCHRES  54        1
IMPLND  14                           1.42     RCHRES  54        2
  *** SUB-CATCHMENT MC-4
PERLND  34                           0.27     RCHRES 135        1
PERLND  44                          16.51     RCHRES 135        1
PERLND  45                           4.23     RCHRES 135        1
PERLND  54                          11.98     RCHRES 135        1
IMPLND  14                           3.31     RCHRES 135        2
  *** SUB-CATCHMENT MC-5
PERLND  26                          13.43     RCHRES  35        1
PERLND  44                          33.84     RCHRES  35        1
PERLND  54                           7.44     RCHRES  35        1
IMPLND  14                           0.02     RCHRES  35        2
  *** SUB-CATCHMENT MC-6
PERLND  44                          14.10     RCHRES  35        1
PERLND  45                           0.09     RCHRES  35        1
PERLND  54                           0.90     RCHRES  35        1
IMPLND  14                           0.26     RCHRES  35        2
  *** SUB-CATCHMENT MC-7
PERLND  26                          11.26     COPY    55       21
PERLND  44                          31.80     COPY    55       21
PERLND  54                           3.20     COPY    55       21
IMPLND  14                           0.03     COPY    55       22

***note: SDN AGWO TO VACCA FARMS (135)NOT TO PONDS

  *** SUB-CATCHMENT SDN-1
PERLND  26                           1.97     RCHRES 552        6
PERLND  44                           1.29     RCHRES 552        6
PERLND  54                           0.20     RCHRES 552        6
PERLND  26                           1.97     RCHRES 135        7
PERLND  44                           1.29     RCHRES 135        7
PERLND  54                           0.20     RCHRES 135        7
IMPLND  14                          12.68     RCHRES 552        2

  *** SUB-CATCHMENT SDN-1-LWR
PERLND  44                           4.79     RCHRES 552        6
PERLND  54                           0.07     RCHRES 552        6
PERLND  44                           4.79     RCHRES 135        7
```

```
PERLND  54                          0.07     RCHRES 135        7
IMPLND  14                          0.56     RCHRES 552        2

  *** SUB-CATCHMENT SDN-1-OFF
PERLND  26                         23.01     RCHRES  52        6
PERLND  44                          3.58     RCHRES  52        6
PERLND  54                          1.67     RCHRES  52        6
PERLND  26                         23.01     RCHRES 135        7
PERLND  44                          3.58     RCHRES 135        7
PERLND  54                          1.67     RCHRES 135        7
IMPLND  14                          8.00     RCHRES  52        2

  *** SUB-CATCHMENT SDN-2X (TO POND)
PERLND  26                          0.63     COPY    61       26
PERLND  44                          2.40     COPY    61       26
PERLND  45                          0.86     COPY    61       26
PERLND  26                          0.63     RCHRES 135        7
PERLND  44                          2.40     RCHRES 135        7
PERLND  45                          0.86     RCHRES 135        7
IMPLND  14                          0.36     COPY    61       22

  *** SUB-CATCHMENT SDN-3 (TO POND)
PERLND  26                         23.56     RCHRES  43        6
PERLND  26                         23.56     RCHRES 135        7
IMPLND  14                         24.30     RCHRES  43        2

  *** SUB-CATCHMENT SDN-3X (TO POND)
PERLND  26                          1.61     RCHRES  43        6
PERLND  45                         23.77     RCHRES  43        6
PERLND  26                          1.61     RCHRES 135        7
PERLND  45                         23.77     RCHRES 135        7

  *** SUB-CATCHMENT SDN-4 (TO POND)
PERLND  26                         15.75     COPY    44       26
PERLND  44                          1.31     COPY    44       26
PERLND  45                          0.99     COPY    44       26
PERLND  26                         15.75     RCHRES 135        7
PERLND  44                          1.31     RCHRES 135        7
PERLND  45                          0.99     RCHRES 135        7
IMPLND  14                         12.26     COPY    44       22

  *** SUB-CATCHMENT SDN-4X (TO POND)
PERLND  26                          1.92     COPY    44       26
PERLND  44                          0.75     COPY    44       26
PERLND  45                          8.31     COPY    44       26
PERLND  26                          1.92     RCHRES 135        7
PERLND  44                          0.75     RCHRES 135        7
PERLND  45                          8.31     RCHRES 135        7
IMPLND  14                          4.21     COPY    44       22

  *** SUB-CATCHMENT IWS-NCPS (TO POND)
PERLND  26                          4.78     RCHRES 242        6
PERLND  26                          4.78     RCHRES 135        7
IMPLND  14                         30.93     RCHRES 242        2

  *** SUB-CATCHMENT IWS-NSMPS (TO POND)
PERLND  26                          2.69     RCHRES 240        6
PERLND  44                          1.97     RCHRES 240        6
PERLND  45                          0.01     RCHRES 240        6
PERLND  26                          2.69     RCHRES 135        7
PERLND  44                          1.97     RCHRES 135        7
PERLND  45                          0.01     RCHRES 135        7
IMPLND  14                          1.95     RCHRES 240        2

  *** SUB-CATCHMENT NEPL (TO POND)
PERLND  26                         10.00     RCHRES 452        6
PERLND  26                         10.00     RCHRES 135        7
IMPLND  14                          6.00     RCHRES 451        2
IMPLND  14                         26.29     RCHRES 452        2

  *** SUB-CATCHMENT CARGO (TO POND)
```

```
IMPLND  14                               8.12      RCHRES  46         2

  *** SUB-CATCHMENT SDN3AI (TO VAULT)
IMPLND  14                               5.87      RCHRES  37         2

  *** SUB-CATCHMENT SDN3AO (TO POND)
PERLND  26                               0.08      RCHRES 237         6
PERLND  44                               0.03      RCHRES 237         6
PERLND  45                              22.12      RCHRES 237         6
PERLND  26                               0.08      RCHRES 135         7
PERLND  44                               0.03      RCHRES 135         7
PERLND  45                              22.12      RCHRES 135         7
IMPLND  14                               2.35      RCHRES 237         2

  *** SUB-CATCHMENT SDW1O (TO POND)
PERLND  26                               4.28      RCHRES 247         6
PERLND  44                               0.69      RCHRES 247         6
PERLND  45                              32.44      RCHRES 247         6
PERLND  26                               4.28      RCHRES 135         7
PERLND  44                               0.69      RCHRES 135         7
PERLND  45                              32.44      RCHRES 135         7
IMPLND  14                               1.64      RCHRES 247         2

  *** SUB-CATCHMENT SDN1AI (TO VAULT)
IMPLND  14                              13.78      RCHRES 147         2

  *** SUB-CATCHMENT SDW1B (TO POND)
  *** AGWO TO 35, AS 57 IS D/S OF VACCA FARMS (135)
PERLND  26                              21.25      RCHRES 570         6
PERLND  44                               2.39      RCHRES 570         6
PERLND  45                              46.26      RCHRES 570         6
PERLND  26                              21.25      RCHRES  35         7
PERLND  44                               2.39      RCHRES  35         7
PERLND  45                              46.26      RCHRES  35         7
IMPLND  14                              26.95      RCHRES 570         2

  *** ADD SUB-CATCHMENT IWS-PRIMARY TO PREDEVELOPEMENT ONLY

***ROUTING FOR MILLER CREEK
 *** M1 TO M2 TO M3 TO STORAGE 50.  M4 TO M5 TO STORAGE 50
RCHRES   1                                         RCHRES   2         4
RCHRES  23                                         RCHRES  24         4
RCHRES  24                                         RCHRES   3         3
RCHRES   2                                         RCHRES   3         3
RCHRES   3                                         RCHRES  33         3
RCHRES  33                                         RCHRES  50         3
RCHRES   4                                         RCHRES   5         4
RCHRES   5                                         RCHRES  50         3
 *** PONDS TO 52, 53 & 54
RCHRES 242                                         RCHRES 240         5
 *** OVERFLOW ONLY TO 61
RCHRES 240                                         RCHRES  51         5
COPY    61                                         RCHRES  51        12
COPY    44                                         RCHRES  51        12
RCHRES  51                                         RCHRES  52         3
RCHRES  43                                         RCHRES  54         3
 *** 2 NEPL VAULTS* (FK-Changed to eliminate run-of-river tables)
RCHRES 451                                         COPY    45        11
RCHRES 452                                         COPY    45        11
COPY    45                                         COPY   645        10
COPY   645                                         RCHRES  53        12
RCHRES  46                                         RCHRES  53         3
 *** NEW STREAM REACH 52 TO LAKE REBA 53 TO RDF 54 (FK-changed to insert new POC at Lake
Reba)
RCHRES 552                                         RCHRES  52         3
RCHRES  52                                         RCHRES  53         3
RCHRES  53                                         COPY    53        11
COPY    53                                         RCHRES  54        12
RCHRES  50                                         RCHRES  54         3
 *** RDF 54 TO 35
RCHRES  54                                         RCHRES 135         3
```

```
<-Source->                   <--Area-->        <-Target->   MBLK   ***
<Name>   #                   <-factor->        <Name>   #   Tbl#   ***
 *** PONDS TO 34
RCHRES  37                                     COPY     37    11
RCHRES 237                                     COPY     37    11
COPY    37                                     RCHRES 135     12
 *** SDW1A flow to bypass added (FK, June 2001)
SDW1AI VAULT FLOW TO INFILTRATION 1                                    ***
RCHRES 147                                     RCHRES   47     4
SDW1AI VAULT FLOW TO BYPASS                                            ***
RCHRES 147                                     COPY     70    15
STORMWATER Q 1ST EXIT AT POND G (Bypass)                               ***
RCHRES 247                                     COPY     70    14
RCHRES 247                                     COPY     66    14
2ND EXIT TO INFILTRATION TANK-MILLER CREEK                             ***
RCHRES 247                                     RCHRES   47     5
RCHRES 247                                     COPY     69    15
STORMWATER Q 1ST EXIT TO BYPASS                                        ***
RCHRES  47                                     COPY     70    14
2ND EXIT TO SOIL AND MILLER CREEK                                      ***
RCHRES  47                                     COPY     70    15
COPY BLOCK FOR OUTPUT PURPOSES                                         ***
RCHRES  47                                     COPY     62    14
RCHRES  47                                     COPY     63    15
RCHRES 147                                     COPY     67    14
RCHRES 147                                     COPY     68    15
  ***  --> output SDW1A infiltration discharge to WDM dataset 5 <--
RCHRES  47                                     COPY     47    15
COPY    70                                     RCHRES 135     12
RCHRES  34                                     RCHRES 135      4
RCHRES  34                                     RCHRES 135      5
RCHRES 135                                     RCHRES   35     3
RCHRES  10                                     RCHRES   16     3
 *** PONDS TO 35
 *** Configuration changed to flow splitter to Pond D and Infiltration Basin 3 (FK, June
2001)
STORM Q - 1ST EXIT OF FLOW SPLITTER TO POND D                          ***
RCHRES 570                                     RCHRES   57     4
INFILTRATION Q - 2ND EXIT OF FLOW SPLITTER TO SOIL                     ***
RCHRES 570                                     RCHRES 257      5
STORM Q EXIT OF POND D TO MILLER CREEK                              ***
RCHRES  57                                     COPY     71    11
COPY BLOCK FOR OUTPUT PURPOSES                                         ***
RCHRES  57                                     COPY    357    11
RCHRES 570                                     COPY     64    14
RCHRES 570                                     COPY     65    15
  ***  --> output SDW1B infiltration discharge to WDM dataset 6 <--
RCHRES 257                                     COPY     56    14
RCHRES 257                                     COPY     57    15
RCHRES 257                                     COPY     71    14
RCHRES 257                                     COPY     71    15
COPY    71                                     RCHRES   35    12
RCHRES  35                                     COPY     55    11
COPY    55                                     RCHRES   16    12
RCHRES  11                                     RCHRES   15     3
RCHRES  13                                     RCHRES   12     4
RCHRES  13                                     RCHRES   12     5
RCHRES  12                                     RCHRES   15     3
RCHRES  16                                     RCHRES   15     3
RCHRES  14                                     RCHRES   17     3
RCHRES  15                                     RCHRES   17     3
END SCHEMATIC

NETWORK
***       <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>        <-MEMBER->
<NAME>   # <NAME>    TEM STRG<-FACTOR->STRG <NAME>    #    # <-GRP> <NAME> # # ***
END NETWORK
                                                                                  ***
RCHRES
  GEN-INFO
    RCHRES        Name          Nexits    Unit Systems    Printer                 ***
```

```
                                                                          ***
 # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in   out
   1      Arbor Lake  M 1          2    1    1    1    62    0    0
   2      Arbor Ck -03710 M 2      1    1    1    1    62    0    0
   3      Arbor Ck    M 3          1    1    1    1    62    0    0
   4      Tub Lake    M 4          2    1    1    1    62    0    0
   5      Miller Ck SR518 M5       1    1    1    1    62    0    0
  10      Trib (0371G)    M 10     1    1    1    1    62    0    0
  11      M11 Ambaum Detention     1    1    1    1    62    0    0
  12      Trib(0354)  M 12         1    1    1    1    62    0    0
  13      Burien Lake M 13         2    1    1    1    62    0    0
  14      Trib (0353) M 14         1    1    1    1    62    0    0
  15      M/S U/S OF 17            1    1    1    1    62    0    0
  16      U/S OF 15 M/S            1    1    1    1    62    0    0
  17      GAGE                     1    1    1    1    62    0    0
  23      BASIN M23                2    1    1    1    62    0    0
  24      BASIN M24                1    1    1    1    62    0    0
  33      detention m3             1    1    1    1    62    0    0
  34      LORA LAKE                2    1    1    1    62    0    0
  35      D/S OF VACA FARM         1    1    1    1    62    0    0
  37      sdn3ai vault             1    1    1    1    62    0    0
  38      MC basins                1    1    1    1    62    0    0
***   39     SDN3A/SDW1A POC          1    1    1    1    62    0    0
  43      sdn3 pond                1    1    1    1    62    0    0
***   44     sdn4 pond                1    1    1    1    62    0    0
***   45     nepl poc                 1    1    1    1    62    0    0
  46      cargo pond               1    1    1    1    62    0    0
  47      sdwla infiltration       2    1    1    1    62    0    0
  50      sr 518                   1    1    1    1    62    0    0
  51      SDN2X+SDN4X              1    1    1    1    62    0    0
  52      U/S OF LAKE REBA         1    1    1    1    62    0    0
  53      Reba outflow             1    1    1    1    62    0    0
  54      Miller RDF outflow       1    1    1    1    62    0    0
  57      sdwlb pond               1    1    1    1    62    0    0
 135      VACA FARMS               1    1    1    1    62    0    0
 147      sdwla vault              2    1    1    1    62    0    0
 237      sdn3ao-pond c            1    1    1    1    62    0    0
 240      iws-ncps                 2    1    1    1    62    0    0
 242      iws-nsmps                2    1    1    1    62    0    0
 247      sdwla pond g             2    1    1    1    62    0    0
 257      sdwlb infiltration       2    1    1    1    62    0    0
 451      nepl VAULT               1    1    1    1    62    0    0
 452      nepl VAULT               1    1    1    1    62    0    0
 552      SDN1 POC                 1    1    1    1    62    0    0
 570      SDW1B flow splitter      2    1    1    1    62    0    0
***  645     nepl POC                 1    1    1    1    62    0    0
END GEN-INFO

ACTIVITY
  RCHRES *************** Active Sections ****************
  # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG                  ***
  1  999    1    0    0    0    0    0    0    0    0    0
END ACTIVITY

PRINT-INFO
  RCHRES *************** Printout Flags ***************** PIVL  PYR
  # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
  1  999    5    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO

HYDR-PARM1
  RCHRES  Flags for each HYDR Section                                      ***
  # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
          FG FG FG FG  possible   exit *** possible   exit     possible   exit
          *  *  *  *    *  *  *  *  *      *  *  *  *  *         ***
  1        0  1  0  0   4  5  0  0  0      0  0  0  0  0       2  2  2  2  2
  2        0  0  0  0   4  0  0  0  0      0  0  0  0  0       2  2  2  2  2
  3        0  0  0  0   4  0  0  0  0      0  0  0  0  0       2  2  2  2  2
  4        0  1  0  0   4  5  0  0  0      0  0  0  0  0       2  2  2  2  2
  5   12   0  0  0  0   4  0  0  0  0      0  0  0  0  0       2  2  2  2  2
 13        0  1  0  0   4  5  0  0  0      0  0  0  0  0       2  2  2  2  2
```

```
  14    22    0  0  0  0     4  0  0  0  0         0  0  0  0  0         2  2  2  2  2
  23          0  1  0  0     4  5  0  0  0         0  0  0  0  0         2  2  2  2  2
  24    33    0  0  0  0     4  0  0  0  0         0  0  0  0  0         2  2  2  2  2
  34          0  1  0  0     4  5  0  0  0         0  0  0  0  0         2  2  2  2  2
  35    46    0  1  0  0     4  0  0  0  0         0  0  0  0  0         2  2  2  2  2
  47          0  1  0  0     4  5  0  0  0         0  0  0  0  0         2  2  2  2  2
  50    54    0  1  0  0     4  0  0  0  0         0  0  0  0  0         2  2  2  2  2
  57          0  1  0  0     4  0  0  0  0         0  0  0  0  0         2  2  2  2  2
 100   135    0  1  1  0     4  0  0  0  0         0  0  0  0  0         2  2  2  2  2
 147          0  1  1  0     4  0  0  0  0         0  0  0  0  0         2  2  2  2  2
 237          0  1  1  0     4  0  0  0  0         0  0  0  0  0         2  2  2  2  2
 240   300    0  1  1  0     4  5  0  0  0         0  0  0  0  0         2  2  2  2  2
 301   552    0  1  0  0     4  0  0  0  0         0  0  0  0  0         2  2  2  2  2
 570          0  1  1  0     4  5  0  0  0         0  0  0  0  0         2  2  2  2  2
END HYDR-PARM1

HYDR-PARM2                                                                      ***
  RCHRES                                                                        ***
  # -  #     FTABNO       LEN     DELTH     STCOR        KS      DB50          ***
<------><--------><--------><--------><--------><--------><-------->
   1            1  0.010                                0.3
   2            2  0.776                                0.3
   3            3  0.980                                0.3
   4            4  0.010                                0.3
   5            5  0.380                                0.3
  10           10  0.380                                0.3
  11           11  0.010                                0.3
  12           12  1.000                                0.3
  13           13  0.015                                0.3
  14           14  0.450                                0.3
  15           15  0.735                                0.3
  16           16  0.587                                0.3
  17           17  0.379                                0.3
  23           23  0.379                      0.0       0.3
  24           24  0.379                                0.3
  33           33  0.200                                0.3
  34           34  0.852                                0.3
  35           35  0.663                                0.3
  37           37  0.010                      0.0       0.3
  38           38  0.010                                0.3
  43           43  0.010                                0.3
  46           46  0.010                                0.3
  47           47  0.010                      0.0       0.3
  50           50  0.010                                0.3
  51           51  0.010                                0.3
  52           52  0.010                                0.3
  53           53  0.010                                0.3
  54           54  0.010                      0.0       0.3
  57           57  0.010                      0.0       0.3
 135          135  0.350                                0.3
 147          147  0.010                      0.0       0.3
 237          237  0.010                      0.0       0.3
 240          240  0.010                                0.3
 242          242  0.010                                0.3
 247          247  0.010                      0.0       0.3
 257          257  0.010                      0.0       0.3
 451          451  0.010                      0.0       0.3
 452          452  0.010                      0.0       0.3
 552          552  0.010                      0.0       0.3
 570          570  0.010                      0.0       0.3
END HYDR-PARM2

HYDR-INIT
  RCHRES  Initial conditions for each HYDR section                           ***
  # -  # ***     VOL    Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit         for each possible exit
<------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
   1     2.0             4.0  5.0
   2     0.0             4.0
   3     0.0             4.0
   4     2.0             4.0  5.0
```

```
     5     0.0              4.0
    10     0.0              4.0
    11     0.0              4.0
    12     0.0              4.0
    13     10.0             4.0  5.0
    14     0.0              4.0
    15     0.0              4.0
    16     0.0              4.0
    17     0.0              4.0
    23     6.0              4.0  5.0
    24     0.0              4.0
    33     0.0              4.0
    34     9.0              4.0  5.0
    35     0.1              4.0
    37     0.0              4.0
    38     0.1              4.0
    43     0.0              4.0
    46     0.0              4.0
    47     0.0              4.0  5.0
    50     0.0              4.0
    51     0.0              4.0
    52     0.0              4.0
    53     0.1              4.0
    54     2.25             4.0
    57     0.0              4.0
   237     0.00             4.0
   147     1.00             4.0  5.0
   135     0.00             4.0
   240     0.0              4.0  5.0
   242     0.0              4.0  5.0
   247     0.0              4.0  5.0
   257     0.0              4.0  5.0
   451     0.0              4.0
   452     0.0              4.0
   552     0.0              4.0
   570     0.0              4.0  5.0
  END HYDR-INIT
END RCHRES


FTABLES
***UPPER BASIN
***===========

  FTABLE      1
           *** REVISED 8/16/00 ADDED 2ND OUTFLOW
 ROWS COLS ***
   11    5
     DEPTH      AREA    VOLUME    OUTFLOW OUTFLOW2***
     0.00       3.00     0.00      0.00    0.00
     2.50       3.00     7.50      0.00    0.11
     3.00       3.00     9.00      1.80    0.11
     3.50       3.30    10.58      5.00    0.11
     4.00       3.60    12.30     10.90    0.11
     4.50       3.90    14.18     17.50    0.11
     5.00       4.10    16.18     26.20    0.11
     5.50       4.30    18.28     32.50    0.11
     6.00       4.50    20.48     35.90    0.11
     7.00       5.00    25.23     38.10    0.11
     8.00       5.50    30.48     46.40    0.11
  END FTABLE  1

  FTABLE      2
 ROWS COLS ***
    9    4
     DEPTH      AREA    VOLUME    OUTFLOW   ***
     0.000    0.0000    0.0000      0.00
     0.100    0.2571    0.0129      0.16
     0.500    0.3873    0.1417      6.53
     1.000    0.5501    0.3761     25.95
     1.500    0.7128    0.6918     59.86
```

```
    2.000     0.8756     1.0889     110.67
    3.000     1.2011     2.1273     272.24
    3.500     1.3639     2.7685     387.38
    4.000     1.5266     3.4912     528.19
 END FTABLE  2

 FTABLE      3
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000     0.0000     0.0000       0.00
    0.100     0.9669     0.0483       0.13
    0.500     1.0637     0.4545       4.92
    1.000     1.1846     1.0165      17.12
    1.500     1.3055     1.6390      34.92
    2.000     1.4264     2.3220      57.95
    2.500     1.5473     3.0654      86.14
    3.000     1.6682     3.8693     119.53
    3.500     1.7891     4.7336     158.24
    4.000     1.9100     5.6584     202.41
    4.500     2.0294     6.6310     251.52
    5.000     2.1488     7.6624     306.28
 END FTABLE  3

 FTABLE      4
          *** REVISED 8/16/00 ADDED 2ND OUTFLOW
ROWS COLS ***
   7    5
    DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.00     3.00     0.00        0.00       0.00
     2.50     4.50     9.38        0.00       0.11
     3.00     6.00     12.00       6.00       0.11
     4.00     10.00    20.00       13.00      0.11
     5.00     15.00    32.50       20.00      0.11
     6.00     20.00    50.00       26.00      0.11
     7.00     25.00    72.50       168.00     0.11
 END FTABLE  4

 FTABLE      5
ROWS COLS ***
  10    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000     0.0000     0.0000       0.00
    0.100     0.1010     0.0051       0.03
    0.500     0.1754     0.0603       1.46
    1.000     0.2684     0.1713       6.16
    1.500     0.3614     0.3288      14.89
    2.000     0.4544     0.5327      28.48
    2.500     0.5474     0.7832      47.70
    3.000     0.6404     1.0801      73.29
    3.500     0.7334     1.4236     105.94
    4.000     0.8264     1.8136     146.33
 END FTABLE  5

 FTABLE     10
ROWS COLS ***
   9    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000     0.0000     0.0000       0.00
    0.100     0.1010     0.0051       0.06
    0.500     0.1660     0.0585       2.27
    1.000     0.2472     0.1618       9.32
    1.500     0.3285     0.3057      22.08
    2.000     0.4097     0.4902      41.66
    2.500     0.4909     0.7154      69.09
    3.000     0.5722     0.9811     105.37
    4.000     0.6887     1.6116     209.70
 END FTABLE 10

 POST AMBAUM DETENTION ***
 FTABLE     11
```

```
ROWS COLS ***
  12    4
    DEPTH        AREA      VOLUME     OUTFLOW    ***
    0.000      0.0000      0.0000        0.00
    1.000      0.1000      0.2300        3.90
    2.000      0.2000      0.6000        6.30
    3.000      0.3000      0.9700        8.10
    4.000      0.4000      1.3400       11.10
    5.000      0.5000      1.8200       16.00
    6.000      0.6000      2.2700       19.10
    7.000      0.7000      2.8300       21.60
    8.000      0.8000      3.3700       30.80
    9.000      0.9000      4.0000       38.10
   10.000      1.0000      4.6500       74.10
   10.500      1.1000      5.2000      133.00
   11.000      1.1500      6.0000      500.00
   11.500      1.3000      11.000     1300.00
 END FTABLE 11

 FTABLE      12
ROWS COLS ***
   6    4
    DEPTH        AREA      VOLUME     OUTFLOW    ***
    0.000      0.0000      0.0000        0.00
    0.100      0.6327      0.0316        0.15
    0.500      0.7960      0.3174        5.87
    1.000      1.0002      0.7664       21.53
    1.500      1.2043      1.3176       46.43
    2.000      1.4085      1.9708       81.20
    3.000      1.8168      3.5834      183.79
    4.000      2.2251      5.6044      336.22
    5.000      2.6335      8.0337      545.30
    6.000      3.0418     10.8713      817.51
 END FTABLE 12

 FTABLE      13
           *** REVISED 8/16/00 ADDED 2ND OUTFLOW
ROWS COLS ***
   7    5
    DEPTH        AREA      VOLUME     OUTFLOW OUTFLOW2***
    0.000      40.000      0.0000        0.00     0.00
    1.000      41.400      40.000        0.00     0.11
    1.500      42.000      60.000       10.00     0.11
    2.000      42.700      80.000       16.00     0.11
    2.500      43.300      100.00       20.00     0.11
    3.000      44.000      120.00       28.00     0.11
    5.000      45.000      210.00       45.00     0.11
 END FTABLE 13

 FTABLE      14
ROWS COLS ***
   6    4
    DEPTH        AREA      VOLUME     OUTFLOW    ***
    0.000      0.0000      0.0000        0.00
    0.100      0.3361      0.0168        0.24
    0.500      0.3809      0.1602        9.04
    1.000      0.4370      0.3647       31.61
    1.500      0.4930      0.5972       65.00
    2.000      0.5491      0.8577      108.85
    2.500      0.6051      1.1462      163.33
    3.000      0.6612      1.4628      228.78
 END FTABLE 14

 FTABLE      15
ROWS COLS ***
   4    4
    DEPTH        AREA      VOLUME     OUTFLOW    ***
     0.00        0.10        0.00        0.00
     1.00        1.00        0.55       91.00
     2.00        1.10        1.60      268.00
     3.00        1.20        2.75      493.00
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```
 END FTABLE 15

 FTABLE     16
ROWS COLS ***
  4    4
    DEPTH       AREA      VOLUME    OUTFLOW    ***
     0.00       0.10       0.00       0.00
     1.00       1.00       0.55      74.00
     2.00       1.10       1.60     219.00
     3.00       1.20       2.75     403.00
 END FTABLE 16

 FTABLE     17
ROWS COLS ***
  5    4
    DEPTH       AREA      VOLUME    OUTFLOW    ***
     0.00       0.10       0.00       0.00
     1.00       1.00       0.55      59.00
     2.00       1.10       1.60     173.00
     3.00       1.20       2.75     318.00
     4.00       1.30       4.00     484.00
 END FTABLE 17

 FTABLE     23
ROWS COLS ***   HERMES
  9    5
    DEPTH       AREA      VOLUME    OUTFLOW OUTFLOW    ***
     0.00       0.00       0.00       0.00     0.00              0.00
     5.00       0.50       1.91       0.00     0.00            305.00
    11.00       0.79       5.79       0.00     0.00            311.00
    15.00       1.13       9.64       0.50     0.01            315.00
    19.00       1.72      15.34       0.50     0.05            319.00
    29.00       2.86      38.25       0.50     0.10            329.00
    39.00       4.40      74.55       0.50     0.20            339.00
    50.00       6.22     132.98       0.50     0.30            350.00
    60.00      10.00    1212.98       0.50     0.40            360.00
 END FTABLE 23

 FTABLE     24
ROWS COLS ***
  9    4
    DEPTH       AREA      VOLUME    OUTFLOW    ***
    0.000     0.0000     0.0000       0.00
    0.100     0.2571     0.0129       0.16
    0.500     0.3873     0.1417       6.53
    1.000     0.5501     0.3761      25.95
    1.500     0.7128     0.6918      59.86
    2.000     0.8756     1.0889     110.67
    3.000     1.2011     2.1273     272.24
    3.500     1.3639     2.7685     387.38
    4.000     1.5266     3.4912     528.19
 END FTABLE 24

 FTABLE     33
ROWS COLS ***
 11    4
    DEPTH       AREA      VOLUME    OUTFLOW    ***
     0.00       1.00       0.00       0.00
     0.50       1.20       0.55       2.00
     1.00       1.40       1.20       6.00
     1.50       1.60       1.95       9.00
     2.00       1.80       2.80      13.00
     2.50       2.00       3.75      16.50
     3.00       2.20       4.80      20.00
     3.50       2.40       5.95      23.00
     4.00       2.60       7.20      26.00
     5.00       2.80       9.90     104.00
     6.00       3.00      12.80     246.00
 END FTABLE 33

 FTABLE     34
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ROWS COLS *** REVISED 11/19/97 BASED ON HEC-RAS MODEL
          *** REVISED 8/16/00 ADDED 2ND OUTFLOW
   6    5
    DEPTH        AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.00        3.00      0.00       0.00     0.00
     3.00        3.05      9.06       0.00     0.11
     4.00        3.10     12.15       0.00     0.11
     5.00        3.15     15.28       0.00     0.11
     6.00        3.20     18.45       72.0     0.11
     7.00        3.25     21.68      225.0     0.11
 END FTABLE 34

 FTABLE     35
ROWS COLS *** REVISED 11/19/97 BASED ON HECRAS MODEL
   5    4
    DEPTH        AREA     VOLUME    OUTFLOW    ***
     0.00       0.10       0.00       0.00
     1.00       1.10       0.60      38.00
     2.00       1.20       1.75     108.00
     3.00       1.30       3.00     194.00
     4.00       1.40       4.35     290.00
 END FTABLE 35


 FTABLE     38
ROWS COLS ***
   7    4
    DEPTH        AREA     VOLUME    OUTFLOW    ***
    0.000      0.0000     0.0000       0.00
    1.000      0.4000     0.4000       2.00
    1.500      0.5000     1.0000       4.00
    2.000      0.9000     1.3000      11.00
    2.500      1.3000     1.6000      15.00
    3.000      1.6000     2.0000      18.00
    3.500      1.9000     2.5000      20.80
 END FTABLE 38

 FTABLE     45
ROWS COLS ***
   4    4
    DEPTH        AREA     VOLUME    OUTFLOW    ***
    0.000      0.0010     0.0000       0.00
    0.000      0.0100     0.0100      10.00
    0.100      0.1000     0.1000     100.00
    1.000      1.0000     1.0000    1000.00
   10.000     10.0000    10.0000   10000.00
 END FTABLE 45

 FTABLE    645
ROWS COLS ***
   4    4
    DEPTH        AREA     VOLUME    OUTFLOW    ***
    0.000      0.0010     0.0000       0.00
    0.000      0.0100     0.0100      10.00
    0.100      0.1000     0.1000     100.00
    1.000      1.0000     1.0000    1000.00
   10.000     10.0000    10.0000   10000.00
 END FTABLE645

 FTABLE     50
ROWS COLS ***
  10    4
    DEPTH        AREA     VOLUME    OUTFLOW    ***
     0.00       1.00       0.00       0.00
     0.50       1.10       0.53       5.00
     1.00       1.20       1.10      15.00
     1.50       1.30       1.73      25.00
     2.00       1.40       2.40      35.00
     2.50       1.50       3.13      52.00
     3.00       1.60       3.90      70.00
     3.50       1.70       4.73      87.00
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     4.00      1.80        5.60     105.00
     6.00      1.90        9.30     165.00
 END FTABLE 50

 FTABLE      52
ROWS COLS ***
   6    4
    DEPTH       AREA      VOLUME    OUTFLOW   ***
    0.000     0.0000      0.0000       0.00
    0.100     0.3680      0.0184       0.25
    0.500     0.3717      0.1664       9.39
    1.000     0.3763      0.3534      31.06
    2.000     0.3819      0.7325      94.37
    3.000     0.3874      1.1171     174.33
 END FTABLE 52

 FTABLE     552
ROWS COLS ***   SDN1 VAULT EFFECTIVE DEPTH=12 FT  RISER=24 INCHES
  15    4
    DEPTH       AREA      VOLUME    OUTFLOW   ***
    0.000     0.4308      0.0000       0.00
    1.290     0.4308      0.6520      0.111
    2.130     0.4308      1.0760      0.143
    3.530     0.4308      1.7830      0.184
    4.640     0.4308      2.3430      0.211
    5.200     0.4308      2.6260      0.223
    6.320     0.4308      3.1920      0.246
    7.430     0.4308      3.7530      0.267
    8.200     0.4308      4.1410      0.280
    9.220     0.4308      4.6570      0.407
   10.190     0.4308      5.1460      0.567
   11.250     0.4308      5.6820      0.954
   12.100     0.4308      6.1110      2.130
   12.300     0.4308      6.2120      4.730
   13.700     0.4308      6.9190     21.360
 END FTABLE552

 FTABLE      53
OLD LAKE REBA                                       ***
MAX DEPTH = 4.9 FEET                                ***
30" CMP, 40 CFS DISCHARGE AT MAX DEPTH              ***
ROWS COLS ***
   7    4
    DEPTH       AREA      VOLUME    OUTFLOW   ***
    0.000     2.4000      0.0000       0.00
    1.000     2.5800      2.5000      18.00
    2.000     2.9400      5.3000      26.00
    3.000     3.4100      8.4000      31.00
    4.000     3.8800      12.100      36.00
    4.900     4.3000      15.800      40.00
    6.000     4.3000      15.810     500.00
 END FTABLE 53

 FTABLE      54
EXISTING MILLER CREEK DETENTION FACILITY*** REVISED STORAGE/Q DATA
GATE SETTING: 2.0 FEET***  BASED ON CALIBRATION FILE
ROWS COLS ***
  12    4
    DEPTH       AREA      VOLUME    OUTFLOW   ***
    0.000       0.00        0.00       0.00
    1.300       0.01        0.01      10.00
    2.000       0.01        0.02      20.00
    2.900       0.70        0.40      30.00
    4.000       1.50        1.50      40.00
    5.400       3.50        4.90      50.00
    7.000       8.60       13.30      60.00
    8.800      15.60       34.80      70.00
   10.000      19.90       57.30      76.00
   10.500      21.50       68.00      92.00
   11.000      23.10       78.80     179.00
   11.500      24.70       88.60     303.00
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 END FTABLE 54

 FTABLE    104
MILLER CREEK DETENTION FACILITY*** WITH ADD'L AREA 1+AREA 2 55.5 ACFT @ 10FT
GATE SETTING: 2.0 FEET*** EXISTING OUTLET NO LOW FLOW CONTROL
ROWS COLS ***
  17    4
    DEPTH      AREA     VOLUME    OUTFLOW   ***
    0.000    0.0000    0.0000      0.00
    0.500    0.0100    0.0100      2.50
    1.500    0.0300    0.2800     14.29
    2.500    1.1100    1.3900     24.88
    3.500    2.6100    4.0000     34.51
    4.500    4.6100    9.1400     43.20
    5.500    7.1200    19.600     50.98
    6.000    8.3600    21.180     54.53
    6.500    11.870    30.060     57.87
    7.000    15.370    38.930     61.00
    7.500    18.870    47.800     63.91
    8.000    21.860    59.160     66.62
    8.500    24.850    70.510     69.12
    9.000    27.340    84.160     71.42
    9.500    29.820    97.820     73.53
   10.000    32.050    112.83     75.44
   10.500    34.275    127.84     90.74
   11.500    38.220    161.54    320.00
 END FTABLE104

 FTABLE     69
PRE-MILLER CREEK DETENTION FACILITY***
ROWS COLS ***
  12    4
    DEPTH      AREA     VOLUME    OUTFLOW   ***
    0.000    0.0000    0.0000      0.00
    0.100    0.1860    0.0093      0.12
    0.500    0.2552    0.0975      4.84
    1.000    0.3417    0.2467     18.49
    1.500    0.4282    0.4392     41.30
    2.000    0.5148    0.6750     74.40
    2.500    0.6013    0.9540    119.01
    3.000    0.6878    1.2763    176.30
    3.500    0.7744    1.6418    247.41
    4.000    0.8609    2.0506    333.43
    4.500    0.9470    2.4992    434.59
    5.000    1.0331    2.9905    552.33
 END FTABLE 69

*** PROJECT CONDITION PONDS/VAULTS
 FTABLE    452
ROWS COLS ***
*** NEW NORTH EMPLOYEE PARKING LOT VAULT (NEPL)
*** PARALLEL VAULT BASED ON KCRTS EFFECTIVE DEPTH=20 FT
  20    4
    DEPTH      AREA     VOLUME    OUTFLOW ***
    0.00      3.214     0.000     0.000
    1.11      3.214     0.826     0.129
    1.57      3.214     1.168     0.154
    3.43      3.214     2.551     0.227
    4.83      3.214     3.593     0.269
    8.08      3.214     6.010     0.348
   10.41      3.214     7.743     0.395
   12.74      3.214     9.476     0.437
   14.00      3.214    10.413     0.458
   14.65      3.214    10.897     0.557
   16.09      3.214    11.968     0.665
   16.23      3.214    12.072     0.754
   17.92      3.214    13.329     1.140
   18.22      3.214    13.552     1.310
   18.81      3.214    13.991     1.860
   19.11      3.214    14.214     2.190
   20.00      3.214    14.876     3.350
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  20.20      3.214     15.025     5.110
  20.70      32.14     15.397    14.820
  21.00      32.14     15.620    18.560
 END FTABLE452

 FTABLE    451
ROWS COLS ***
*** NORTH EMPLOYEE PARKING LOT VAULT (NEPL)
*** EXISTING VAULT W/MODIFIED OUTLET   EFFECTIVE DEPTH= 18.0 FT
  14    4
   DEPTH       AREA     VOLUME    OUTFLOW  ***
   0.000     0.2240     0.0000      0.00
   2.170     0.2240     0.4860     0.031
   4.260     0.2240     0.9550     0.043
   5.930     0.2240     1.3290     0.051
   8.030     0.2240     1.8000     0.059
  10.120     0.2240     2.2680     0.066
  12.210     0.2240     2.7360     0.073
  14.040     0.2240     3.1460     0.109
  15.510     0.2240     3.4760     0.166
  16.220     0.2240     3.6350     0.295
  18.000     0.2240     4.0340     1.080
  18.400     0.2240     4.1240     5.400
  19.000     0.2240     4.2580    12.680
  19.900     0.2240     4.4600    17.080
 END FTABLE451


 FTABLE     46
ROWS COLS ***
SDN-6: 24TH STREET CARGO VAULT ***  EFFECTIVE DEPTH=14 FT RISER DIA=12 IN
  20    4
   DEPTH        AREA     VOLUME    OUTFLOW  ***
    0.00        0.35      0.000      0.000
    0.37        0.35      0.131      0.021
    1.19        0.35      0.421      0.037
    3.39        0.35      1.198      0.063
    5.03        0.35      1.778      0.077
    7.23        0.35      2.556      0.092
    9.15        0.35      3.235      0.104
   10.25        0.35      3.624      0.110
   10.53        0.35      3.723      0.111
   10.92        0.35      3.861      0.128
   12.00        0.35      4.242      0.165
   12.13        0.35      4.288      0.190
   12.95        0.35      4.578      0.245
   13.77        0.35      4.868      0.282
   14.00        0.35      4.949      0.291
   14.10        0.35      4.985      0.910
   14.20        0.35      5.020      2.040
   14.30        0.35      5.056      3.500
   14.50        0.35      5.126      7.200
   14.70        0.35      5.197     11.720
 END FTABLE 46


*** SDW-1A: 3RD RUNWAY POND G TO MILLER CREEK (LEVEL 2): ***
 FTABLE     47
 *** PROJECT  SDW1A    EFFECTIVE DIAMETER=3.0 FT
ROWS COLS ***          INFILTRATION TANK TO OBTAIN 0.3 CFS
  14    5
   DEPTH       AREA     VOLUME       STORMQ   INFILTRQ ***
   0.000      0.000     0.000        0.000      0.000
   0.250      0.002     0.002        0.000      0.027
   0.500      0.004     0.004        0.000      0.054
   1.000      0.012     0.012        0.000      0.109
   1.500      0.020     0.020        0.000      0.164
   2.000      0.029     0.029        0.000      0.218
   2.500      0.036     0.036        0.000      0.272
   3.000      0.041     0.0406       0.000      0.327
   3.100      0.041     0.0419       0.596      0.338
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3.200	0.041	0.0420	1.685	0.349
3.300	0.041	0.0421	3.096	0.360
3.400	0.041	0.0422	4.766	0.371
3.500	0.041	0.0423	6.661	0.382
3.750	0.041	0.0424	12.237	0.409

END FTABLE 47

*** SDW-1A: 3RD RUNWAY NORTH POND G TO MILLER CREEK (LEVEL 2): ***

FTABLE 147

*** PROJECT SDW1A EFFECTIVE DEPTH=14.0 FT RISER DIA 24 INCHES

ROWS COLS *** VAULT BASED ON INFILTRATION=0.15CFS

17 5

DEPTH	AREA	VOLUME	INFILTRQ	BYPASS Q***
0.000	0.689	0.000	0.0000	0.0000
0.010	0.689	0.007	0.1400	0.0000
1.000	0.689	0.689	0.1408	0.0000
2.000	0.689	1.377	0.1417	0.0000
4.000	0.689	2.755	0.1432	0.0000
6.000	0.689	4.132	0.1446	0.0000
8.000	0.689	5.510	0.1461	0.0000
10.000	0.689	6.887	0.1475	0.0000
12.000	0.689	8.264	0.1489	0.0000
14.000	0.689	9.642	0.1503	0.0000
16.000	0.689	11.019	0.1517	0.0000
16.750	0.689	11.536	0.1517	10.7600
16.900	0.689	11.639	0.1517	13.9600
17.000	0.689	11.708	0.1517	16.1000
17.100	0.689	11.777	0.1517	18.5700
17.300	0.689	11.915	0.1517	23.8600
18.000	0.689	12.397	0.1517	45.5400

END FTABLE147

*** SDW-1A: 3RD RUNWAY NORTH POND G TO MILLER CREEK (LEVEL 2): ***

FTABLE 247

*** PROJECT SDW1A EFFECTIVE DEPTH=12.0 FT RISER DIA 12 INCHES

ROWS COLS *** POND BASED ON INFILTRATION=0.15CFS

17 5

DEPTH	AREA	VOLUME	STORMQ	INFILTRQ ***
0.000	1.300	0.000	0.00	0.00
0.010	1.310	0.010	0.001	0.15
1.000	1.320	1.320	0.007	0.15
2.000	1.342	2.650	0.010	0.15
3.000	1.363	4.000	0.012	0.15
4.000	1.385	5.370	0.013	0.15
5.000	2.672	8.000	0.015	0.15
6.000	2.739	10.700	0.017	0.15
7.000	2.807	13.470	0.018	0.15
8.000	2.876	16.300	0.019	0.15
8.300	2.896	17.176	0.031	0.15
9.000	2.945	19.210	0.041	0.15
10.000	3.014	22.180	0.051	0.15
11.000	3.084	25.228	0.058	0.15
11.100	3.092	25.540	0.675	0.15
11.300	3.106	26.162	3.260	0.15
12.000	3.155	28.340	15.190	0.15

END FTABLE247

*** SDN3A: 3RD RUNWAY VAULT TO MILLER CREEK (LEVEL 2): ***

FTABLE 37

*** PROJECT C SDN3A EFFECTIVE DEPTH=11.0FT RISER DIA=24 INCHES

ROWS COLS *** VAULT BASED ON IMPERVIOUS TOP SURO

14 4

DEPTH	AREA	VOLUME	OUTFLOW ***
0.000	0.644	0.000	0.000
0.010	0.644	0.006	0.001
1.000	0.644	0.643	0.016
3.980	0.644	2.558	0.033
6.030	0.644	3.876	0.041
9.010	0.644	5.792	0.050
10.00	0.644	6.428	0.052
10.46	0.644	6.724	0.072

11.00	0.644	7.071	0.082
11.10	0.644	7.135	0.699
11.20	0.644	7.199	1.830
11.30	0.644	7.264	3.290
11.40	0.644	7.328	5.020
11.60	0.644	7.456	9.140

END FTABLE 37

*** SDN3A: 3RD RUNWAY POND C TO MILLER CREEK (LEVEL 2): ***
FTABLE 237
*** PROJECT C SDN3A EFFECTIVE DEPTH= 9.0FT RISER DIA=24 INCHES
ROWS COLS *** POND BASED ON INTERFLOW AND PERVIOUS TOP SURO
19 4

DEPTH	AREA	VOLUME	OUTFLOW ***
0.000	1.3090	0.000	0.00
0.020	1.3120	0.026	0.009
1.020	1.3550	1.358	0.070
2.070	1.4030	2.806	0.100
3.130	1.4530	4.320	0.123
4.020	1.4980	5.632	0.139
5.070	1.5460	7.229	0.156
7.750	1.6720	11.549	0.193
7.800	1.6800	11.633	0.199
7.850	1.6840	11.718	0.213
8.250	1.7050	12.395	0.249
8.340	1.7090	12.549	0.270
8.570	1.7210	12.944	0.313
8.950	1.7410	13.601	0.354
9.500	1.7690	14.567	0.399
9.600	1.7740	14.744	0.714
9.800	1.7850	15.100	2.020
10.300	1.8110	15.999	3.840
10.900	1.8430	17.095	4.960

END FTABLE237

*** SDN-3X: 3RD RUNWAY NORTH VAULT (LEVEL 2): ***
FTABLE 43
ROWS COLS *** EFFECTIVE DEPTH=20 FT RISER DIA=24 INCHES
21 4

DEPTH (FT)	AREA (ACRES)	VOLUME (ACRE-FT)	FLOW (FT3/S) ***
0.00	1.288	0.00	0.00
0.14	1.288	0.180	0.067
1.39	1.288	1.790	0.216
3.35	1.288	4.314	0.336
5.31	1.288	6.839	0.423
8.06	1.288	10.380	0.521
8.84	1.288	11.385	0.545
10.02	1.288	12.905	0.580
11.98	1.288	15.429	0.635
12.37	1.288	15.931	0.645
14.00	1.288	18.030	0.686
14.10	1.288	18.159	0.705
14.91	1.288	19.202	0.757
16.09	1.288	20.722	0.810
18.00	1.288	23.182	0.881
18.32	1.288	23.594	1.150
18.76	1.288	24.161	1.360
20.00	1.288	25.758	1.680
20.10	1.288	25.886	2.320
20.50	1.288	26.402	8.620
20.80	1.288	26.788	15.370

END FTABLE 43

*** SDN-4X/2X: 3RD RUNWAY NORTH VAULT (COMBINED FACILITY)
FTABLE 51
ROWS COLS *** EFFECTIVE DEPTH=19FT RISER DIA=24 INCHES
20 4

DEPTH (FT)	AREA (ACRES)	VOLUME (ACRE-FT)	OUTFLOW (FT3/S) ***
0.00	0.789	0.000	0.000

```
     0.16      0.789      0.126      0.056
     1.51      0.789      1.192      0.169
     3.28      0.789      2.588      0.249
     5.49      0.789      4.332      0.322
     7.26      0.789      5.729      0.370
    10.35      0.789      8.168      0.442
    12.12      0.789      9.564      0.478
    13.44      0.789     10.606      0.503
    14.33      0.789     11.308      0.520
    15.57      0.789     12.287      0.654
    16.72      0.789     13.194      0.828
    17.19      0.789     13.565      0.950
    17.63      0.789     13.913      1.030
    18.00      0.789     14.205      1.080
    19.00      0.789     14.994      1.960
    19.10      0.789     15.073      2.580
    19.40      0.789     15.309      6.930
    19.60      0.789     15.467     11.080
    20.00      0.789     15.783     17.190
  END FTABLE 51

*** SDW-1B:3RD RUNWAY CENTRAL SOUTH POND D TO MILLER CREEK (LEVEL 2): ***
  FTABLE      57
 ROWS COLS ***      EFFECTIVE DEPTH = 14.0 FT
   17    4
    DEPTH      AREA     VOLUME     STORMQ      ***
     (FT)    (ACRES)  (ACRE-FT)   (FT3/S)      ***
     0.00     2.430      0.000      0.000
     0.01     2.430      0.041      0.010
     1.00     2.680      2.411      0.183
     2.00     2.760      4.860      0.257
     3.00     2.818      7.370      0.319
     4.00     3.079      9.945      0.366
     5.00     5.832     15.320      0.411
     6.00     5.927     20.742      0.450
     7.00     6.022     26.264      0.481
     8.00     6.118     31.888      0.518
     9.00     6.210     37.613      0.550
    10.00     6.311     43.441      0.583
    11.00     6.408     49.372      0.609
    12.00     6.607     55.406      0.634
    13.00     6.405     61.543      0.764
    14.00     6.504     67.786      1.320
    15.00     7.000     70.000     16.600
  END FTABLE 57

*** SDW-1B:3RD RUNWAY CENTRAL SOUTH POND D TO MILLER CREEK (LEVEL 2): ***
  FTABLE     257
  *** PROJECT  SDW1B    EFFECTIVE DIAMETER=3.0 FT
 ROWS COLS ***          INFILTRATION TANK TO OBTAIN 0.2 CFS
   15    5
    DEPTH      AREA     VOLUME      STORMQ   INFILTRQ ***
    0.000     0.001     0.000       0.000     0.000
    0.010     0.001     0.001       0.000     0.002
    0.250     0.002     0.002       0.000     0.017
    0.500     0.004     0.004       0.000     0.035
    1.000     0.012     0.012       0.000     0.071
    1.500     0.020     0.020       0.000     0.106
    2.000     0.029     0.029       0.000     0.142
    2.500     0.036     0.036       0.000     0.178
    3.000     0.041    0.0406       0.000     0.213
    3.100     0.041    0.0420       0.596     0.220
    3.200     0.041    0.0421       1.685     0.227
    3.300     0.041    0.0422       3.096     0.233
    3.400     0.041    0.0423       4.766     0.241
    3.500     0.041    0.0424       6.661     0.248
    3.750     0.041    0.0425      12.237     0.266
  END FTABLE257

  FTABLE     570
  *** PROJECT  SDW1B    FLOW SPLITTER (to 257 and 57)
```

ROWS COLS ***
15 5

DEPTH	AREA	VOLUME	STORMQ	INFILTRQ ***
0.000	0.00	0.000	0.000	0.000
0.100	0.01	0.0002	0.000	0.050
0.400	0.01	0.0009	0.000	0.110
0.600	0.01	0.0014	0.000	0.130
0.750	0.01	0.0017	0.000	0.150
0.800	0.01	0.0018	0.720	0.150
1.000	0.01	0.0023	8.050	0.170
1.100	0.01	0.0025	13.330	0.180
1.200	0.01	0.0027	19.440	0.190
1.300	0.01	0.0030	26.270	0.190
1.400	0.01	0.0032	33.750	0.200
1.420	0.01	0.0033	35.320	0.200
1.440	0.01	0.0033	36.910	0.200
1.450	0.01	0.0034	37.920	0.200
1.460	0.01	0.0035	38.530	0.200

END FTABLE570

FTABLE 61
ROWS COLS ***
*** SDN-2X: DETAIN OVERFLOW FROM NCPS AND NSMPS-
17 4

DEPTH	AREA	VOLUME	OUTFLOW ***
0.000	0.5740	0.0000	0.00
1.200	0.5740	0.7710	0.151
2.220	0.5740	1.4270	0.205
3.240	0.5740	2.0830	0.247
3.650	0.5740	2.3460	0.262
4.260	0.5740	2.7380	0.283
4.660	0.5740	2.9950	0.296
5.680	0.5740	3.6510	0.327
6.640	0.5740	4.2680	0.517
7.650	0.5740	4.9170	0.644
8.670	0.5740	5.9710	0.739
9.810	0.5740	6.3570	0.836
10.700	0.5740	6.8780	0.894
12.000	0.5740	7.7130	0.978
12.100	0.5740	7.7780	1.600
12.300	0.5740	7.9060	4.200
12.800	0.5740	8.2280	14.560

END FTABLE 61

PRE AMBAUM DETENTION ***
FTABLE 111
ROWS COLS ***
15 4

DEPTH	AREA	VOLUME	OUTFLOW ***
0.000	0.0000	0.0000	0.00
0.500	0.2160	0.0750	5.30
1.000	0.2730	0.1990	21.10
1.500	0.2890	0.3410	43.90
2.000	0.2900	0.4830	68.80
2.500	0.2910	0.6070	89.10
3.000	0.2950	0.6820	90.00
3.500	0.3000	2.1000	100.00
4.000	0.3050	2.5000	105.00
4.500	0.3100	3.0000	110.00
5.000	0.3200	3.5000	120.00
5.500	0.3300	4.0000	130.00
6.000	0.3800	5.0530	166.48
6.500	0.3980	5.9430	225.31
7.000	0.4150	6.9040	320.10

END FTABLE111

FTABLE 135
ROWS COLS *** VACA FARM
6 4

DEPTH	AREA	VOLUME	OUTFLOW ***
0.00	0.10	0.00	0.00

```
      1.00      0.10       0.10       4.00
      2.00      0.11       0.21       8.00
      2.50      1.00       0.48      13.00
      3.50      6.50       4.23      86.00
      4.50     13.00      13.98     235.00
  END FTABLE135

  FTABLE    240
*** NORTH SNOWMELT PUMP STATION (SDN-2) (INSTALLED IN LATE 1997/1998)      ***
 ROWS COLS
   14    5
     DEPTH      AREA    VOLUME       (IWS)       (SDS)                     ***
      (FT)   (ACRES) (ACRE-FT)       (CFS)       (CFS)                     ***
       0.0     0.002      0.00        0.00        0.00
      1.00     0.002    0.0023        0.00        0.00
      2.00     0.002    0.0046        1.67        0.00
      3.00     0.002    0.0069        1.67        0.00
      4.00     0.002    0.0092        1.67        0.00
      5.00     0.002    0.0115        1.67        0.00
      5.25     0.002    0.0121        1.67        1.53
      5.50     0.002    0.0126        1.67        6.06
      5.75     0.002    0.0132        1.67       12.65
      6.00     0.002    0.0138        1.67       19.83
      6.25     0.002    0.0144        1.67       25.66
      6.50     0.002    0.0149        1.67       25.70
      6.75     0.002    0.0155        1.67       26.70
      7.00     0.002    0.0161        1.67       50.00
  END FTABLE240

  FTABLE    242
*** NORTH CARGO PUMP STATION (SDN-2) (INSTALLED IN OCTOBER 1997)
 ROWS COLS                                                                 ***
   14    5
     DEPTH      AREA    VOLUME       (IWS)       (SDS)                     ***
      (FT)   (ACRES) (ACRE-FT)       (CFS)       (CFS)                     ***
       0.0     0.002      0.00        0.00        0.00
      1.00     0.002    0.0023        0.00        0.00
      2.00     0.002    0.0046        6.13        0.00
      3.00     0.002    0.0069        6.13        0.00
      4.00     0.002    0.0092        6.13        0.00
      5.00     0.002    0.0115        6.13        0.00
      5.25     0.002    0.0121        6.13        0.28
      5.50     0.002    0.0126        6.13        1.16
      5.75     0.002    0.0132        6.13        2.53
      6.00     0.002    0.0138        6.13        4.23
      6.25     0.002    0.0144        6.13        6.05
      6.50     0.002    0.0149        6.13        7.72
      6.75     0.002    0.0155        6.13        8.50
      7.00     0.002    0.0161        6.13        20.0
  END FTABLE242

END FTABLES

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>        <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                 <Name> # #***
  MASS-LINK       1
  conversion from acre-inches to acre-ft (1/12)              ***
PERLND     PWATER PERO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK   1

  MASS-LINK       2
IMPLND     IWATER SURO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK   2

  MASS-LINK       3
RCHRES     ROFLOW                          RCHRES          INFLOW
  END MASS-LINK   3

  MASS-LINK       4
RCHRES     OFLOW  OVOL   1                 RCHRES          INFLOW IVOL
```

```
  END MASS-LINK     4

  MASS-LINK         5
RCHRES      OFLOW  OVOL    2                  RCHRES          INFLOW IVOL
  END MASS-LINK     5

  MASS-LINK         6
PERLND      PWATER SURO       0.0833333       RCHRES          INFLOW IVOL
PERLND      PWATER IFWO       0.0833333       RCHRES          INFLOW IVOL
  END MASS-LINK     6

  MASS-LINK         7
PERLND      PWATER AGWO       0.0833333       RCHRES          INFLOW IVOL
  END MASS-LINK     7

  MASS-LINK         10
COPY        OUTPUT MEAN                       COPY            INPUT  MEAN
  END MASS-LINK     10

  MASS-LINK         11
RCHRES      ROFLOW                            COPY            INPUT  MEAN
  END MASS-LINK     11

  MASS-LINK         12
COPY        OUTPUT MEAN                       RCHRES          INFLOW IVOL
  END MASS-LINK     12

  MASS-LINK         14
RCHRES      OFLOW  OVOL    1                  COPY            INPUT  MEAN
  END MASS-LINK     14

  MASS-LINK         15
RCHRES      OFLOW  OVOL    2                  COPY            INPUT  MEAN
  END MASS-LINK     15

  MASS-LINK         21
PERLND      PWATER PERO       0.0833333       COPY            INPUT  MEAN
  END MASS-LINK     21

  MASS-LINK         22
IMPLND      IWATER SURO       0.0833333       COPY            INPUT  MEAN
  END MASS-LINK     22

  MASS-LINK         26
PERLND      PWATER SURO       0.0833333       COPY            INPUT  MEAN
PERLND      PWATER IFWO       0.0833333       COPY            INPUT  MEAN
  END MASS-LINK     26

  MASS-LINK         27
PERLND      PWATER AGWO       0.0833333       COPY            INPUT  MEAN
  END MASS-LINK     27

END MASS-LINK

COPY
  TIMESERIES
  Copy-opn                                                                   ***
    # -  #  NPT  NMN                                                         ***
   37   71         1
  240  242         1
  357  357         1
  645  645         1
  END TIMESERIES
END COPY

END RUN
```

```
RUN
GLOBAL
  ***  SEATAC AIRPORT HSPF BASIN MODEL OF MILLER CREEK
  ***  FILE: MC23AGIF.INP - 2006 future condition
  ***  Second run to apply re-infiltration
  ***  BASED ON MILL64.INP FILE FROM AQUA TERRA
  ***  MC22WDM:
  ***  ADDED PERLND 47,57,
  ***  ADDED GROUND WATER INFILTRATION TO WDM FOR USE WITH MCAGWC.INP
  ***  FK revised SDW1A and SDW1B with flow splitters, storages at SDN3/3X, SDN2X/4X;
  ***  FK revised MC-1 and SDN-2X land uses, added POC at Lake Reba, removed run-of-
river tables
  MILLER CREEK BASIN HSPF MODEL
*** START       1994  1  1  0  0  END    1996  8 30 24  0
  START       1948 10  1  0  0  END    1997  1 31 24  0
  RUN INTERP OUTPUT LEVEL    6
  RESUME     0 RUN     1
END GLOBAL

FILES
<type>  <fun>***<------------fname------------------------------------------>
MESSU      24   MILL.MES
WDM        25   MCPOND23.WDM
           61   PER.L61
           62   RCH.L62
END FILES

OPN SEQUENCE
    INGRP              INDELT 01:00
      PERLND      16
      PERLND      26
      PERLND      34
      PERLND      44
      PERLND      45
  *** special PERLND for infiltration SDW1A
      PERLND      47
      PERLND      54
  *** special PERLND for infiltration SDW1B
      PERLND      57
      IMPLND      14
      RCHRES       1
      RCHRES      23
      RCHRES      24
      RCHRES       2
      RCHRES       3
      RCHRES      33
      RCHRES       4
      RCHRES       5
      RCHRES      50
      RCHRES     242
      RCHRES     240
      COPY        61
      COPY        44
      RCHRES      51
      RCHRES      43
      RCHRES     451
      RCHRES     452
      COPY        45
      COPY       645
      RCHRES      46
      RCHRES     552
      RCHRES      52
      RCHRES      53
      COPY        53
      RCHRES      54
      RCHRES      37
      RCHRES     237
      COPY        37
      RCHRES     147
      RCHRES     247
      COPY        66
```

```
      COPY         69
      RCHRES       47
      COPY         62
      COPY         63
      COPY         67
      COPY         68
  *** output special PERLND outflow to check
      COPY         47
      COPY         70
      RCHRES       34
      RCHRES      135
      RCHRES      570
      RCHRES       57
      RCHRES      257
      COPY         64
      COPY         65
      COPY        357
      COPY         56
  *** output special PERLND outflow to check
      COPY         57
      COPY         71
      RCHRES       35
      COPY         55
      RCHRES       10
      RCHRES       16
      RCHRES       11
      RCHRES       13
      RCHRES       12
      RCHRES       15
      RCHRES       14
      RCHRES       17
    END INGRP
END OPN SEQUENCE                                                         ***

PERLND
  GEN-INFO
    <PLS >      Name           NBLKS  Unit-systems   Printer             ***
    # -  #                          User  t-series Engl Metr             ***
                                          in  out                        ***
   16      TFM- TILL FOR MOD       1    1    1    1   61    0
   26      TGM- TILL GR MOD        1    1    1    1   61    0
   34      OF - OUTWASH FOR        1    1    1    1   61    0
   44      OG - OUTWASH GR         1    1    1    1   61    0
 ***PERLND FOR NEW AIRPORT FILL; NONE IN CALIBRATION
   45      AIRPORT FILL            1    1    1    1   61    0
   47      OG - INFILTRATION 1     1    1    1    1   61    0
   54      SA - WETLANDS           1    1    1    1   61    0
   57      OG - INFILTRATION 3     1    1    1    1   61    0
  END GEN-INFO
  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC      ***
   14  200    0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    <PLS > ******************** Print-flags ************************* PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
   14  200    0    0    5    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  PWAT-PARM1
    <PLS > ***************** Flags *******************
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                    ***
   14  200    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1
  PWAT-PARM2
    <PLS > ***
    # -  # ***FOREST    LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16                 9.0000    0.3200    400.00    0.1000    0.5000    0.9960
   26                 9.0000    0.1200    400.00    0.1000    0.5000    0.9960
   34                10.0000    2.0000    400.00    0.0500    0.3000    0.9960
   44                10.0000    0.8000    400.00    0.0500    0.3000    0.9960
```

```
  45                 7.5000      0.0200     300.00     0.0700     0.0000     0.9960
  47                10.0000      0.8000     400.00     0.0500     0.3000     0.9960
  54                 8.0000      2.0000     100.00     0.0010     0.5000     0.9960
  57                10.0000      0.8000     400.00     0.0500     0.3000     0.9960
  END PWAT-PARM2
  PWAT-PARM3
    <PLS >***
    # -  #*** PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  16                             2.0000    2.0000      0.33      0.00       0.0
  26                             2.0000    2.0000      0.33        0.        0.
  34                             2.0000    2.0000      0.33      0.00       0.0
  44                             2.0000    2.0000      0.33        0.        0.
  47                             2.0000    2.0000      0.33        0.        0.
  45                             2.0000    2.0000      0.33        0.        0.
  54                             10.000    2.0000      0.33        0.       0.7
  57                             2.0000    2.0000      0.33        0.        0.
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >                                                             ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP***
  16          0.2000    0.7500    0.3500     9.000    0.7000    0.7000
  26          0.1000    0.3750    0.2500     9.000    0.7000    0.2500
  34          0.2000    0.7500    0.3500     0.000    0.7000    0.7000
  44          0.1000    0.7500    0.2500     0.000    0.7000    0.2500
  47          0.1000    0.7500    0.2500     0.000    0.7000    0.2500
  45          0.1000    0.2800    0.2500     6.000    0.1500    0.6000
  54          0.1000    2.2500    0.5000     1.000    0.7000    0.8000
  57          0.1000    0.7500    0.2500     0.000    0.7000    0.2500

  END PWAT-PARM4
  PWAT-STATE1
    <PLS >  PWATER state variables***
    # -  #***   CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  16           0.078        0.    0.2500      0.10     2.000     2.000     0.000
  26           0.051        0.    0.2500      0.10     2.000     2.000     0.000
  34           0.078        0.    0.2500      0.10     2.000     2.000     0.000
  44           0.051        0.    0.2500      0.10     2.000     2.000     0.000
  47           0.051        0.    0.2500      0.10     2.000     2.000     0.000
  45           0.051        0.    0.2500      0.10     2.000     2.000     0.000
  54           0.051        0.    0.2500      0.10     2.000     2.000     0.000
  57           0.051        0.    0.2500      0.10     2.000     2.000     0.000
  END PWAT-STATE1
END PERLND

IMPLND
  GEN-INFO
    <ILS >       Name             Unit-systems   Printer                       ***
    # -  #                    User  t-series Engl Metr                         ***
                                     in  out                                   ***
  14       IMPERVIOUS            1    1    1   60    0
  END GEN-INFO
  ACTIVITY
    <ILS > ************* Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  14          0    0    1    0    0    0
  END ACTIVITY
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
  14          0    0    6    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1
    <ILS >        Flags            ***                                         ***
    # -  # CSNO RTOP  VRS  VNN RTLI    ***                                     ***
  14          0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2
    <ILS >                                                                     ***
    # -  #      LSUR     SLSUR      NSUR     RETSC                             ***
  14          100.00    0.0100    0.1000    0.1000
  END IWAT-PARM2
```

```
  IWAT-PARM3                                                                ***
    <ILS >                                                                  ***
    # -  #     PETMAX    PETMIN
   14
  END IWAT-PARM3
  IWAT-STATE1                                                               ***
    <ILS >  IWATER state variables                                          ***
    # -  #        RETS       SURS
   14       1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND                                                                  ***

EXT SOURCES                                                                 ***

*** NOTE: The only RCHRES that precip and PET are applied to are lakes and ponds
*** FOLLOWING RCHRES ARE PONDS: 57, 247, 237
                                                                            ***
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
*** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
WDM   1002 PREC      ENGLZERO  1.00          PERLND  14 200 EXTNL  PREC
WDM   1002 PREC      ENGLZERO  1.00          IMPLND  14     EXTNL  PREC
WDM      1 EVAP      ENGLZERO  0.8           PERLND  14 200 EXTNL  PETINP
WDM      1 EVAP      ENGLZERO  0.8           IMPLND  14     EXTNL  PETINP
  ***  --> lateral inflow from reinfiltration chamber for SDW1A
WDM      5 FLOW      ENGLZERO  1.0           PERLND  47     EXTNL  AGWLI
  ***  --> lateral inflow from reinfiltration chamber for SDW1B
WDM      6 FLOW      ENGLZERO  1.0           PERLND  57     EXTNL  AGWLI
*** PRECIP/EVAP TO LAKES
WDM   1002 PREC      ENGLZERO                RCHRES   1     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8         RCHRES   1     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                RCHRES   4     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8         RCHRES   4     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                RCHRES  11     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8         RCHRES  11     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                RCHRES  13     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8         RCHRES  13     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                RCHRES  23     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8         RCHRES  23     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                RCHRES  34     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8         RCHRES  34     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                RCHRES  53     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8         RCHRES  53     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                RCHRES  54     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8         RCHRES  54     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                RCHRES 237     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8         RCHRES 237     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                RCHRES 247     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8         RCHRES 247     EXTNL  POTEV
WDM   1002 PREC      ENGLZERO                RCHRES  57     EXTNL  PREC
WDM      1 EVAP      ENGLZERO    0.8         RCHRES  57     EXTNL  POTEV
END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
***PROJECT CONDITION FLOWS
*** RCHRES=LOCATION:
*** 54=MCDF       47=SDW1A INFILTRATION TANK       43=SDN3X      247=SDW1A POND G
*** 17=MOUTH      49=SDW2          44=SDN4X        52=SDN1       451= EXISTING NEPL
*** 61=SDN2X      57=SDW1B         51=SDN2X+SDN4X  53=Lake Reba 452=NEW NEPL
*** 45=NEPL POC   55=SR509         39=SDN3A/SDW1A POC
*** 46=CARGO      37=SDN3AI VAULT 237=SDN3AO POND
*** GAUGE POINTS (17=MOUTH, 54=MILLER RDF, 55=SR509)
RCHRES  17 HYDR   RO       1 1                WDM     113 FLOW     ENGL        REPL
COPY    55 OUTPUT MEAN     1 1 12.1           WDM     118 FLOW     ENGL        REPL
RCHRES  54 HYDR   RO       1 1                WDM     114 FLOW     ENGL        REPL
*** DETENTION POND FLOWS
COPY    61 OUTPUT MEAN     1 1 12.1           WDM     101 FLOW     ENGL        REPL
RCHRES 552 HYDR   RO       1 1                WDM     102 FLOW     ENGL        REPL
RCHRES 451 HYDR   RO       1 1                WDM     105 FLOW     ENGL        REPL
```

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RCHRES 452 HYDR   RO      1 1              WDM    119 FLOW     ENGL     REPL
RCHRES  46 HYDR   RO      1 1              WDM    106 FLOW     ENGL     REPL
*** write RCHRES 47 (Inf. Area # 1)outlet 1 and 2 to WDM 107 and 108 like so:
COPY     62 OUTPUT MEAN   1 1 12.1         WDM    107 FLOW     ENGL     REPL
COPY     63 OUTPUT MEAN   1 1 12.1         WDM    108 FLOW     ENGL     REPL
COPY     66 OUTPUT MEAN   1 1 12.1         WDM    112 FLOW     ENGL     REPL
COPY     69 OUTPUT MEAN   1 1 12.1         WDM   1120 FLOW     ENGL     REPL
*** write SDW1a vault flows to WDM:
COPY     67 OUTPUT MEAN   1 1 12.1         WDM    109 FLOW     ENGL     REPL
COPY     68 OUTPUT MEAN   1 1 12.1         WDM   1090 FLOW     ENGL     REPL
*** write RCHRES 570 outlet 1 and 2 to WDM 110 and 115 like so:
RCHRES 570 HYDR   RO      1 1              WDM    210 FLOW     ENGL     REPL
COPY     64 OUTPUT MEAN   1 1 12.1         WDM    110 FLOW     ENGL     REPL
COPY     65 OUTPUT MEAN   1 1 12.1         WDM    115 FLOW     ENGL     REPL
COPY    357 OUTPUT MEAN   1 1 12.1         WDM    211 FLOW     ENGL     REPL
COPY     56 OUTPUT MEAN   1 1 12.1         WDM    121 FLOW     ENGL     REPL
*** write RCHRES 37 vault to WDM 111
RCHRES  37 HYDR   RO      1 1              WDM    111 FLOW     ENGL     REPL
RCHRES 237 HYDR   RO      1 1              WDM    122 FLOW     ENGL     REPL
RCHRES  43 HYDR   RO      1 1              WDM    103 FLOW     ENGL     REPL
COPY     44 OUTPUT MEAN   1 1 12.1         WDM    104 FLOW     ENGL     REPL
RCHRES  51 HYDR   RO      1 1              WDM    139 FLOW     ENGL     REPL
*** DETENTION STAGES
RCHRES  47 HYDR   STAGE                    WDM    652 STAG     ENGL     REPL
RCHRES 147 HYDR   STAGE                    WDM    657 STAG     ENGL     REPL
RCHRES 247 HYDR   STAGE                    WDM    654 STAG     ENGL     REPL
RCHRES 552 HYDR   STAGE                    WDM    601 STAG     ENGL     REPL
RCHRES  57 HYDR   STAGE                    WDM    651 STAG     ENGL     REPL
RCHRES 257 HYDR   STAGE                    WDM    655 STAG     ENGL     REPL
RCHRES 237 HYDR   STAGE                    WDM    656 STAG     ENGL     REPL
RCHRES  37 HYDR   STAGE                    WDM    650 STAG     ENGL     REPL
RCHRES  54 HYDR   STAGE                    WDM     61 STAG     ENGL     REPL
RCHRES 451 HYDR   STAGE                    WDM    662 STAG     ENGL     REPL
RCHRES 452 HYDR   STAGE                    WDM    667 STAG     ENGL     REPL
RCHRES  46 HYDR   STAGE                    WDM    663 STAG     ENGL     REPL
RCHRES  43 HYDR   STAGE                    WDM    664 STAG     ENGL     REPL
***RCHRES  44 HYDR   STAGE                    WDM    665 STAG     ENGL     REPL
RCHRES  51 HYDR   STAGE                    WDM    666 STAG     ENGL     REPL
*** DETENTION VOLUMES
RCHRES  47 HYDR   VOL                      WDM    752 VOL      ENGL     REPL
RCHRES 147 HYDR   VOL                      WDM    757 VOL      ENGL     REPL
RCHRES 247 HYDR   VOL                      WDM    754 VOL      ENGL     REPL
RCHRES 552 HYDR   VOL                      WDM    602 VOL      ENGL     REPL
RCHRES  57 HYDR   VOL                      WDM    751 VOL      ENGL     REPL
RCHRES 257 HYDR   VOL                      WDM    755 VOL      ENGL     REPL
RCHRES 237 HYDR   VOL                      WDM    756 VOL      ENGL     REPL
RCHRES  37 HYDR   VOL                      WDM    750 VOL      ENGL     REPL
RCHRES  54 HYDR   VOL                      WDM     62 VOL      ENGL     REPL
RCHRES 451 HYDR   VOL                      WDM    762 VOL      ENGL     REPL
RCHRES 452 HYDR   VOL                      WDM    767 VOL      ENGL     REPL
RCHRES  46 HYDR   VOL                      WDM    763 VOL      ENGL     REPL
RCHRES  43 HYDR   VOL                      WDM    764 VOL      ENGL     REPL
***RCHRES  44 HYDR   VOL                      WDM    765 VOL      ENGL     REPL
RCHRES  51 HYDR   VOL                      WDM    766 VOL      ENGL     REPL
*** POINT OF COMPLIANCE (POC)FLOWS
COPY     37 OUTPUT MEAN   1 1 12.1         WDM    125 FLOW     ENGL     REPL
COPY     45 OUTPUT MEAN   1 1 12.1         WDM    199 FLOW     ENGL     REPL
COPY     53 OUTPUT MEAN   1 1 12.1         WDM    399 FLOW     ENGL     REPL
COPY     70 OUTPUT MEAN   1 1 12.1         WDM   7000 FLOW     ENGL     REPL
COPY     71 OUTPUT MEAN   1 1 12.1         WDM   7001 FLOW     ENGL     REPL
*** SPECIAL PERLND REINFILTRATION RESULTS
  ***   --> output special PERLND parameters to check operations:
  ***   --> PERLND 47 active ground water storage depth (in)
PERLND   47 PWATER AGWS                    WDM    471 AGWS     ENGL     REPL
  ***   --> PERLND 47 active ground water outflow (acft/2ac -> in/acre)
COPY     47 OUTPUT MEAN   1 1 12           WDM    472 FLOW     ENGL     REPL
  ***   --> PERLND 57 active ground water storage depth (in)
PERLND   57 PWATER AGWS                    WDM    571 AGWS     ENGL     REPL
  ***   --> PERLND 57 active ground water outflow (acft/2ac -> in/acre)
COPY     57 OUTPUT MEAN   1 1 12           WDM    572 FLOW     ENGL     REPL
```

```
END EXT TARGETS

SCHEMATIC
<-Source->                  <--Area-->   <-Target->   MBLK   ***
<Name>   #                  <-factor->   <Name>   #   Tbl#   ***
  *** SUB-CATCHMENT 1 all agwo goes to sound
PERLND  16                     3.41      RCHRES   1      6
PERLND  26                   232.36      RCHRES   1      6
PERLND  34                     3.07      RCHRES   1      6
PERLND  44                    38.03      RCHRES   1      6
PERLND  54                     3.87      RCHRES   1      6
IMPLND  14                    56.14      RCHRES   1      2
 *** SUB-CATCHMENT 2 10% of area GW goes to vaca 90% goes to sound
PERLND  16                     5.56      RCHRES   2      6
PERLND  26                   200.05      RCHRES   2      6
PERLND  34                     0.46      RCHRES   2      6
PERLND  44                    38.71      RCHRES   2      6
PERLND  16                     0.56      RCHRES 135      7
PERLND  26                    20.00      RCHRES 135      7
PERLND  34                     0.05      RCHRES 135      7
PERLND  44                     3.87      RCHRES 135      7
IMPLND  14                    42.22      RCHRES   2      2
 *** SUB-CATCHMENT 23 New subbasin 15 % OF GW GOES TO VACCA 85% TO SOUND
PERLND  16                     3.09      RCHRES  23      6
PERLND  26                   156.15      RCHRES  23      6
PERLND  34                     2.25      RCHRES  23      6
PERLND  44                    45.84      RCHRES  23      6
PERLND  16                     0.46      RCHRES 135      7
PERLND  26                    23.42      RCHRES 135      7
PERLND  34                     0.34      RCHRES 135      7
PERLND  44                     6.88      RCHRES 135      7
IMPLND  14                    58.44      RCHRES  23      2
 *** SUB-CATCHMENT 24 New subbasin 60 % OF GW GOES TO 11 40% TO SOUND
PERLND  26                   135.43      RCHRES  24      6
PERLND  34                     2.02      RCHRES  24      6
PERLND  44                    69.29      RCHRES  24      6
PERLND  26                    81.26      RCHRES  11      7
PERLND  34                     1.21      RCHRES  11      7
PERLND  44                    41.57      RCHRES  11      7
IMPLND  14                    79.98      RCHRES  24      2
  *** SUB-CATCHMENT 3 agwo goes to vaca(135)
PERLND  16                     8.26      RCHRES   3      6
PERLND  26                   108.38      RCHRES   3      6
PERLND  34                    16.02      RCHRES   3      6
PERLND  44                   102.89      RCHRES   3      6
PERLND  54                     0.04      RCHRES   3      6
PERLND  16                     8.26      RCHRES 135      7
PERLND  26                   108.38      RCHRES 135      7
PERLND  34                    16.02      RCHRES 135      7
PERLND  44                   102.89      RCHRES 135      7
PERLND  54                     0.04      RCHRES 135      7
IMPLND  14                    27.30      RCHRES   3      2
  *** SUB-CATCHMENT 4 10% of agwo goes to rchres 90% goes to sound
PERLND  16                     2.95      RCHRES   4      6
PERLND  26                    85.95      RCHRES   4      6
PERLND  34                     3.75      RCHRES   4      6
PERLND  44                    92.06      RCHRES   4      6
PERLND  16                     0.30      RCHRES   4      7
PERLND  26                     8.59      RCHRES   4      7
PERLND  34                     0.38      RCHRES   4      7
PERLND  44                     9.21      RCHRES   4      7
IMPLND  14                    18.43      RCHRES   4      2
  *** SUB-CATCHMENT 4a 70% of agwo goes to rchres 30% goes to sound
PERLND  16                     8.66      RCHRES   4      6
PERLND  26                    61.64      RCHRES   4      6
PERLND  34                    22.06      RCHRES   4      6
PERLND  44                    78.09      RCHRES   4      6
PERLND  54                    12.50      RCHRES   4      6
PERLND  16                     6.06      RCHRES   4      7
PERLND  26                    43.15      RCHRES   4      7
PERLND  34                    15.44      RCHRES   4      7
```

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PERLND  44                        54.66    RCHRES    4      7
PERLND  54                         8.75    RCHRES    4      7
IMPLND  14                        29.14    RCHRES    4      2
  *** SUB-CATCHMENT 5
PERLND  26                        10.29    RCHRES    5      1
PERLND  44                        50.05    RCHRES    5      1
PERLND  54                        10.74    RCHRES    5      1
IMPLND  14                        16.31    RCHRES    5      2
  *** SUB-CATCHMENT 6
PERLND  16                         1.42    COPY    645     26
PERLND  26                        20.38    COPY    645     26
PERLND  34                        13.44    COPY    645     26
PERLND  44                        11.79    COPY    645     26
PERLND  54                         0.82    COPY    645     26
PERLND  16                         1.42    RCHRES   53      7
PERLND  26                        20.38    RCHRES   53      7
PERLND  34                        13.44    RCHRES   53      7
PERLND  44                        11.79    RCHRES   53      7
PERLND  54                         0.82    RCHRES   53      7
IMPLND  14                         6.23    COPY    645     22
  *** SUB-CATCHMENT 8
PERLND  44                        22.21    RCHRES   35      1
IMPLND  14                         6.60    RCHRES   35      2
  *** SUB-CATCHMENT 9
PERLND  16                         4.98    RCHRES   34      1
PERLND  26                        14.38    RCHRES   34      1
PERLND  34                         0.05    RCHRES   34      1
PERLND  44                        56.71    RCHRES   34      1
PERLND  54                         0.01    RCHRES   34      1
IMPLND  14                        22.47    RCHRES   34      2
  *** SUB-CATCHMENT 10
PERLND  16                         4.15    RCHRES   10      1
PERLND  26                        31.94    RCHRES   10      1
PERLND  44                        95.22    RCHRES   10      1
IMPLND  14                        71.98    RCHRES   10      2
  *** SUB-CATCHMENT 11 25% OF AGWO GOES TO 15
PERLND  16                         0.89    RCHRES   11      6
PERLND  26                       217.92    RCHRES   11      6
PERLND  34                         1.32    RCHRES   11      6
PERLND  44                        65.65    RCHRES   11      6
PERLND  16                         0.67    RCHRES   11      7
PERLND  26                       163.44    RCHRES   11      7
PERLND  34                         0.99    RCHRES   11      7
PERLND  44                        49.24    RCHRES   11      7
PERLND  16                         0.22    RCHRES   15      7
PERLND  26                        54.48    RCHRES   15      7
PERLND  34                         0.33    RCHRES   15      7
PERLND  44                        16.41    RCHRES   15      7
IMPLND  14                       230.80    RCHRES   11      2
  *** SUB-CATCHMENT 12
PERLND  16                         0.39    RCHRES   12      1
PERLND  26                       101.18    RCHRES   12      1
PERLND  34                         5.64    RCHRES   12      1
PERLND  44                        54.98    RCHRES   12      1
PERLND  54                         0.64    RCHRES   12      1
IMPLND  14                        79.83    RCHRES   12      2
  *** SUB-CATCHMENT 13
PERLND  16                         0.79    RCHRES   13      1
PERLND  26                       197.68    RCHRES   13      1
IMPLND  14                        27.66    RCHRES   13      2
  *** SUB-CATCHMENT 14 50% OF AGWO GOES TO SOUND
PERLND  16                         0.24    RCHRES   14      6
PERLND  26                       118.67    RCHRES   14      6
PERLND  34                        13.46    RCHRES   14      6
PERLND  44                        41.91    RCHRES   14      6
PERLND  16                         0.12    RCHRES   14      7
PERLND  26                        59.34    RCHRES   14      7
PERLND  34                         6.73    RCHRES   14      7
PERLND  44                        20.95    RCHRES   14      7
IMPLND  14                        20.66    RCHRES   14      2
  *** SUB-CATCHMENT 15
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PERLND  16                                6.59     RCHRES  15        1
PERLND  26                               49.55     RCHRES  15        1
PERLND  34                               50.09     RCHRES  15        1
PERLND  44                               86.52     RCHRES  15        1
IMPLND  14                               19.47     RCHRES  15        2
  *** SUB-CATCHMENT 16
PERLND  16                               10.93     RCHRES  16        1
PERLND  26                               29.93     RCHRES  16        1
PERLND  34                               20.03     RCHRES  16        1
PERLND  44                               31.83     RCHRES  16        1
IMPLND  14                               15.58     RCHRES  16        2
  *** SUB-CATCHMENT 17 AGWO GOES TO SOUND
PERLND  16                                0.90     RCHRES  17        6
PERLND  26                               16.31     RCHRES  17        6
PERLND  34                               34.82     RCHRES  17        6
PERLND  44                               82.11     RCHRES  17        6
PERLND  54                                2.19     RCHRES  17        6
IMPLND  14                               10.49     RCHRES  17        2
  *** SUB-CATCHMENT MC-1
PERLND  26                                0.14     RCHRES  52        1
PERLND  44                                9.44     RCHRES  52        1
PERLND  45                                0.14     RCHRES  52        1
PERLND  54                                0.27     RCHRES  52        1
IMPLND  14                                1.98     RCHRES  52        2
  *** SUB-CATCHMENT MC-2
PERLND  16                                0.08     RCHRES  53        1
PERLND  26                                0.53     RCHRES  53        1
PERLND  34                                3.60     RCHRES  53        1
PERLND  44                                9.20     RCHRES  53        1
PERLND  45                                2.22     RCHRES  53        1
PERLND  54                               15.14     RCHRES  53        1
IMPLND  14                                2.54     RCHRES  53        2
  *** SUB-CATCHMENT MC-3
PERLND  34                                3.70     RCHRES  54        1
PERLND  44                                4.91     RCHRES  54        1
PERLND  45                                1.07     RCHRES  54        1
PERLND  54                                1.84     RCHRES  54        1
IMPLND  14                                1.42     RCHRES  54        2
  *** SUB-CATCHMENT MC-4
PERLND  34                                0.27     RCHRES 135        1
PERLND  44                               16.51     RCHRES 135        1
PERLND  45                                4.23     RCHRES 135        1
PERLND  54                               11.98     RCHRES 135        1
IMPLND  14                                3.31     RCHRES 135        2
  *** SUB-CATCHMENT MC-5
PERLND  26                               13.43     RCHRES  35        1
PERLND  44                               33.84     RCHRES  35        1
PERLND  54                                7.44     RCHRES  35        1
IMPLND  14                                0.02     RCHRES  35        2
  *** SUB-CATCHMENT MC-6
  ***   --> reduce by 2 acres to make special PERLND 47 for SDW1A
***PERLND  44                                14.10     RCHRES  35        1
PERLND  44                               12.10     RCHRES  35        1
PERLND  45                                0.09     RCHRES  35        1
PERLND  54                                0.90     RCHRES  35        1
IMPLND  14                                0.26     RCHRES  35        2
  ***   --> add 2 acres from special PERLND 47 for SDW1A
PERLND  47                                2.00     RCHRES  35        1
  ***   --> output outflow from special PERLND 47 (acft/ac)
PERLND  47                                1.00     COPY    47       21

  *** SUB-CATCHMENT MC-7
  ***   --> reduce by 2 acres to make special PERLND 57 for SDW1B
PERLND  26                               11.26     COPY    55       21
  ***   --> reduce by 2 acres to make special PERLND 57 for SDW1B
***PERLND  44                                31.80     COPY    55       21
  ***   --> add 2 acres from special PERLND 57 for SDW1B
PERLND  57                                2.00     COPY    55       21
  ***   --> output outflow from special PERLND 57 (acft/ac)
PERLND  57                                1.00     COPY    57       21
PERLND  44                               29.80     COPY    55       21
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```
PERLND  54                        3.20     COPY     55      21
IMPLND  14                        0.03     COPY     55      22

***note: SDN AGWO TO VACCA FARMS (135)NOT TO PONDS

 *** SUB-CATCHMENT SDN-1
PERLND  26                        1.97     RCHRES 552        6
PERLND  44                        1.29     RCHRES 552        6
PERLND  54                        0.20     RCHRES 552        6
PERLND  26                        1.97     RCHRES 135        7
PERLND  44                        1.29     RCHRES 135        7
PERLND  54                        0.20     RCHRES 135        7
IMPLND  14                       12.68     RCHRES 552        2

 *** SUB-CATCHMENT SDN-1-LWR
PERLND  44                        4.79     RCHRES 552        6
PERLND  54                        0.07     RCHRES 552        6
PERLND  44                        4.79     RCHRES 135        7
PERLND  54                        0.07     RCHRES 135        7
IMPLND  14                        0.56     RCHRES 552        2

 *** SUB-CATCHMENT SDN-1-OFF
PERLND  26                       23.01     RCHRES  52        6
PERLND  44                        3.58     RCHRES  52        6
PERLND  54                        1.67     RCHRES  52        6
PERLND  26                       23.01     RCHRES 135        7
PERLND  44                        3.58     RCHRES 135        7
PERLND  54                        1.67     RCHRES 135        7
IMPLND  14                        8.00     RCHRES  52        2

 *** SUB-CATCHMENT SDN-2X (TO POND)
PERLND  26                        0.63     COPY     61      26
PERLND  44                        2.40     COPY     61      26
PERLND  45                        0.86     COPY     61      26
PERLND  26                        0.63     RCHRES 135        7
PERLND  44                        2.40     RCHRES 135        7
PERLND  45                        0.86     RCHRES 135        7
IMPLND  14                        0.36     COPY     61      22

 *** SUB-CATCHMENT SDN-3 (TO POND)
PERLND  26                       23.56     RCHRES  43        6
PERLND  26                       23.56     RCHRES 135        7
IMPLND  14                       24.30     RCHRES  43        2

 *** SUB-CATCHMENT SDN-3X (TO POND)
PERLND  26                        1.61     RCHRES  43        6
PERLND  45                       23.77     RCHRES  43        6
PERLND  26                        1.61     RCHRES 135        7
PERLND  45                       23.77     RCHRES 135        7

 *** SUB-CATCHMENT SDN-4 (TO POND)
PERLND  26                       15.75     COPY     44      26
PERLND  44                        1.31     COPY     44      26
PERLND  45                        0.99     COPY     44      26
PERLND  26                       15.75     RCHRES 135        7
PERLND  44                        1.31     RCHRES 135        7
PERLND  45                        0.99     RCHRES 135        7
IMPLND  14                       12.26     COPY     44      22

 *** SUB-CATCHMENT SDN-4X (TO POND)
PERLND  26                        1.92     COPY     44      26
PERLND  44                        0.75     COPY     44      26
PERLND  45                        8.31     COPY     44      26
PERLND  26                        1.92     RCHRES 135        7
PERLND  44                        0.75     RCHRES 135        7
PERLND  45                        8.31     RCHRES 135        7
IMPLND  14                        4.21     COPY     44      22

 *** SUB-CATCHMENT IWS-NCPS (TO POND)
PERLND  26                        4.78     RCHRES 242        6
PERLND  26                        4.78     RCHRES 135        7
```

```
IMPLND  14                              30.93     RCHRES 242        2

  *** SUB-CATCHMENT IWS-NSMPS (TO POND)
PERLND  26                               2.69     RCHRES 240        6
PERLND  44                               1.97     RCHRES 240        6
PERLND  45                               0.01     RCHRES 240        6
PERLND  26                               2.69     RCHRES 135        7
PERLND  44                               1.97     RCHRES 135        7
PERLND  45                               0.01     RCHRES 135        7
IMPLND  14                               1.95     RCHRES 240        2

  *** SUB-CATCHMENT NEPL (TO POND)
PERLND  26                              10.00     RCHRES 452        6
PERLND  26                              10.00     RCHRES 135        7
IMPLND  14                               6.00     RCHRES 451        2
IMPLND  14                              26.29     RCHRES 452        2

  *** SUB-CATCHMENT CARGO (TO POND)
IMPLND  14                               8.12     RCHRES  46        2

  *** SUB-CATCHMENT SDN3AI (TO VAULT)
IMPLND  14                               5.87     RCHRES  37        2

  *** SUB-CATCHMENT SDN3AO (TO POND)
PERLND  26                               0.08     RCHRES 237        6
PERLND  44                               0.03     RCHRES 237        6
PERLND  45                              22.12     RCHRES 237        6
PERLND  26                               0.08     RCHRES 135        7
PERLND  44                               0.03     RCHRES 135        7
PERLND  45                              22.12     RCHRES 135        7
IMPLND  14                               2.35     RCHRES 237        2

  *** SUB-CATCHMENT SDW1O (TO POND)
PERLND  26                               4.28     RCHRES 247        6
PERLND  44                               0.69     RCHRES 247        6
PERLND  45                              32.44     RCHRES 247        6
PERLND  26                               4.28     RCHRES 135        7
PERLND  44                               0.69     RCHRES 135        7
PERLND  45                              32.44     RCHRES 135        7
IMPLND  14                               1.64     RCHRES 247        2

  *** SUB-CATCHMENT SDN1AI (TO VAULT)
IMPLND  14                              13.78     RCHRES 147        2

  *** SUB-CATCHMENT SDW1B (TO POND)
  *** AGWO TO 35, AS 57 IS D/S OF VACCA FARMS (135)
PERLND  26                              21.25     RCHRES 570        6
PERLND  44                               2.39     RCHRES 570        6
PERLND  45                              46.26     RCHRES 570        6
PERLND  26                              21.25     RCHRES  35        7
PERLND  44                               2.39     RCHRES  35        7
PERLND  45                              46.26     RCHRES  35        7
IMPLND  14                              26.95     RCHRES 570        2

  *** ADD SUB-CATCHMENT IWS-PRIMARY TO PREDEVELOPEMENT ONLY

***ROUTING FOR MILLER CREEK
 *** M1 TO M2 TO M3 TO STORAGE 50.  M4 TO M5 TO STORAGE 50
RCHRES   1                                        RCHRES   2        4
RCHRES  23                                        RCHRES  24        4
RCHRES  24                                        RCHRES   3        3
RCHRES   2                                        RCHRES   3        3
RCHRES   3                                        RCHRES  33        3
RCHRES  33                                        RCHRES  50        3
RCHRES   4                                        RCHRES   5        4
RCHRES   5                                        RCHRES  50        3
 *** PONDS TO 52, 53 & 54
RCHRES 242                                        RCHRES 240        5
 *** OVERFLOW ONLY TO 61
RCHRES 240                                        RCHRES  51        5
COPY    61                                        RCHRES  51       12
```

```
COPY     44                                   RCHRES  51       12
RCHRES  51                                    RCHRES  52        3
RCHRES  43                                    RCHRES  54        3
 *** 2 NEPL VAULTS* (FK-Changed to eliminate run-of-river tables)
RCHRES 451                                    COPY    45       11
RCHRES 452                                    COPY    45       11
COPY     45                                   COPY   645       10
COPY   645                                    RCHRES  53       12
RCHRES  46                                    RCHRES  53        3
 *** NEW STREAM REACH 52 TO LAKE REBA 53 TO RDF 54 (FK-changed to insert new POC at
Lake Reba)
RCHRES 552                                    RCHRES  52        3
RCHRES  52                                    RCHRES  53        3
RCHRES  53                                    COPY    53       11
COPY     53                                   RCHRES  54       12
RCHRES  50                                    RCHRES  54        3
 *** RDF 54 TO 35
RCHRES  54                                    RCHRES 135        3
<-Source->                 <--Area-->         <-Target->  MBLK    ***
<Name>   #                 <-factor->         <Name>   #  Tbl#    ***
 *** PONDS TO 34
RCHRES  37                                    COPY    37       11
RCHRES 237                                    COPY    37       11
COPY     37                                   RCHRES 135       12
 *** SDW1A flow to bypass added (FK, June 2001)
SDW1AI VAULT FLOW TO INFILTRATION 1                                   ***
RCHRES 147                                    RCHRES  47        4
SDW1AI VAULT FLOW TO BYPASS                                           ***
RCHRES 147                                    COPY    70       15
STORMWATER Q 1ST EXIT AT POND G (Bypass)                              ***
RCHRES 247                                    COPY    70       14
RCHRES 247                                    COPY    66       14
RCHRES 247                                    COPY    69       15
2ND EXIT TO INFILTRATION TANK-MILLER CREEK                            ***
RCHRES 247                                    RCHRES  47        5
STORMWATER Q 1ST EXIT TO BYPASS                                       ***
RCHRES  47                                    COPY    70       14
*** 2ND EXIT TO SOIL AND MILLER CREEK (2nd exit intr. as AGWLI)***
*** RCHRES  47                                   COPY    70       15
COPY BLOCK FOR OUTPUT PURPOSES                                        ***
RCHRES  47                                    COPY    62       14
RCHRES  47                                    COPY    63       15
RCHRES 147                                    COPY    67       14
RCHRES 147                                    COPY    68       15
COPY     70                                   RCHRES 135       12
RCHRES  34                                    RCHRES 135        4
RCHRES  34                                    RCHRES 135        5
RCHRES 135                                    RCHRES  35        3
RCHRES  10                                    RCHRES  16        3
 *** PONDS TO 35
 *** Configuration changed to flow splitter to Pond D and Infiltration Basin 3 (FK,
June 2001)
STORM Q - 1ST EXIT OF FLOW SPLITTER TO POND D                         ***
RCHRES 570                                    RCHRES  57        4
***INFILTRATION Q - 2ND EXIT OF FLOW SPLITTER TO SOIL                 ***
RCHRES 570                                    RCHRES 257        5
STORM Q EXIT OF POND D TO MILLER CREEK                            ***
RCHRES  57                                    COPY    71       11
COPY BLOCK FOR OUTPUT PURPOSES                                        ***
RCHRES 570                                    COPY    64       14
RCHRES 570                                    COPY    65       15
RCHRES  57                                    COPY   357       11
RCHRES 257                                    COPY    56       14
RCHRES 257                                    COPY    71       14
*** RCHRES 257                                   COPY    71       15
COPY     71                                   RCHRES  35       12
RCHRES  35                                    COPY    55       11
COPY     55                                   RCHRES  16       12
RCHRES  11                                    RCHRES  15        3
RCHRES  13                                    RCHRES  12        4
RCHRES  13                                    RCHRES  12        5
```

```
RCHRES  12                                    RCHRES  15        3
RCHRES  16                                    RCHRES  15        3
RCHRES  14                                    RCHRES  17        3
RCHRES  15                                    RCHRES  17        3
END SCHEMATIC

NETWORK
***          <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>         <-MEMBER->
<NAME>   # <NAME>    TEM STRG<-FACTOR->STRG <NAME>    #    # <-GRP> <NAME> # # ***
END NETWORK                                                                     ***

RCHRES
  GEN-INFO                                                                      ***
    RCHRES       Name          Nexits   Unit Systems   Printer                  ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG               ***
                                          in   out

     1     Arbor Lake  M 1         2     1     1     1    62     0     0
     2     Arbor Ck -03710 M 2     1     1     1     1    62     0     0
     3     Arbor Ck    M 3         1     1     1     1    62     0     0
     4     Tub Lake    M 4         2     1     1     1    62     0     0
     5     Miller Ck SR518 M5      1     1     1     1    62     0     0
    10     Trib (0371G)   M 10     1     1     1     1    62     0     0
    11     M11 Ambaum Detention    1     1     1     1    62     0     0
    12     Trib(0354)  M 12        1     1     1     1    62     0     0
    13     Burien Lake M 13        2     1     1     1    62     0     0
    14     Trib (0353) M 14        1     1     1     1    62     0     0
    15     M/S U/S OF 17           1     1     1     1    62     0     0
    16     U/S OF 15 M/S           1     1     1     1    62     0     0
    17     GAGE                    1     1     1     1    62     0     0
    23     BASIN M23               2     1     1     1    62     0     0
    24     BASIN M24               1     1     1     1    62     0     0
    33     detention m3            1     1     1     1    62     0     0
    34     LORA LAKE               2     1     1     1    62     0     0
    35     D/S OF VACA FARM        1     1     1     1    62     0     0
    37     sdn3ai vault            1     1     1     1    62     0     0
    38     MC basins               1     1     1     1    62     0     0
***   39      SDN3A/SDW1A POC         1     1     1     1    62     0     0
    43     sdn3 pond               1     1     1     1    62     0     0
***   44      sdn4 pond               1     1     1     1    62     0     0
***   45      nepl poc                1     1     1     1    62     0     0
    46     cargo pond              1     1     1     1    62     0     0
    47     sdw1a infiltration      2     1     1     1    62     0     0
    50     sr 518                  1     1     1     1    62     0     0
    51     SDN2X+SDN4X             1     1     1     1    62     0     0
    52     U/S OF LAKE REBA        1     1     1     1    62     0     0
    53     Reba outflow            1     1     1     1    62     0     0
    54     Miller RDF outflow      1     1     1     1    62     0     0
    57     sdw1b pond              1     1     1     1    62     0     0
   135     VACA FARMS              1     1     1     1    62     0     0
   147     sdw1a vault             2     1     1     1    62     0     0
   237     sdn3ao-pond c           1     1     1     1    62     0     0
   240     iws-ncps                2     1     1     1    62     0     0
   242     iws-nsmps               2     1     1     1    62     0     0
   247     sdw1a pond g            2     1     1     1    62     0     0
   257     sdw1b infiltration      2     1     1     1    62     0     0
   451     nepl VAULT              1     1     1     1    62     0     0
   452     nepl VAULT              1     1     1     1    62     0     0
   552     SDN1 POC                1     1     1     1    62     0     0
   570     SDW1B flow splitter     2     1     1     1    62     0     0
***  645      nepl POC                1     1     1     1    62     0     0
  END GEN-INFO

  ACTIVITY
    RCHRES *************** Active Sections ****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG                    ***
    1  999    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    RCHRES *************** Printout Flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
```

```
  1  999    5     0     0     0     0     0     0     0     0     0     1     9
END PRINT-INFO

HYDR-PARM1                                                                           ***
  RCHRES   Flags for each HYDR Section
  # -  #   VC A1 A2 A3   ODFVFG for each *** ODGTFG for each        FUNCT  for each
           FG FG FG FG   possible  exit  *** possible  exit         possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *              ***
  1         0  1  0  0    4  5  0  0  0       0  0  0  0  0         2  2  2  2  2
  2         0  0  0  0    4  0  0  0  0       0  0  0  0  0         2  2  2  2  2
  3         0  0  0  0    4  0  0  0  0       0  0  0  0  0         2  2  2  2  2
  4         0  1  0  0    4  5  0  0  0       0  0  0  0  0         2  2  2  2  2
  5     12  0  0  0  0    4  0  0  0  0       0  0  0  0  0         2  2  2  2  2
 13         0  1  0  0    4  5  0  0  0       0  0  0  0  0         2  2  2  2  2
 14     22  0  0  0  0    4  0  0  0  0       0  0  0  0  0         2  2  2  2  2
 23         0  1  0  0    4  5  0  0  0       0  0  0  0  0         2  2  2  2  2
 24     33  0  0  0  0    4  0  0  0  0       0  0  0  0  0         2  2  2  2  2
 34         0  1  0  0    4  5  0  0  0       0  0  0  0  0         2  2  2  2  2
 35     46  0  1  0  0    4  0  0  0  0       0  0  0  0  0         2  2  2  2  2
 47         0  1  0  0    4  5  0  0  0       0  0  0  0  0         2  2  2  2  2
 48    146  0  1  0  0    4  0  0  0  0       0  0  0  0  0         2  2  2  2  2
147         0  1  1  0    4  0  0  0  0       0  0  0  0  0         2  2  2  2  2
148    239  0  1  1  0    4  0  0  0  0       0  0  0  0  0         2  2  2  2  2
240    257  0  1  1  0    4  5  0  0  0       0  0  0  0  0         2  2  2  2  2
258    552  0  1  0  0    4  0  0  0  0       0  0  0  0  0         2  2  2  2  2
553    570  0  1  1  0    4  5  0  0  0       0  0  0  0  0         2  2  2  2  2
END HYDR-PARM1

HYDR-PARM2                                                                           ***
  RCHRES                                                                             ***
  # -  #      FTABNO       LEN     DELTH      STCOR         KS      DB50             ***
<------><--------><--------><--------><--------><--------><-------->
  1              1  0.010                                  0.3
  2              2  0.776                                  0.3
  3              3  0.980                                  0.3
  4              4  0.010                                  0.3
  5              5  0.380                                  0.3
 10             10  0.380                                  0.3
 11             11  0.010                                  0.3
 12             12  1.000                                  0.3
 13             13  0.015                                  0.3
 14             14  0.450                                  0.3
 15             15  0.735                                  0.3
 16             16  0.587                                  0.3
 17             17  0.379                                  0.3
 23             23  0.379                    0.0           0.3
 24             24  0.379                                  0.3
 33             33  0.200                                  0.3
 34             34  0.852                                  0.3
 35             35  0.663                                  0.3
 37             37  0.010                    0.0           0.3
 38             38  0.010                                  0.3
 43             43  0.010                                  0.3
 46             46  0.010                                  0.3
 47             47  0.010                    0.0           0.3
 50             50  0.010                                  0.3
 51             51  0.010                                  0.3
 52             52  0.010                                  0.3
 53             53  0.010                                  0.3
 54             54  0.010                    0.0           0.3
 57             57  0.010                    0.0           0.3
135            135  0.350                                  0.3
147            147  0.010                                  0.3
237            237  0.010                    0.0           0.3
240            240  0.010                                  0.3
242            242  0.010                                  0.3
247            247  0.010                    0.0           0.3
257            257  0.010                    0.0           0.3
451            451  0.010                    0.0           0.3
452            452  0.010                    0.0           0.3
552            552  0.010                    0.0           0.3
```

```
570            570   0.010                0.0         0.3
END HYDR-PARM2

HYDR-INIT                                                                  ***
  RCHRES  Initial conditions for each HYDR section
   # -  # ***   VOL     Initial  value  of COLIND    Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
<------><-------->      <---><---><---><---><---> *** <---><---><---><---><--->
  1      2.0              4.0  5.0
  2      0.0              4.0
  3      0.0              4.0
  4      2.0              4.0  5.0
  5      0.0              4.0
 10      0.0              4.0
 11      0.0              4.0
 12      0.0              4.0
 13      10.0             4.0  5.0
 14      0.0              4.0
 15      0.0              4.0
 16      0.0              4.0
 17      0.0              4.0
 23      6.0              4.0  5.0
 24      0.0              4.0
 33      0.0              4.0
 34      9.0              4.0  5.0
 35      0.1              4.0
 37      0.0              4.0
 38      0.1              4.0
 43      0.0              4.0
 46      0.0              4.0
 47      0.0              4.0  5.0
 50      0.0              4.0
 51      0.0              4.0
 52      0.0              4.0
 53      0.1              4.0
 54      2.25             4.0
 57      0.0              4.0
237      0.00             4.0
147      0.00             4.0  5.0
135      0.00             4.0
240      0.0              4.0  5.0
242      0.0              4.0  5.0
247      0.0              4.0  5.0
257      0.0              4.0  5.0
451      0.0              4.0
452      0.0              4.0
552      0.0              4.0
570      0.0              4.0  5.0
 END HYDR-INIT
END RCHRES

FTABLES
***UPPER BASIN
***===========

 FTABLE      1
         *** REVISED 8/16/00 ADDED 2ND OUTFLOW
 ROWS COLS ***
   11    5
     DEPTH      AREA    VOLUME   OUTFLOW OUTFLOW2***
     0.00       3.00     0.00      0.00    0.00
     2.50       3.00     7.50      0.00    0.11
     3.00       3.00     9.00      1.80    0.11
     3.50       3.30    10.58      5.00    0.11
     4.00       3.60    12.30     10.90    0.11
     4.50       3.90    14.18     17.50    0.11
     5.00       4.10    16.18     26.20    0.11
     5.50       4.30    18.28     32.50    0.11
     6.00       4.50    20.48     35.90    0.11
     7.00       5.00    25.23     38.10    0.11
     8.00       5.50    30.48     46.40    0.11
```

```
 END FTABLE  1

 FTABLE      2
ROWS COLS ***
   9   4
    DEPTH      AREA     VOLUME   OUTFLOW   ***
    0.000    0.0000     0.0000      0.00
    0.100    0.2571     0.0129      0.16
    0.500    0.3873     0.1417      6.53
    1.000    0.5501     0.3761     25.95
    1.500    0.7128     0.6918     59.86
    2.000    0.8756     1.0889    110.67
    3.000    1.2011     2.1273    272.24
    3.500    1.3639     2.7685    387.38
    4.000    1.5266     3.4912    528.19
 END FTABLE  2

 FTABLE      3
ROWS COLS ***
  12   4
    DEPTH      AREA     VOLUME   OUTFLOW   ***
    0.000    0.0000     0.0000      0.00
    0.100    0.9669     0.0483      0.13
    0.500    1.0637     0.4545      4.92
    1.000    1.1846     1.0165     17.12
    1.500    1.3055     1.6390     34.92
    2.000    1.4264     2.3220     57.95
    2.500    1.5473     3.0654     86.14
    3.000    1.6682     3.8693    119.53
    3.500    1.7891     4.7336    158.24
    4.000    1.9100     5.6584    202.41
    4.500    2.0294     6.6310    251.52
    5.000    2.1488     7.6624    306.28
 END FTABLE  3

 FTABLE      4
          *** REVISED 8/16/00 ADDED 2ND OUTFLOW
ROWS COLS ***
   7   5
    DEPTH      AREA     VOLUME   OUTFLOW OUTFLOW2***
     0.00    3.00      0.00      0.00       0.00
     2.50    4.50      9.38      0.00       0.11
     3.00    6.00      12.00     6.00       0.11
     4.00    10.00     20.00     13.00      0.11
     5.00    15.00     32.50     20.00      0.11
     6.00    20.00     50.00     26.00      0.11
     7.00    25.00     72.50     168.00     0.11
 END FTABLE  4

 FTABLE      5
ROWS COLS ***
  10   4
    DEPTH      AREA     VOLUME   OUTFLOW   ***
    0.000    0.0000     0.0000      0.00
    0.100    0.1010     0.0051      0.03
    0.500    0.1754     0.0603      1.46
    1.000    0.2684     0.1713      6.16
    1.500    0.3614     0.3288     14.89
    2.000    0.4544     0.5327     28.48
    2.500    0.5474     0.7832     47.70
    3.000    0.6404     1.0801     73.29
    3.500    0.7334     1.4236    105.94
    4.000    0.8264     1.8136    146.33
 END FTABLE  5

 FTABLE     10
ROWS COLS ***
   9   4
    DEPTH      AREA     VOLUME   OUTFLOW   ***
    0.000    0.0000     0.0000      0.00
    0.100    0.1010     0.0051      0.06
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```
     0.500     0.1660     0.0585       2.27
     1.000     0.2472     0.1618       9.32
     1.500     0.3285     0.3057      22.08
     2.000     0.4097     0.4902      41.66
     2.500     0.4909     0.7154      69.09
     3.000     0.5722     0.9811     105.37
     4.000     0.6887     1.6116     209.70
  END FTABLE 10

  POST AMBAUM DETENTION ***
  FTABLE     11
 ROWS COLS ***
   12    4
     DEPTH       AREA     VOLUME    OUTFLOW     ***
     0.000     0.0000     0.0000       0.00
     1.000     0.1000     0.2300       3.90
     2.000     0.2000     0.6000       6.30
     3.000     0.3000     0.9700       8.10
     4.000     0.4000     1.3400      11.10
     5.000     0.5000     1.8200      16.00
     6.000     0.6000     2.2700      19.10
     7.000     0.7000     2.8300      21.60
     8.000     0.8000     3.3700      30.80
     9.000     0.9000     4.0000      38.10
    10.000     1.0000     4.6500      74.10
    10.500     1.1000     5.2000     133.00
    11.000     1.1500     6.0000     500.00
    11.500     1.3000     11.000    1300.00
  END FTABLE 11

  FTABLE     12
 ROWS COLS ***
    6    4
     DEPTH       AREA     VOLUME    OUTFLOW     ***
     0.000     0.0000     0.0000       0.00
     0.100     0.6327     0.0316       0.15
     0.500     0.7960     0.3174       5.87
     1.000     1.0002     0.7664      21.53
     1.500     1.2043     1.3176      46.43
     2.000     1.4085     1.9708      81.20
     3.000     1.8168     3.5834     183.79
     4.000     2.2251     5.6044     336.22
     5.000     2.6335     8.0337     545.30
     6.000     3.0418    10.8713     817.51
  END FTABLE 12

  FTABLE     13
          *** REVISED 8/16/00 ADDED 2ND OUTFLOW
 ROWS COLS ***
    7    5
     DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.000     40.000     0.0000       0.00      0.00
     1.000     41.400     40.000       0.00      0.11
     1.500     42.000     60.000      10.00      0.11
     2.000     42.700     80.000      16.00      0.11
     2.500     43.300     100.00      20.00      0.11
     3.000     44.000     120.00      28.00      0.11
     5.000     45.000     210.00      45.00      0.11
  END FTABLE 13

  FTABLE     14
 ROWS COLS ***
    6    4
     DEPTH       AREA     VOLUME    OUTFLOW     ***
     0.000     0.0000     0.0000       0.00
     0.100     0.3361     0.0168       0.24
     0.500     0.3809     0.1602       9.04
     1.000     0.4370     0.3647      31.61
     1.500     0.4930     0.5972      65.00
     2.000     0.5491     0.8577     106.85
     2.500     0.6051     1.1462     163.33
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    3.000    0.6612    1.4628    228.78
 END FTABLE 14

 FTABLE     15
ROWS COLS ***
  4    4
    DEPTH       AREA      VOLUME    OUTFLOW    ***
     0.00      0.10       0.00       0.00
     1.00      1.00       0.55      91.00
     2.00      1.10       1.60     268.00
     3.00      1.20       2.75     493.00
 END FTABLE 15

 FTABLE     16
ROWS COLS ***
  4    4
    DEPTH       AREA      VOLUME    OUTFLOW    ***
     0.00      0.10       0.00       0.00
     1.00      1.00       0.55      74.00
     2.00      1.10       1.60     219.00
     3.00      1.20       2.75     403.00
 END FTABLE 16

 FTABLE     17
ROWS COLS ***
  5    4
    DEPTH       AREA      VOLUME    OUTFLOW    ***
     0.00      0.10       0.00       0.00
     1.00      1.00       0.55      59.00
     2.00      1.10       1.60     173.00
     3.00      1.20       2.75     318.00
     4.00      1.30       4.00     484.00
 END FTABLE 17

 FTABLE     23
ROWS COLS ***  HERMES
  9    5
    DEPTH       AREA      VOLUME    OUTFLOW OUTFLOW    ***
     0.00      0.00       0.00      0.00    0.00            0.00
     5.00      0.50       1.91      0.00    0.00          305.00
    11.00      0.79       5.79      0.00    0.00          311.00
    15.00      1.13       9.64      0.50    0.01          315.00
    19.00      1.72      15.34      0.50    0.05          319.00
    29.00      2.86      38.25      0.50    0.10          329.00
    39.00      4.40      74.55      0.50    0.20          339.00
    50.00      6.22     132.98      0.50    0.30          350.00
    60.00     10.00    1212.98      0.50    0.40          360.00
 END FTABLE 23

 FTABLE     24
ROWS COLS ***
  9    4
    DEPTH      AREA      VOLUME     OUTFLOW    ***
    0.000    0.0000    0.0000       0.00
    0.100    0.2571    0.0129       0.16
    0.500    0.3873    0.1417       6.53
    1.000    0.5501    0.3761      25.95
    1.500    0.7128    0.6918      59.86
    2.000    0.8756    1.0889     110.67
    3.000    1.2011    2.1273     272.24
    3.500    1.3639    2.7685     387.38
    4.000    1.5266    3.4912     528.19
 END FTABLE 24

 FTABLE     33
ROWS COLS ***
 11    4
    DEPTH       AREA      VOLUME    OUTFLOW    ***
     0.00      1.00       0.00      0.00
     0.50      1.20       0.55      2.00
     1.00      1.40       1.20      6.00
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     1.50      1.60      1.95      9.00
     2.00      1.80      2.80     13.00
     2.50      2.00      3.75     16.50
     3.00      2.20      4.80     20.00
     3.50      2.40      5.95     23.00
     4.00      2.60      7.20     26.00
     5.00      2.80      9.90    104.00
     6.00      3.00     12.80    246.00
  END FTABLE 33

  FTABLE     34
 ROWS COLS *** REVISED 11/19/97 BASED ON HEC-RAS MODEL
           *** REVISED 8/16/00 ADDED 2ND OUTFLOW
    6    5
     DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.00        3.00      0.00      0.00    0.00
     3.00        3.05      9.08      0.00    0.11
     4.00        3.10     12.15      0.00    0.11
     5.00        3.15     15.28      0.00    0.11
     6.00        3.20     18.45      72.0    0.11
     7.00        3.25     21.68     225.0    0.11
  END FTABLE 34

  FTABLE     35
 ROWS COLS *** REVISED 11/19/97 BASED ON HECRAS MODEL
    5    4
     DEPTH      AREA      VOLUME    OUTFLOW    ***
     0.00       0.10      0.00       0.00
     1.00       1.10      0.60      38.00
     2.00       1.20      1.75     108.00
     3.00       1.30      3.00     194.00
     4.00       1.40      4.35     290.00
  END FTABLE 35


  FTABLE     38
 ROWS COLS ***
    7    4
     DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.000     0.0000    0.0000      0.00
     1.000     0.4000    0.4000      2.00
     1.500     0.5000    1.0000      4.00
     2.000     0.9000    1.3000     11.00
     2.500     1.3000    1.6000     15.00
     3.000     1.6000    2.0000     18.00
     3.500     1.9000    2.5000     20.80
  END FTABLE 38

  FTABLE     45
 ROWS COLS ***
    4    4
     DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.000     0.0010    0.0000      0.00
     0.000     0.0100    0.0100     10.00
     0.100     0.1000    0.1000    100.00
     1.000     1.0000    1.0000   1000.00
    10.000    10.0000   10.0000  10000.00
  END FTABLE 45

  FTABLE    645
 ROWS COLS ***
    4    4
     DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.000     0.0010    0.0000      0.00
     0.000     0.0100    0.0100     10.00
     0.100     0.1000    0.1000    100.00
     1.000     1.0000    1.0000   1000.00
    10.000    10.0000   10.0000  10000.00
  END FTABLE645

  FTABLE     50
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ROWS COLS ***
  10    4
    DEPTH       AREA     VOLUME   OUTFLOW   ***
     0.00       1.00      0.00      0.00
     0.50       1.10      0.53      5.00
     1.00       1.20      1.10     15.00
     1.50       1.30      1.73     25.00
     2.00       1.40      2.40     35.00
     2.50       1.50      3.13     52.00
     3.00       1.60      3.90     70.00
     3.50       1.70      4.73     87.00
     4.00       1.80      5.60    105.00
     6.00       1.90      9.30    165.00
 END FTABLE 50

 FTABLE     52
ROWS COLS ***
   6    4
    DEPTH       AREA     VOLUME   OUTFLOW   ***
    0.000     0.0000    0.0000      0.00
    0.100     0.3680    0.0184      0.25
    0.500     0.3717    0.1664      9.39
    1.000     0.3763    0.3534     31.06
    2.000     0.3819    0.7325     94.37
    3.000     0.3874    1.1171    174.33
 END FTABLE 52

 FTABLE    552
ROWS COLS ***   SDN1 VAULT EFFECTIVE DEPTH=12 FT  RISER=24 INCHES
  15    4
    DEPTH       AREA     VOLUME   OUTFLOW   ***
    0.000     0.4308    0.0000      0.00
    1.290     0.4308    0.6520     0.111
    2.130     0.4308    1.0760     0.143
    3.530     0.4308    1.7830     0.184
    4.640     0.4308    2.3430     0.211
    5.200     0.4308    2.6260     0.223
    6.320     0.4308    3.1920     0.246
    7.430     0.4308    3.7530     0.267
    8.200     0.4308    4.1410     0.280
    9.220     0.4308    4.6570     0.407
   10.190     0.4308    5.1460     0.567
   11.250     0.4308    5.6820     0.954
   12.100     0.4308    6.1110     2.130
   12.300     0.4308    6.2120     4.730
   13.700     0.4308    6.9190    21.360
 END FTABLE552

 FTABLE     53
OLD LAKE REBA                                ***
MAX DEPTH = 4.9 FEET                         ***
30" CMP, 40 CFS DISCHARGE AT MAX DEPTH       ***
ROWS COLS ***
   7    4
    DEPTH       AREA     VOLUME   OUTFLOW   ***
    0.000     2.4000    0.0000      0.00
    1.000     2.5800    2.5000     18.00
    2.000     2.9400    5.3000     26.00
    3.000     3.4100    8.4000     31.00
    4.000     3.8800    12.100     36.00
    4.900     4.3000    15.800     40.00
    6.000     4.3000    15.810    500.00
 END FTABLE 53

 FTABLE     54
EXISTING MILLER CREEK DETENTION FACILITY*** REVISED STORAGE/Q DATA
GATE SETTING: 2.0 FEET***  BASED ON CALIBRATION FILE
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME   OUTFLOW   ***
    0.000       0.00      0.00      0.00
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      1.300       0.01       0.01      10.00
      2.000       0.01       0.02      20.00
      2.900       0.70       0.40      30.00
      4.000       1.50       1.50      40.00
      5.400       3.50       4.90      50.00
      7.000       8.60      13.30      60.00
      8.800      15.60      34.80      70.00
     10.000      19.90      57.30      76.00
     10.500      21.50      68.00      92.00
     11.000      23.10      78.80     179.00
     11.500      24.70      88.60     303.00
  END FTABLE 54

  FTABLE     104
 MILLER CREEK DETENTION FACILITY*** WITH ADD'L AREA 1+AREA 2 55.5 ACFT @ 10FT
 GATE SETTING: 2.0 FEET*** EXISTING OUTLET NO LOW FLOW CONTROL
 ROWS COLS ***
   17    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.000     0.0000     0.0000       0.00
     0.500     0.0100     0.0100       2.50
     1.500     0.0300     0.2800      14.29
     2.500     1.1100     1.3900      24.88
     3.500     2.6100     4.0000      34.51
     4.500     4.6100     9.1400      43.20
     5.500     7.1200     19.600      50.98
     6.000     8.3600     21.180      54.53
     6.500     11.870     30.060      57.87
     7.000     15.370     38.930      61.00
     7.500     18.870     47.800      63.91
     8.000     21.860     59.160      66.62
     8.500     24.850     70.510      69.12
     9.000     27.340     84.160      71.42
     9.500     29.820     97.820      73.53
    10.000     32.050     112.83      75.44
    10.500     34.275     127.84      90.74
    11.500     38.220     161.54     320.00
  END FTABLE104

  FTABLE      69
 PRE-MILLER CREEK DETENTION FACILITY***
 ROWS COLS ***
   12    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.000     0.0000     0.0000       0.00
     0.100     0.1860     0.0093       0.12
     0.500     0.2552     0.0975       4.84
     1.000     0.3417     0.2467      18.49
     1.500     0.4282     0.4392      41.30
     2.000     0.5148     0.6750      74.40
     2.500     0.6013     0.9540     119.01
     3.000     0.6878     1.2763     176.30
     3.500     0.7744     1.6418     247.41
     4.000     0.8609     2.0506     333.43
     4.500     0.9470     2.4992     434.59
     5.000     1.0331     2.9905     552.33
  END FTABLE 69

*** PROJECT CONDITION PONDS/VAULTS
  FTABLE     452
 ROWS COLS ***
 *** NEW NORTH EMPLOYEE PARKING LOT VAULT (NEPL)
 *** PARALLEL VAULT BASED ON KCRTS EFFECTIVE DEPTH=20 FT
   20    4
     DEPTH      AREA     VOLUME    OUTFLOW ***
     0.00      3.214      0.000      0.000
     1.11      3.214      0.826      0.129
     1.57      3.214      1.168      0.154
     3.43      3.214      2.551      0.227
     4.83      3.214      3.593      0.269
     8.08      3.214      6.010      0.348
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     10.41       3.214      7.743      0.395
     12.74       3.214      9.476      0.437
     14.00       3.214     10.413      0.458
     14.65       3.214     10.897      0.557
     16.09       3.214     11.968      0.665
     16.23       3.214     12.072      0.754
     17.92       3.214     13.329      1.140
     18.22       3.214     13.552      1.310
     18.81       3.214     13.991      1.860
     19.11       3.214     14.214      2.190
     20.00       3.214     14.876      3.350
     20.20       3.214     15.025      5.110
     20.70       32.14     15.397     14.820
     21.00       32.14     15.620     18.560
  END FTABLE452

  FTABLE     451
 ROWS COLS ***
 *** NORTH EMPLOYEE PARKING LOT VAULT (NEPL)
 *** EXISTING VAULT W/MODIFIED OUTLET   EFFECTIVE DEPTH= 18.0 FT
   14    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.2240     0.0000      0.00
    2.170     0.2240     0.4860     0.031
    4.260     0.2240     0.9550     0.043
    5.930     0.2240     1.3290     0.051
    8.030     0.2240     1.8000     0.059
   10.120     0.2240     2.2680     0.066
   12.210     0.2240     2.7360     0.073
   14.040     0.2240     3.1460     0.109
   15.510     0.2240     3.4760     0.166
   16.220     0.2240     3.6350     0.295
   18.000     0.2240     4.0340     1.080
   18.400     0.2240     4.1240     5.400
   19.000     0.2240     4.2580    12.680
   19.900     0.2240     4.4600    17.080
  END FTABLE451


  FTABLE      46
 ROWS COLS ***
 SDN-6: 24TH STREET CARGO VAULT ***  EFFECTIVE DEPTH=14 FT RISER DIA=12 IN
   20    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
     0.00       0.35      0.000     0.000
     0.37       0.35      0.131     0.021
     1.19       0.35      0.421     0.037
     3.39       0.35      1.198     0.063
     5.03       0.35      1.778     0.077
     7.23       0.35      2.556     0.092
     9.15       0.35      3.235     0.104
    10.25       0.35      3.624     0.110
    10.53       0.35      3.723     0.111
    10.92       0.35      3.861     0.128
    12.00       0.35      4.242     0.165
    12.13       0.35      4.286     0.190
    12.95       0.35      4.578     0.245
    13.77       0.35      4.868     0.282
    14.00       0.35      4.949     0.291
    14.10       0.35      4.985     0.910
    14.20       0.35      5.020     2.040
    14.30       0.35      5.056     3.500
    14.50       0.35      5.126     7.200
    14.70       0.35      5.197    11.720
  END FTABLE 46


*** SDW-1A: 3RD RUNWAY POND G TO MILLER CREEK (LEVEL 2): ***
  FTABLE      47
  *** PROJECT  SDW1A   EFFECTIVE DIAMETER=3.0 FT
 ROWS COLS ***          INFILTRATION TANK TO OBTAIN 0.3 CFS
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  14    5
    DEPTH       AREA      VOLUME       STORMQ   INFILTRQ ***
    0.000      0.000      0.000        0.000     0.000
    0.250      0.002      0.002        0.000     0.027
    0.500      0.004      0.004        0.000     0.054
    1.000      0.012      0.012        0.000     0.109
    1.500      0.020      0.020        0.000     0.164
    2.000      0.029      0.029        0.000     0.218
    2.500      0.036      0.036        0.000     0.272
    3.000      0.041     0.0406        0.000     0.327
    3.100      0.041     0.0419        0.596     0.338
    3.200      0.041     0.0420        1.685     0.349
    3.300      0.041     0.0421        3.096     0.360
    3.400      0.041     0.0422        4.766     0.371
    3.500      0.041     0.0423        6.661     0.382
    3.750      0.041     0.0424       12.237     0.409
  END FTABLE 47

*** SDW-1A: 3RD RUNWAY NORTH POND G TO MILLER CREEK (LEVEL 2): ***
  FTABLE    147
  *** PROJECT  SDW1A    EFFECTIVE DEPTH=14.0 FT RISER DIA 24 INCHES
 ROWS COLS ***         VAULT BASED ON INFILTRATION=0.15CFS
  17    5
    DEPTH       AREA      VOLUME     INFILTRQ     BYPASS Q***
    0.000      0.689      0.000       0.0000     0.0000
    0.010      0.689      0.007       0.1400     0.0000
    1.000      0.689      0.689       0.1408     0.0000
    2.000      0.689      1.377       0.1417     0.0000
    4.000      0.689      2.755       0.1432     0.0000
    6.000      0.689      4.132       0.1446     0.0000
    8.000      0.689      5.510       0.1461     0.0000
   10.000      0.689      6.887       0.1475     0.0000
   12.000      0.689      8.264       0.1489     0.0000
   14.000      0.689      9.642       0.1503     0.0000
   16.000      0.689     11.019       0.1517     0.0000
   16.750      0.689     11.536       0.1517    10.7600
   16.900      0.689     11.639       0.1517    13.9600
   17.000      0.689     11.708       0.1517    16.1000
   17.100      0.689     11.777       0.1517    18.5700
   17.300      0.689     11.915       0.1517    23.8600
   18.000      0.689     12.397       0.1517    45.5400
  END FTABLE147

*** SDW-1A: 3RD RUNWAY NORTH POND G TO MILLER CREEK (LEVEL 2): ***
  FTABLE    247
  *** PROJECT  SDW1A    EFFECTIVE DEPTH=12.0 FT RISER DIA 12 INCHES
 ROWS COLS ***          POND BASED ON INFILTRATION=0.15CFS
  17    5
    DEPTH       AREA      VOLUME       STORMQ    INFILTRQ ***
    0.000      1.300      0.000         0.00      0.00
    0.010      1.310      0.010        0.001      0.15
    1.000      1.320      1.320        0.007      0.15
    2.000      1.342      2.650        0.010      0.15
    3.000      1.363      4.000        0.012      0.15
    4.000      1.385      5.370        0.013      0.15
    5.000      2.672      8.000        0.015      0.15
    6.000      2.739     10.700        0.017      0.15
    7.000      2.807     13.470        0.018      0.15
    8.000      2.876     16.300        0.019      0.15
    8.300      2.896     17.176        0.031      0.15
    9.000      2.945     19.210        0.041      0.15
   10.000      3.014     22.180        0.051      0.15
   11.000      3.084     25.228        0.058      0.15
   11.100      3.092     25.540        0.675      0.15
   11.300      3.106     26.162        3.260      0.15
   12.000      3.155     26.340       15.190      0.15
  END FTABLE247

*** SDN3A: 3RD RUNWAY VAULT TO MILLER CREEK (LEVEL 2): ***
  FTABLE     37
  *** PROJECT C SDN3A     EFFECTIVE DEPTH=11.0FT RISER DIA=24 INCHES
```

ROWS COLS *** VAULT BASED ON IMPERVIOUS TOP SURO
14 4

DEPTH	AREA	VOLUME	OUTFLOW ***
0.000	0.644	0.000	0.000
0.010	0.644	0.006	0.001
1.000	0.644	0.643	0.016
3.980	0.644	2.558	0.033
6.030	0.644	3.876	0.041
9.010	0.644	5.792	0.050
10.00	0.644	6.428	0.052
10.46	0.644	6.724	0.072
11.00	0.644	7.071	0.082
11.10	0.644	7.135	0.699
11.20	0.644	7.199	1.830
11.30	0.644	7.264	3.290
11.40	0.644	7.328	5.020
11.60	0.644	7.456	9.140

END FTABLE 37

*** SDN3A: 3RD RUNWAY POND C TO MILLER CREEK (LEVEL 2): ***
FTABLE 237
*** PROJECT C SDN3A EFFECTIVE DEPTH= 9.0FT RISER DIA=24 INCHES
ROWS COLS *** POND BASED ON INTERFLOW AND. PERVIOUS TOP SURO
19 4

DEPTH	AREA	VOLUME	OUTFLOW ***
0.000	1.3090	0.000	0.00
0.020	1.3120	0.026	0.009
1.020	1.3550	1.358	0.070
2.070	1.4030	2.806	0.100
3.130	1.4530	4.320	0.123
4.020	1.4980	5.632	0.139
5.070	1.5460	7.229	0.156
7.750	1.6720	11.549	0.193
7.800	1.6800	11.633	0.199
7.850	1.6840	11.718	0.213
8.250	1.7050	12.395	0.249
8.340	1.7090	12.549	0.270
8.570	1.7210	12.944	0.313
8.950	1.7410	13.601	0.354
9.500	1.7690	14.567	0.399
9.600	1.7740	14.744	0.714
9.800	1.7850	15.100	2.020
10.300	1.8110	15.999	3.840
10.900	1.8430	17.095	4.960

END FTABLE237

*** SDN-3X: 3RD RUNWAY NORTH VAULT (LEVEL 2): ***
FTABLE 43
ROWS COLS *** EFFECTIVE DEPTH=20 FT RISER DIA=24 INCHES
21 4

DEPTH (FT)	AREA (ACRES)	VOLUME (ACRE-FT)	FLOW (FT3/S) ***
0.00	1.288	0.00	0.00
0.14	1.288	0.180	0.067
1.39	1.288	1.790	0.216
3.35	1.288	4.314	0.336
5.31	1.288	6.839	0.423
8.06	1.288	10.380	0.521
8.84	1.288	11.385	0.545
10.02	1.288	12.905	0.580
11.98	1.288	15.429	0.635
12.37	1.288	15.931	0.645
14.00	1.288	18.030	0.686
14.10	1.288	18.159	0.705
14.91	1.288	19.202	0.757
16.09	1.288	20.722	0.810
18.00	1.288	23.182	0.881
18.32	1.288	23.594	1.150
18.76	1.288	24.161	1.360
20.00	1.288	25.758	1.680
20.10	1.288	25.886	2.320

```
    20.50      1.288     26.402      8.620
    20.80      1.288     26.788     15.370
  END FTABLE 43

 *** SDN-4X/2X: 3RD RUNWAY NORTH VAULT      (COMBINED FACILITY)
  FTABLE     51
 ROWS COLS ***        EFFECTIVE DEPTH=19FT RISER DIA=24 INCHES
  20    4
    DEPTH      AREA    VOLUME    OUTFLOW                                 ***
     (FT)   (ACRES)  (ACRE-FT)   (FT3/S)                                 ***
     0.00     0.789      0.000     0.000
     0.16     0.789      0.126     0.056
     1.51     0.789      1.192     0.169
     3.28     0.789      2.588     0.249
     5.49     0.789      4.332     0.322
     7.26     0.789      5.729     0.370
    10.35     0.789      8.168     0.442
    12.12     0.789      9.564     0.478
    13.44     0.789     10.606     0.503
    14.33     0.789     11.308     0.520
    15.57     0.789     12.287     0.654
    16.72     0.789     13.194     0.828
    17.19     0.789     13.565     0.950
    17.63     0.789     13.913     1.030
    18.00     0.789     14.205     1.080
    19.00     0.789     14.994     1.960
    19.10     0.789     15.073     2.580
    19.40     0.789     15.309     6.930
    19.60     0.789     15.467    11.080
    20.00     0.789     15.783    17.190
  END FTABLE 51

*** SDW-1B:3RD RUNWAY CENTRAL SOUTH POND D TO MILLER CREEK (LEVEL 2): ***
  FTABLE     57
 ROWS COLS ***      EFFECTIVE DEPTH = 14.0 FT
  17    4
    DEPTH      AREA    VOLUME     STORMQ      ***
     (FT)   (ACRES)  (ACRE-FT)   (FT3/S)      ***
     0.00     2.430      0.000     0.000
     0.01     2.430      0.041     0.010
     1.00     2.680      2.411     0.183
     2.00     2.760      4.860     0.257
     3.00     2.818      7.370     0.319
     4.00     3.079      9.945     0.366
     5.00     5.832     15.320     0.411
     6.00     5.927     20.742     0.450
     7.00     6.022     26.264     0.481
     8.00     6.118     31.888     0.518
     9.00     6.210     37.613     0.550
    10.00     6.311     43.441     0.583
    11.00     6.408     49.372     0.609
    12.00     6.607     55.406     0.634
    13.00     6.405     61.543     0.764
    14.00     6.504     67.786     1.320
    15.00     7.000     70.000    16.600
  END FTABLE 57

*** SDW-1B:3RD RUNWAY CENTRAL SOUTH POND D TO MILLER CREEK (LEVEL 2): ***
  FTABLE     257
  *** PROJECT  SDW1B    EFFECTIVE DIAMETER=3.0 FT
 ROWS COLS ***          INFILTRATION TANK TO OBTAIN 0.2 CFS
  15    5
    DEPTH       AREA     VOLUME      STORMQ   INFILTRQ ***
    0.000      0.001     0.000       0.000     0.000
    0.010      0.001     0.001       0.000     0.002
    0.250      0.002     0.002       0.000     0.017
    0.500      0.004     0.004       0.000     0.035
    1.000      0.012     0.012       0.000     0.071
    1.500      0.020     0.020       0.000     0.106
    2.000      0.029     0.029       0.000     0.142
    2.500      0.036     0.036       0.000     0.178
```

3.000	0.041	0.0406	0.000	0.213
3.100	0.041	0.0420	0.596	0.220
3.200	0.041	0.0421	1.685	0.227
3.300	0.041	0.0422	3.096	0.233
3.400	0.041	0.0423	4.766	0.241
3.500	0.041	0.0424	6.661	0.248
3.750	0.041	0.0425	12.237	0.266

END FTABLE257

FTABLE 570
*** PROJECT SDW1B FLOW SPLITTER (to 257 and 57)
ROWS COLS ***
15 5

DEPTH	AREA	VOLUME	STORMQ	INFILTRQ ***
0.000	0.00	0.000	0.000	0.000
0.100	0.01	0.0002	0.000	0.050
0.400	0.01	0.0009	0.000	0.110
0.600	0.01	0.0014	0.000	0.130
0.750	0.01	0.0017	0.000	0.150
0.800	0.01	0.0018	0.720	0.150
1.000	0.01	0.0023	8.050	0.170
1.100	0.01	0.0025	13.330	0.180
1.200	0.01	0.0027	19.440	0.190
1.300	0.01	0.0030	26.270	0.190
1.400	0.01	0.0032	33.750	0.200
1.420	0.01	0.0033	35.320	0.200
1.440	0.01	0.0033	36.910	0.200
1.450	0.01	0.0034	37.920	0.200
1.460	0.01	0.0035	38.530	0.200

END FTABLE570

FTABLE 61
ROWS COLS ***
*** SDN-2X: DETAIN OVERFLOW FROM NCPS AND NSMPS-
17 4

DEPTH	AREA	VOLUME	OUTFLOW ***
0.000	0.5740	0.0000	0.00
1.200	0.5740	0.7710	0.151
2.220	0.5740	1.4270	0.205
3.240	0.5740	2.0830	0.247
3.650	0.5740	2.3460	0.262
4.260	0.5740	2.7380	0.283
4.660	0.5740	2.9950	0.296
5.680	0.5740	3.6510	0.327
6.640	0.5740	4.2680	0.517
7.650	0.5740	4.9170	0.644
8.670	0.5740	5.9710	0.739
9.810	0.5740	6.3570	0.836
10.700	0.5740	6.8780	0.894
12.000	0.5740	7.7130	0.978
12.100	0.5740	7.7780	1.600
12.300	0.5740	7.9060	4.200
12.800	0.5740	8.2280	14.560

END FTABLE 61

PRE AMBAUM DETENTION ***
FTABLE 111
ROWS COLS ***
15 4

DEPTH	AREA	VOLUME	OUTFLOW ***
0.000	0.0000	0.0000	0.00
0.500	0.2160	0.0750	5.30
1.000	0.2730	0.1990	21.10
1.500	0.2890	0.3410	43.90
2.000	0.2900	0.4830	68.80
2.500	0.2910	0.6070	89.10
3.000	0.2950	0.6820	90.00
3.500	0.3000	2.1000	100.00
4.000	0.3050	2.5000	105.00
4.500	0.3100	3.0000	110.00
5.000	0.3200	3.5000	120.00

```
     5.500     0.3300     4.0000     130.00
     6.000     0.3800     5.0530     166.48
     6.500     0.3980     5.9430     225.31
     7.000     0.4150     6.9040     320.10
  END FTABLE111

  FTABLE    135
 ROWS COLS *** VACA FARM
    6    4
     DEPTH       AREA     VOLUME    OUTFLOW  ***
      0.00       0.10       0.00       0.00
      1.00       0.10       0.10       4.00
      2.00       0.11       0.21       8.00
      2.50       1.00       0.48      13.00
      3.50       6.50       4.23      86.00
      4.50      13.00      13.98     235.00
  END FTABLE135

  FTABLE    240
*** NORTH SNOWMELT PUMP STATION (SDN-2) (INSTALLED IN LATE 1997/1998)             ***
 ROWS COLS
   14    5
     DEPTH      AREA     VOLUME      (IWS)      (SDS)                             ***
      (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)                             ***
       0.0      0.002       0.00      0.00       0.00
      1.00      0.002     0.0023      0.00       0.00
      2.00      0.002     0.0046      1.67       0.00
      3.00      0.002     0.0069      1.67       0.00
      4.00      0.002     0.0092      1.67       0.00
      5.00      0.002     0.0115      1.67       0.00
      5.25      0.002     0.0121      1.67       1.53
      5.50      0.002     0.0126      1.67       6.06
      5.75      0.002     0.0132      1.67      12.65
      6.00      0.002     0.0138      1.67      19.83
      6.25      0.002     0.0144      1.67      25.66
      6.50      0.002     0.0149      1.67      25.70
      6.75      0.002     0.0155      1.67      26.70
      7.00      0.002     0.0161      1.67      50.00
  END FTABLE240

  FTABLE    242
*** NORTH CARGO PUMP STATION (SDN-2) (INSTALLED IN OCTOBER 1997)                  ***
 ROWS COLS
   14    5
     DEPTH      AREA     VOLUME      (IWS)      (SDS)                             ***
      (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)                             ***
       0.0      0.002       0.00      0.00       0.00
      1.00      0.002     0.0023      0.00       0.00
      2.00      0.002     0.0046      6.13       0.00
      3.00      0.002     0.0069      6.13       0.00
      4.00      0.002     0.0092      6.13       0.00
      5.00      0.002     0.0115      6.13       0.00
      5.25      0.002     0.0121      6.13       0.28
      5.50      0.002     0.0126      6.13       1.16
      5.75      0.002     0.0132      6.13       2.53
      6.00      0.002     0.0138      6.13       4.23
      6.25      0.002     0.0144      6.13       6.05
      6.50      0.002     0.0149      6.13       7.72
      6.75      0.002     0.0155      6.13       8.50
      7.00      0.002     0.0161      6.13       20.0
  END FTABLE242

END FTABLES

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>      <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>               <Name> # #***
  MASS-LINK        1
  conversion from acre-inches to acre-ft (1/12)              ***
PERLND     PWATER PERO      0.0833333      RCHRES        INFLOW IVOL
  END MASS-LINK    1
```

```
  MASS-LINK        2
IMPLND     IWATER SURO        0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
RCHRES     ROFLOW                           RCHRES         INFLOW
  END MASS-LINK    3

  MASS-LINK        4
RCHRES     OFLOW  OVOL   1                  RCHRES         INFLOW IVOL
  END MASS-LINK    4

  MASS-LINK        5
RCHRES     OFLOW  OVOL   2                  RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
PERLND     PWATER SURO        0.0833333     RCHRES         INFLOW IVOL
PERLND     PWATER IFWO        0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    6

  MASS-LINK        7
PERLND     PWATER AGWO        0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK       10
COPY       OUTPUT MEAN                      COPY           INPUT  MEAN
  END MASS-LINK   10

  MASS-LINK       11
RCHRES     ROFLOW                           COPY           INPUT  MEAN
  END MASS-LINK   11

  MASS-LINK       12
COPY       OUTPUT MEAN                      RCHRES         INFLOW IVOL
  END MASS-LINK   12

  MASS-LINK       14
RCHRES     OFLOW  OVOL   1                  COPY           INPUT  MEAN
  END MASS-LINK   14

  MASS-LINK       15
RCHRES     OFLOW  OVOL   2                  COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       21
PERLND     PWATER PERO        0.0833333     COPY           INPUT  MEAN
  END MASS-LINK   21

  MASS-LINK       22
IMPLND     IWATER SURO        0.0833333     COPY           INPUT  MEAN
  END MASS-LINK   22

  MASS-LINK       26
PERLND     PWATER SURO        0.0833333     COPY           INPUT  MEAN
PERLND     PWATER IFWO        0.0833333     COPY           INPUT  MEAN
  END MASS-LINK   26

  MASS-LINK       27
PERLND     PWATER AGWO        0.0833333     COPY           INPUT  MEAN
  END MASS-LINK   27

END MASS-LINK

COPY
  TIMESERIES
  Copy-opn
    # -  #  NPT   NMN
   37   71          1
  240  242          1
```

```
  357  357         1
  645  645         1
  END TIMESERIES
END COPY

END RUN
```

WALKER CREEK WATERSHED
HSPF INPUT FILES

- PREDEVELOPMENT CONDITIONS
- 2006 CONDITIONS

PREDEVELOPMENT CONDITIONS

```
RUN
GLOBAL
  ***  COPY COMMAND ADDED
  ***  FILE: WCPRED04.inp REVISED OCTOBER 2000
  ***  SEATAC AIRPORT HSPF BASIN MODEL OF WALKER CREEK
  WALKER CREEK BASIN HSPF MODEL
  START       1948 10  1  0  0  END    1996  8 30 24  0
  RUN INTERP OUTPUT LEVEL    3
  RESUME     0 RUN     1
END GLOBAL

FILES
<type>  <fun>***<------------fname------------------------------------------->
MESSU       24    D:\PARA\SEATAC\MILLER\WALKERf\WALKER.MES
WDM         25    D:\PARA\SEATAC\MILLER\WALKERf\WCPOND03.WDM
            61    D:\PARA\SEATAC\MILLER\WALKERf\wPER.L61
            62    D:\PARA\SEATAC\MILLER\WALKERf\wRCH.L62
END FILES

OPN SEQUENCE
    INGRP              INDELT 01:00
      PERLND      14
      PERLND      16
      PERLND      18
      PERLND      24
      PERLND      26
      PERLND      28
      PERLND      34
      PERLND      44
      PERLND      45
      PERLND      54
      PERLND      64
      PERLND      65
      IMPLND      14
      COPY         2
      COPY         1
      COPY         3
      RCHRES      20
      RCHRES      19
      RCHRES      18
    END INGRP
END OPN SEQUENCE
                                                                      ***
COPY
  TIMESERIES
  Copy-opn                                                            ***
    # -  #  NPT  NMN                                                  ***
    1    5        1
  END TIMESERIES
END COPY

PERLND
  GEN-INFO
    <PLS >      Name         NBLKS  Unit-systems   Printer            ***
    # -  #                          User  t-series Engl Metr          ***
                                           in  out                    ***
   14      TFF- TILL FOR FLT      1    1    1    1   61    0
```

```
  16        TFM- TILL FOR MOD       1    1    1    1   61     0
  18        TFS- TILL FOR STP       1    1    1    1   61     0
  24        TGF- TILL GR FLT        1    1    1    1   61     0
  26        TGM- TILL GR MOD        1    1    1    1   61     0
  28        TGS- TILL GR STP        1    1    1    1   61     0
  34        OF - OUTWASH FOR        1    1    1    1   61     0
  44        OG - OUTWASH GR         1    1    1    1   61     0
***PERLND FOR NEW AIRPORT FILL; NONE IN CALIBRATION
  45        AIRPORT FILL            1    1    1    1   61     0
  54        SA - WETLANDS           1    1    1    1   61     0
  64        TGM DES MOINES          1    1    1    1   61     0
  65        OG  DES MOINES          1    1    1    1   61     0
 END GEN-INFO
 ACTIVITY
   <PLS > ************* Active Sections ******************************
   # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC         ***
  14  200    0    0    1    0    0    0    0    0    0    0    0    0
 END ACTIVITY
 PRINT-INFO
   <PLS > ********************** Print-flags ************************* PIVL  PYR
   # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
  14  200    0    0    5    0    0    0    0    0    0    0    0    0    1    9
 END PRINT-INFO
 PWAT-PARM1
   <PLS > ***************** Flags ********************
   # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                        ***
  14         0    0    0    0    0    0    0    0    0
  16         0    0    0    0    0    0    0    0    0
  18         0    0    0    0    0    0    0    0    0
  24         0    0    0    0    0    0    0    0    0
  26         0    0    0    0    0    0    0    0    0
  28         0    0    0    0    0    0    0    0    0
  34         0    0    0    0    0    0    0    0    0
  44         0    0    0    0    0    0    0    0    0
  45         0    0    0    0    0    0    0    0    0
  54         0    0    0    0    0    0    0    0    0
  64         0    0    0    0    0    0    0    0    0
 END PWAT-PARM1
 PWAT-PARM2
   <PLS > ***
   # -  # ***FOREST       LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  14                    4.5000    0.0800    400.00    0.0500    0.5000    0.9960
  16                    4.5000    0.0800    400.00    0.1000    0.5000    0.9960
  18                    4.5000    0.0800    200.00    0.2000    0.5000    0.9960
  24                    4.5000    0.0300    400.00    0.0500    0.5000    0.9960
  26                    4.5000    0.0300    400.00    0.1000    0.5000    0.9960
  28                    4.5000    0.0300    200.00    0.2000    0.5000    0.9960
  34                    5.0000    2.0000    400.00    0.0500    0.3000    0.9960
  44                    5.0000    0.8000    400.00    0.0500    0.3000    0.9960
  45                    7.5000    0.0200    300.00    0.0700    0.0000    0.9960
  54                    4.0000    2.0000    100.00    0.0010    0.5000    0.9960
  64                    4.5000    0.1200    400.00    0.1000    0.5000    0.9990
  65                    5.0000    0.8000    400.00    0.0500    0.5000    0.9960
 END PWAT-PARM2
 PWAT-PARM3
   <PLS >***
   # -  #*** PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
```

```
    14                                      2.0000     2.0000      0.00       0.00       0.0
    16                                      2.0000     2.0000      0.00       0.00       0.0
    18                                      2.0000     2.0000      0.00       0.00       0.0
    24                                      2.0000     2.0000      0.00       0.00       0.
    26                                      2.0000     2.0000      0.00       0.         0.
    28                                      2.0000     2.0000      0.00       0.         0.
    34                                      2.0000     2.0000      0.00       0.00       0.0
    44                                      2.0000     2.0000      0.00       0.         0.
    45                                      2.0000     2.0000      0.00       0.         0.
    54                                      10.000     2.0000      0.00       0.         0.7
    64                                      2.0000     2.0000      0.00       0.         0.0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >                                                                 ***
    # -  #     CEPSC      UZSN       NSUR      INTFW        IRC      LZETP***
    14        0.2000     1.0000     0.3500     2.000     0.1500     0.7000
    16        0.2000     0.5000     0.3500     2.000     0.1500     0.7000
    18        0.2000     0.3000     0.3500     2.000     0.1500     0.7000
    24        0.1000     0.5000     0.2500     2.000     0.1500     0.2500
    26        0.1000     0.2500     0.2500     2.000     0.1500     0.2500
    28        0.1000     0.1500     0.2500     2.000     0.1500     0.2500
    34        0.2000     0.5000     0.3500     0.000     0.5000     0.7000
    44        0.1000     0.5000     0.2500     0.000     0.5000     0.2500
    45        0.1000     0.2800     0.2500     6.000     0.1500     0.6000
    54        0.1000     3.0000     0.5000     1.000     0.7000     0.8000
    64        0.1000     0.2500     0.2500     3.000     0.5000     0.2500
    65        0.1000     0.5000     0.2500     0.000     0.5000     0.2500
  END PWAT-PARM4
  PWAT-STATE1
    <PLS >  PWATER state variables***
    # -  #***    CEPS       SURS        UZS       IFWS        LZS       AGWS       GWVS
    14          0.078        0.      0.2500      0.10      2.500       2.00      0.000
    16          0.078        0.      0.2500      0.10      2.500       2.00      0.000
    18          0.078        0.      0.2500      0.10      2.500       2.00      0.000
    24          0.051        0.      0.2500      0.10      2.500       2.00      0.000
    26          0.051        0.      0.2500      0.10      2.500       2.00      0.000
    28          0.051        0.      0.2500      0.10      2.500       2.00      0.000
    34          0.078        0.      0.2500      0.10      0.000       2.00      0.000
    44          0.051        0.      0.2500      0.10      0.000       2.00      0.000
    45          0.051        0.      0.2500      0.10      0.000       2.00      0.000
    54          0.051        0.      0.2500      0.10      2.000       2.00      0.000
    64          0.051        0.      0.2500      0.10      2.000      20.00      0.000
    65          0.051        0.      0.2500      0.10      0.000      20.00      0.000
  END PWAT-STATE1
END PERLND
IMPLND
  GEN-INFO
    <ILS >      Name             Unit-systems   Printer                      ***
    # -  #                     User  t-series Engl Metr                      ***
                                       in  out                               ***
    14      IMPERVIOUS            1    1    1   60    0
  END GEN-INFO
  ACTIVITY
    <ILS > ************* Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    14        0    0    1    0    0    0
  END ACTIVITY
```

```
    PRINT-INFO
      <ILS > ******** Print-flags ******** PIVL  PYR
      # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
     14       0    0    6    0    0    0    1    9
    END PRINT-INFO
    IWAT-PARM1                                                                ***
      <ILS >            Flags            ***                                  ***
      # -  # CSNO RTOP  VRS  VNN RTLI    ***
     14       0    0    0    0    0
    END IWAT-PARM1
    IWAT-PARM2                                                                ***
      <ILS >                                                                  ***
      # -  #      LSUR     SLSUR      NSUR     RETSC
     14         100.00    0.0100    0.1000    0.1000
    END IWAT-PARM2
    IWAT-PARM3                                                                ***
      <ILS >                                                                  ***
      # -  #    PETMAX    PETMIN
     14
    END IWAT-PARM3
    IWAT-STATE1                                                               ***
      <ILS >  IWATER state variables                                          ***
      # -  #      RETS      SURS
     14      1.0000E-3 1.0000E-3
    END IWAT-STATE1
  END IMPLND
                                                                              ***
  EXT SOURCES
                                                                              ***
  *** NOTE: The only RCHRES that precip and PET are applied to are lakes.
                                                                              ***
  <-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
  <Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
  *** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
  WDM   1002 PREC     ENGLZERO  1.00         PERLND  14 200 EXTNL  PREC
  WDM   1002 PREC     ENGLZERO  1.00         IMPLND  14     EXTNL  PREC
  WDM      1 EVAP     ENGLZERO  0.8          PERLND  14  65 EXTNL  PETINP
  WDM      1 EVAP     ENGLZERO  0.8          IMPLND  14     EXTNL  PETINP
  *** PRECIP/EVAP TO LAKES
  WDM   1002 PREC     ENGLZERO               RCHRES  20     EXTNL  PREC
  WDM      1 EVAP     ENGLZERO    0.8        RCHRES  20     EXTNL  POTEV

  END EXT SOURCES
                                                                              ***
  EXT TARGETS
  <-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
  <Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
  ***WALKER NR MTH
  RCHRES  18 HYDR   RO                       WDM     96 FLOW     ENGL      REPL
  *** MISC (20=WALKER WETLAND, 55=SR509, 56=1ST AVE)
  RCHRES  20 HYDR   RO       ***             WDM     97 FLOW     ENGL      REPL
  COPY     2 OUTPUT MEAN   1 1     12.1      WDM     89 FLOW     ENGL      REPL
  END EXT TARGETS
                                                                              ***
  SCHEMATIC
  <-Source->                  <--Area-->     <-Target->   MBLK    ***
  <Name>   #                  <-factor->     <Name>   #   Tbl#    ***
```

```
***WALKER CREEK
  *** SUB-CATCHMENT  MC 8
PERLND  26                         4.10     COPY      1       8
PERLND  44                        18.57     COPY      1       8
PERLND  54                         2.72     COPY      1       8
IMPLND  14                         1.34     COPY      1       9
***  *** SUB-CATCHMENT  SDW2  10-75-15 PREDEVELOPMENT W/1994 IMP
***PERLND  16                        30.91     COPY      2      10
***PERLND  26                         7.16     COPY      2      10
***PERLND  34                         1.69     COPY      2      10
***PERLND  44                         0.39     COPY      2      10
***PERLND  54                         1.13     COPY      2      10
***PERLND  16                        30.91     COPY      1      11
***PERLND  26                         7.16     COPY      1      11
***PERLND  34                         1.69     COPY      1      11
***PERLND  44                         0.39     COPY      1      11
***PERLND  54                         1.13     COPY      1      11
***IMPLND  14                         3.31     COPY      2       9
  *** SUB-CATCHMENT  SDW2  10-75-15 PREDEVELOPMENT W/1994 IMP
PERLND  16                        16.38     COPY      2      10
PERLND  26                         4.37     COPY      2      10
PERLND  34                        16.47     COPY      2      10
PERLND  44                         4.39     COPY      2      10
PERLND  54                         1.05     COPY      2      10
PERLND  16                        16.38     COPY      1      11
PERLND  26                         4.37     COPY      1      11
PERLND  34                        16.47     COPY      1      11
PERLND  44                         4.39     COPY      1      11
PERLND  54                         1.05     COPY      1      11
IMPLND  14                         2.20     COPY      2       9
  *** SUB-CATCHMENT  MC 9
PERLND  26                         9.44     COPY      1       8
PERLND  44                         0.74     COPY      1       8
PERLND  54          ***            0.00     COPY      1       8
IMPLND  14                         0.24     COPY      1       9
  *** SUB-CATCHMENT 18
PERLND  16                         0.76     RCHRES   18       1
PERLND  26                        16.08     RCHRES   18       1
PERLND  34                        20.95     RCHRES   18       1
PERLND  44                        49.22     RCHRES   18       1
IMPLND  14                         3.30     RCHRES   18       2
  *** SUB-CATCHMENT 19
PERLND  16                        12.72     RCHRES   19       1
PERLND  26                        92.07     RCHRES   19       1
PERLND  34                         8.39     RCHRES   19       1
PERLND  44                        95.55     RCHRES   19       1
IMPLND  14                        30.53     RCHRES   19       2
  *** SUB-CATCHMENT 20
PERLND  26                        12.53     RCHRES   20       1
PERLND  44                        53.43     RCHRES   20       1
PERLND  54                        33.43     RCHRES   20       1
IMPLND  14                        52.83     RCHRES   20       2
*** DOWN STREAM OF WALKER CREEK GAGE
  *** SUB-CATCHMENT 21 33% OF GW GOES TO GAGE REST GOES TO SOUND
PERLND  16                         2.54     RCHRES   18       7
PERLND  26                        44.30     RCHRES   18       7
```

```
PERLND  34                          2.03      RCHRES  18        7
PERLND  44                         41.13      RCHRES  18        7
PERLND  16                          2.54      RCHRES  21        6
PERLND  26                         44.30      RCHRES  21        6
PERLND  34                          2.03      RCHRES  21        6
PERLND  44                         41.13      RCHRES  21        6
PERLND  16                          5.07      RCHRES  21        1
PERLND  26                         88.61      RCHRES  21        1
PERLND  34                          4.06      RCHRES  21        1
PERLND  44                         82.26      RCHRES  21        1
IMPLND  14                         33.09      RCHRES  21        2
IMPLND  14                         16.54      RCHRES  21        2
  *** SUB-CATCHMENT 22
PERLND  34                          4.30      RCHRES  22        1
PERLND  44                         19.49      RCHRES  22        1
PERLND  54                          3.21      RCHRES  22        1
IMPLND  14                          3.95      RCHRES  22        2

***GROUNDWATER FROM OUTSIDE OF WALKER CREEK

PERLND  64                        630.00      RCHRES  20        7
PERLND  65                 ***    130.00      RCHRES  20        7

***STREAM ROUTING
COPY      2                                   COPY     3       14
COPY      1                                   COPY     3       14
COPY      3                                   RCHRES  20       13
RCHRES   20                                   RCHRES  19        3
RCHRES   19                                   RCHRES  18        3

END SCHEMATIC


NETWORK
                                                                          ***
***         <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>        <-MEMBER->
<NAME>    # <NAME>    TEM STRG<-FACTOR->STRG <NAME>    #    # <-GRP> <NAME> # # ***
                                                                          ***
END NETWORK
                                                                          ***
RCHRES
  GEN-INFO
    RCHRES        Name          Nexits   Unit Systems   Printer           ***
    # -   #<------------------><---> User T-series  Engl Metr LKFG        ***
                                              in  out                     ***
   18     Trib (0371A) M 18        1    1    1    1   62    0    0
   19     Trib (0371A) M 19        1    1    1    1   62    0    0
   20     Trib   M 20              1    1    1    1   62    0    1
   21     Trib (0371H) M 21        1    1    1    1   62    0    0
   22     Trib (0371A) M 22        1    1    1    1   62    0    0

  END GEN-INFO
  ACTIVITY
    RCHRES *************** Active Sections *****************
    # -   # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG              ***
    1   63    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
 PRINT-INFO
   RCHRES *************** Printout Flags ****************** PIVL  PYR
   # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
   1  63    5    0    0    0    0    0    0    0    0    0    1    9
 END PRINT-INFO
 HYDR-PARM1                                                               ***
   RCHRES  Flags for each HYDR Section
   # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *   *  *  *  *  *       *  *  *  *  *           ***
   1   99   0  1  0  0   4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 END HYDR-PARM1
 HYDR-PARM2                                                               ***
   RCHRES                                                                 ***
   #  -  #     FTABNO        LEN      DELTH      STCOR        KS      DB50  ***
 <------><--------><--------><--------><--------><--------><-------->     ***
  18             18   0.800                                  0.3
  19             19   0.568                                  0.3
  20             20   0.379                                  0.3
  21             21   0.450                                  0.3
  22             22   0.300                                  0.3
 END HYDR-PARM2
 HYDR-INIT
   RCHRES  Initial conditions for each HYDR section                       ***
   #  -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
 <------><-------->      <---><---><---><---><---> *** <---><---><---><---><--->
  18      0.1              4.0
  19      0.1              4.0
  20      10.0             4.0
  21      0.1              4.0
  22      0.1              4.0
 END HYDR-INIT
END RCHRES

FTABLES

  FTABLE     18
 ROWS COLS ***
    3    4
     DEPTH      AREA     VOLUME    OUTFLOW   ***
      0.00      1.30       0.00       0.00
      1.00      1.30       1.30     166.00
      2.00      1.40       2.65     490.00
  END FTABLE 18

  FTABLE     19
 ROWS COLS ***
    3    4
     DEPTH      AREA     VOLUME    OUTFLOW   ***
      0.00      1.10       0.00       0.00
      1.00      1.10       1.10      65.00
      2.00      1.20       2.25     223.00
  END FTABLE 19

  FTABLE     20
*** WALKER CREEK WETLAND
```

```
 ROWS COLS ***
   10    4
     DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW ***
      0.00       0.00       0.00       0.00
      1.00       2.50       1.25       7.04
      2.00       5.00       5.00      17.84
      3.00      12.00      13.50      32.17
      4.00      19.00      29.00      45.13
      5.00      22.00      49.50      54.95
      6.00      23.00      72.00      61.62
      6.10      23.00      74.30      62.15
      7.00      23.50      95.25      67.00
      7.24      24.10     101.10     100.00
  END FTABLE 20

  FTABLE     21
 ROWS COLS ***
    8    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.000     0.0000     0.0000       0.00
     0.100     0.2259     0.0113       0.11
     0.500     0.2707     0.1106       4.27
     1.000     0.3268     0.2600      15.13
     1.500     0.3828     0.4374      31.67
     2.000     0.4389     0.6428      54.02
     2.500     0.4949     0.8763      82.52
     3.000     0.5510     1.1377     117.55
  END FTABLE 21

  FTABLE     22
 ROWS COLS ***
    9    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.000     0.0000     0.0000       0.00
     0.100     0.3680     0.0184       0.25
     0.500     0.3717     0.1664       9.39
     1.000     0.3763     0.3534      31.06
     2.000     0.3819     0.7325      94.37
     3.000     0.3874     1.1171     174.33
     4.000     0.3930     1.5073     265.38
     5.000     0.3985     1.9030     364.68
     6.000     0.4040     2.3043     470.60
  END FTABLE 22
END FTABLES
MASS-LINK
<Volume>    <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        1
  conversion from acre-inches to acre-ft (1/12)               ***
PERLND      PWATER PERO        0.0833333    RCHRES         INFLOW IVOL
  END MASS-LINK    1

  MASS-LINK        2
IMPLND      IWATER SURO        0.0833333    RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
```

```
RCHRES      ROFLOW                              RCHRES          INFLOW
  END MASS-LINK    3

  MASS-LINK        4
RCHRES      OFLOW  OVOL   1                     RCHRES          INFLOW IVOL
  END MASS-LINK    4

  MASS-LINK        5
RCHRES      OFLOW  OVOL   2                     RCHRES          INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
PERLND      PWATER SURO          0.0833333      RCHRES          INFLOW IVOL
PERLND      PWATER IFWO          0.0833333      RCHRES          INFLOW IVOL
  END MASS-LINK    6

  MASS-LINK        7
PERLND      PWATER AGWO          0.0833333      RCHRES          INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
PERLND      PWATER PERO          0.0833333      COPY            INPUT  MEAN
  END MASS-LINK    8

  MASS-LINK        9
IMPLND      IWATER SURO          0.0833333      COPY            INPUT  MEAN
  END MASS-LINK    9

  MASS-LINK        10
PERLND      PWATER SURO          0.0833333      COPY            INPUT  MEAN
PERLND      PWATER IFWO          0.0833333      COPY            INPUT  MEAN
  END MASS-LINK    10

  MASS-LINK        11
PERLND      PWATER AGWO          0.0833333      COPY            INPUT  MEAN
  END MASS-LINK    11

  MASS-LINK        12
PERLND      PWATER AGWO          0.0833333      COPY            INPUT  MEAN
  END MASS-LINK    12

  MASS-LINK        13
COPY        OUTPUT MEAN                         RCHRES          INFLOW IVOL
  END MASS-LINK    13

  MASS-LINK        14
COPY        OUTPUT MEAN                         COPY            INPUT  MEAN
  END MASS-LINK    14

END MASS-LINK
END RUN
```

2006 CONDITIONS

```
RUN
GLOBAL
  ***  FILE: WCPOND05.inp REVISED April 2001. ATC
  ***  SEATAC AIRPORT HSPF BASIN MODEL OF WALKER CREEK
  ***  2006 FUTURE PROJECT CONDITION SIZING BASED
  ***  CHANGED PREC DSN 2 TO NEW PREC DSN 1002
  WALKER CREEK BASIN HSPF MODEL
  START       1948 10  1  0  0  END    1996  8 30 24  0

  RUN INTERP OUTPUT LEVEL    3
  RESUME     0 RUN     1
END GLOBAL

FILES
<type>  <fun>***<------------fname------------------------------------------->
MESSU       24   D:\PARA\SEATAC\MILLER\WALKERf\WALKER.MES
WDM         25   D:\PARA\SEATAC\MILLER\WALKERf\WCPOND03.WDM
            61   D:\PARA\SEATAC\MILLER\WALKERf\wPER.L61
            62   D:\PARA\SEATAC\MILLER\WALKERf\wRCH.L62
END FILES

OPN SEQUENCE
    INGRP              INDELT 01:00
      PERLND      14
      PERLND      16
      PERLND      18
      PERLND      24
      PERLND      26
      PERLND      28
      PERLND      34
      PERLND      44
      PERLND      45
      PERLND      54
      PERLND      64
      PERLND      65
      IMPLND      14
      RCHRES      49
      RCHRES      20
      RCHRES      19
      RCHRES      18
    END INGRP
END OPN SEQUENCE
                                                                     ***
COPY
  TIMESERIES
  Copy-opn                                                           ***
    # -  #  NPT  NMN                                                 ***
    1    5        1
  END TIMESERIES
END COPY

PERLND
  GEN-INFO
    <PLS >      Name           NBLKS   Unit-systems   Printer        ***
    # -  #                           User  t-series Engl Metr        ***
                                              in  out                ***
   14       TFF- TILL FOR FLT      1     1    1    1   61    0
```

```
  16      TFM- TILL FOR MOD       1    1    1    1   61    0
  18      TFS- TILL FOR STP       1    1    1    1   61    0
  24      TGF- TILL GR FLT        1    1    1    1   61    0
  26      TGM- TILL GR MOD        1    1    1    1   61    0
  28      TGS- TILL GR STP        1    1    1    1   61    0
  34      OF - OUTWASH FOR        1    1    1    1   61    0
  44      OG - OUTWASH GR         1    1    1    1   61    0
***PERLND FOR NEW AIRPORT FILL; NONE IN CALIBRATION
  45      AIRPORT FILL            1    1    1    1   61    0
  54      SA - WETLANDS           1    1    1    1   61    0
  64      TGM DES MOINES          1    1    1    1   61    0
  65      OG  DES MOINES          1    1    1    1   61    0
 END GEN-INFO
 ACTIVITY
   <PLS > ************* Active Sections *****************************
   # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC      ***
  14  200    0    0    1    0    0    0    0    0    0    0    0    0
 END ACTIVITY
 PRINT-INFO
   <PLS > ********************* Print-flags ************************ PIVL  PYR
   # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
  14  200    0    0    5    0    0    0    0    0    0    0    0    0    1    9
 END PRINT-INFO
 PWAT-PARM1
   <PLS > ***************** Flags *******************
   # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                      ***
  14         0    0    0    0    0    0    0    0    0
  16         0    0    0    0    0    0    0    0    0
  18         0    0    0    0    0    0    0    0    0
  24         0    0    0    0    0    0    0    0    0
  26         0    0    0    0    0    0    0    0    0
  28         0    0    0    0    0    0    0    0    0
  34         0    0    0    0    0    0    0    0    0
  44         0    0    0    0    0    0    0    0    0
  45         0    0    0    0    0    0    0    0    0
  54         0    0    0    0    0    0    0    0    0
  64         0    0    0    0    0    0    0    0    0
 END PWAT-PARM1
 PWAT-PARM2
   <PLS > ***
   # -  # ***FOREST        LZSN     INFILT       LSUR      SLSUR      KVARY      AGWRC
  14                     4.5000     0.0800     400.00     0.0500     0.5000     0.9960
  16                     4.5000     0.0800     400.00     0.1000     0.5000     0.9960
  18                     4.5000     0.0800     200.00     0.2000     0.5000     0.9960
  24                     4.5000     0.0300     400.00     0.0500     0.5000     0.9960
  26                     4.5000     0.0300     400.00     0.1000     0.5000     0.9960
  28                     4.5000     0.0300     200.00     0.2000     0.5000     0.9960
  34                     5.0000     2.0000     400.00     0.0500     0.3000     0.9960
  44                     5.0000     0.8000     400.00     0.0500     0.3000     0.9960
  45                     7.5000     0.0200     300.00     0.0700     0.0000     0.9960
  54                     4.0000     2.0000     100.00     0.0010     0.5000     0.9960
  64                     4.5000     0.1200     400.00     0.1000     0.5000     0.9990
  65                     5.0000     0.8000     400.00     0.0500     0.5000     0.9960
 END PWAT-PARM2
 PWAT-PARM3
   <PLS >***
   # -  #*** PETMAX     PETMIN     INFEXP     INFILD     DEEPFR     BASETP     AGWETP
```

```
   14                         2.0000    2.0000      0.00      0.00      0.0
   16                         2.0000    2.0000      0.00      0.00      0.0
   18                         2.0000    2.0000      0.00      0.00      0.0
   24                         2.0000    2.0000      0.00      0.00      0.
   26                         2.0000    2.0000      0.00      0.        0.
   28                         2.0000    2.0000      0.00      0.        0.
   34                         2.0000    2.0000      0.00      0.00      0.0
   44                         2.0000    2.0000      0.00      0.        0.
   45                         2.0000    2.0000      0.00      0.        0.
   54                         10.000    2.0000      0.00      0.        0.7
   64                         2.0000    2.0000      0.00      0.        0.0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >                                                          ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP***
   14         0.2000    1.0000    0.3500     2.000    0.1500    0.7000
   16         0.2000    0.5000    0.3500     2.000    0.1500    0.7000
   18         0.2000    0.3000    0.3500     2.000    0.1500    0.7000
   24         0.1000    0.5000    0.2500     2.000    0.1500    0.2500
   26         0.1000    0.2500    0.2500     2.000    0.1500    0.2500
   28         0.1000    0.1500    0.2500     2.000    0.1500    0.2500
   34         0.2000    0.5000    0.3500     0.000    0.5000    0.7000
   44         0.1000    0.5000    0.2500     0.000    0.5000    0.2500
   45         0.1000    0.2800    0.2500     6.000    0.1500    0.6000
   54         0.1000    3.0000    0.5000     1.000    0.7000    0.8000
   64         0.1000    0.2500    0.2500     3.000    0.5000    0.2500
   65         0.1000    0.5000    0.2500     0.000    0.5000    0.2500
  END PWAT-PARM4
  PWAT-STATE1
    <PLS >  PWATER state variables***
    # -  #***     CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   14            0.078        0.    0.2500      0.10     2.500      2.00     0.000
   16            0.078        0.    0.2500      0.10     2.500      2.00     0.000
   18            0.078        0.    0.2500      0.10     2.500      2.00     0.000
   24            0.051        0.    0.2500      0.10     2.500      2.00     0.000
   26            0.051        0.    0.2500      0.10     2.500      2.00     0.000
   28            0.051        0.    0.2500      0.10     2.500      2.00     0.000
   34            0.078        0.    0.2500      0.10     0.000      2.00     0.000
   44            0.051        0.    0.2500      0.10     0.000      2.00     0.000
   45            0.051        0.    0.2500      0.10     0.000      2.00     0.000
   54            0.051        0.    0.2500      0.10     2.000      2.00     0.000
   64            0.051        0.    0.2500      0.10     2.000     20.00     0.000
   65            0.051        0.    0.2500      0.10     0.000     20.00     0.000
  END PWAT-STATE1
END PERLND
IMPLND
  GEN-INFO
    <ILS >       Name             Unit-systems   Printer                     ***
    # -  #                    User  t-series Engl Metr                     ***
                                      in  out                              ***
   14      IMPERVIOUS            1    1    1   60    0
  END GEN-INFO
  ACTIVITY
    <ILS > ************* Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
   14         0    0    1    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
   14         0    0    6    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1                                                                     ***
    <ILS >          Flags            ***                                         ***
    # -  # CSNO RTOP  VRS  VNN RTLI  ***
   14         0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2                                                                     ***
    <ILS >                                                                       ***
    # -  #       LSUR     SLSUR      NSUR     RETSC
   14          100.00    0.0100    0.1000    0.1000
  END IWAT-PARM2
  IWAT-PARM3                                                                     ***
    <ILS >                                                                       ***
    # -  #     PETMAX    PETMIN
   14
  END IWAT-PARM3
  IWAT-STATE1                                                                    ***
    <ILS >  IWATER state variables                                               ***
    # -  #       RETS      SURS
   14       1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND
                                                                                 ***
EXT SOURCES                                                                      ***

*** NOTE: The only RCHRES that precip and PET are applied to are lakes.
                                                                                 ***
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
*** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
WDM   1002 PREC     ENGLZERO  1.00         PERLND  14 200 EXTNL  PREC
WDM   1002 PREC     ENGLZERO  1.00         IMPLND  14     EXTNL  PREC
WDM      1 EVAP     ENGLZERO  0.8          PERLND  14  65 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO  0.8          IMPLND  14     EXTNL  PETINP
*** PRECIP/EVAP TO LAKES
WDM   1002 PREC     ENGLZERO               RCHRES  20     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8        RCHRES  20     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO               RCHRES  49     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8        RCHRES  49     EXTNL  POTEV

END EXT SOURCES
                                                                                 ***
EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES  18 HYDR   RO                       WDM    116 FLOW     ENGL      REPL
 ***PROJECT CONDITION FLOWS
RCHRES  49 HYDR   RO     1 1               WDM    109 FLOW     ENGL      REPL
*** DETENTION STAGES
RCHRES  49 HYDR   STAGE                    WDM    649 STAG     ENGL      REPL
*** DETENTION VOLUME
RCHRES  49 HYDR   VOL                      WDM    749 VOL      ENGL      REPL
*** 39=SR509     37=SDW2
```

```
END EXT TARGETS                                                                          ***

SCHEMATIC
<-Source->                          <--Area-->    <-Target->   MBLK     ***
<Name>   #                          <-factor->    <Name>   #   Tbl#     ***

***WALKER CREEK
*** SUB-CATCHMENT  MC 8
PERLND  26                             3.93       RCHRES  20       1
PERLND  44                            18.73       RCHRES  20       1
PERLND  54                             2.70       RCHRES  20       1
IMPLND  14                             0.01       RCHRES  20       2
***  *** SUB-CATCHMENT  SDW-2
***PERLND  26                            26.82      RCHRES  49       6
***PERLND  44                             1.42      RCHRES  49       6
***PERLND  45                             6.70      RCHRES  49       6
***PERLND  26                            26.82      RCHRES  20       7
***PERLND  44                             1.42      RCHRES  20       7
***PERLND  45                             6.70      RCHRES  20       7
***IMPLND  14                             9.51      RCHRES  49       2
***REPLACE SUBCATCHMENT SDW-2   WITH NEW SDW-2 SUBBASIN
***SUBBASIN SDW-2 ROUTING AS OF 4/19/01
PERLND  26                            26.88       RCHRES  49       6
PERLND  44                             1.51       RCHRES  49       6
PERLND  45                            6.700       RCHRES  49       6
PERLND  26                            26.88       RCHRES  20       7
PERLND  44                             1.51       RCHRES  20       7
PERLND  45                            6.700       RCHRES  20       7
IMPLND  14                             9.51       RCHRES  49       2
*** SUB-CATCHMENT  MC 9
PERLND  26                             9.28       RCHRES  20       1
PERLND  44                             0.76       RCHRES  20       1
IMPLND  14                             0.40       RCHRES  20       2
  *** SUB-CATCHMENT 18
PERLND  16                             0.76       RCHRES  18       1
PERLND  26                            16.08       RCHRES  18       1
PERLND  34                            20.95       RCHRES  18       1
PERLND  44                            49.22       RCHRES  18       1
IMPLND  14                             3.30       RCHRES  18       2
  *** SUB-CATCHMENT 19
PERLND  16                            12.72       RCHRES  19       1
PERLND  26                            92.07       RCHRES  19       1
PERLND  34                             8.39       RCHRES  19       1
PERLND  44                            95.55       RCHRES  19       1
IMPLND  14                            30.53       RCHRES  19       2
  *** SUB-CATCHMENT 20
PERLND  26                            12.54       RCHRES  20       1
PERLND  44                            53.42       RCHRES  20       1
PERLND  54                            33.43       RCHRES  20       1
IMPLND  14                            52.83       RCHRES  20       2
*** DOWN STREAM OF WALKER CREEK GAGE
  *** SUB-CATCHMENT 21 33% OF GW GOES TO GAGE REST GOES TO SOUND
PERLND  16                             2.54       RCHRES  18       7
PERLND  26                            44.30       RCHRES  18       7
PERLND  34                             2.03       RCHRES  18       7
PERLND  44                            41.13       RCHRES  18       7
PERLND  16                             2.54       RCHRES  21       6
```

```
PERLND  26                        44.30     RCHRES  21        6
PERLND  34                         2.03     RCHRES  21        6
PERLND  44                        41.13     RCHRES  21        6
IMPLND  14                        16.54     RCHRES  21        2
PERLND  16                         5.07     RCHRES  21        1
PERLND  26                        88.61     RCHRES  21        1
PERLND  34                         4.06     RCHRES  21        1
PERLND  44                        82.26     RCHRES  21        1
IMPLND  14                        33.09     RCHRES  21        2
  *** SUB-CATCHMENT 22
PERLND  34                         4.30     RCHRES  22        1
PERLND  44                        19.49     RCHRES  22        1
PERLND  54                         3.21     RCHRES  22        1
IMPLND  14                         3.95     RCHRES  22        2

***GROUNDWATER FROM OUTSIDE OF WALKER CREEK

PERLND  64                       630.00     RCHRES  20        7
PERLND  65                 ***   130.00     RCHRES  20        7


***STREAM ROUTING
RCHRES  49                                  RCHRES  20        3
RCHRES  20                                  RCHRES  19        3
RCHRES  19                                  RCHRES  18        3

END SCHEMATIC


NETWORK
                                                                        ***
***         <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>       <-MEMBER->
<NAME>   # <NAME>   TEM STRG<-FACTOR->STRG <NAME>   #   # <-GRP> <NAME> # # ***
                                                                        ***
END NETWORK
                                                                        ***
RCHRES
  GEN-INFO
    RCHRES       Name         Nexits  Unit Systems   Printer            ***
    # -   #<------------------><---> User T-series  Engl Metr LKFG      ***
                                           in  out                      ***
   18     Trib (0371A) M 18       1     1    1    1   62    0    0
   19     Trib (0371A) M 19       1     1    1    1   62    0    0
   20     Trib   M 20             1     1    1    1   62    0    1
   21     Trib (0371H) M 21       1     1    1    1   62    0    0
   22     Trib (0371A) M 22       1     1    1    1   62    0    0
   39     SR509                   1     1    1    1   62    0    0
   49     SDW2 POND               1     1    1    1   62    0    0

  END GEN-INFO
  ACTIVITY
    RCHRES *************** Active Sections *****************
    # -   # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG                ***
    1   63    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    RCHRES *************** Printout Flags ****************** PIVL  PYR
```

```
  # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
  1   63    5    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO
HYDR-PARM1
                                                                          ***
  RCHRES  Flags for each HYDR Section
  # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each      FUNCT  for each
          FG FG FG FG  possible  exit  *** possible  exit       possible  exit
           *  *  *  *    *  *  *  *  *       *  *  *  *  *          ***
  1   99   0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
END HYDR-PARM1
HYDR-PARM2
                                                                          ***
  RCHRES
  # -  #     FTABNO        LEN     DELTH     STCOR        KS      DB50      ***
<------><--------><--------><--------><--------><--------><-------->      ***
 18            18  0.800                               0.3
 19            19  0.568                               0.3
 20            20  0.379                               0.3
 21            21  0.450                               0.3
 22            22  0.300                               0.3
 49            49  0.010                  0.0          0.3

END HYDR-PARM2
HYDR-INIT
  RCHRES  Initial conditions for each HYDR section                        ***
  # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit        for each possible exit
<------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
 18      0.1             4.0
 19      0.1             4.0
 20      10.0            4.0
 21      0.1             4.0
 22      0.1             4.0
 49      0.0             4.0

END HYDR-INIT
END RCHRES

FTABLES

 FTABLE      18
 ROWS COLS ***
   3    4
    DEPTH      AREA     VOLUME    OUTFLOW    ***
     0.00      1.30      0.00       0.00
     1.00      1.30      1.30     166.00
     2.00      1.40      2.65     490.00
 END FTABLE 18

 FTABLE      19
 ROWS COLS ***
   3    4
    DEPTH      AREA     VOLUME    OUTFLOW    ***
     0.00      1.10      0.00       0.00
     1.00      1.10      1.10      65.00
     2.00      1.20      2.25     223.00
 END FTABLE 19
```

```
 FTABLE      49
 *** PROJECT POND F SDW2
ROWS COLS ***
  12     4
    DEPTH        AREA     VOLUME    OUTFLOW    ***
    0.000      0.8880     0.0000    0.00
    1.000      0.9270     1.0823    0.25
    2.000      0.9690     2.2096    0.35
    3.000      1.0450     3.3828    0.42
    4.000      1.0450     4.6027    0.49
    5.000      1.0860     5.8726    0.55
    6.000      1.1260     7.1935    0.60
    7.000      1.1670     8.5645    1.20
    8.000      1.2130     9.9861    2.69
    8.300      1.2560     10.454    3.09
    9.000      1.2560     11.459    7.57
   10.000      1.3000     12.987    16.88
 END FTABLE 49

 FTABLE      20
*** WALKER CREEK WETLAND
ROWS COLS ***
  10     4
    DEPTH        AREA     VOLUME    OUTFLOW   OUTFLOW ***
     0.00        0.00       0.00       0.00
     1.00        2.50       1.25       7.04
     2.00        5.00       5.00      17.84
     3.00       12.00      13.50      32.17
     4.00       19.00      29.00      45.13
     5.00       22.00      49.50      54.95
     6.00       23.00      72.00      61.62
     6.10       23.00      74.30      62.15
     7.00       23.50      95.25      67.00
     7.24       24.10     101.10     100.00
 END FTABLE 20

 FTABLE      21
ROWS COLS ***
   8     4
    DEPTH        AREA     VOLUME    OUTFLOW    ***
    0.000      0.0000     0.0000       0.00
    0.100      0.2259     0.0113       0.11
    0.500      0.2707     0.1106       4.27
    1.000      0.3268     0.2600      15.13
    1.500      0.3828     0.4374      31.67
    2.000      0.4389     0.6428      54.02
    2.500      0.4949     0.8763      82.52
    3.000      0.5510     1.1377     117.55
 END FTABLE 21

 FTABLE      22
ROWS COLS ***
   9     4
    DEPTH        AREA     VOLUME    OUTFLOW    ***
    0.000      0.0000     0.0000       0.00
    0.100      0.3680     0.0184       0.25
    0.500      0.3717     0.1664       9.39
```

```
     1.000    0.3763    0.3534      31.06
     2.000    0.3819    0.7325      94.37
     3.000    0.3874    1.1171     174.33
     4.000    0.3930    1.5073     265.38
     5.000    0.3985    1.9030     364.68
     6.000    0.4040    2.3043     470.60
  END FTABLE 22
END FTABLES
MASS-LINK
<Volume>    <-Grp> <-Member-><--Mult-->        <Target>        <-Grp> <-Member->***
<Name>             <Name> # #<-factor->        <Name>                 <Name> # #***
  MASS-LINK        1
  conversion from acre-inches to acre-ft (1/12)                 ***
PERLND      PWATER PERO       0.0833333        RCHRES          INFLOW IVOL
  END MASS-LINK    1

  MASS-LINK        2
IMPLND      IWATER SURO       0.0833333        RCHRES          INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
RCHRES      ROFLOW                             RCHRES          INFLOW
  END MASS-LINK    3

  MASS-LINK        4
RCHRES      OFLOW  OVOL   1                    RCHRES          INFLOW IVOL
  END MASS-LINK    4

  MASS-LINK        5
RCHRES      OFLOW  OVOL   2                    RCHRES          INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
PERLND      PWATER SURO       0.0833333        RCHRES          INFLOW IVOL
PERLND      PWATER IFWO       0.0833333        RCHRES          INFLOW IVOL
  END MASS-LINK    6

  MASS-LINK        7
PERLND      PWATER AGWO       0.0833333        RCHRES          INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
PERLND      PWATER PERO       0.0833333        COPY            INPUT  MEAN
  END MASS-LINK    8
  MASS-LINK        12
PERLND      PWATER AGWO       0.0833333        COPY            INPUT  MEAN
  END MASS-LINK    12

  MASS-LINK        9
IMPLND      IWATER SURO       0.0833333        COPY            INPUT  MEAN
  END MASS-LINK    9

  MASS-LINK        10
COPY        OUTPUT MEAN                        RCHRES          INFLOW IVOL
  END MASS-LINK    10

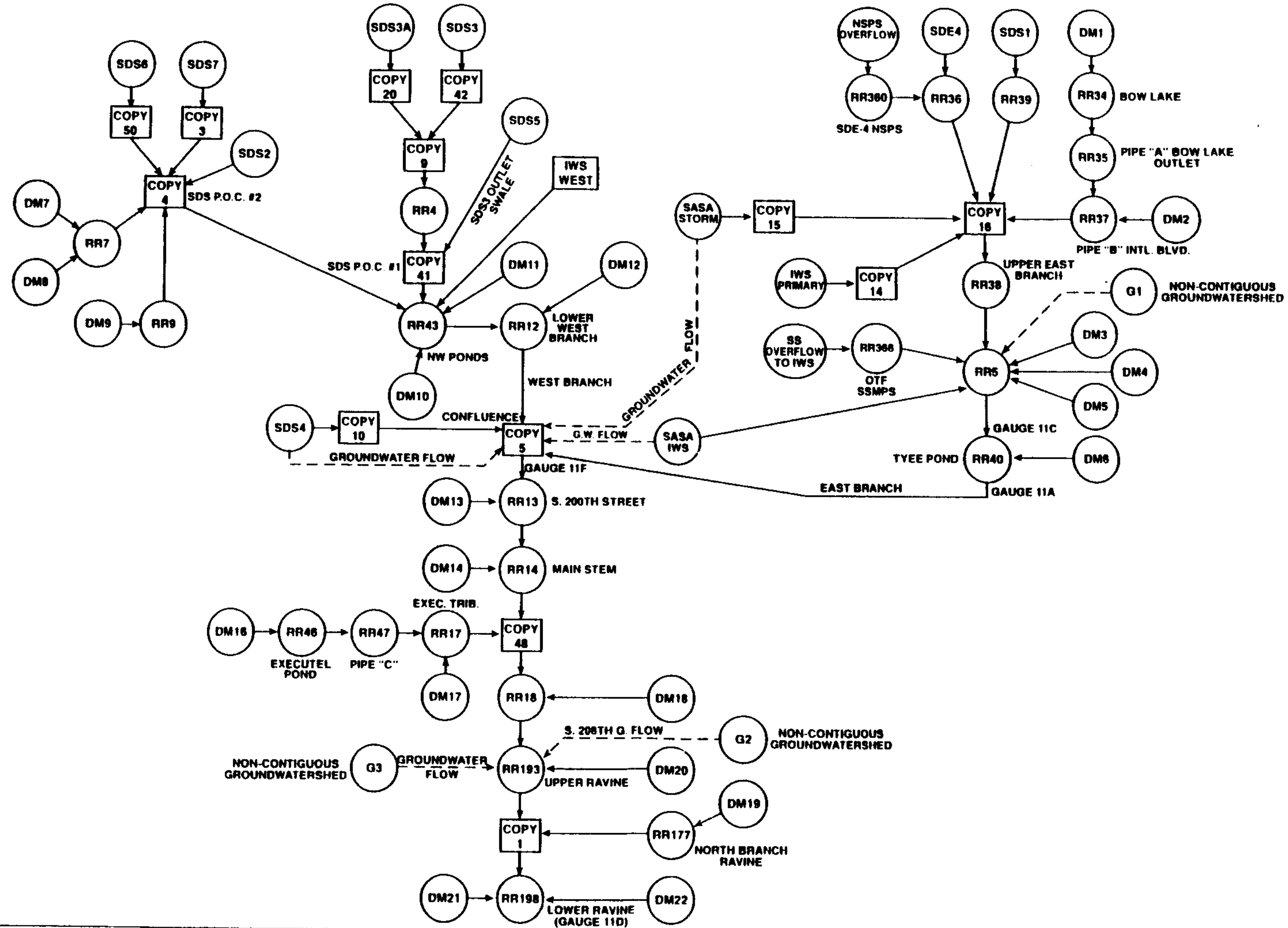
END MASS-LINK
```

END RUN

DES MOINES CREEK WATERSHED
HSPF INPUT FILES

- **PREDEVELOPMENT CONDITIONS**
- **2006 CONDITIONS**

PREDEVELOPMENT CONDITIONS



July 2001
556 2912 001 (28)

Parametrix, Inc. Port of Seattle/HSPF Model/556 2912 001 01(028) 12 00 (K)

Stormwater (solid arrow)
IWS (dash-dot arrow)
Groundwater (dashed arrow)

DM# = Des Moines Creek Subbasin Number
SDS# = Storm Drainage South Number
SDE# = Storm Drainage East Number
R# = Routing Reach Number (Channel or Storage Pond)

DM1 – Subbasin ID
RR12 – Routing Reach Number

COPY 8 – Summation of upstream flow

Figure 1
Des Moines Creek
HSPF Model Schematic
Predevelopment Conditions

AR 046939

```
RUN
GLOBAL
  ***  FILE: DMPRER5M.INP (MODIFY DMPRE.INP)
  ***  Revised March 2001 to reflect King County changes (FK, 03/22/2001)
  ***  HSPF MODEL OF DES MOINES CREEK
  ***  UPDATE MODEL TO CREATE DOWNSTREAM EVALUATION POINT FOR SDS TO WEST BRANCH
  ***  FUTURE CONDITIONS = DM06R.INP
  ***  PREDEVELOPED CONDITION (SDS2,5,6 removed; SDS2, SDS5, SDS6 watersheds added)
  ***  10-75-15 LAND USE (<10% 94 IMPERV -->GRASS) ON STIA PROJECT AREA
  ***  1994 COVER CONDITIONS ON NON PROJECT AREAS
  ***  ELIMINATE IWS SYSTEM COMPONENTS NOT ROUTED TO SDS
  DES MOINES CREEK BASIN HSPF MODEL
  START       1948/10/01 00:00  END    1996/09/30 24:00
  START       1992/01/01 00:00  END    1996/09/30 24:00***
  RUN INTERP OUTPUT LEVEL    0
  RESUME     0 RUN     1
END GLOBAL

FILES
MESSU       24    DMPRE.MES
WDM         25    DM.WDM
END FILES

OPN SEQUENCE
    INGRP              INDELT 01:00
      PERLND      16
      PERLND      26
      PERLND      34
      PERLND      44
      PERLND      54
      IMPLND      14
      RCHRES     360
      RCHRES      36
      RCHRES      39
      COPY        20
      COPY        42
      COPY         9
      RCHRES       4
      COPY        41
      COPY        10
      RCHRES     366
      COPY        50
      COPY         3
      RCHRES       7
      RCHRES       9
      COPY         4
      RCHRES      43
      COPY        15
      RCHRES      34
      RCHRES      35
      RCHRES      37
      COPY        14
      COPY        16
      RCHRES      38
      RCHRES       5
      RCHRES      40
      RCHRES      12
      COPY         5
      RCHRES      13
      RCHRES      14
      RCHRES     177
      RCHRES      46
      RCHRES      47
      RCHRES      17
      COPY        48
      RCHRES      18
      RCHRES     193
      COPY         1
      RCHRES     198
    END INGRP
END OPN SEQUENCE

PERLND
  GEN-INFO
    <PLS >      Name          NBLKS   Unit-systems   Printer              ***
    # -  #                           User  t-series Engl Metr             ***
```

```
                                                in  out                                    ***
 16      TFM- TILL FOR MOD        1     1     1    1    60     0
 26      TGM- TILL GR MOD         1     1     1    1    60     0
 34      OF - OUTWASH FOR         1     1     1    1    60     0
 44      OG - OUTWASH GR          1     1     1    1    60     0
 54      SA - WETLANDS            1     1     1    1    60     0
END GEN-INFO
ACTIVITY
  <PLS > ************* Active Sections *****************************                 ***
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC
 14   54    0    0    1    0    0    0    0    0    0    0    0    0
END ACTIVITY
PRINT-INFO
  <PLS > ********************* Print-flags ************************ PIVL  PYR
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
 14   54    0    0    6    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO
PWAT-PARM1
  <PLS > ***************** Flags ********************                                 ***
  # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE
 14   54    C    0    0    0    0    0    0    0    0
END PWAT-PARM1

PWAT-PARM2
  <PLS > ***
  # -  # ***FOREST         LZSN     INFILT       LSUR      SLSUR      KVARY      AGWRC
 16                      4.5000     0.2000     200.00     0.1000     0.5000     0.9960
 26                      4.5000     0.0750     400.00     0.1000     0.5000     0.9960
 34                      5.0000     2.0000     200.00     0.0500     0.3000     0.9960
 44                      5.0000     0.8000     200.00     0.0500     0.3000     0.9960
 54                      4.0000     2.0000     200.00     0.0010     0.5000     0.9960
END PWAT-PARM2
PWAT-PARM3
  <PLS >***
  # -  #*** PETMAX    PETMIN     INFEXP     INFILD     DEEPFR     BASETP     AGWETP
 16                             2.0000     2.0000       0.55       0.00        0.0
 26                             2.0000     2.0000       0.55       0.00        0.0
 34                             2.0000     2.0000       0.55       0.00        0.0
 44                             2.0000     2.0000       0.55       0.00        0.0
 54                             10.000     2.0000       0.55       0.00        0.7
END PWAT-PARM3
PWAT-PARM4
  <PLS >                                                                  ***
  # -  #       CEPSC      UZSN       NSUR      INTFW        IRC      LZETP***
 16           0.2000    0.5000     0.3500      3.000     0.5000     0.7000
 26           0.1000    0.2500     0.2500      3.000     0.5000     0.2500
 34           0.2000    0.5000     0.3500      0.000     0.7000     0.7000
 44           0.1000    0.5000     0.2500      0.000     0.7000     0.2500
 54           0.2000    3.0000     0.5000      1.000     0.7000     0.8000
END PWAT-PARM4

PWAT-STATE1
  <PLS >  PWATER state variables***
  # -  #***   CEPS       SURS        UZS       IFWS        LZS       AGWS       GWVS
 16           0.078         0.     0.0010         0.      0.075      0.267      0.026
 26           0.051         0.     0.0350         0.      1.928      0.680      0.049
 34           0.078         0.     0.0010         0.      0.090      0.676      0.038
 44           0.051         0.     0.0040         0.      1.127      0.614      0.152
 54           0.051         0.     0.3330         0.      0.622      0.000      0.000
END PWAT-STATE1
END PERLND

IMPLND
  GEN-INFO
    <ILS >      Name             Unit-systems   Printer                              ***
    # -  #                   User  t-series Engl Metr                                ***
                                     in   out                                        ***
   13  140 IMPERVIOUS            1     1    1   60    0
  END GEN-INFO
  ACTIVITY
    <ILS > ************* Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL  ***
   13  140    0    0    1    0    0    0
  END ACTIVITY
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
```

```
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
  13  140    0    0    6    0    0    0    1    9
 END PRINT-INFO
 IWAT-PARM1
   <ILS >          Flags            ***                                  ***
   # -  # CSNO RTOP  VRS  VNN RTLI  ***                                  ***
  13  140    0    0    0    0    0
 END IWAT-PARM1
 IWAT-PARM2
   <ILS >                                                                ***
   # -  #       LSUR     SLSUR      NSUR     RETSC ***
  14           500.0    0.0100    0.1000    0.100
 140          100.00    0.0500    0.1000    0.0500
 END IWAT-PARM2
 IWAT-PARM3
   <ILS >                                                                ***
   # -  #     PETMAX    PETMIN                                           ***
  13  140
 END IWAT-PARM3
 IWAT-STATE1
   <ILS >  IWATER state variables                                        ***
   # -  #       RETS      SURS                                           ***
  13  140 1.0000E-3 1.0000E-3
 END IWAT-STATE1
END IMPLND

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer             ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG        ***
                                         in  out                         ***
     4     SDS-3 Outlet Swale      1    1    1    1    0    0    0
     5     E.Branch above TyeeP    1    1    1    1    0    0    0
     7     DM7 & DM8 Conveyance    1    1    1    1    0    0    0
     9     DM9 Conveyance          1    1    1    1    0    0    0
    12     Lower W. Branch         1    1    1    1    0    0    0
    13     Confl. to 200th St.     1    1    1    1    0    0    0
    14     200th to Exec. Trib.    1    1    1    1    0    0    0
    17     Executel Tributary      1    1    1    1    0    0    0
    18     Exec.Confl. to 208th    1    1    1    1    0    0    0
    34     Bow Lake                1    1    1    1    0    0    1
    35     Pipe A Bow LK Outlet    1    1    1    1    0    0    0
    36     SDE-4 Combined Disch    1    1    1    1    0    0    0
    37     Pipe B 60" Intl Blvd    1    1    1    1    0    0    0
    38     Upper E. Branch         1    1    1    1    0    0    0
    39     SDS-1 Storm Only        1    1    1    1    0    0    0
    40     Tyee Pond Reach         1    1    1    1    0    0    0
    43     Northwest Ponds Rch     1    1    1    1    0    0    1
    46     Executel Pond Reach     1    1    1    1    0    0    0
    47     Pipe C Exec.Pond Dis    1    1    1    1    0    0    0
   177     North Branch Ravine     1    1    1    1    0    0    0
   193     Upper Ravine            1    1    1    1    0    0    0
   198     Lower Ravine            1    1    1    1    0    0    0
   360     SDE-4 NSPS              1    1    1    1    0    0    0
   366     CTF   SSMPS             1    1    1    1    0    0    0
  END GEN-INFO

  ACTIVITY
    RCHRES *************** Active Sections ****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG              ***
    1  366    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    RCHRES *************** Printout Flags ***************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
    1  366    6    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible   exit *** possible   exit     possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    4   17   0  1  1  0    4  0  0  0  0       0  0  0  0  0      2  2  2  2  2
   18   34   0  1  1  0    4  0  0  0  0       0  0  0  0  0      2  2  2  2  2
   35   42   0  1  1  0    4  0  0  0  0       0  0  0  0  0      2  2  2  2  2
   43        0  1  1  0    4  5  0  0  0       0  0  0  0  0      2  2  2  2  2
```

```
  46  198   0  1  1  0    4  0  0  0  0       0  0  0  0  0      2  2  2  2  2
 360  366   0  1  1  0    4  0  0  0  0       0  0  0  0  0      2  2  2  2  2
 END HYDR-PARM1

 HYDR-PARM2
***Modified by FK to include 40 and 46 in the model
   RCHRES                                                                    ***
   # -  #    FTABNO      LEN     DELTH     STCOR       KS      DB50          ***
 <------><--------><--------><--------><--------><--------><-------->        ***
   4              4  0.530                               0.3
   5              5  0.380                               0.3
   7              7  0.341                               0.3
   9              9  0.189                               0.3
  12             12  0.273                               0.3
  13             13  0.218                               0.3
  14             14  0.218                               0.3
  17             17  0.246                               0.3
  18             18  0.303                               0.3
  34             34  0.208                               0.3
  35             35  0.123                               0.3
  36              1  0.100                               0.3
  37             37  0.381                               0.3
  38             38  0.142                               0.3
  39              1  0.100                               0.3
  40             40  0.189                               0.3
  43             43  0.189                               0.3
  46             46  0.047                               0.3
  47             47  0.417                               0.3
 177            177  0.407                               0.3
 193            193  0.795                               0.3
 198            198  0.631                               0.3
 360              1  0.100                               0.3
 366              1  0.100                               0.3
 END HYDR-PARM2

 HYDR-INIT
   RCHRES  Initial conditions for each HYDR section                          ***
   # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
 <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
   3    0.1                4.0
   4    0.1                4.0
   5    0.1                4.0
   7    0.1                4.0
   9    0.1                4.0
  12    0.1                4.0
  13    0.1                4.0
  14    0.1                4.0
  17    0.1                4.0
  18    0.1                4.0
  34    35.                4.0
  35    0.0                4.0
  36    0.0                4.0
  37    0.0                4.0
  38    0.0                4.0
  39    0.0                4.0
  40    0.0                4.0
  43    0.1                4.0  5.0
  46    0.0                4.0
  47    0.0                4.0
 177    0.0                4.0
 193    0.0                4.0
 198    0.0                4.0
 360    0.0                4.0
 366    0.0                4.0
 END HYDR-INIT
END RCHRES

FTABLES

 FTABLE      1
 ROWS COLS ***
   8    4
     DEPTH      AREA    VOLUME      DISCH  OUTFLOW2 ***
      (FT)   (ACRES)   (AC-FT)      (CFS)     (CFS) ***
      0.00     0.000     0.000        0.0
```

```
      0.50      0.016      0.006            1
      1.00      0.016      0.011            4
      1.50      0.024      0.025           12
      2.00      0.032      0.045           30
      2.50      0.040      0.070           50
      3.00      0.048      0.101           80
      5.00      0.064      0.225          250
  END FTABLE  1

  FTABLE       4
*** SDS-3 OUTLET SWALE
 ROWS COLS ***
    7    4
***   DEPTH        AREA    VOLUME    OUTFLOW   OUTFLOW2                      ***
       (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
       .000        .000       0.0        0.0
       .500        .198       0.1        9.0
      1.000        .236       0.5       30.9
      2.000        .306       1.0      115.8
      3.000        .376       1.5      265.5
      4.000        .446       5.0      491.8
      5.000        .517      20.0      806.3
  END FTABLE  4

  FTABLE       5
*** EAST BRANCH ABOVE TYEE POND
 ROWS COLS ***
   13    4
***   DEPTH        AREA    VOLUME    OUTFLOW   OUTFLOW2                      ***
       (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
       .000        .000      .000       .000
       .550        .290      .100      4.900
      1.100        .543      .200     20.800
      1.650        .609      .300     46.500
      2.200        .671      .400     80.000
      2.750        .732     0.500    118.700
      3.300        .778     0.600    159.500
      3.850        .819     0.700    198.400
      4.400        .849     0.801    231.900
      4.950        .866     1.000    252.900
      5.500        .865     1.200    253.000
      8.200        .973     1.500    400.000
     10.200       1.043     2.000    520.000
  END FTABLE  5

  FTABLE       7
*** DM7 & DM8 CONVEYANCE
 ROWS COLS ***
    8    4
***   DEPTH        AREA    VOLUME    OUTFLOW   OUTFLOW2                      ***
       (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
       .000        .000      .000       .000
       .500        .360      .120      6.200
      1.000        .416      .276     20.800
      2.000        .520      .694     75.400
      3.000        .626     1.252    168.700
      4.000        .732     1.950    306.900
      5.000        .836     2.790    496.100
      6.000        .942     3.768    742.300
  END FTABLE  7

  FTABLE       9
*** DM9 CONVEYANCE
 ROWS COLS ***
    8    4
***   DEPTH        AREA    VOLUME    OUTFLOW   OUTFLOW2                      ***
       (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
       .000         .00       0.0         .0
       .500         .20       0.7        9.7
      1.000         .23       3.1       32.6
      2.000         .29      14.9        118
      3.000         .35      38.4        265
      4.000         .41        77        482
      5.000         .47       135        778
      6.000         .52       214       1165
  END FTABLE  9
```

```
  FTABLE      12
*** LOWER WEST BRANCH
*** REVISED BASED ON HEC-RAS MODEL
 ROWS COLS ***
   13    4
***   DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                        ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)     (CFS)
       .000       .000      0.000       .000
       .500       .291      0.030      0.150
      1.000       .346      0.260      6.600
      2.000       .450      0.430     14.100
      3.000       .554      0.650     25.000
      4.000       .656      1.180     50.000
      5.000       .753      2.170     75.000
      6.000       .796      3.820    100.000
      7.000       .837      8.820    150.000
      8.000       .837     16.200    200.000
      9.000       .837     27.920    250.000
     10.000       .837     33.530    350.000
     11.000       .837     35.380    450.000
  END FTABLE 12

  FTABLE      13
*** CONFLUENCE TO 200TH STREET
 ROWS COLS ***
    9    4
***   DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                        ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)     (CFS)
       .000       .000       .000       .000
       .500       .153       .051      4.300
      1.000       .272       .132     14.400
      2.000       .317       .312     50.400
      3.000       .360       .544    109.600
      4.000       .404       .826    195.000
      5.000       .450      1.163    309.500
      6.000       .497      1.548    456.300
      7.000       .542      1.984    638.000
  END FTABLE 13

  FTABLE      14
*** 200TH STREET TO EXECUTEL TRIBUTARY
*** REACH 190 FROM TR-20/KING COUNTY BASIN PLAN MODEL:
 ROWS COLS ***
    5    4
***   DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                        ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)     (CFS)
      0.000      0.000      0.000      0.000
      0.900      0.70      0.4000      30.00
      1.800      0.80      1.1000     115.60
      2.700      1.10      2.1000     269.80
      4.200      1.30      4.3000     707.10
  END FTABLE 14

  FTABLE      17
*** EXECUTEL TRIBUTARY
 ROWS COLS ***
   10    4
***   DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                        ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)     (CFS)
       .000       .000       .000       .000
       .300       .169       .034      2.900
       .600       .192       .076      9.800
       .900       .215       .128     20.400
      1.200       .238       .189     35.100
      1.500       .259       .258     54.100
      1.800       .282       .336     77.700
      2.100       .303       .423    106.200
      3.100       .376       .779    245.000
      3.600       .412       .988    335.000
  END FTABLE 17

  FTABLE      18
*** CONFLUENCE WITH EXECUTEL TRIBUTARY TO 208TH STREET
*** REPRESENTS GW LOSS IN WETLAND BELOW 200TH
 ROWS COLS ***
```

```
   14    5
***  DEPTH        AREA    VOLUME    OUTFLOW   OUTFLOW2                              ***
      (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
      .000       .000       .000       .000       0.00
      .500       .572       .191      7.300       0.00
     1.000       .799       .438     10.000       0.00
     2.000       .968      1.001     20.700       0.00
     3.000      1.155      1.727    100.000       0.00
     4.000      1.317      2.542    262.700       0.00
     5.000      1.478      3.475    400.300       0.00
     6.000      1.643      4.545    570.200       0.00
     7.000      1.791      5.688    774.400       0.00
     8.000      1.932      6.822   1015.100       0.00
     9.000      1.945      7.025   1294.500       0.00
    10.000      1.958      7.244   1614.500       0.00
    11.000      1.970      7.481   1977.000       0.00
    12.000      1.983      7.734   2384.700       0.00
  END FTABLE 18

  FTABLE      34
*** BOW LAKE
*** BASED ON ENTRANCE CONTROL FOR 36 INCH OUTLET PIPE
 ROWS COLS ***
    8    5
***  DEPTH        AREA    VOLUME    OUTFLOW   OUTFLOW2                              ***
      (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
     0.000     14.000      0.000      0.000       0.00
     1.000     14.000     14.000      7.000       0.00
     1.500     14.000     21.000     13.000       0.00
     2.000     14.000     28.000     17.000       0.00
     3.000     14.000     42.000     35.000       0.00
     4.000     14.000     56.000     49.000       0.00
     5.000     14.000     70.000     60.000       0.00
     6.000     14.000     84.000     70.000       0.00
  END FTABLE 34

  FTABLE      35
*** 36" BOW LAKE DISCHARGE PIPELINE (A)
 ROWS COLS ***
   13    4
***  DEPTH        AREA    VOLUME    OUTFLOW   OUTFLOW2                              ***
      (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
      .000       .000       .000       .000
      .300       .020      .0006      1.000
      .600       .026      .0026      4.200
      .900       .032      .0068      9.400
     1.200       .034      .0134     16.200
     1.500       .037      .0226     24.000
     1.800       .039      .0346     32.300
     2.100       .040      .0492     40.100
     2.400       .040      .0667     46.900
     2.700       .039      .0857     51.200
     3.000       .037      .1000     55.300
*** SURCHARGING-
     3.300       .038      .2500     60.300
     4.000       .038      .4000     80.000
  END FTABLE 35

  FTABLE      37
*** 60" INTERNATIONAL BLVD PIPELINE (B)
 ROWS COLS ***
   13    4
***  DEPTH        AREA    VOLUME    OUTFLOW   OUTFLOW2                              ***
      (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
      .000       .000       .000       .000
      .450       .134       .045      4.800
      .900       .190       .100     20.300
     1.350       .225       .150     45.400
     1.800       .249       .200     78.000
     2.250       .266       .250    115.900
     2.700       .271       .300    155.800
     3.150       .264       .350    193.800
     3.600       .251       .400    226.500
     4.050       .238       .450    247.000
     4.500       .234       .500    247.100
     6.500       .185       .600    340.000
```

```
    8.500       .166       .700   415.000
  END FTABLE 37

  FTABLE     38
*** UPPER EAST BRANCH
 ROWS COLS ***
    9    4
***  DEPTH      AREA   VOLUME   OUTFLOW  OUTFLOW2                        ***
      (FT)   (ACRES) (ACRE-FT)    (CFS)     (CFS)
      .000      .000      .000      .000
      .500      .176      .100     9.200
     1.000      .194     0.150    30.400
     2.000      .232     0.200   105.800
     3.000      .271     0.250   228.900
     4.000      .310     0.350   405.800
     5.000      .349     0.450   642.700
     6.000      .387     0.600   945.700
     7.000      .426     0.800  1320.700
  END FTABLE 38

  FTABLE     40
*** TYEE POND
*** BASED ON TYEE POND AS-BUILTS AND AUTOMATED GATE OPERATION MANUAL
*** K RITLAND 2/4/98
*** Inserted by FK to reflect KC comments (03/22/2001)
 ROWS COLS ***
   20    4
***  DEPTH      AREA   VOLUME   OUTFLOW  OUTFLOW2                        ***
      (FT)   (ACRES) (ACRE-FT)    (CFS)     (CFS)
      0.00      0.00      0.00      0.00
      0.90      0.01      0.01     10.00
      1.65      0.02      0.02     20.00
      3.11      0.07      0.07     30.00
      4.56      0.22      0.29     40.00
      6.02      0.63      0.89     50.00
      7.48      0.88      2.02     60.00
      8.62      1.06      3.18     70.00
      9.79      1.18      4.29     80.00
     10.88      1.34      5.83     90.00
     11.99      1.48      7.20    100.00
     13.12      1.69      9.17    110.00
     15.13      2.04     12.90    120.00
     16.10      2.20     14.92    124.10
     16.30      2.24     15.40    129.65
     16.57      2.28     15.88    150.36
     16.64      2.32     16.36    155.00
     16.80      2.36     16.84    208.74
     17.03      2.40     17.32    293.59
     17.26      2.43     17.79    428.11
  END FTABLE 40

  FTABLE     43
*** NORTHWEST PONDS
*** BASED ON KING COUNTY BASIN PLANNING MODEL
 ROWS COLS ***
   17    5
***  DEPTH      AREA   VOLUME   OUTFLOW  OUTFLOW2                        ***
      (FT)   (ACRES) (ACRE-FT)    (CFS)     (CFS)
     0.000    12.000     0.000     0.000     0.00
     0.100    12.000    18.800     0.000     0.00
     1.000    12.000    24.000     0.200     0.00
     2.000    12.000    30.000     0.500     0.00
     3.000    12.000    37.000     1.000     0.00
     3.500    13.000    41.000     5.000     0.00
     4.000    13.000    45.700    15.000     0.00
     4.500    13.000    51.000    35.000     0.00
     5.000    14.000    56.500   150.000     0.00
     5.500    14.000    62.800   200.000     0.00
     6.000    14.000    69.000   300.000     0.00
     6.500    14.000    83.500   350.000     0.00
     7.000    15.000    99.900   400.000     0.00
     8.000    17.000    119.00   500.000     0.00
     9.000    20.000    141.50   550.000     0.00
    10.000    23.000    180.00   600.000     0.00
    11.000    27.000    200.00   650.000     0.00
  END FTABLE 43
```

```
  FTABLE      46
*** EXECUTEL POND
***Inserted by FK to reflect KC comments (03/22/2001)
 ROWS COLS ***
   20    4
***   DEPTH       AREA     VOLUME    OUTFLOW   OUTFLOW2                          ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)
       .000       .000       .000       .000
      1.000       .080       .080     24.420
      2.000       .230       .310     34.540
      3.000       .393       .703     42.300
      3.500       .494       .950     45.690
      4.000       .508      1.204     48.850
      4.500       .532      1.470     51.810
      5.000       .540      1.740     54.610
      5.500       .540      2.010     57.280
      6.000       .580      2.300     59.820
      6.500       .600      2.600     62.270
      7.000       .600      2.900     64.620
      7.500       .600      3.200     66.900
      8.000       .620      3.510     69.100
      8.500       .640      3.830     71.200
      9.000       .740      4.200     82.220
     10.000       .650      4.850    119.830
     11.000       .720      5.570    169.000
     12.000       .750      6.320    250.900
     13.000      1.000      7.320    500.900
  END FTABLE 46

  FTABLE      47
*** EXECUTEL POND DISCHARGE PIPELINE (C)
 ROWS COLS ***
   11    4
***   DEPTH       AREA     VOLUME    OUTFLOW   OUTFLOW2                          ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)
       .000       .000       .000       .000
       .350       .069       .020      4.600
       .700       .096       .056     19.200
      1.050       .112       .099     42.800
      1.400       .124       .150     73.400
      1.750       .125       .203    109.000
      2.100       .121       .240    146.600
      2.450       .110       .264    182.400
      2.800       .096       .284    213.200
      3.150       .090       .290    232.400
      3.500       .088       .293    232.600
  END FTABLE 47

  FTABLE     177
*** NORTH BRANCH RAVINE
 ROWS COLS ***
   14    4
***   DEPTH       AREA     VOLUME    OUTFLOW   OUTFLOW2                          ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)
       .000       .000       .000         .0
       .500       .572       .191        7.3
      1.000       .799       .438       23.2
      2.000       .968      1.001       75.7
      3.000      1.155      1.727      155.1
      4.000      1.317      2.542      262.7
      5.000      1.478      3.475      400.3
      6.000      1.643      4.545      570.2
      7.000      1.791      5.688      774.4
      8.000      1.932      6.822     1015.1
      9.000      1.945      7.025     1294.5
     10.000      1.958      7.244     1614.5
     11.000      1.970      7.481     1977.0
     12.000      1.983      7.734     2384.7
  END FTABLE177

  FTABLE     193
*** UPPER RAVINE
 ROWS COLS ***
   14    4
***   DEPTH       AREA     VOLUME    OUTFLOW   OUTFLOW2
```

```
                                                                            ***
     (FT)     (ACRES)  (ACRE-FT)       (CFS)       (CFS)
     0.00       0.00       0.00          0.0
     0.35       0.72       0.75          7.8
     0.70       0.72       1.51         23.5
     1.05       0.72       2.28         44.3
     1.40       0.72       3.03         68.2
     1.75       0.72       3.81         95.8
     2.10       0.72       4.56        125.2
     2.45       0.75       5.36        169.0
     2.80       0.89       6.30        171.5
     3.15       1.00       7.35        247.6
     3.50       1.08       8.49        332.7
     3.85       1.21       9.75        396.5
     4.20       1.32      11.13        521.2
     4.55       1.41      12.60        655.5
  END FTABLE193

  FTABLE    198
 ROWS COLS ***
*** LOWER RAVINE
*** ROUGH ESTIMATE BASED ON FIELD VISIT OF 12/20/95
*** FLOW WAS 6 TO 7 CFS WITH DEPTH OF 8"
*** NEAR OUTLET.
*** DRIVE WHICH REPRESENTS A RESTRICTION ACCORDING TO OBSERVATION
    8    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2
      (FT)     (ACRES)  (ACRE-FT)     (CFS)     (CFS)                       ***
      0.00       0.00       0.00        0.0
      1.00       0.50       0.80       10.0
      2.00       0.55       1.30       25.0
      3.00       0.60       1.80       50.0
      5.00       0.70       2.50      100.0
*** SUBMERGENCE OF CULVERT
     10.00       2.50      12.00      245.0
*** OVERBANK STORAGE
*** FLOWS BASED ON 243', .03 D-W FACTOR, PLUS LOSS OF 1. VELOCITY HEAD
     15.00      10.00      40.00      325.0
     20.00      11.00      90.00      390.0
  END FTABLE198

END FTABLES

COPY
  TIMESERIES
  Copy-opn                                                                  ***
    # -  #  NPT  NMN                                                        ***
    1   59         1
  END TIMESERIES
END COPY

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGLZERO               PERLND  14  54 EXTNL  PREC
WDM      2 PREC     ENGLZERO               IMPLND  14     EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  34     EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  40     EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  43     EXTNL  PREC
WDM      1 EVAP     ENGLZERO     0.8       PERLND  14 440 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO     0.8       IMPLND  14 140 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO     0.8       RCHRES  34     EXTNL  POTEV
WDM      1 EVAP     ENGLZERO     0.8       RCHRES  43     EXTNL  POTEV
WDM      1 EVAP     ENGLZERO     0.8       RCHRES  40     EXTNL  POTEV
END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
*******************************************************************************
*** SDS
*******************************************************************************
*** SDE-4 (TOTAL)
RCHRES  36 HYDR   RO                       WDM    121 FLOW     ENGL      REPL
*******************************************************************************
*** SDS-1 (TOTAL)
RCHRES  39 HYDR   RO                       WDM    122 FLOW     ENGL      REPL
```

```
********************************************************************************
*** SDS-3
COPY     42 OUTPUT MEAN   1      12.1           WDM    157 FLOW      ENGL       REPL
********************************************************************************
*** SDS-4
COPY     10 OUTPUT MEAN   1      12.1           WDM    158 FLOW      ENGL       REPL
********************************************************************************
*** SDS-3A TAXIWAY VAULT
COPY     20 OUTPUT MEAN   1      12.1           WDM    124 FLOW      ENGL       REPL
********************************************************************************
*** SDS-7 3RD RUNWAY VAULT
COPY      3 OUTPUT MEAN   1      12.1           WDM    126 FLOW      ENGL       REPL
********************************************************************************

*** WEST BRANCH
********************************************************************************
*** NORTHWEST PONDS REACH
RCHRES  43 HYDR   RO                            WDM    131 FLOW      ENGL       REPL
********************************************************************************
*** LOWER WEST BRANCH
RCHRES  12 HYDR   RO                            WDM    135 FLOW      ENGL       REPL
********************************************************************************
*** EVALUATION POINT FOR SDS DISCHARGE TO WEST BRANCH - POC-1
COPY     41 OUTPUT MEAN   1      12.1           WDM    160 FLOW      ENGL       REPL
********************************************************************************
*** EVALUATION POINT FOR SDS DISCHARGE TO WEST BRANCH - POC-2
COPY     4  OUTPUT MEAN   1      12.1           WDM    161 FLOW      ENGL       REPL
********************************************************************************

*** EAST BRANCH
********************************************************************************
*** BOW LAKE OUTFLOW
RCHRES  35 HYDR   RO                            WDM    136 FLOW      ENGL       REPL
RCHRES  37 HYDR   RO                            WDM     47 FLOW      ENGL       REPL
*** SASA POC
COPY     16 OUTPUT MEAN   1      12.1           WDM    438 FLOW      ENGL       REPL

********************************************************************************
*** EXISTING UPPER EAST BRANCH (FUTURE SASA DETENTION SITE)
RCHRES  38 HYDR   RO                            WDM    137 FLOW      ENGL       REPL
********************************************************************************
*** TYEE INFLOW (GAUGE 11C)
RCHRES   5 HYDR   RO                            WDM    138 FLOW      ENGL       REPL
********************************************************************************

*** MAIN STEM
********************************************************************************
*** BELOW CONFLUENCE AT TYEE GOLF COURSE WEIR (GAUGE 11F)
COPY      5 OUTPUT MEAN   1      12.1           WDM    140 FLOW      ENGL       REPL
********************************************************************************
*** BELOW CONFLUENCE AT SOUTH 200TH STREET
RCHRES  13 HYDR   RO                            WDM    141 FLOW      ENGL       REPL
********************************************************************************
*** LOWER DES MOINES CREEK NEAR MOUTH (GAUGE 11D)
RCHRES 198 HYDR   RO                            WDM    142 FLOW      ENGL       REPL
********************************************************************************

END EXT TARGETS
                                                                             ***
NETWORK
***        <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>        <-MEMBER->
<NAME>   # <NAME>   TEM STRG<-FACTOR->STRG <NAME>    #    # <-GRP> <NAME> # # ***
********************************************************************************
*** AIRPORT SUBBASINS
********************************************************************************
*** (DM23) SDE-4
PERLND  16 PWATER SURO         10.389      RCHRES  36       EXTNL  IVOL
PERLND  16 PWATER IFWO         10.389      RCHRES  36       EXTNL  IVOL
PERLND  26 PWATER SURO          2.078      RCHRES  36       EXTNL  IVOL
PERLND  26 PWATER IFWO          2.078      RCHRES  36       EXTNL  IVOL
IMPLND  14 IWATER SURO          1.385      RCHRES  36       EXTNL  IVOL
********************************************************************************
*** (DM24) SDS-1
PERLND  16 PWATER SURO          1.109      RCHRES  39       EXTNL  IVOL
PERLND  16 PWATER IFWO          1.109      RCHRES  39       EXTNL  IVOL
PERLND  26 PWATER SURO          0.222      RCHRES  39       EXTNL  IVOL
```

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PERLND  26 PWATER IFWO          0.222       RCHRES  39      EXTNL  IVOL
IMPLND  14 IWATER SURO          0.148       RCHRES  39      EXTNL  IVOL
***************************************************************************
*** (DM25) SDS-3A
PERLND  16 PWATER SURO          4.361       COPY    20      INPUT  MEAN   1
PERLND  16 PWATER IFWO          4.361       COPY    20      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.872       COPY    20      INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.872       COPY    20      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.581       COPY    20      INPUT  MEAN   1
***************************************************************************
*** (DM25) SDS-7
PERLND  16 PWATER SURO          5.392       COPY     3      INPUT  MEAN   1
PERLND  16 PWATER IFWO          5.392       COPY     3      INPUT  MEAN   1
PERLND  26 PWATER SURO          1.164       COPY     3      INPUT  MEAN   1
PERLND  26 PWATER IFWO          1.164       COPY     3      INPUT  MEAN   1
PERLND  34 PWATER SURO          0.287       COPY     3      INPUT  MEAN   1
PERLND  34 PWATER IFWO          0.287       COPY     3      INPUT  MEAN   1
PERLND  44 PWATER SURO          0.062       COPY     3      INPUT  MEAN   1
PERLND  44 PWATER IFWO          0.062       COPY     3      INPUT  MEAN   1
PERLND  54 PWATER SURO          0.033       COPY     3      INPUT  MEAN   1
PERLND  54 PWATER IFWO          0.033       COPY     3      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.668       COPY     3      INPUT  MEAN   1
***************************************************************************
*** (DM25) SDS-3
PERLND  16 PWATER SURO         21.455       COPY    42      INPUT  MEAN   1
PERLND  16 PWATER IFWO         21.455       COPY    42      INPUT  MEAN   1
PERLND  26 PWATER SURO          4.291       COPY    42      INPUT  MEAN   1
PERLND  26 PWATER IFWO          4.291       COPY    42      INPUT  MEAN   1
IMPLND  14 IWATER SURO          2.861       COPY    42      INPUT  MEAN   1
***************************************************************************
*** (New watershed SDS-6)
PERLND  16 PWATER SURO          1.045       COPY    50      INPUT  MEAN   1
PERLND  16 PWATER IFWO          1.045       COPY    50      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.209       COPY    50      INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.209       COPY    50      INPUT  MEAN   1
PERLND  34 PWATER SURO          *****       COPY    50      INPUT  MEAN   1
PERLND  34 PWATER IFWO          *****       COPY    50      INPUT  MEAN   1
PERLND  44 PWATER SURO          *****       COPY    50      INPUT  MEAN   1
PERLND  44 PWATER IFWO          *****       COPY    50      INPUT  MEAN   1
PERLND  54 PWATER SURO          *****       COPY    50      INPUT  MEAN   1
PERLND  54 PWATER IFWO          *****       COPY    50      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.139       COPY    50      INPUT  MEAN   1
***************************************************************************
*** (New watershed SDS-5)
PERLND  16 PWATER SURO          2.029       COPY    41      INPUT  MEAN   1
PERLND  16 PWATER IFWO          2.029       COPY    41      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.406       COPY    41      INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.406       COPY    41      INPUT  MEAN   1
PERLND  34 PWATER SURO          *****       COPY    41      INPUT  MEAN   1
PERLND  34 PWATER IFWO          *****       COPY    41      INPUT  MEAN   1
PERLND  44 PWATER SURO          *****       COPY    41      INPUT  MEAN   1
PERLND  44 PWATER IFWO          *****       COPY    41      INPUT  MEAN   1
PERLND  54 PWATER SURO          *****       COPY    41      INPUT  MEAN   1
PERLND  54 PWATER IFWO          *****       COPY    41      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.270       COPY    41      INPUT  MEAN   1
***************************************************************************
*** (New watershed SDS-2)
PERLND  16 PWATER SURO          0.225       COPY     4      INPUT  MEAN   1
PERLND  16 PWATER IFWO          0.225       COPY     4      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.045       COPY     4      INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.045       COPY     4      INPUT  MEAN   1
PERLND  34 PWATER SURO          0.315       COPY     4      INPUT  MEAN   1
PERLND  34 PWATER IFWO          0.315       COPY     4      INPUT  MEAN   1
PERLND  44 PWATER SURO          0.063       COPY     4      INPUT  MEAN   1
PERLND  44 PWATER IFWO          0.063       COPY     4      INPUT  MEAN   1
PERLND  54 PWATER SURO          0.043       COPY     4      INPUT  MEAN   1
PERLND  54 PWATER IFWO          0.043       COPY     4      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.072       COPY     4      INPUT  MEAN   1
***************************************************************************

*** (DM27) SDS-4
PERLND  16 PWATER SURO          0.940       COPY    10      INPUT  MEAN   1
PERLND  16 PWATER IFWO          0.940       COPY    10      INPUT  MEAN   1
PERLND  16 PWATER AGWO          0.940       COPY     5      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.188       COPY    10      INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.188       COPY    10      INPUT  MEAN   1
```

```
PERLND  26 PWATER AGWO          0.188      COPY     5     INPUT  MEAN   1
PERLND  34 PWATER SURO          3.095      COPY    10     INPUT  MEAN   1
PERLND  34 PWATER IFWO          3.095      COPY    10     INPUT  MEAN   1
PERLND  34 PWATER AGWO          3.095      COPY     5     INPUT  MEAN   1
PERLND  44 PWATER SURO          0.619      COPY    10     INPUT  MEAN   1
PERLND  44 PWATER IFWO          0.619      COPY    10     INPUT  MEAN   1
PERLND  44 PWATER AGWO          0.619      COPY     5     INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.538      COPY    10     INPUT  MEAN   1
********************************************************************************
*** SASA STORM
PERLND  16 PWATER SURO          2.088      COPY    15     INPUT  MEAN   1
PERLND  16 PWATER IFWO          2.088      COPY    15     INPUT  MEAN   1
PERLND  16 PWATER AGWO          2.088      COPY     5     INPUT  MEAN   1
PERLND  26 PWATER SURO          0.418      COPY    15     INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.418      COPY    15     INPUT  MEAN   1
PERLND  26 PWATER AGWO          0.418      COPY     5     INPUT  MEAN   1
PERLND  34 PWATER SURO          0.020      COPY    15     INPUT  MEAN   1
PERLND  34 PWATER IFWO          0.020      COPY    15     INPUT  MEAN   1
PERLND  34 PWATER AGWO          0.020      COPY     5     INPUT  MEAN   1
PERLND  44 PWATER SURO          0.004      COPY    15     INPUT  MEAN   1
PERLND  44 PWATER IFWO          0.004      COPY    15     INPUT  MEAN   1
PERLND  44 PWATER AGWO          0.004      COPY     5     INPUT  MEAN   1
PERLND  54 PWATER SURO          0.045      COPY    15     INPUT  MEAN   1
PERLND  54 PWATER IFWO          0.045      COPY    15     INPUT  MEAN   1
PERLND  54 PWATER AGWO          0.045      COPY     5     INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.281      COPY    15     INPUT  MEAN   1
********************************************************************************

*** IWS SYSTEM PRIMARY SYSTEM AND PUMP STATIONS
********************************************************************************
*** I-3: NORTH SATELLITE PUMP STATION (NSPS) TO IWS
*** OVERFLOW TO SDE-4
*** INSTALLED IN 1995
PERLND  16 PWATER SURO          0.859      RCHRES 360     EXTNL  IVOL
PERLND  16 PWATER IFWO          0.859      RCHRES 360     EXTNL  IVOL
PERLND  26 PWATER SURO          0.172      RCHRES 360     EXTNL  IVOL
PERLND  26 PWATER IFWO          0.172      RCHRES 360     EXTNL  IVOL
IMPLND  14 IWATER SURO          0.115      RCHRES 360     EXTNL  IVOL
********************************************************************************
********************************************************************************
*** I-5: SOUTH SNOWMELT (OLYMPIC TANK FARM) PUMP STATION TO IWS
*** OVERFLOW TO DES MOINES EAST BRANCH
*** INSTALLED IN LATE 1997/1998
IMPLND  14 IWATER SURO          0.001      RCHRES 366     EXTNL  IVOL
********************************************************************************
********************************************************************************
*** I-7: IWS - PRIMARY
***
PERLND  16 PWATER SURO         15.430      COPY    14     INPUT  MEAN   1
PERLND  16 PWATER IFWO         15.430      COPY    14     INPUT  MEAN   1
PERLND  26 PWATER SURO          3.086      COPY    14     INPUT  MEAN   1
PERLND  26 PWATER IFWO          3.086      COPY    14     INPUT  MEAN   1
IMPLND  14 IWATER SURO          2.057      COPY    14     INPUT  MEAN   1
********************************************************************************
*** SASA IWS
PERLND  16 PWATER SURO          3.163      RCHRES   5     EXTNL  IVOL
PERLND  16 PWATER IFWO          3.163      RCHRES   5     EXTNL  IVOL
PERLND  16 PWATER AGWO          3.163      COPY     5     INPUT  MEAN   1
PERLND  26 PWATER SURO          0.633      RCHRES   5     EXTNL  IVOL
PERLND  26 PWATER IFWO          0.633      RCHRES   5     EXTNL  IVOL
PERLND  26 PWATER AGWO          0.633      COPY     5     INPUT  MEAN   1
PERLND  34 PWATER SURO          0.402      RCHRES   5     EXTNL  IVOL
PERLND  34 PWATER IFWO          0.402      RCHRES   5     EXTNL  IVOL
PERLND  34 PWATER AGWO          0.402      COPY     5     INPUT  MEAN   1
PERLND  44 PWATER SURO          0.080      RCHRES   5     EXTNL  IVOL
PERLND  44 PWATER IFWO          0.080      RCHRES   5     EXTNL  IVOL
PERLND  44 PWATER AGWO          0.080      COPY     5     INPUT  MEAN   1
PERLND  54 PWATER SURO          0.113      RCHRES   5     EXTNL  IVOL
PERLND  54 PWATER IFWO          0.113      RCHRES   5     EXTNL  IVOL
PERLND  54 PWATER AGWO          0.113      COPY     5     INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.475      RCHRES   5     EXTNL  IVOL
********************************************************************************
*** IWS WEST
PERLND  16 PWATER SURO          0.364      RCHRES  43     EXTNL  IVOL
PERLND  16 PWATER IFWO          0.364      RCHRES  43     EXTNL  IVOL
PERLND  26 PWATER SURO          0.104      RCHRES  43     EXTNL  IVOL
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PERLND  26 PWATER IFWO          0.104      RCHRES  43      EXTNL  IVOL
PERLND  34 PWATER SURO          0.384      RCHRES  43      EXTNL  IVOL
PERLND  34 PWATER IFWO          0.384      RCHRES  43      EXTNL  IVOL
PERLND  44 PWATER SURO          0.109      RCHRES  43      EXTNL  IVOL
PERLND  44 PWATER IFWO          0.109      RCHRES  43      EXTNL  IVOL
IMPLND  14 IWATER SURO          0.037      RCHRES  43      EXTNL  IVOL
********************************************************************************

*** EAST BRANCH OF CREEK
********************************************************************************
*** DM1
PERLND  16 PWATER SURO          0.860      RCHRES  34      EXTNL  IVOL
PERLND  16 PWATER IFWO          0.860      RCHRES  34      EXTNL  IVOL
PERLND  16 PWATER AGWO          0.241      RCHRES  34      EXTNL  IVOL
PERLND  26 PWATER SURO         11.078      RCHRES  34      EXTNL  IVOL
PERLND  26 PWATER IFWO         11.078      RCHRES  34      EXTNL  IVOL
PERLND  26 PWATER AGWO          3.101      RCHRES  34      EXTNL  IVOL
PERLND  34 PWATER SURO          0.599      RCHRES  34      EXTNL  IVOL
PERLND  34 PWATER IFWO          0.599      RCHRES  34      EXTNL  IVOL
PERLND  34 PWATER AGWO          0.168      RCHRES  34      EXTNL  IVOL
PERLND  44 PWATER SURO          7.697      RCHRES  34      EXTNL  IVOL
PERLND  44 PWATER IFWO          7.697      RCHRES  34      EXTNL  IVOL
PERLND  44 PWATER AGWO          2.155      RCHRES  34      EXTNL  IVOL
PERLND  54 PWATER SURO          1.176      RCHRES  34      EXTNL  IVOL
PERLND  54 PWATER IFWO          1.176      RCHRES  34      EXTNL  IVOL
PERLND  54 PWATER AGWO          0.329      RCHRES  34      EXTNL  IVOL
IMPLND  14 IWATER SURO         14.274      RCHRES  34      EXTNL  IVOL
********************************************************************************
*** DM2
PERLND  16 PWATER SURO          *****      RCHRES  37      EXTNL  IVOL
PERLND  16 PWATER IFWO          *****      RCHRES  37      EXTNL  IVOL
PERLND  26 PWATER SURO          1.232      RCHRES  37      EXTNL  IVOL
PERLND  26 PWATER IFWO          1.232      RCHRES  37      EXTNL  IVOL
IMPLND  14 IWATER SURO          0.821      RCHRES  37      EXTNL  IVOL
********************************************************************************
*** DM3
PERLND  16 PWATER PERO          3.645      RCHRES   5      EXTNL  IVOL
PERLND  26 PWATER PERO          *****      RCHRES   5      EXTNL  IVOL
PERLND  54 PWATER PERO          0.013      RCHRES   5      EXTNL  IVOL
IMPLND  14 IWATER SURO          5.030      RCHRES   5      EXTNL  IVOL
********************************************************************************
*** DM4
PERLND  16 PWATER PERO          3.165      RCHRES   5      EXTNL  IVOL
PERLND  26 PWATER PERO          0.633      RCHRES   5      EXTNL  IVOL
PERLND  54 PWATER PERO          0.005      RCHRES   5      EXTNL  IVOL
IMPLND  14 IWATER SURO          0.422      RCHRES   5      EXTNL  IVOL
********************************************************************************
*** DM5
PERLND  16 PWATER PERO          1.013      RCHRES   5      EXTNL  IVOL
PERLND  26 PWATER PERO          0.203      RCHRES   5      EXTNL  IVOL
PERLND  34 PWATER PERO          0.210      RCHRES   5      EXTNL  IVOL
PERLND  44 PWATER PERO          0.042      RCHRES   5      EXTNL  IVOL
PERLND  54 PWATER PERO          0.112      RCHRES   5      EXTNL  IVOL
IMPLND  14 IWATER SURO          0.163      RCHRES   5      EXTNL  IVOL
********************************************************************************
*** DM6
PERLND  16 PWATER PERO          0.401      RCHRES  40      EXTNL  IVOL
PERLND  26 PWATER PERO          0.131      RCHRES  40      EXTNL  IVOL
PERLND  34 PWATER PERO          0.538      RCHRES  40      EXTNL  IVOL
PERLND  44 PWATER PERO          0.175      RCHRES  40      EXTNL  IVOL
PERLND  54 PWATER PERO          0.312      RCHRES  40      EXTNL  IVOL
IMPLND  14 IWATER SURO          0.008      RCHRES  40      EXTNL  IVOL
********************************************************************************

*** WEST BRANCH OF CREEK
********************************************************************************
*** DM7
PERLND  16 PWATER SURO          2.190      RCHRES   7      EXTNL  IVOL
PERLND  16 PWATER IFWO          2.190      RCHRES   7      EXTNL  IVOL
PERLND  16 PWATER AGWO          0.788      RCHRES   7      EXTNL  IVOL
PERLND  26 PWATER SURO          2.944      RCHRES   7      EXTNL  IVOL
PERLND  26 PWATER IFWO          2.944      RCHRES   7      EXTNL  IVOL
PERLND  26 PWATER AGWO          1.060      RCHRES   7      EXTNL  IVOL
PERLND  34 PWATER SURO          1.969      RCHRES   7      EXTNL  IVOL
PERLND  34 PWATER IFWO          1.969      RCHRES   7      EXTNL  IVOL
PERLND  34 PWATER AGWO          0.709      RCHRES   7      EXTNL  IVOL
```

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PERLND  44 PWATER SURO           4.142        RCHRES   7        EXTNL  IVOL
PERLND  44 PWATER IFWO           4.142        RCHRES   7        EXTNL  IVOL
PERLND  44 PWATER AGWO           1.491        RCHRES   7        EXTNL  IVOL
PERLND  54 PWATER SURO           0.551        RCHRES   7        EXTNL  IVOL
PERLND  54 PWATER IFWO           0.551        RCHRES   7        EXTNL  IVOL
PERLND  54 PWATER AGWO           0.198        RCHRES   7        EXTNL  IVOL
IMPLND  14 IWATER SURO           2.399        RCHRES   7        EXTNL  IVOL
******************************************************************************
*** DM8
PERLND  16 PWATER SURO           0.203        RCHRES   7        EXTNL  IVOL
PERLND  16 PWATER IFWO           0.203        RCHRES   7        EXTNL  IVOL
PERLND  16 PWATER AGWO           0.077        RCHRES   7        EXTNL  IVOL
PERLND  26 PWATER SURO           0.609        RCHRES   7        EXTNL  IVOL
PERLND  26 PWATER IFWO           0.609        RCHRES   7        EXTNL  IVOL
PERLND  26 PWATER AGWO           0.231        RCHRES   7        EXTNL  IVOL
PERLND  34 PWATER SURO           0.715        RCHRES   7        EXTNL  IVOL
PERLND  34 PWATER IFWO           0.715        RCHRES   7        EXTNL  IVOL
PERLND  34 PWATER AGWO           0.272        RCHRES   7        EXTNL  IVOL
PERLND  44 PWATER SURO           1.132        RCHRES   7        EXTNL  IVOL
PERLND  44 PWATER IFWO           1.132        RCHRES   7        EXTNL  IVOL
PERLND  44 PWATER AGWO           0.430        RCHRES   7        EXTNL  IVOL
PERLND  54 PWATER SURO           0.161        RCHRES   7        EXTNL  IVOL
PERLND  54 PWATER IFWO           0.161        RCHRES   7        EXTNL  IVOL
PERLND  54 PWATER AGWO           0.061        RCHRES   7        EXTNL  IVOL
IMPLND  14 IWATER SURO           2.420        RCHRES   7        EXTNL  IVOL
******************************************************************************
*** DM9
PERLND  16 PWATER SURO           0.002        RCHRES   9        EXTNL  IVOL
PERLND  16 PWATER IFWO           0.002        RCHRES   9        EXTNL  IVOL
PERLND  16 PWATER AGWO           0.001        RCHRES   9        EXTNL  IVOL
PERLND  26 PWATER SURO           1.200        RCHRES   9        EXTNL  IVOL
PERLND  26 PWATER IFWO           1.200        RCHRES   9        EXTNL  IVOL
PERLND  26 PWATER AGWO           0.600        RCHRES   9        EXTNL  IVOL
PERLND  34 PWATER SURO           0.016        RCHRES   9        EXTNL  IVOL
PERLND  34 PWATER IFWO           0.016        RCHRES   9        EXTNL  IVOL
PERLND  34 PWATER AGWO           0.008        RCHRES   9        EXTNL  IVOL
PERLND  44 PWATER SURO           3.040        RCHRES   9        EXTNL  IVOL
PERLND  44 PWATER IFWO           3.040        RCHRES   9        EXTNL  IVOL
PERLND  44 PWATER AGWO           1.520        RCHRES   9        EXTNL  IVOL
PERLND  54 PWATER SURO           0.010        RCHRES   9        EXTNL  IVOL
PERLND  54 PWATER IFWO           0.010        RCHRES   9        EXTNL  IVOL
PERLND  54 PWATER AGWO           0.005        RCHRES   9        EXTNL  IVOL
IMPLND  14 IWATER SURO           0.634        RCHRES   9        EXTNL  IVOL
******************************************************************************
*** DM10
PERLND  16 PWATER PERO           0.944        RCHRES  43        EXTNL  IVOL
PERLND  26 PWATER PERO           0.738        RCHRES  43        EXTNL  IVOL
PERLND  34 PWATER PERO           1.935        RCHRES  43        EXTNL  IVOL
PERLND  44 PWATER PERO           0.510        RCHRES  43        EXTNL  IVOL
PERLND  54 PWATER PERO           0.712        RCHRES  43        EXTNL  IVOL
IMPLND  14 IWATER SURO           0.185        RCHRES  43        EXTNL  IVOL
******************************************************************************
*** DM11
PERLND  16 PWATER PERO           0.321        RCHRES  43        EXTNL  IVOL
PERLND  26 PWATER PERO           0.408        RCHRES  43        EXTNL  IVOL
PERLND  34 PWATER PERO           1.024        RCHRES  43        EXTNL  IVOL
PERLND  44 PWATER PERO           0.467        RCHRES  43        EXTNL  IVOL
PERLND  54 PWATER PERO           1.036        RCHRES  43        EXTNL  IVOL
IMPLND  14 IWATER SURO           2.726        RCHRES  43        EXTNL  IVOL
******************************************************************************
*** DM12
PERLND  16 PWATER PERO           0.510        RCHRES  12        EXTNL  IVOL
PERLND  26 PWATER PERO           0.001        RCHRES  12        EXTNL  IVOL
PERLND  34 PWATER PERO           0.375        RCHRES  12        EXTNL  IVOL
PERLND  44 PWATER PERO           1.740        RCHRES  12        EXTNL  IVOL
PERLND  54 PWATER PERO           0.543        RCHRES  12        EXTNL  IVOL
******************************************************************************
*** DM13
PERLND  16 PWATER PERO           2.822        RCHRES  13        EXTNL  IVOL
PERLND  26 PWATER PERO           0.564        RCHRES  13        EXTNL  IVOL
PERLND  34 PWATER PERO           2.298        RCHRES  13        EXTNL  IVOL
PERLND  44 PWATER PERO           0.460        RCHRES  13        EXTNL  IVOL
PERLND  54 PWATER PERO           0.025        RCHRES  13        EXTNL  IVOL
IMPLND  14 IWATER SURO           0.683        RCHRES  13        EXTNL  IVOL
******************************************************************************
```

```
*** LOWER BASIN
********************************************************************************
*** DM14
PERLND  16 PWATER PERO           0.481      RCHRES  14      EXTNL  IVOL
PERLND  26 PWATER PERO           0.291      RCHRES  14      EXTNL  IVOL
PERLND  34 PWATER PERO           1.940      RCHRES  14      EXTNL  IVOL
PERLND  44 PWATER PERO           1.195      RCHRES  14      EXTNL  IVOL
IMPLND  14 IWATER SURO           0.340      RCHRES  14      EXTNL  IVOL
********************************************************************************

*** EXECUTEL TRIBUTARY
********************************************************************************
*** DM16 INFLOW TO EXECUTEL POND REACH
PERLND  16 PWATER SURO           0.647      RCHRES  46      EXTNL  IVOL
PERLND  16 PWATER IFWO           0.647      RCHRES  46      EXTNL  IVOL
PERLND  16 PWATER AGWO           0.446      RCHRES  46      EXTNL  IVOL
PERLND  26 PWATER SURO           5.573      RCHRES  46      EXTNL  IVOL
PERLND  26 PWATER IFWO           5.573      RCHRES  46      EXTNL  IVOL
PERLND  26 PWATER AGWO           3.846      RCHRES  46      EXTNL  IVOL
PERLND  34 PWATER SURO           0.639      RCHRES  46      EXTNL  IVOL
PERLND  34 PWATER IFWO           0.639      RCHRES  46      EXTNL  IVOL
PERLND  34 PWATER AGWO           0.441      RCHRES  46      EXTNL  IVOL
PERLND  44 PWATER SURO           8.023      RCHRES  46      EXTNL  IVOL
PERLND  44 PWATER IFWO           8.023      RCHRES  46      EXTNL  IVOL
PERLND  44 PWATER AGWO           5.536      RCHRES  46      EXTNL  IVOL
PERLND  54 PWATER SURO           0.183      RCHRES  46      EXTNL  IVOL
PERLND  54 PWATER IFWO           0.183      RCHRES  46      EXTNL  IVOL
PERLND  54 PWATER AGWO           0.126      RCHRES  46      EXTNL  IVOL
IMPLND  14 IWATER SURO           4.249      RCHRES  46      EXTNL  IVOL
********************************************************************************
*** DM17
PERLND  16 PWATER PERO           2.078      RCHRES  17      EXTNL  IVOL
PERLND  26 PWATER PERO           2.261      RCHRES  17      EXTNL  IVOL
PERLND  34 PWATER PERO           3.003      RCHRES  17      EXTNL  IVOL
PERLND  44 PWATER PERO           3.280      RCHRES  17      EXTNL  IVOL
IMPLND  14 IWATER SURO           2.655      RCHRES  17      EXTNL  IVOL
********************************************************************************

*** MAINSTEM RAVINE
********************************************************************************
*** DM18
PERLND  16 PWATER PERO           0.789      RCHRES  18      EXTNL  IVOL
PERLND  26 PWATER PERO           0.277      RCHRES  18      EXTNL  IVOL
PERLND  34 PWATER PERO           3.151      RCHRES  18      EXTNL  IVOL
PERLND  44 PWATER PERO           1.106      RCHRES  18      EXTNL  IVOL
PERLND  54 PWATER PERO           0.300      RCHRES  18      EXTNL  IVOL
IMPLND  14 IWATER SURO           0.296      RCHRES  18      EXTNL  IVOL
********************************************************************************

*** NORTH BRANCH RAVINE
********************************************************************************
*** DM19
PERLND  16 PWATER PERO           0.182      RCHRES 177      EXTNL  IVOL
PERLND  26 PWATER PERO           6.019      RCHRES 177      EXTNL  IVOL
PERLND  34 PWATER PERO           0.167      RCHRES 177      EXTNL  IVOL
PERLND  44 PWATER PERO           5.552      RCHRES 177      EXTNL  IVOL
IMPLND  14 IWATER SURO           2.617      RCHRES 177      EXTNL  IVOL
********************************************************************************
*** DM20
PERLND  16 PWATER PERO           4.007      RCHRES 193      EXTNL  IVOL
PERLND  26 PWATER PERO           6.624      RCHRES 193      EXTNL  IVOL
PERLND  34 PWATER PERO           2.784      RCHRES 193      EXTNL  IVOL
PERLND  44 PWATER PERO           4.602      RCHRES 193      EXTNL  IVOL
PERLND  54 PWATER PERO           0.116      RCHRES 193      EXTNL  IVOL
IMPLND  14 IWATER SURO           3.714      RCHRES 193      EXTNL  IVOL
********************************************************************************

*** LOWER MAINSTEM
********************************************************************************
*** DM21
PERLND  16 PWATER PERO           2.143      RCHRES 198      EXTNL  IVOL
PERLND  26 PWATER PERO           6.306      RCHRES 198      EXTNL  IVOL
PERLND  34 PWATER PERO           1.429      RCHRES 198      EXTNL  IVOL
PERLND  44 PWATER PERO           4.205      RCHRES 198      EXTNL  IVOL
IMPLND  14 IWATER SURO           3.091      RCHRES 198      EXTNL  IVOL
********************************************************************************
```

```
*** DM22
PERLND  16 PWATER PERO          0.391      RCHRES 198     EXTNL  IVOL
PERLND  26 PWATER PERO          4.654      RCHRES 198     EXTNL  IVOL
PERLND  34 PWATER PERO          0.218      RCHRES 198     EXTNL  IVOL
PERLND  44 PWATER PERO          2.620      RCHRES 198     EXTNL  IVOL
PERLND  54 PWATER PERO          0.016      RCHRES 198     EXTNL  IVOL
IMPLND  14 IWATER SURO          1.972      RCHRES 198     EXTNL  IVOL
********************************************************************************

*** NONCONTIGUOUS GROUNDWATER BASINS
********************************************************************************
*** G1
PERLND  16 PWATER AGWO          2.833      RCHRES   5     EXTNL  IVOL
PERLND  26 PWATER AGWO          9.917      RCHRES   5     EXTNL  IVOL
********************************************************************************
*** G2
PERLND  16 PWATER AGWO          0.417      RCHRES 193     EXTNL  IVOL
PERLND  26 PWATER AGWO          1.333      RCHRES 193     EXTNL  IVOL
********************************************************************************
*** G3
PERLND  16 PWATER AGWO          5.083      RCHRES 193     EXTNL  IVOL
PERLND  26 PWATER AGWO         17.667      RCHRES 193     EXTNL  IVOL
PERLND  34 PWATER AGWO          1.167      RCHRES 193     EXTNL  IVOL
PERLND  44 PWATER AGWO          4.250      RCHRES 193     EXTNL  IVOL
********************************************************************************
********************************************************************************

*** CHANNEL NETWORK LINKAGES ***
********************************************************************************

*** DISCHARGE FROM IWS SUBBASINS
********************************************************************************
RCHRES 360 HYDR   ROVOL  1                 RCHRES  36     EXTNL  IVOL
RCHRES 366 HYDR   ROVOL  1                 RCHRES   5     EXTNL  IVOL
********************************************************************************

*** EAST BRANCH OF CREEK
********************************************************************************
RCHRES  34 HYDR   OVOL   1                 RCHRES  35     EXTNL  IVOL
RCHRES  35 HYDR   ROVOL  1                 RCHRES  37     EXTNL  IVOL
RCHRES  36 HYDR   ROVOL  1                 COPY    16     INPUT  MEAN   1
COPY    14 OUTPUT MEAN   1                 COPY    16     INPUT  MEAN   1
COPY    15 OUTPUT MEAN   1                 COPY    16     INPUT  MEAN   1
RCHRES  39 HYDR   ROVOL  1                 COPY    16     INPUT  MEAN   1
RCHRES  37 HYDR   ROVOL  1                 COPY    16     INPUT  MEAN   1
COPY    16 OUTPUT MEAN   1                 RCHRES  38     EXTNL  IVOL
RCHRES  38 HYDR   ROVOL  1                 RCHRES   5     EXTNL  IVOL
RCHRES   5 HYDR   ROVOL  1                 RCHRES  40     EXTNL  IVOL
RCHRES  40 HYDR   ROVOL  1                 COPY     5     INPUT  MEAN   1
********************************************************************************


*** WEST BRANCH OF CREEK
********************************************************************************
COPY    20 OUTPUT MEAN   1                 COPY     9     INPUT  MEAN   1
COPY    42 OUTPUT MEAN   1                 COPY     9     INPUT  MEAN   1
COPY     9 OUTPUT MEAN   1                 RCHRES   4     EXTNL  IVOL
RCHRES   4 HYDR   ROVOL  1                 COPY    41     INPUT  MEAN   1
COPY    50 OUTPUT MEAN   1                 COPY     4     INPUT  MEAN   1
COPY     3 OUTPUT MEAN   1                 COPY     4     INPUT  MEAN   1
RCHRES   7 HYDR   ROVOL  1                 COPY     4     INPUT  MEAN   1
RCHRES   9 HYDR   ROVOL  1                 COPY     4     INPUT  MEAN   1
COPY     4 OUTPUT MEAN   1                 RCHRES  43     EXTNL  IVOL
COPY    41 OUTPUT MEAN   1                 RCHRES  43     EXTNL  IVOL
RCHRES  43 HYDR   ROVOL  1                 RCHRES  12     EXTNL  IVOL
COPY    10 OUTPUT MEAN   1                 COPY     5     INPUT  MEAN   1
RCHRES  12 HYDR   ROVOL  1                 COPY     5     INPUT  MEAN   1
********************************************************************************

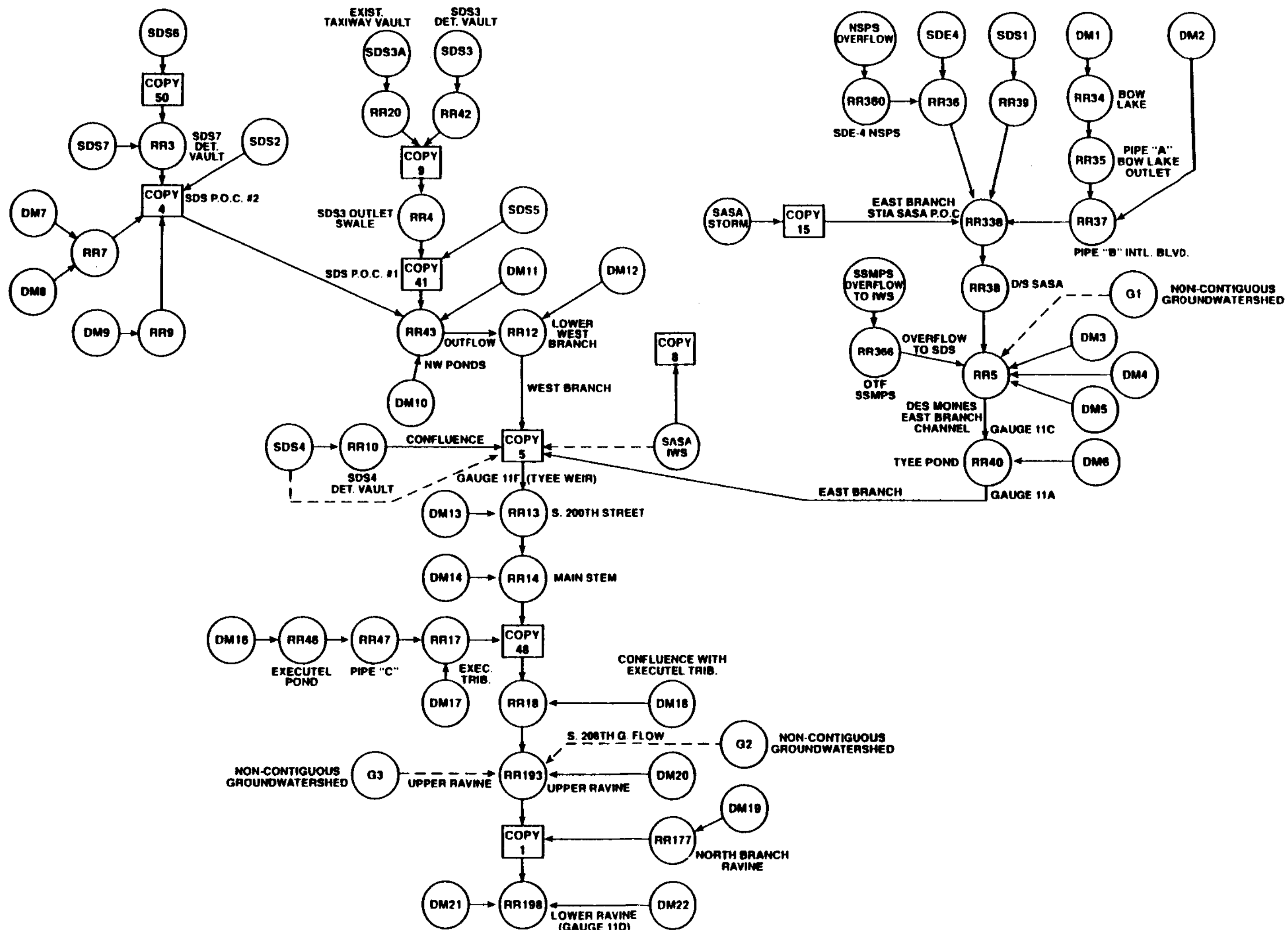
*** MAINSTEM BELOW CONFLUENCE OF E. AND W. BRANCH
********************************************************************************
*** MAINSTEM ABOVE EXECUTEL TRIBUTARY
COPY     5 OUTPUT MEAN   1                 RCHRES  13     EXTNL  IVOL
RCHRES  13 HYDR   ROVOL  1                 RCHRES  14     EXTNL  IVOL
RCHRES  14 HYDR   ROVOL  1                 COPY    48     INPUT  MEAN   1
********************************************************************************
```

```
*** EXECUTEL TRIBUTARY
RCHRES  46 HYDR   ROVOL  1                    RCHRES  47     EXTNL  IVOL
RCHRES  47 HYDR   ROVOL  1                    RCHRES  17     EXTNL  IVOL
RCHRES  17 HYDR   ROVOL  1                    COPY    48     INPUT  MEAN   1
********************************************************************************
*** MAINSTEM FROM HEAD OF RAVINE TO NORTH BRANCH CONFLUENCE
COPY    48 OUTPUT MEAN   1                    RCHRES  18     EXTNL  IVOL
RCHRES  18 HYDR   ROVOL  1                    RCHRES 193     EXTNL  IVOL
RCHRES 193 HYDR   ROVOL  1                    COPY     1     INPUT  MEAN   1
********************************************************************************
*** NORTH BRANCH RAVINE TO MAINSTEM
RCHRES 177 HYDR   ROVOL  1                    COPY     1     INPUT  MEAN   1
********************************************************************************
*** MAINSTEM FROM NORTH BRANCH CONFLUENCE TO PARK BELOW MVD CULVERT
COPY     1 OUTPUT MEAN   1                    RCHRES 198     EXTNL  IVOL
********************************************************************************

END NETWORK

END RUN
```

2006 CONDITIONS



July 2001
556 2912 001 (28)

Parametrix, Inc. Port of Seattle/HSPF Model 556 2912 001 01(028) 12:00 (K)

→ Stormwater	DM# = Des Moines Creek Subbasin Number
-·-·→ IWS	SDS# = Storm Drainage South Number
- - -→ Groundwater	SDE# = Storm Drainage East Number
	R# = Routing Reach Number (Channel or Storage Pond)

DM1 – Subbasin ID
RR12 – Routing Reach Number

COPY 8 – Summation of upstream flow

Figure 2
Des Moines Creek
HSPF Model Schematic
2006 Conditions

AR 046959

```
RUN
GLOBAL
  ***  FILE: DM06R6M.INP (MODIFY DM06.INP)
  ***  HSPF MODEL OF DES MOINES CREEK
  ***  2006 CONDITIONS (SDS2,5,6 removed: SDS6,SDS7,SDS2 drain west..
  ***  Modified to include King County comments, April 2001
  ***  SDS5 drains with SDS3A and SDS3 east)
  ***  WITH NORTHWEST PONDS RDF (1994 NW PONDS CONFIGURATION)
  ***  TYEE POND NOT REMOVED
  ***  LEVEL 2 DETENTION FOR STIA
  ***  SASA RETROFIT FOR STIA & NONSTIA UPSTREAM WATERSHED
  ***  EXISTING SDS3A VAULT FTAB (JD)
  ***  ELIMINATE IWS SYSTEM COMPONENTS NOT ROUTED TO SDS
  ***  REVISIONS TO SUBBASIN 2,5,6 ROUTING
  DES MOINES CREEK BASIN HSPF MODEL
  START       1948/10/01 00:00  END    1996/09/30 24:00
  START       1992/01/01 00:00  END    1996/09/30 24:00***
  RUN INTERP OUTPUT LEVEL    0
  RESUME     0 RUN     1
END GLOBAL

FILES
MESSU      24   DM06.MES
WDM        25   DM.WDM
END FILES

OPN SEQUENCE
    INGRP              INDELT 01:00
      PERLND     16
      PERLND     26
      PERLND     34
      PERLND     44
      PERLND     45
      PERLND     54
      IMPLND     14
      RCHRES    360
      RCHRES     36
      RCHRES     39
      RCHRES     20
      RCHRES     42
      COPY        9
      RCHRES      4
      COPY       41
      RCHRES     10
      RCHRES    366
      COPY        8
      COPY       50
      RCHRES      3
      RCHRES      7
      RCHRES      9
      COPY        4
      RCHRES     43
      COPY       15
      RCHRES     34
      RCHRES     35
      RCHRES     37
      RCHRES    338
      RCHRES     38
      RCHRES      5
      RCHRES     40
      RCHRES     12
      COPY        5
      RCHRES     13
      RCHRES     14
      RCHRES    177
      RCHRES     46
      RCHRES     47
      RCHRES     17
      COPY       48
      RCHRES     18
      RCHRES    193
      COPY        1
      RCHRES    198
    END INGRP
END OPN SEQUENCE
```

```
PERLND
  GEN-INFO                                                                        ***
    <PLS >        Name           NBLKS   Unit-systems   Printer                   ***
    # -  #                               User  t-series Engl Metr                 ***
                                               in   out
   16       TFM- TILL FOR MOD        1     1     1     1    60    0
   26       TGM- TILL GR MOD         1     1     1     1    60    0
   34       OF - OUTWASH FOR         1     1     1     1    60    0
   44       OG - OUTWASH GR          1     1     1     1    60    0
   45       AF - AIRPORT FILL        1     1     1     1    60    0
   54       SA - WETLANDS            1     1     1     1    60    0
  END GEN-INFO
  ACTIVITY
    <PLS > ************* Active Sections *****************************            ***
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC
   14   54    0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    <PLS > ******************** Print-flags *************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
   14   54    0    0    6    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  PWAT-PARM1
    <PLS > **************** Flags *******************                              ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE
   14   54    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS > ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16                   4.5000    0.2000    200.00    0.1000    0.5000    0.9960
   26                   4.5000    0.0750    400.00    0.1000    0.5000    0.9960
   34                   5.0000    2.0000    200.00    0.0500    0.3000    0.9960
   44                   5.0000    0.8000    200.00    0.0500    0.3000    0.9960
   45                   7.5000    0.0200    300.00    0.0700    0.0000    0.9960
   54                   4.0000    2.0000    200.00    0.0010    0.5000    0.9960
  END PWAT-PARM2
  PWAT-PARM3
    <PLS >***
    # -  #*** PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16                             2.0000    2.0000      0.55      0.00       0.0
   26                             2.0000    2.0000      0.55      0.00       0.0
   34                             2.0000    2.0000      0.55      0.00       0.0
   44                             2.0000    2.0000      0.55      0.00       0.0
   45                             2.0000    2.0000      0.55      0.00       0.0
   54                             10.000    2.0000      0.55      0.00       0.7
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >                                                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP***
   16         0.2000    0.5000    0.3500     3.000    0.5000    0.7000
   26         0.1000    0.2500    0.2500     3.000    0.5000    0.2500
   34         0.2000    0.5000    0.3500     0.000    0.7000    0.7000
   44         0.1000    0.5000    0.2500     0.000    0.7000    0.2500
   45         0.1000    0.2800    0.2500     6.000    0.1500    0.6000
   54         0.2000    3.0000    0.5000     1.000    0.7000    0.8000
  END PWAT-PARM4
  PWAT-STATE1
    <PLS >  PWATER state variables***
    # -  #***   CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16          0.078        0.    0.0010        0.     0.075     0.267     0.026
   26          0.051        0.    0.0350        0.     1.928     0.680     0.049
   34          0.078        0.    0.0010        0.     0.090     0.676     0.038
   44          0.051        0.    0.0040        0.     1.127     0.614     0.152
   45          0.051        0.    0.0200        0.     1.528     0.647     0.101
   54          0.051        0.    0.3330        0.     0.622     0.000     0.000
  END PWAT-STATE1
END PERLND

IMPLND
  GEN-INFO
    <ILS >        Name             Unit-systems   Printer                         ***
    # -  #                       User  t-series Engl Metr                         ***
                                         in   out                                 ***
   13  140 IMPERVIOUS              1     1     1    60    0
```

```
  END GEN-INFO
  ACTIVITY
    <ILS > ************* Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL  ***
   13  140    0    0    1    0    0    0
  END ACTIVITY
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
   13  140    0    0    6    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1                                                          ***
    <ILS >             Flags             ***                          ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
   13  140    0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2                                                          ***
    <ILS >
    # -  #       LSUR     SLSUR      NSUR     RETSC ***
   14           500.0    0.0100    0.1000     0.100
  140          100.00    0.0500    0.1000    0.0500
  END IWAT-PARM2
  IWAT-PARM3                                                          ***
    <ILS >                                                            ***
    # -  #     PETMAX    PETMIN
   13  140
  END IWAT-PARM3
  IWAT-STATE1                                                         ***
    <ILS >  IWATER state variables                                    ***
    # -  #       RETS      SURS
   13  140 1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND

RCHRES
  GEN-INFO                                                            ***
    RCHRES       Name          Nexits   Unit Systems   Printer        ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG     ***
                                             in  out
     3     SDS-7 Det. Vault          1    1    1    1    0    0    0
     4     SDS-3 Outlet Swale        1    1    1    1    0    0    0
     5     E.Branch above TyeeP      1    1    1    1    0    0    0
     7     DM7 & DM8 Conveyance      1    1    1    1    0    0    0
     9     DM9 Conveyance            1    1    1    1    0    0    0
    10     SDS-4 Det. Vault          1    1    1    1    0    0    0
    12     Lower W. Branch           1    1    1    1    0    0    0
    13     Confl. to 200th St.       1    1    1    1    0    0    0
    14     200th to Exec. Trib.      1    1    1    1    0    0    0
    17     Executel Tributary        1    1    1    1    0    0    0
    18     Exec.Confl. to 208th      2    1    1    1    0    0    0
    20     SDS-3A Det. Vault         1    1    1    1    0    0    0
    34     Bow Lake                  2    1    1    1    0    0    1
    35     Pipe A Bow LK Outlet      1    1    1    1    0    0    0
    36     SDE-4 Combined Disch      1    1    1    1    0    0    0
    37     Pipe B 60" Intl Blvd      1    1    1    1    0    0    0
    38     D/S SASA                  1    1    1    1    0    0    0
    39     SDS-1 Storm Only          1    1    1    1    0    0    0
    40     Tyee Pond                 1    1    1    1    0    0    0
    42     SDS-3 Det. Vault          1    1    1    1    0    0    0
    43     NW Ponds                  2    1    1    1    0    0    1
    46     Executel Pond             1    1    1    1    0    0    0
    47     Pipe C Exec.Pond Dis      1    1    1    1    0    0    0
   177     North Branch Ravine       1    1    1    1    0    0    0
   193     Upper Ravine              1    1    1    1    0    0    0
   198     Lower Ravine              1    1    1    1    0    0    0
   338     E.BR. STIA SASA POC       1    1    1    1    0    0    0
   360     SDE-4 NSPS                2    1    1    1    0    0    0
   366     OTF   SSMPS               2    1    1    1    0    0    0
  END GEN-INFO

  ACTIVITY
    RCHRES *************** Active Sections ****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG              ***
    1  366    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
```

```
  RCHRES *************** Printout Flags ****************** PIVL  PYR
  # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
  1  366    6    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO
HYDR-PARM1                                                                ***
  RCHRES  Flags for each HYDR Section
  # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each      FUNCT  for each
          FG FG FG FG  possible  exit  *** possible  exit       possible  exit
          *  *  *  *   *  *  *  *  *       *  *  *  *  *           ***
  3   17  0  1  1  0   4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
 18       0  1  1  0   4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
 20       0  1  1  0   4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
 34       0  1  1  0   4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
 35   40  0  1  1  0   4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
 42       0  1  1  0   4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
 43       0  1  1  0   4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
 46  338  0  1  1  0   4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
360  366  0  1  1  0   4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
END HYDR-PARM1

HYDR-PARM2                                                                ***
  RCHRES                                                                  ***
  # -  #     FTABNO       LEN     DELTH     STCOR        KS      DB50     ***
<------><--------><--------><--------><--------><--------><-------->
  3              3  0.071                                 0.3
  4              4  0.530                                 0.3
  5              5  0.380                                 0.3
  7              7  0.341                                 0.3
  9              9  0.189                                 0.3
 10             10  0.071                                 0.3
 12             12  0.273                                 0.3
 13             13  0.218                                 0.3
 14             14  0.218                                 0.3
 17             17  0.246                                 0.3
 18             18  0.303                                 0.3
 20             20  0.071                                 0.3
 34             34  0.208                                 0.3
 35             35  0.123                                 0.3
 36             36  0.100                                 0.3
 37             37  0.381                                 0.3
 38             38  0.142                                 0.3
 39             39  0.100                                 0.3
 40             40  0.189                                 0.3
 42             42  0.071                                 0.3
 43             43  0.189                                 0.3
 46             46  0.047                                 0.3
 47             47  0.417                                 0.3
177            177  0.407                                 0.3
193            193  0.795                                 0.3
198            198  0.631                                 0.3
338            338  0.010                                 0.3
360            360  0.010                                 0.0
366            366  0.010                                 0.0
END HYDR-PARM2

HYDR-INIT
  RCHRES  Initial conditions for each HYDR section                        ***
  # -  # ***   VOL   Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft   for each possible exit        for each possible exit
<------><-------->   <---><---><---><---><---> *** <---><---><---><---><--->
  3      0.1            4.0
  4      0.1            4.0
  5      0.1            4.0
  7      0.1            4.0
  9      0.1            4.0
 10      0.1            4.0
 12      0.1            4.0
 13      0.1            4.0
 14      0.1            4.0
 17      0.1            4.0
 18      0.1            4.0  5.0
 20      0.1            4.0
 34      35.            4.0  5.0
 35      0.0            4.0
 36      0.0            4.0
 37      0.0            4.0
```

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   38     0.0              4.0
   39     0.0              4.0
   40     0.0              4.0
   42     0.1              4.0
   43     0.7              4.0  5.0
   46     0.0              4.0
   47     0.0              4.0
  177     0.0              4.0
  193     0.0              4.0
  198     0.0              4.0
  338     0.0              4.0
  360     0.0              4.0  5.0
  366     0.0              4.0  5.0
  END HYDR-INIT
END RCHRES

FTABLES
  FTABLE      3

*** SDS-7 DETENTION VAULT   20 FT DEPTH 36-in riser diam.+3 orifices
***SDS-7 DET. VAULT accepts runoff from SDS-6 and SDS-7
 ROWS COLS ***
   23    4
     DEPTH      AREA     VOLUME    OUTFLOW                                   ***
      (FT)    (ACRES)  (ACRE-FT)    (CFS)                                    ***
      0.00     1.079      0.00      0.00
      1.72     1.079      1.86      0.53
      7.30     1.079      7.87      1.10
     14.28     1.079     15.40      1.54
     14.50     1.079     15.64      1.55
     14.59     1.079     15.74      1.58
     15.34     1.079     16.55      2.10
     17.20     1.079     18.55      2.59
     17.50     1.079     18.88      2.66
     17.55     1.079     18.93      2.67
     17.69     1.079     19.08      2.79
     17.83     1.079     19.23      2.99
     18.25     1.079     19.69      3.28
     18.69     1.079     20.16      3.94
     19.13     1.079     20.64      4.73
     19.56     1.079     21.10      5.53
     20.00     1.079     21.57      6.61
     20.10     1.079     21.68      7.57
     20.20     1.079     21.79      9.29
     20.30     1.079     21.90     11.51
     21.00     1.079     22.65     36.14
     21.30     1.079     22.98     45.82
     21.90     1.079     23.62     54.10
  END FTABLE  3


  FTABLE      4
*** SDS-3 OUTLET SWALE
 ROWS COLS ***
    7    4
***   DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2
       (FT)     (ACRES)  (ACRE-FT)    (CFS)     (CFS)                        ***
       .000       .000       0.0       0.0
       .500       .198       0.1       9.0
      1.000       .236       0.5      30.9
      2.000       .306       1.0     115.8
      3.000       .376       1.5     265.5
      4.000       .446       5.0     491.8
      5.000       .517      20.0     806.3
  END FTABLE  4

  FTABLE      5
*** EAST BRANCH ABOVE TYEE POND
 ROWS COLS ***
   13    4
***   DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2
       (FT)     (ACRES)  (ACRE-FT)    (CFS)     (CFS)                        ***
      0.000       .000      .000      .000
      0.550       .290      .100     4.900
      1.100       .543      .200    20.800
      1.650       .609      .300    46.500
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    2.200       .671       .400    80.000
    2.750       .732      0.500   118.700
    3.300       .778      0.600   159.500
    3.850       .819      0.700   198.400
    4.400       .849      0.801   231.900
    4.950       .866      1.000   252.900
    5.500       .865      1.200   253.000
    8.200       .973      1.500   400.000
   10.200      1.043      2.000   520.000
  END FTABLE  5

  FTABLE      7
*** DM7 & DM8 CONVEYANCE
 ROWS COLS ***
    8    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                        ***
      (FT)    (ACRES)  (ACRE-FT)      (CFS)     (CFS)
      .000       .000       .000       .000
      .500       .360       .120      6.200
     1.000       .416       .276     20.800
     2.000       .520       .694     75.400
     3.000       .626      1.252    168.700
     4.000       .732      1.950    306.900
     5.000       .836      2.790    496.100
     6.000       .942      3.768    742.300
  END FTABLE  7

  FTABLE      9
*** DM9 CONVEYANCE
 ROWS COLS ***
    8    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                        ***
      (FT)    (ACRES)  (ACRE-FT)      (CFS)     (CFS)
      .000        .00        0.0         .0
      .500        .20        0.7        9.7
     1.000        .23        3.1       32.6
     2.000        .29       14.9        118
     3.000        .35       38.4        265
     4.000        .41         77        482
     5.000        .47        135        778
     6.000        .52        214       1165
  END FTABLE  9

  FTABLE     10
*** SDS-4 DETENTION VAULT  15 FT DEPTH 10-IN RISER DIA
 ROWS COLS ***
   18    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
      0.00       0.87       0.00       0.00
      0.54       0.87      0.471      0.180
      1.72       0.87      1.501      0.320
      2.60       0.87      2.270      0.394
      3.49       0.87      3.047      0.456
      5.25       0.87      4.583      0.559
      7.60       0.87      6.634      0.673
      8.19       0.87      7.149      0.699
      8.78       0.87      7.664      0.723
      9.37       0.87      8.179      0.747
      9.96       0.87      8.694      0.770
     10.54       0.87      9.201      0.793
     12.21       0.87     10.659      1.220
     14.55       0.87     12.701      2.240
     15.00       0.87     13.094      2.390
     15.10       0.87     13.181      2.670
     15.50       0.87     13.530      4.390
     16.80       0.80     14.665      6.400
  END FTABLE 10

  FTABLE     12
*** LOWER WEST BRANCH
*** REVISED BASED ON HEC-RAS MODEL
 ROWS COLS ***
   13    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                        ***
      (FT)    (ACRES)  (ACRE-FT)      (CFS)     (CFS)
      .000       .000      0.000       .000
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       .500        .291      0.030      0.150
      1.000        .346      0.260      6.600
      2.000        .450      0.430     14.100
      3.000        .554      0.650     25.000
      4.000        .656      1.180     50.000
      5.000        .753      2.170     75.000
      6.000        .796      3.820    100.000
      7.000        .837      8.820    150.000
      8.000        .837     16.200    200.000
      9.000        .837     27.920    250.000
     10.000        .837     33.530    350.000
     11.000        .837     35.380    450.000
  END FTABLE 12

  FTABLE       13
*** CONFLUENCE TO 200TH STREET
 ROWS COLS ***
    9    4
***   DEPTH       AREA    VOLUME    OUTFLOW   OUTFLOW2                              ***
       (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
       .000        .000       .000       .000
       .500        .153       .051      4.300
      1.000        .272       .132     14.400
      2.000        .317       .312     50.400
      3.000        .360       .544    109.600
      4.000        .404       .826    195.000
      5.000        .450      1.163    309.500
      6.000        .497      1.548    456.300
      7.000        .542      1.984    638.000
  END FTABLE 13

  FTABLE       14
*** 200TH STREET TO EXECUTEL TRIBUTARY
*** REACH 190 FROM TR-20/KING COUNTY BASIN PLAN MODEL:
 ROWS COLS ***
    5    4
***   DEPTH       AREA    VOLUME    OUTFLOW   OUTFLOW2                              ***
       (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
      0.000      0.000      0.000      0.000
      0.900      0.70       0.4000     30.00
      1.800      0.80       1.1000    115.60
      2.700      1.10       2.1000    269.80
      4.200      1.30       4.3000    707.10
  END FTABLE 14

  FTABLE       17
*** EXECUTEL TRIBUTARY
 ROWS COLS ***
   10    4
***   DEPTH       AREA    VOLUME    OUTFLOW   OUTFLOW2                              ***
       (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
       .000        .000       .000       .000
       .300        .169       .034      2.900
       .600        .192       .076      9.800
       .900        .215       .128     20.400
      1.200        .238       .189     35.100
      1.500        .259       .258     54.100
      1.800        .282       .336     77.700
      2.100        .303       .423    106.200
      3.100        .376       .779    245.000
      3.600        .412       .988    335.000
  END FTABLE 17

  FTABLE       18
*** CONFLUENCE WITH EXECUTEL TRIBUTARY TO 208TH STREET
*** REPRESENTS GW LOSS IN WETLAND BELOW 200TH
 ROWS COLS ***
   14    5
***   DEPTH       AREA    VOLUME    OUTFLOW   OUTFLOW2                              ***
       (FT)     (ACRES)  (ACRE-FT)     (CFS)      (CFS)
       .000        .000       .000       .000       0.00
       .500        .572       .191      7.300       0.00
      1.000        .799       .438     10.000       0.00
      2.000        .968      1.001     20.700       0.00
      3.000       1.155      1.727    100.000       0.00
      4.000       1.317      2.542    262.700       0.00
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    5.000      1.478      3.475   400.300        0.00
    6.000      1.643      4.545   570.200        0.00
    7.000      1.791      5.688   774.400        0.00
    8.000      1.932      6.822  1015.100        0.00
    9.000      1.945      7.025  1294.500        0.00
   10.000      1.958      7.244  1614.500        0.00
   11.000      1.970      7.481  1977.000        0.00
   12.000      1.983      7.734  2384.700        0.00
  END FTABLE 18

  FTABLE      20
*** SDS-3A EXISTING TAXIWAY DETENTION VAULT  EFFECTIVE DEPTH=7.94 FT 36-IN RISER
 ROWS COLS ***
   14    4
     DEPTH      AREA    VOLUME   OUTFLOW                                     ***
      (FT)   (ACRES)  (ACRE-FT)    (CFS)                                     ***
      0.00      0.69      0.00      0.00
      1.06      0.69      0.73      1.09
      2.00      0.69      1.38      1.50
      3.08      0.69      2.12      1.86
      4.00      0.69      2.77      2.12
      5.10      0.69      3.51      2.39
      5.70      0.69      3.93      2.53
      6.24      0.69      4.30      4.47
      7.05      0.69      4.86      9.28
      7.58      0.69      5.22     12.80
      7.94      0.69      5.47     15.07
      8.54      0.69      5.88     28.76
      9.04      0.69      6.23     48.98
      9.54      0.69      6.57     58.41
  END FTABLE 20

  FTABLE      34
*** BOW LAKE
*** BASED ON ENTRANCE CONTROL FOR 36 INCH OUTLET PIPE
 ROWS COLS ***
    8    5
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                           ***
      (FT)   (ACRES)  (ACRE-FT)    (CFS)     (CFS)
     0.000    14.000     0.000     0.000      0.00
     1.000    14.000    14.000     7.000      0.00
     1.500    14.000    21.000    13.000      0.00
     2.000    14.000    28.000    17.000      0.00
     3.000    14.000    42.000    35.000      0.00
     4.000    14.000    56.000    49.000      0.00
     5.000    14.000    70.000    60.000      0.00
     6.000    14.000    84.000    70.000      0.00
  END FTABLE 34

  FTABLE      35
*** 36" BOW LAKE DISCHARGE PIPELINE (A)
 ROWS COLS ***
   13    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                           ***
      (FT)   (ACRES)  (ACRE-FT)    (CFS)     (CFS)
      .000      .000      .000      .000
      .300      .020     .0006     1.000
      .600      .026     .0026     4.200
      .900      .032     .0068     9.400
     1.200      .034     .0134    16.200
     1.500      .037     .0226    24.000
     1.800      .039     .0346    32.300
     2.100      .040     .0492    40.100
     2.400      .040     .0667    46.900
     2.700      .039     .0857    51.200
     3.000      .037     .1000    55.300
*** SURCHARGING-
     3.300      .038     .2500    60.300
     4.000      .038     .4000    80.000
  END FTABLE 35

  FTABLE      36
*** SDE-4 COMBINED DISCHARGE
 ROWS COLS ***
   11    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2
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                                                                                              ***
     (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)
     .000      .000      .000        .000
     .400      .343     0.090       2.200
     .800      .442     0.150       9.500
    1.200      .523     0.200      21.100
    1.600      .577     0.250      36.300
    2.000      .618     0.300      54.000
    2.400      .646     0.350      72.500
    2.800      .659     0.400      90.200
    3.200      .662     0.450     105.500
    3.600      .649     0.550     115.000
    4.000      .618     0.650     115.100
  END FTABLE 36

  FTABLE      37
*** 60" INTERNATIONAL BLVD PIPELINE (B)
 ROWS COLS ***
   13    4
***  DEPTH      AREA    VOLUME    OUTFLOW  OUTFLOW2                                           ***
     (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)
     .000      .000      .000        .000
     .450      .134      .045       4.800
     .900      .190      .100      20.300
    1.350      .225      .150      45.400
    1.800      .249      .200      78.000
    2.250      .266      .250     115.900
    2.700      .271      .300     155.800
    3.150      .264      .350     193.800
    3.600      .251      .400     226.500
    4.050      .238      .450     247.000
    4.500      .234      .500     247.100
    6.500      .185      .600     340.000
    8.500      .166      .700     415.000
  END FTABLE 37

  FTABLE     238
  *** STIA FLOW COMBINED (NOT USED)
 ROWS COLS ***
    5    4
    DEPTH      AREA    VOLUME    OUTFLOW  ***
    0.000    0.0010    0.0000       0.00
    0.000    0.0100    0.0100      10.00
    0.100    0.1000    0.1000     100.00
    1.000    1.0000    1.0000    1000.00
   10.000   10.0000   10.0000   10000.00
  END FTABLE238

  FTABLE     338
*** SASA DETENTION FACILITY RETROFIT SIZE ***
 ROWS COLS ***                             EFFECTIVE DEPTH=14 FT
   14    4
    DEPTH      AREA    VOLUME      DISCH             ***
     (FT)    (ACRES)   (AC-FT)     (CFS)             ***
     0.00     0.000      0.00       0.00
     1.31     2.802     3.620      13.70
     2.30     2.881     6.472      18.14
     3.40     2.983     9.761      22.05
     4.22     3.043    12.296      24.57
     5.32     3.151    15.809      27.59
     6.14     3.233    18.514      29.65
     7.13     3.326    21.878      33.26
     8.05     3.426    25.103      38.80
    10.10     3.608    32.636      56.04
    11.20     3.699    36.880      76.55
    12.29     4.053    41.227      99.16
    13.12     4.154    44.633     116.70
    14.40     4.311    50.050     144.31
  END FTABLE338

  FTABLE      39
*** SDS-1 DISCHARGE
 ROWS COLS ***
   11    4
***  DEPTH      AREA    VOLUME    OUTFLOW  OUTFLOW2                                           ***
     (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)
     .000      .000      .000        .000
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```
      .250       .020       .030      2.200
      .500       .027       .035      9.400
      .750       .031       .042     21.000
     1.000       .035       .049     36.000
     1.250       .039      0.056     53.600
     1.500       .039      0.064     72.000
     1.750       .041      0.074     89.500
     2.000       .041      0.084    104.700
     2.250       .041      0.094    114.200
     2.500       .038      0.100    114.300
  END FTABLE 39

  FTABLE     40
*** TYEE POND
*** BASED ON TYEE POND AS-BUILTS AND AUTOMATED GATE OPERATION MANUAL
*** K RITLAND 2/4/98
 ROWS COLS ***
   20    4
***  DEPTH      AREA    VOLUME    OUTFLOW  OUTFLOW2                           ***
      (FT)   (ACRES) (ACRE-FT)      (CFS)     (CFS)
      0.00      0.00      0.00      0.00
      0.90      0.01      0.01     10.00
      1.65      0.02      0.02     20.00
      3.11      0.07      0.07     30.00
      4.56      0.22      0.29     40.00
      6.02      0.63      0.89     50.00
      7.48      0.88      2.02     60.00
      8.62      1.06      3.18     70.00
      9.79      1.18      4.29     80.00
     10.88      1.34      5.83     90.00
     11.99      1.48      7.20    100.00
     13.12      1.69      9.17    110.00
     15.13      2.04     12.90    120.00
     16.10      2.20     14.92    124.10
     16.30      2.24     15.40    129.65
     16.57      2.28     15.88    150.36
     16.64      2.32     16.36    155.00
     16.80      2.36     16.84    208.74
     17.03      2.40     17.32    293.59
     17.26      2.43     17.79    428.11
  END FTABLE 40

  FTABLE     42
*** SDS-3 DETENTION VAULT EFFECTIVE DEPTH = 20.0 FT
 ROWS COLS ***
   17    4
     DEPTH      AREA    VOLUME    OUTFLOW              ***
      (FT)   (ACRES) (ACRE-FT)      (CFS)              ***
      0.00      4.19       .00      0.00
      0.51      4.19     2.254      0.95
      1.37      4.19     6.054      1.55
      3.33      4.19    14.716      2.42
      6.07      4.19    26.824      3.28
      8.43      4.19    37.254      3.86
     10.00      4.19    44.192      4.20
     12.74      4.19    56.301      4.74
     14.50      4.19    64.078      5.06
     15.46      4.19    68.321      8.74
     16.63      4.19    73.491     10.66
     18.39      4.19    81.269     16.63
     20.00      4.19    88.384     20.79
     20.20      4.19    89.268     23.84
     20.70      4.19    91.477     39.37
     21.00      4.19    92.803     52.07
     21.90      4.19    96.780     71.43
  END FTABLE 42

  FTABLE     43
*** NORTHWEST PONDS
*** BASED ON KING COUNTY BASIN PLANNING MODEL
 ROWS COLS ***
   17    5
***  DEPTH      AREA    VOLUME    OUTFLOW  OUTFLOW2                           ***
      (FT)   (ACRES) (ACRE-FT)      (CFS)     (CFS)
     0.000    12.000     0.000     0.000      0.00
     0.100    12.000    18.800     0.000      0.00
```

```
     1.000     12.000     24.000      0.200      0.00
     2.000     12.000     30.000      0.500      0.00
     3.000     12.000     37.000      1.000      0.00
     3.500     13.000     41.000      5.000      0.00
     4.000     13.000     45.700     15.000      0.00
     4.500     13.000     51.000     35.000      0.00
     5.000     14.000     56.500    150.000      0.00
     5.500     14.000     62.800    200.000      0.00
     6.000     14.000     69.000    300.000      0.00
     6.500     14.000     83.500    350.000      0.00
     7.000     15.000     99.900    400.000      0.00
     8.000     17.000     119.00    500.000      0.00
     9.000     20.000     141.50    550.000      0.00
    10.000     23.000     180.00    600.000      0.00
    11.000     27.000     200.00    650.000      0.00
  END FTABLE 43

  FTABLE      46
*** EXECUTEL POND
 ROWS COLS ***
   20    4
***   DEPTH       AREA     VOLUME    OUTFLOW   OUTFLOW2                          ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)
       .000       .000       .000       .000
      1.000       .080       .080     24.420
      2.000       .230       .310     34.540
      3.000       .393       .703     42.300
      3.500       .494       .950     45.690
      4.000       .508      1.204     48.850
      4.500       .532      1.470     51.810
      5.000       .540      1.740     54.610
      5.500       .540      2.010     57.280
      6.000       .580      2.300     59.820
      6.500       .600      2.600     62.270
      7.000       .600      2.900     64.620
      7.500       .600      3.200     66.900
      8.000       .620      3.510     69.100
      8.500       .640      3.830     71.200
      9.000       .740      4.200     82.220
     10.000       .650      4.850    119.830
     11.000       .720      5.570    169.000
     12.000       .750      6.320    250.900
     13.000      1.000      7.320    500.900
  END FTABLE 46

  FTABLE      47
*** EXECUTEL POND DISCHARGE PIPELINE (C)
 ROWS COLS ***
   11    4
***   DEPTH       AREA     VOLUME    OUTFLOW   OUTFLOW2                          ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)
       .000       .000       .000       .000
       .350       .069       .020      4.600
       .700       .096       .056     19.200
      1.050       .112       .099     42.800
      1.400       .124       .150     73.400
      1.750       .125       .203    109.000
      2.100       .121       .240    146.600
      2.450       .110       .264    182.400
      2.800       .096       .284    213.200
      3.150       .090       .290    232.400
      3.500       .088       .293    232.600
  END FTABLE 47

  FTABLE     177
*** NORTH BRANCH RAVINE
 ROWS COLS ***
   14    4
***   DEPTH       AREA     VOLUME    OUTFLOW   OUTFLOW2                          ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)
       .000       .000       .000         .0
       .500       .572       .191        7.3
      1.000       .799       .438       23.2
      2.000       .968      1.001       75.7
      3.000      1.155      1.727      155.1
      4.000      1.317      2.542      262.7
```

```
      5.000      1.478      3.475      400.3
      6.000      1.643      4.545      570.2
      7.000      1.791      5.688      774.4
      8.000      1.932      6.822     1015.1
      9.000      1.945      7.025     1294.5
     10.000      1.958      7.244     1614.5
     11.000      1.970      7.481     1977.0
     12.000      1.983      7.734     2384.7
  END FTABLE177

  FTABLE    193
*** UPPER RAVINE
 ROWS COLS ***
   14    4
***  DEPTH       AREA    VOLUME    OUTFLOW   OUTFLOW2
      (FT)    (ACRES)  (ACRE-FT)     (CFS)      (CFS)                        ***
      0.00       0.00      0.00        0.0
      0.35       0.72      0.75        7.8
      0.70       0.72      1.51       23.5
      1.05       0.72      2.28       44.3
      1.40       0.72      3.03       68.2
      1.75       0.72      3.81       95.8
      2.10       0.72      4.56      125.2
      2.45       0.75      5.36      169.0
      2.80       0.89      6.30      171.5
      3.15       1.00      7.35      247.6
      3.50       1.08      8.49      332.7
      3.85       1.21      9.75      396.5
      4.20       1.32     11.13      521.2
      4.55       1.41     12.60      655.5
  END FTABLE193

  FTABLE    198
 ROWS COLS ***
*** LOWER RAVINE
*** ROUGH ESTIMATE BASED ON FIELD VISIT OF 12/20/95
*** FLOW WAS 6 TO 7 CFS WITH DEPTH OF 8"
*** NEAR OUTLET.
*** DRIVE WHICH REPRESENTS A RESTRICTION ACCORDING TO OBSERVATION
   8    4
***  DEPTH       AREA    VOLUME    OUTFLOW   OUTFLOW2
      (FT)    (ACRES)  (ACRE-FT)     (CFS)      (CFS)                        ***
      0.00       0.00 ,    0.00        0.0
      1.00       0.50      0.80       10.0
      2.00       0.55      1.30       25.0
      3.00       0.60      1.80       50.0
      5.00       0.70      2.50      100.0
*** SUBMERGENCE OF CULVERT
     10.00       2.50     12.00      245.0
*** OVERBANK STORAGE
*** FLOWS BASED ON 243', .03 D-W FACTOR, PLUS LOSS OF 1. VELOCITY HEAD
     15.00      10.00     40.00      325.0
     20.00      11.00     90.00      390.0
  END FTABLE198

  FTABLE     38
*** UPPER EAST BRANCH
 ROWS COLS ***
    9    4
***  DEPTH       AREA    VOLUME    OUTFLOW
      (FT)    (ACRES)  (ACRE-FT)     (CFS)      ***
      .000       .000      .000       .000
      .500       .176      .100      9.200
     1.000       .194     0.150     30.400
     2.000       .232     0.200    105.800
     3.000       .271     0.250    228.900
     4.000       .310     0.350    405.800
     5.000       .349     0.450    642.700
     6.000       .387     0.600    945.700
     7.000       .426     0.800   1320.700
  END FTABLE 38

  FTABLE    360
*** NORTH SATELLITE PUMP STATION (SDE-4) (INSTALLED IN 1995)
 ROWS COLS                                                                   ***
    5    5
```

```
     DEPTH       AREA    VOLUME       (IWS)       (SDS)                        ***
      (FT)     (ACRES)  (ACRE-FT)     (CFS)       (CFS)                        ***
        .0         1.0       .00      0.00         0.00
      1.00         1.0       .01      4.79         0.00
      2.00         1.0       .02      4.79         0.00
      3.00         1.0       .03      4.79        25.00
      4.00         1.0       .04      4.79        50.00
  END FTABLE360


  FTABLE    366
*** SOUTH SNOWMELT (OLYMPIC TANK FARM) PUMP STATION (INSTALLED IN LATE 1997/1998)
 ROWS COLS                                                                     ***
    5    5
     DEPTH       AREA    VOLUME       (IWS)       (SDS)                        ***
      (FT)     (ACRES)  (ACRE-FT)     (CFS)       (CFS)                        ***
        .0        1.00       .00      0.00         0.00
      1.00        1.00       .01      1.67         0.00
      2.00        1.00       .02      1.67         0.00
      3.00        1.00       .03      1.67        25.00
      4.00        1.00       .04      1.67        50.00
  END FTABLE366


END FTABLES

COPY
  TIMESERIES
  Copy-opn                                                                     ***
    # -  #  NPT  NMN                                                           ***
    1   54         1
  END TIMESERIES
END COPY

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGLZERO               PERLND  14   54 EXTNL  PREC
WDM      2 PREC     ENGLZERO               IMPLND  14      EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  34      EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  40      EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  43      EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8        PERLND  14  440 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO    0.8        IMPLND  14  140 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO    0.8        RCHRES  34      EXTNL  POTEV
WDM      1 EVAP     ENGLZERO    0.8        RCHRES  43      EXTNL  POTEV
WDM      1 EVAP     ENGLZERO    0.8        RCHRES  40      EXTNL  POTEV
END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
*******************************************************************************
*** SDS
*******************************************************************************
*** SDE-4 (TOTAL)
RCHRES  36 HYDR   RO                       WDM    221 FLOW     ENGL      REPL
*******************************************************************************
*** SDS-1 (TOTAL)
RCHRES  39 HYDR   RO                       WDM    222 FLOW     ENGL      REPL
*******************************************************************************
*** SDS-3
RCHRES  42 HYDR   RO                       WDM    257 FLOW     ENGL      REPL
RCHRES  42 HYDR   STAGE                    WDM    757 STAG     ENGL      REPL
RCHRES  42 HYDR   VOL                      WDM    857 VOL      ENGL      REPL

*******************************************************************************
*** SDS-4
RCHRES  10 HYDR   RO                       WDM    258 FLOW     ENGL      REPL
RCHRES  10 HYDR   STAGE                    WDM    758 STAG     ENGL      REPL
RCHRES  10 HYDR   VOL                      WDM    858 VOL      ENGL      REPL

*******************************************************************************
*** SDS-3A TAXIWAY VAULT
RCHRES  20 HYDR   RO                       WDM    224 FLOW     ENGL      REPL
```

```
RCHRES  20 HYDR   STAGE                           WDM    724 STAG      ENGL       REPL
RCHRES  20 HYDR   VOL                             WDM    824 VOL       ENGL       REPL

*******************************************************************************
*** SDS-7 3RD RUNWAY VAULT
RCHRES   3 HYDR   RO                              WDM    226 FLOW      ENGL       REPL
RCHRES   3 HYDR   STAGE                           WDM    726 STAG      ENGL       REPL
RCHRES   3 HYDR   VOL                             WDM    826 VOL       ENGL       REPL

*******************************************************************************
*** SASA DETENTION FACILITY
RCHRES 338 HYDR   RO                              WDM    338 FLOW      ENGL       REPL
RCHRES 338 HYDR   STAGE                           WDM    745 STAG      ENGL       REPL
RCHRES 338 HYDR   VOL                             WDM    845 VOL       ENGL       REPL

*******************************************************************************
*** EVALUATION POINT 1 FOR SDS DISCHARGE TO WEST BRANCH
COPY    41 OUTPUT MEAN   1     12.1               WDM    260 FLOW      ENGL       REPL
*******************************************************************************
*** EVALUATION POINT 2 FOR SDS DISCHARGE TO WEST BRANCH
COPY    4  OUTPUT MEAN   1     12.1               WDM    261 FLOW      ENGL       REPL

*** WEST BRANCH
*******************************************************************************
*** NORTHWEST PONDS
RCHRES  43 HYDR   RO                              WDM    231 FLOW      ENGL       REPL
*******************************************************************************
*** LOWER WEST BRANCH
RCHRES  12 HYDR   RO                              WDM    235 FLOW      ENGL       REPL
*******************************************************************************

*** EAST BRANCH
*******************************************************************************
*** BOW LAKE OUTFLOW
RCHRES  35 HYDR   RO                              WDM    236 FLOW      ENGL       REPL
RCHRES  37 HYDR   RO                              WDM     37 FLOW      ENGL       REPL
*** D/S SASA
RCHRES  38 HYDR   RO                              WDM    245 FLOW      ENGL       REPL

*******************************************************************************
*** TYEE INFLOW (GAUGE 11C)
RCHRES   5 HYDR   RO                              WDM    238 FLOW      ENGL       REPL
*******************************************************************************
*** TYEE OUTFLOW
RCHRES  40 HYDR   RO                              WDM    239 FLOW      ENGL       REPL
*******************************************************************************

*** MAIN STEM
*******************************************************************************
*** BELOW CONFLUENCE AT TYEE GOLF COURSE WEIR (GAUGE 11F)
COPY     5 OUTPUT MEAN   1     12.1               WDM    240 FLOW      ENGL       REPL
*******************************************************************************
*** BELOW CONFLUENCE AT SOUTH 200TH STREET
RCHRES  13 HYDR   RO                              WDM    241 FLOW      ENGL       REPL
*******************************************************************************
*** LOWER DES MOINES CREEK NEAR MOUTH (GAUGE 11D)
RCHRES 198 HYDR   RO                              WDM    242 FLOW      ENGL       REPL
*******************************************************************************

END EXT TARGETS
                                                                              ***
NETWORK
***         <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>        <-MEMBER->
<NAME>   # <NAME>   TEM STRG<-FACTOR->STRG <NAME>    #    # <-GRP> <NAME> # # ***
*******************************************************************************
*** AIRPORT SUBBASINS
*******************************************************************************
*** (DM23) SDE-4
PERLND  26 PWATER SURO          3.344       RCHRES  36      EXTNL  IVOL
PERLND  26 PWATER IFWO          3.344       RCHRES  36      EXTNL  IVOL
IMPLND  14 IWATER SURO         10.507       RCHRES  36      EXTNL  IVOL
*******************************************************************************
*** (DM24) SDS-1
PERLND  26 PWATER SURO          0.115       RCHRES  39      EXTNL  IVOL
PERLND  26 PWATER IFWO          0.115       RCHRES  39      EXTNL  IVOL
IMPLND  14 IWATER SURO          1.360       RCHRES  39      EXTNL  IVOL
```

```
******************************************************************************
*** (DM25) SDS-3A  TAXIWAY VAULT
PERLND  26 PWATER SURO           2.886       RCHRES  20       EXTNL  IVOL
PERLND  26 PWATER IFWO           2.886       RCHRES  20       EXTNL  IVOL
IMPLND  14 IWATER SURO           2.928       RCHRES  20       EXTNL  IVOL
******************************************************************************
*** (DM25) SDS-7    3RD RUNWAY VAULT
PERLND  26 PWATER SURO           3.808       RCHRES   3       EXTNL  IVOL
PERLND  26 PWATER IFWO           3.808       RCHRES   3       EXTNL  IVOL
PERLND  44 PWATER SURO           0.327       RCHRES   3       EXTNL  IVOL
PERLND  44 PWATER IFWO           0.327       RCHRES   3       EXTNL  IVOL
PERLND  45 PWATER SURO           0.457       RCHRES   3       EXTNL  IVOL
PERLND  45 PWATER IFWO           0.457       RCHRES   3       EXTNL  IVOL
IMPLND  14 IWATER SURO           3.013       RCHRES   3       EXTNL  IVOL
******************************************************************************
*** (DM25) SDS-3
PERLND  26 PWATER SURO          12.026       RCHRES  42       EXTNL  IVOL
PERLND  26 PWATER IFWO          12.026       RCHRES  42       EXTNL  IVOL
IMPLND  14 IWATER SURO          16.598       RCHRES  42       EXTNL  IVOL
******************************************************************************
****SDS-6*NEW WATERSHED
PERLND  26 PWATER SURO           1.128       COPY    50       INPUT  MEAN   1
PERLND  26 PWATER IFWO           1.128       COPY    50       INPUT  MEAN   1
PERLND  44 PWATER SURO           *****       COPY    50       INPUT  MEAN   1
PERLND  44 PWATER IFWO           *****       COPY    50       INPUT  MEAN   1
PERLND  54 PWATER SURO           *****       COPY    50       INPUT  MEAN   1
PERLND  54 PWATER IFWO           *****       COPY    50       INPUT  MEAN   1
IMPLND  14 IWATER SURO           0.265       COPY    50       INPUT  MEAN   1
******************************************************************************
****SDS-5*NEW WATERSHED
PERLND  26 PWATER SURO           2.356       COPY    41       INPUT  MEAN   1
PERLND  26 PWATER IFWO           2.356       COPY    41       INPUT  MEAN   1
PERLND  44 PWATER SURO           *****       COPY    41       INPUT  MEAN   1
PERLND  44 PWATER IFWO           *****       COPY    41       INPUT  MEAN   1
PERLND  54 PWATER SURO           *****       COPY    41       INPUT  MEAN   1
PERLND  54 PWATER IFWO           *****       COPY    41       INPUT  MEAN   1
IMPLND  14 IWATER SURO           0.348       COPY    41       INPUT  MEAN   1
******************************************************************************
****SDS-2*NEW WATERSHED
PERLND  26 PWATER SURO           0.249       COPY     4       INPUT  MEAN   1
PERLND  26 PWATER IFWO           0.249       COPY     4       INPUT  MEAN   1
PERLND  44 PWATER SURO           0.384       COPY     4       INPUT  MEAN   1
PERLND  44 PWATER IFWO           0.384       COPY     4       INPUT  MEAN   1
PERLND  54 PWATER SURO           0.043       COPY     4       INPUT  MEAN   1
PERLND  54 PWATER IFWO           0.043       COPY     4       INPUT  MEAN   1
IMPLND  14 IWATER SURO           0.086       COPY     4       INPUT  MEAN   1
******************************************************************************

*** (DM27) SDS-4
PERLND  26 PWATER SURO           0.564       RCHRES  10       EXTNL  IVOL
PERLND  26 PWATER IFWO           0.564       RCHRES  10       EXTNL  IVOL
PERLND  26 PWATER AGWO           0.564       COPY     5       INPUT  MEAN   1
PERLND  44 PWATER SURO           2.109       RCHRES  10       EXTNL  IVOL
PERLND  44 PWATER IFWO           2.109       RCHRES  10       EXTNL  IVOL
PERLND  44 PWATER AGWO           2.109       COPY     5       INPUT  MEAN   1
IMPLND  14 IWATER SURO           2.707       RCHRES  10       EXTNL  IVOL
******************************************************************************
*** SASA STORM
IMPLND  14 IWATER SURO           2.855       COPY    15       INPUT  MEAN   1
******************************************************************************

*** IWS SYSTEM PUMP STATION OVERFLOWS
******************************************************************************
******************************************************************************
*** I-3: NORTH SATELLITE PUMP STATION (NSPS) TO IWS
*** OVERFLOW TO SDE-4
*** INSTALLED IN 1995
PERLND  26 PWATER SURO           0.026       RCHRES 360       EXTNL  IVOL
PERLND  26 PWATER IFWO           0.026       RCHRES 360       EXTNL  IVOL
IMPLND  14 IWATER SURO           1.120       RCHRES 360       EXTNL  IVOL
******************************************************************************
******************************************************************************
*** I-5: SOUTH SNOWMELT (OLYMPIC TANK FARM) PUMP STATION (SSMPS) TO IWS
*** OVERFLOW TO DES MOINES EAST BRANCH
*** INSTALLED IN LATE 1997/1998
IMPLND  14 IWATER SURO           0.001       RCHRES 366       EXTNL  IVOL
```

```
**************************************************************************
*** SASA IWS
PERLND  26 PWATER SURO           0.004         COPY      8       INPUT  MEAN    1
PERLND  26 PWATER IFWO           0.004         COPY      8       INPUT  MEAN    1
PERLND  26 PWATER AGWO           0.004         COPY      5       INPUT  MEAN    1
PERLND  44 PWATER SURO           0.004         COPY      8       INPUT  MEAN    1
PERLND  44 PWATER IFWO           0.004         COPY      8       INPUT  MEAN    1
PERLND  44 PWATER AGWO           0.004         COPY      5       INPUT  MEAN    1
PERLND  54 PWATER SURO           0.001         COPY      8       INPUT  MEAN    1
PERLND  54 PWATER IFWO           0.001         COPY      8       INPUT  MEAN    1
PERLND  54 PWATER AGWO           0.001         COPY      5       INPUT  MEAN    1
IMPLND  14 IWATER SURO           4.860         COPY      8       INPUT  MEAN    1
**************************************************************************

*** EAST BRANCH OF CREEK
**************************************************************************
*** DM1
PERLND  16 PWATER SURO           0.860         RCHRES   34       EXTNL  IVOL
PERLND  16 PWATER IFWO           0.860         RCHRES   34       EXTNL  IVOL
PERLND  16 PWATER AGWO           0.241         RCHRES   34       EXTNL  IVOL
PERLND  26 PWATER SURO          11.078         RCHRES   34       EXTNL  IVOL
PERLND  26 PWATER IFWO          11.078         RCHRES   34       EXTNL  IVOL
PERLND  26 PWATER AGWO           3.102         RCHRES   34       EXTNL  IVOL
PERLND  34 PWATER SURO           0.599         RCHRES   34       EXTNL  IVOL
PERLND  34 PWATER IFWO           0.599         RCHRES   34       EXTNL  IVOL
PERLND  34 PWATER AGWO           0.168         RCHRES   34       EXTNL  IVOL
PERLND  44 PWATER SURO           7.697         RCHRES   34       EXTNL  IVOL
PERLND  44 PWATER IFWO           7.697         RCHRES   34       EXTNL  IVOL
PERLND  44 PWATER AGWO           2.155         RCHRES   34       EXTNL  IVOL
PERLND  54 PWATER SURO           1.176         RCHRES   34       EXTNL  IVOL
PERLND  54 PWATER IFWO           1.176         RCHRES   34       EXTNL  IVOL
PERLND  54 PWATER AGWO           0.329         RCHRES   34       EXTNL  IVOL
IMPLND  14 IWATER SURO          14.274         RCHRES   34       EXTNL  IVOL
**************************************************************************
*** DM2
PERLND  26 PWATER SURO           1.232         RCHRES   37       EXTNL  IVOL
PERLND  26 PWATER IFWO           1.232         RCHRES   37       EXTNL  IVOL
IMPLND  14 IWATER SURO           0.821         RCHRES   37       EXTNL  IVOL
**************************************************************************
*** DM3
PERLND  26 PWATER PERO           3.553         RCHRES    5       EXTNL  IVOL
PERLND  54 PWATER PERO           0.006         RCHRES    5       EXTNL  IVOL
IMPLND  14 IWATER SURO           4.508         RCHRES    5       EXTNL  IVOL
**************************************************************************
*** DM4
PERLND  16 PWATER PERO           0.286         RCHRES    5       EXTNL  IVOL
PERLND  26 PWATER PERO           0.591         RCHRES    5       EXTNL  IVOL
PERLND  54 PWATER PERO           0.005         RCHRES    5       EXTNL  IVOL
IMPLND  14 IWATER SURO           3.357         RCHRES    5       EXTNL  IVOL
**************************************************************************
*** DM5
PERLND  16 PWATER PERO           0.173         RCHRES    5       EXTNL  IVOL
PERLND  26 PWATER PERO           0.485         RCHRES    5       EXTNL  IVOL
PERLND  34 PWATER PERO           0.074         RCHRES    5       EXTNL  IVOL
PERLND  44 PWATER PERO           0.077         RCHRES    5       EXTNL  IVOL
PERLND  54 PWATER PERO           0.112         RCHRES    5       EXTNL  IVOL
IMPLND  14 IWATER SURO           0.799         RCHRES    5       EXTNL  IVOL
**************************************************************************
*** DM6
PERLND  16 PWATER PERO           *****         RCHRES   40       EXTNL  IVOL
PERLND  26 PWATER PERO           0.534         RCHRES   40       EXTNL  IVOL
PERLND  34 PWATER PERO           0.002         RCHRES   40       EXTNL  IVOL
PERLND  44 PWATER PERO           0.709         RCHRES   40       EXTNL  IVOL
PERLND  54 PWATER PERO           0.312         RCHRES   40       EXTNL  IVOL
IMPLND  14 IWATER SURO           0.007         RCHRES   40       EXTNL  IVOL
**************************************************************************

*** WEST BRANCH OF CREEK
**************************************************************************
*** DM7
PERLND  16 PWATER SURO           2.190         RCHRES    7       EXTNL  IVOL
PERLND  16 PWATER IFWO           2.190         RCHRES    7       EXTNL  IVOL
PERLND  16 PWATER AGWO           0.788         RCHRES    7       EXTNL  IVOL
PERLND  26 PWATER SURO           2.944         RCHRES    7       EXTNL  IVOL
PERLND  26 PWATER IFWO           2.944         RCHRES    7       EXTNL  IVOL
PERLND  26 PWATER AGWO           1.060         RCHRES    7       EXTNL  IVOL
```

```
PERLND  34 PWATER SURO          1.970      RCHRES   7      EXTNL  IVOL
PERLND  34 PWATER IFWO          1.970      RCHRES   7      EXTNL  IVOL
PERLND  34 PWATER AGWO          0.709      RCHRES   7      EXTNL  IVOL
PERLND  44 PWATER SURO          4.143      RCHRES   7      EXTNL  IVOL
PERLND  44 PWATER IFWO          4.143      RCHRES   7      EXTNL  IVOL
PERLND  44 PWATER AGWO          1.492      RCHRES   7      EXTNL  IVOL
PERLND  54 PWATER SURO          0.552      RCHRES   7      EXTNL  IVOL
PERLND  54 PWATER IFWO          0.552      RCHRES   7      EXTNL  IVOL
PERLND  54 PWATER AGWO          0.199      RCHRES   7      EXTNL  IVOL
IMPLND  14 IWATER SURO          2.401      RCHRES   7      EXTNL  IVOL
******************************************************************************
*** DM8
PERLND  16 PWATER SURO          0.203      RCHRES   7      EXTNL  IVOL
PERLND  16 PWATER IFWO          0.203      RCHRES   7      EXTNL  IVOL
PERLND  16 PWATER AGWO          0.077      RCHRES   7      EXTNL  IVOL
PERLND  26 PWATER SURO          0.609      RCHRES   7      EXTNL  IVOL
PERLND  26 PWATER IFWO          0.609      RCHRES   7      EXTNL  IVOL
PERLND  26 PWATER AGWO          0.231      RCHRES   7      EXTNL  IVOL
PERLND  34 PWATER SURO          0.715      RCHRES   7      EXTNL  IVOL
PERLND  34 PWATER IFWO          0.715      RCHRES   7      EXTNL  IVOL
PERLND  34 PWATER AGWO          0.272      RCHRES   7      EXTNL  IVOL
PERLND  44 PWATER SURO          1.133      RCHRES   7      EXTNL  IVOL
PERLND  44 PWATER IFWO          1.133      RCHRES   7      EXTNL  IVOL
PERLND  44 PWATER AGWO          0.431      RCHRES   7      EXTNL  IVOL
PERLND  54 PWATER SURO          0.161      RCHRES   7      EXTNL  IVOL
PERLND  54 PWATER IFWO          0.161      RCHRES   7      EXTNL  IVOL
PERLND  54 PWATER AGWO          0.061      RCHRES   7      EXTNL  IVOL
IMPLND  14 IWATER SURO          2.422      RCHRES   7      EXTNL  IVOL
******************************************************************************
*** DM9
PERLND  16 PWATER SURO          0.002      RCHRES   9      EXTNL  IVOL
PERLND  16 PWATER IFWO          0.002      RCHRES   9      EXTNL  IVOL
PERLND  16 PWATER AGWO          0.001      RCHRES   9      EXTNL  IVOL
PERLND  26 PWATER SURO          1.201      RCHRES   9      EXTNL  IVOL
PERLND  26 PWATER IFWO          1.201      RCHRES   9      EXTNL  IVOL
PERLND  26 PWATER AGWO          0.528      RCHRES   9      EXTNL  IVOL
PERLND  34 PWATER SURO          0.017      RCHRES   9      EXTNL  IVOL
PERLND  34 PWATER IFWO          0.017      RCHRES   9      EXTNL  IVOL
PERLND  34 PWATER AGWO          0.007      RCHRES   9      EXTNL  IVOL
PERLND  44 PWATER SURO          3.040      RCHRES   9      EXTNL  IVOL
PERLND  44 PWATER IFWO          3.040      RCHRES   9      EXTNL  IVOL
PERLND  44 PWATER AGWO          1.338      RCHRES   9      EXTNL  IVOL
PERLND  54 PWATER SURO          0.010      RCHRES   9      EXTNL  IVOL
PERLND  54 PWATER IFWO          0.010      RCHRES   9      EXTNL  IVOL
PERLND  54 PWATER AGWO          0.005      RCHRES   9      EXTNL  IVOL
IMPLND  14 IWATER SURO          0.634      RCHRES   9      EXTNL  IVOL
******************************************************************************
*** DM10
PERLND  16 PWATER PERO          0.945      RCHRES  43      EXTNL  IVOL
PERLND  26 PWATER PERO          0.738      RCHRES  43      EXTNL  IVOL
PERLND  34 PWATER PERO          1.935      RCHRES  43      EXTNL  IVOL
PERLND  44 PWATER PERO          0.510      RCHRES  43      EXTNL  IVOL
PERLND  54 PWATER PERO          0.712      RCHRES  43      EXTNL  IVOL
IMPLND  14 IWATER SURO          0.185      RCHRES  43      EXTNL  IVOL
******************************************************************************
*** DM11
PERLND  16 PWATER PERO          0.321      RCHRES  43      EXTNL  IVOL
PERLND  26 PWATER PERO          0.408      RCHRES  43      EXTNL  IVOL
PERLND  34 PWATER PERO          1.024      RCHRES  43      EXTNL  IVOL
PERLND  44 PWATER PERO          0.467      RCHRES  43      EXTNL  IVOL
PERLND  54 PWATER PERO          1.036      RCHRES  43      EXTNL  IVOL
IMPLND  14 IWATER SURO          2.726      RCHRES  43      EXTNL  IVOL
******************************************************************************
*** DM12
PERLND  16 PWATER PERO          0.510      RCHRES  12      EXTNL  IVOL
PERLND  26 PWATER PERO          0.001      RCHRES  12      EXTNL  IVOL
PERLND  34 PWATER PERO          0.375      RCHRES  12      EXTNL  IVOL
PERLND  44 PWATER PERO          1.728      RCHRES  12      EXTNL  IVOL
PERLND  54 PWATER PERO          0.554      RCHRES  12      EXTNL  IVOL
******************************************************************************
*** DM13
PERLND  16 PWATER PERO          0.961      RCHRES  13      EXTNL  IVOL
PERLND  26 PWATER PERO          1.562      RCHRES  13      EXTNL  IVOL
PERLND  34 PWATER PERO          1.203      RCHRES  13      EXTNL  IVOL
PERLND  44 PWATER PERO          1.778      RCHRES  13      EXTNL  IVOL
PERLND  54 PWATER PERO          0.089      RCHRES  13      EXTNL  IVOL
```

```
IMPLND  14 IWATER SURO          1.259       RCHRES  13       EXTNL  IVOL
********************************************************************************

*** LOWER BASIN
********************************************************************************
*** DM14
PERLND  16 PWATER PERO          0.481       RCHRES  14       EXTNL  IVOL
PERLND  26 PWATER PERO          0.295       RCHRES  14       EXTNL  IVOL
PERLND  34 PWATER PERO          1.940       RCHRES  14       EXTNL  IVOL
PERLND  44 PWATER PERO          1.195       RCHRES  14       EXTNL  IVOL
IMPLND  14 IWATER SURO          0.340       RCHRES  14       EXTNL  IVOL
********************************************************************************

*** EXECUTEL TRIBUTARY
********************************************************************************
*** DM16 INFLOW TO EXECUTEL POND
PERLND  16 PWATER SURO          0.647       RCHRES  46       EXTNL  IVOL
PERLND  16 PWATER IFWO          0.647       RCHRES  46       EXTNL  IVOL
PERLND  16 PWATER AGWO          0.446       RCHRES  46       EXTNL  IVOL
PERLND  26 PWATER SURO          5.573       RCHRES  46       EXTNL  IVOL
PERLND  26 PWATER IFWO          5.573       RCHRES  46       EXTNL  IVOL
PERLND  26 PWATER AGWO          3.845       RCHRES  46       EXTNL  IVOL
PERLND  34 PWATER SURO          0.639       RCHRES  46       EXTNL  IVOL
PERLND  34 PWATER IFWO          0.639       RCHRES  46       EXTNL  IVOL
PERLND  34 PWATER AGWO          0.441       RCHRES  46       EXTNL  IVOL
PERLND  44 PWATER SURO          8.023       RCHRES  46       EXTNL  IVOL
PERLND  44 PWATER IFWO          8.023       RCHRES  46       EXTNL  IVOL
PERLND  44 PWATER AGWO          5.536       RCHRES  46       EXTNL  IVOL
PERLND  54 PWATER SURO          0.183       RCHRES  46       EXTNL  IVOL
PERLND  54 PWATER IFWO          0.183       RCHRES  46       EXTNL  IVOL
PERLND  54 PWATER AGWO          0.126       RCHRES  46       EXTNL  IVOL
IMPLND  14 IWATER SURO          4.249       RCHRES  46       EXTNL  IVOL
********************************************************************************
*** DM17
PERLND  16 PWATER PERO          2.078       RCHRES  17       EXTNL  IVOL
PERLND  26 PWATER PERO          2.261       RCHRES  17       EXTNL  IVOL
PERLND  34 PWATER PERO          3.003       RCHRES  17       EXTNL  IVOL
PERLND  44 PWATER PERO          3.280       RCHRES  17       EXTNL  IVOL
IMPLND  14 IWATER SURO          2.655       RCHRES  17       EXTNL  IVOL
********************************************************************************

*** MAINSTEM RAVINE
********************************************************************************
*** DM18
PERLND  16 PWATER PERO          0.789       RCHRES  18       EXTNL  IVOL
PERLND  26 PWATER PERO          0.277       RCHRES  18       EXTNL  IVOL
PERLND  34 PWATER PERO          3.151       RCHRES  18       EXTNL  IVOL
PERLND  44 PWATER PERO          1.106       RCHRES  18       EXTNL  IVOL
PERLND  54 PWATER PERO          0.300       RCHRES  18       EXTNL  IVOL
IMPLND  14 IWATER SURO          0.296       RCHRES  18       EXTNL  IVOL
********************************************************************************

*** NORTH BRANCH RAVINE
********************************************************************************
*** DM19
PERLND  16 PWATER PERO          0.182       RCHRES 177       EXTNL  IVOL
PERLND  26 PWATER PERO          6.019       RCHRES 177       EXTNL  IVOL
PERLND  34 PWATER PERO          0.167       RCHRES 177       EXTNL  IVOL
PERLND  44 PWATER PERO          5.552       RCHRES 177       EXTNL  IVOL
IMPLND  14 IWATER SURO          2.617       RCHRES 177       EXTNL  IVOL
********************************************************************************
*** DM20
PERLND  16 PWATER PERO          4.007       RCHRES 193       EXTNL  IVOL
PERLND  26 PWATER PERO          6.624       RCHRES 193       EXTNL  IVOL
PERLND  34 PWATER PERO          2.784       RCHRES 193       EXTNL  IVOL
PERLND  44 PWATER PERO          4.602       RCHRES 193       EXTNL  IVOL
PERLND  54 PWATER PERO          0.116       RCHRES 193       EXTNL  IVOL
IMPLND  14 IWATER SURO          3.714       RCHRES 193       EXTNL  IVOL
********************************************************************************

*** LOWER MAINSTEM
********************************************************************************
*** DM21
PERLND  16 PWATER PERO          2.143       RCHRES 198       EXTNL  IVOL
PERLND  26 PWATER PERO          6.306       RCHRES 198       EXTNL  IVOL
PERLND  34 PWATER PERO          1.429       RCHRES 198       EXTNL  IVOL
```

```
PERLND  44 PWATER PERO          4.205      RCHRES 198      EXTNL  IVOL
IMPLND  14 IWATER SURO          3.091      RCHRES 198      EXTNL  IVOL
*****************************************************************************
*** DM22
PERLND  16 PWATER PERO          0.381      RCHRES 198      EXTNL  IVOL
PERLND  26 PWATER PERO          4.654      RCHRES 198      EXTNL  IVOL
PERLND  34 PWATER PERO          0.218      RCHRES 198      EXTNL  IVOL
PERLND  44 PWATER PERO          2.620      RCHRES 198      EXTNL  IVOL
PERLND  54 PWATER PERO          0.016      RCHRES 198      EXTNL  IVOL
IMPLND  14 IWATER SURO          1.972      RCHRES 198      EXTNL  IVOL
*****************************************************************************

*** NONCONTIGUOUS GROUNDWATER BASINS
*****************************************************************************
*** G1
PERLND  16 PWATER AGWO          2.833      RCHRES   5      EXTNL  IVOL
PERLND  26 PWATER AGWO          9.917      RCHRES   5      EXTNL  IVOL
*****************************************************************************
*** G2
PERLND  16 PWATER AGWO          0.417      RCHRES 193      EXTNL  IVOL
PERLND  26 PWATER AGWO          1.333      RCHRES 193      EXTNL  IVOL
*****************************************************************************
*** G3
PERLND  16 PWATER AGWO          5.083      RCHRES 193      EXTNL  IVOL
PERLND  26 PWATER AGWO         17.667      RCHRES 193      EXTNL  IVOL
PERLND  34 PWATER AGWO          1.167      RCHRES 193      EXTNL  IVOL
PERLND  44 PWATER AGWO          4.250      RCHRES 193      EXTNL  IVOL
*****************************************************************************
*****************************************************************************

*** CHANNEL NETWORK LINKAGES ***
*****************************************************************************

*****************************************************************************

*** PUMP STATION OVERFLOW TO SDS
*****************************************************************************
RCHRES 360 HYDR   OVOL   2                 RCHRES  36      EXTNL  IVOL
RCHRES 366 HYDR   OVOL   2                 RCHRES   5      EXTNL  IVOL
*****************************************************************************

*** EAST BRANCH OF CREEK
*****************************************************************************
RCHRES  34 HYDR   OVOL   1                 RCHRES  35      EXTNL  IVOL
RCHRES  35 HYDR   ROVOL  1                 RCHRES  37      EXTNL  IVOL
RCHRES  36 HYDR   ROVOL  1                 RCHRES 338      EXTNL  IVOL
COPY    15 OUTPUT MEAN   1                 RCHRES 338      EXTNL  IVOL
RCHRES  39 HYDR   ROVOL  1                 RCHRES 338      EXTNL  IVOL
RCHRES  37 HYDR   ROVOL  1                 RCHRES 338      EXTNL  IVOL
RCHRES 338 HYDR   ROVOL  1                 RCHRES  38      EXTNL  IVOL
RCHRES  38 HYDR   ROVOL  1                 RCHRES   5      EXTNL  IVOL
RCHRES   5 HYDR   ROVOL  1                 RCHRES  40      EXTNL  IVOL
RCHRES  40 HYDR   ROVOL  1                 COPY     5      INPUT  MEAN   1
*****************************************************************************


*** WEST BRANCH OF CREEK
*****************************************************************************
RCHRES  20 HYDR   ROVOL  1                 COPY     9      INPUT  MEAN   1
RCHRES  42 HYDR   ROVOL  1                 COPY     9      INPUT  MEAN   1
COPY     9 OUTPUT MEAN   1                 RCHRES   4      EXTNL  IVOL
RCHRES   4 HYDR   ROVOL  1                 COPY    41      INPUT  MEAN   1
COPY    50 OUTPUT MEAN   1                 RCHRES   3      EXTNL  IVOL
RCHRES   3 HYDR   ROVOL  1                 COPY     4      INPUT  MEAN   1
RCHRES   7 HYDR   ROVOL  1                 COPY     4      INPUT  MEAN   1
RCHRES   9 HYDR   ROVOL  1                 COPY     4      INPUT  MEAN   1
COPY    41 OUTPUT MEAN   1                 RCHRES  43      EXTNL  IVOL
COPY     4 OUTPUT MEAN   1                 RCHRES  43      EXTNL  IVOL
RCHRES  43 HYDR   OVOL   1                 RCHRES  12      EXTNL  IVOL
RCHRES  10 HYDR   ROVOL  1                 COPY     5      INPUT  MEAN   1
RCHRES  12 HYDR   ROVOL  1                 COPY     5      INPUT  MEAN   1
*****************************************************************************

*** MAINSTEM BELOW CONFLUENCE OF E. AND W. BRANCH
*****************************************************************************
*** MAINSTEM ABOVE EXECUTEL TRIBUTARY
```

```
COPY      5 OUTPUT MEAN    1                     RCHRES  13      EXTNL  IVOL
RCHRES   13 HYDR   ROVOL   1                     RCHRES  14      EXTNL  IVOL
RCHRES   14 HYDR   ROVOL   1                     COPY    48      INPUT  MEAN   1
*********************************************************************************
*** EXECUTEL TRIBUTARY
RCHRES   46 HYDR   ROVOL   1                     RCHRES  47      EXTNL  IVOL
RCHRES   47 HYDR   ROVOL   1                     RCHRES  17      EXTNL  IVOL
RCHRES   17 HYDR   ROVOL   1                     COPY    48      INPUT  MEAN   1
*********************************************************************************
*** MAINSTEM FROM HEAD OF RAVINE TO NORTH BRANCH CONFLUENCE
COPY     48 OUTPUT MEAN    1                     RCHRES  18      EXTNL  IVOL
RCHRES   18 HYDR   OVOL    1                     RCHRES 193      EXTNL  IVOL
RCHRES  193 HYDR   ROVOL   1                     COPY     1      INPUT  MEAN   1
*********************************************************************************
*** NORTH BRANCH RAVINE TO MAINSTEM
RCHRES  177 HYDR   ROVOL   1                     COPY     1      INPUT  MEAN   1
*********************************************************************************
*** MAINSTEM FROM NORTH BRANCH CONFLUENCE TO PARK BELOW MVD CULVERT
COPY      1 OUTPUT MEAN    1                     RCHRES 198      EXTNL  IVOL
*********************************************************************************

END NETWORK

END RUN
```

PREFACE

Comprehensive Stormwater Management Plan
Seattle-Tacoma International Airport
Master Plan Update Improvements

July 2001

This document contains replacement pages developed in response to comments received from the Washington State Department of Ecology (Ecology) on Volumes 1 through 4 of the December 2000 Comprehensive Stormwater Management Plan (SMP) for the Seattle-Tacoma International Airport Master Plan Update Improvements. A facilitated process was used to document specific revisions required by Ecology to the December 2000 SMP. Each SMP volume contains an itemized list of replacement pages, and the replacement pages are identified by a July 2001 footer.

SMP VOLUME 3
JULY 2001 REPLACEMENT PAGES

Preface (before pg. *i*)
List of Volume 3 Replacement Pages
APPENDIX B1:
- Certificate of Engineer (before pg. B1-*i*)
- Figure B1-2 (pg. B1-4)
- Section 1.1 (pg. B1-5)
- Figure B1-3 (pg. B1-6)
- Figure B1-4 (pg. B1-7)
- Figure B1-5 (pg. B1-8)
- Figure B1-6 (pg. B1-9)
- Section 1.3 (pg. B1-10)
- Section 1.5.2 (pg. B1-14)
- Des Moines Creek HSPF Calibration Model Input Files (21 pgs.)
- Des Moines Creek Calibrated Model Hydrographs:
  - SDS3 Average and Peak Daily Flow (4 pgs.) *(replaces graphs previously contained on 2 pgs)*
  - Golf Weir Average and Peak Daily Flow (4 pgs.) *(replaces graphs previously contained on 2 pgs)*
  - Near Mouth March 6, 1995 through March 28, 1995 (1 pg.)
  - SDS3 December 28, 1995 through January 18, 1996 (4 pgs.) *(replaces graphs previously contained on 5 pgs.)*

APPENDIX B2:
- Certificate of Engineer (pg. B2-*i*)
- List of Figures, List of Figures, and List of Tables (pgs. B2-*iii* and B2-*iv*)
- Section 1 (pg. B2-1)
- Section 2.1 (pg. B2-2)
- Figure B2-1 (pg. B2-3)
- Table B2-2 (pg. B2-5)
- Table B2-3 (pg. B2-6)
- Figure B2-2 (pg. B2-21)
- Figure B2-3b (pg. B2-27)
- Section 3.7 (pg. B2-28)
- Section 5.3 (pg. B2-51)
- Sections 5.6 and 5.7 (pgs. B2-52 and B2-52a)
- Figure B2-23 (pg. B2-53)
- Table B2-9 (pg. B2-54)
- Table B2-10 (pgs. B2-54a and B2-54b)
- Figures B2-24 through B2-41 (pgs. B2-55 through B2-63e)
- Section 6 (pg. B2-64)
- Miller Creek HSPF Calibration Model Input File (20 pgs.)
- Walker Creek HSPF Calibration Model Input File (9 pgs.)

Note: Listed page totals do not include "guidance" pages (the guidance pages do not need to be inserted as replacement pages).

DES MOINES CREEK HSPF MODEL CALIBRATION REPORT

VOLUME 3—APPENDIX B1

Prepared for

PARAMETRIX, INC.

5808 Lake Washington Blvd. N.E.. Suite 200
Kirkland, Washington 98033-7350

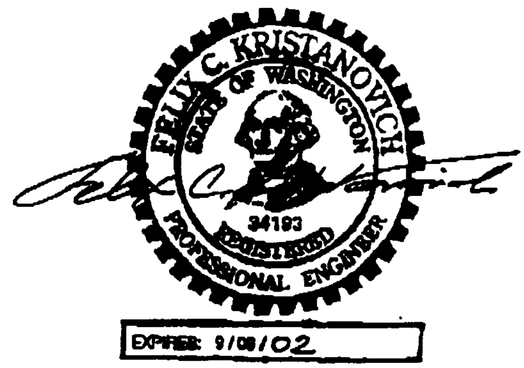
Prepared by

Dave Harms
Roth Hill Engineering Partners. Inc.

AUGUST 2000
556-2912-001 (28)

CERTIFICATE OF ENGINEER

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned.



Felix C. Kristanovich, Ph.D., P.E.

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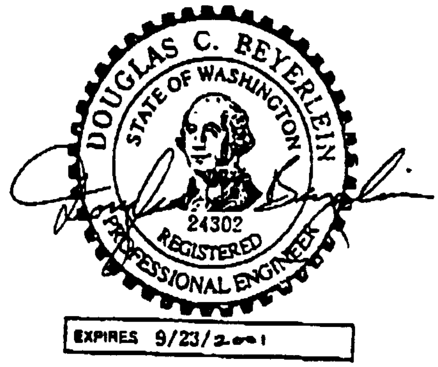
CERTIFICATE OF ENGINEER

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned.



Douglas Beyerlein, P.E., Senior Engineer

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APPENDIX B1

DES MOINES CREEK HSPF MODEL INFORMATION

1. INTRODUCTION

This appendix documents the modifications to and calibration of the Des Moines Creek HSPF model. The HSPF model used for the Des Moines Creek Basin Plan (King County 1997), was used as a basis for the modification of the model that was used in the preparation of the draft Preliminary Comprehensive Stormwater Management Plan (draft SMP) (Parametrix 1999). These modifications led to this current version of the model and its calibration results, presented herein. Calibration results are compared to results obtained using Basin Plan model parameters, U.S. Geological Survey parameters and the previous version of the Des Moines Creek model, used in preparation of the November 1999 draft SMP.

1.1 CHANGES FROM THE KING COUNTY BASIN PLAN MODEL

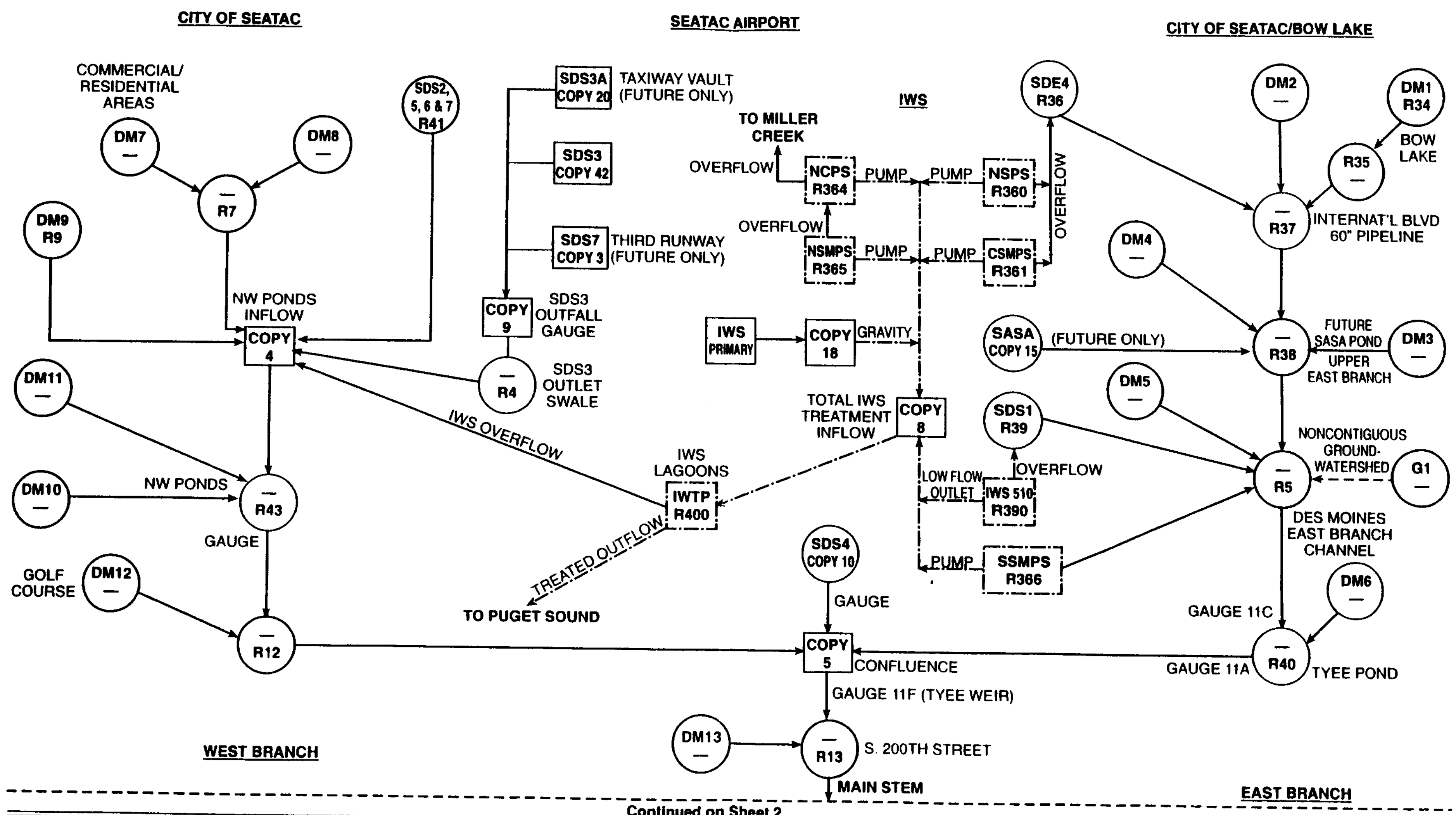
1.1.1 Model Origin

According to the Des Moines Creek Basin Plan, the HSPF model used to perform that analysis resulted from a modification and enhancement of the HSPF model developed by Montgomery Water Group (MWG 1995). The MWG model was also the basis for the previous version of the Des Moines Creek model used in preparation of the November 1999 draft SMP. This current version of the Des Moines Creek model is a modification of the November 1999 draft SMP model, incorporating the Basin Plan model and a number of additional modifications. A schematic representation of the model is shown in Figure B1-1. The HSPF input file for the calibrated model is included at the end of this Appendix.

Changes to the Model

The following changes were incorporated into the November 1999 draft SMP version of the model, to produce the current Des Moines Creek model:

- The drainage basin and subbasin boundaries were modified. Changes include modification of the boundary to subbasin D1, excluding an area south of Bow Lake from discharging through the lake, modifying D16 to exclude an area to the southwest of Executel Pond from discharging through the pond and modifying the boundary of D21 to match the location of flow recording gage 11D. Boundary modifications resulted from examination of topographic mapping and review of basin boundaries determined for the City of SeaTac Surface Water Plan (Earth Tech 1997), which incorporated extensive field examination and the effects of stormwater conveyance on boundary definition. The resulting boundaries are shown in Figure B1-2.



Parametrix, Inc. Port of Seattle/HSPF Model/556-2912-001(028) 5/00 (K)

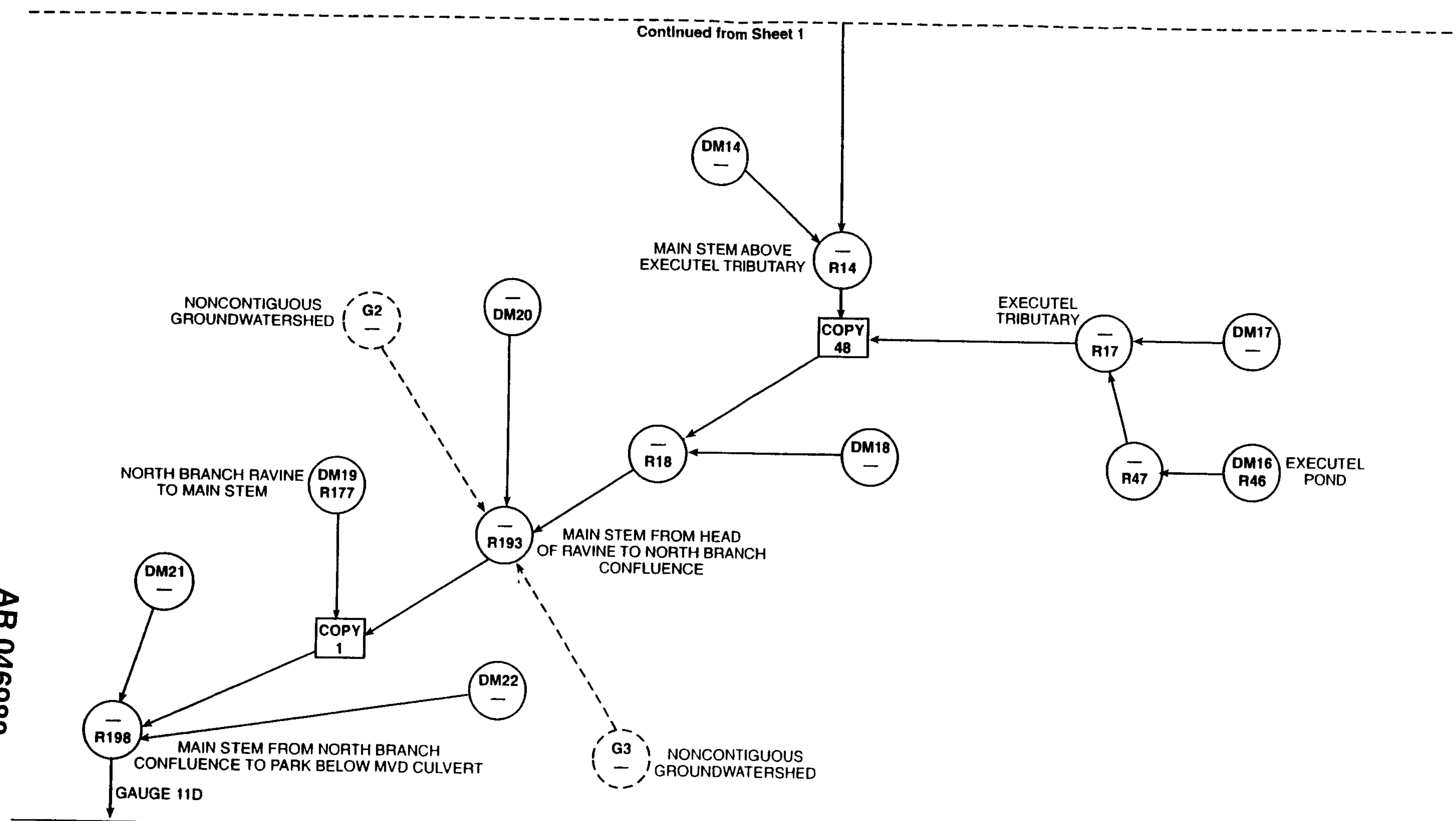
Stormwater
IWS
Groundwater

DM# = Des Moines Creek Subbasin Number
SDS# = Storm Drainage South Number
SDE# = Storm Drainage East Number
R# = Routing Reach Number (Channel or Storage Pond)

DM1 R34 —Subbasin ID —Routing Reach Number

COPY 8 Summation of upstream flow

Figure B1-1
Des Moines Creek
HSPF Model Schematic
Sheet 1



Parametrix, Inc. Port of Seattle/HSPF Model/556-2912-001(028) 5/00 (K)

DM# = Des Moines Creek Subbasin Number
SDS# = Storm Drainage South Number
SDE# = Storm Drainage East Number
R# = Routing Reach Number (Channel or Storage Pond)

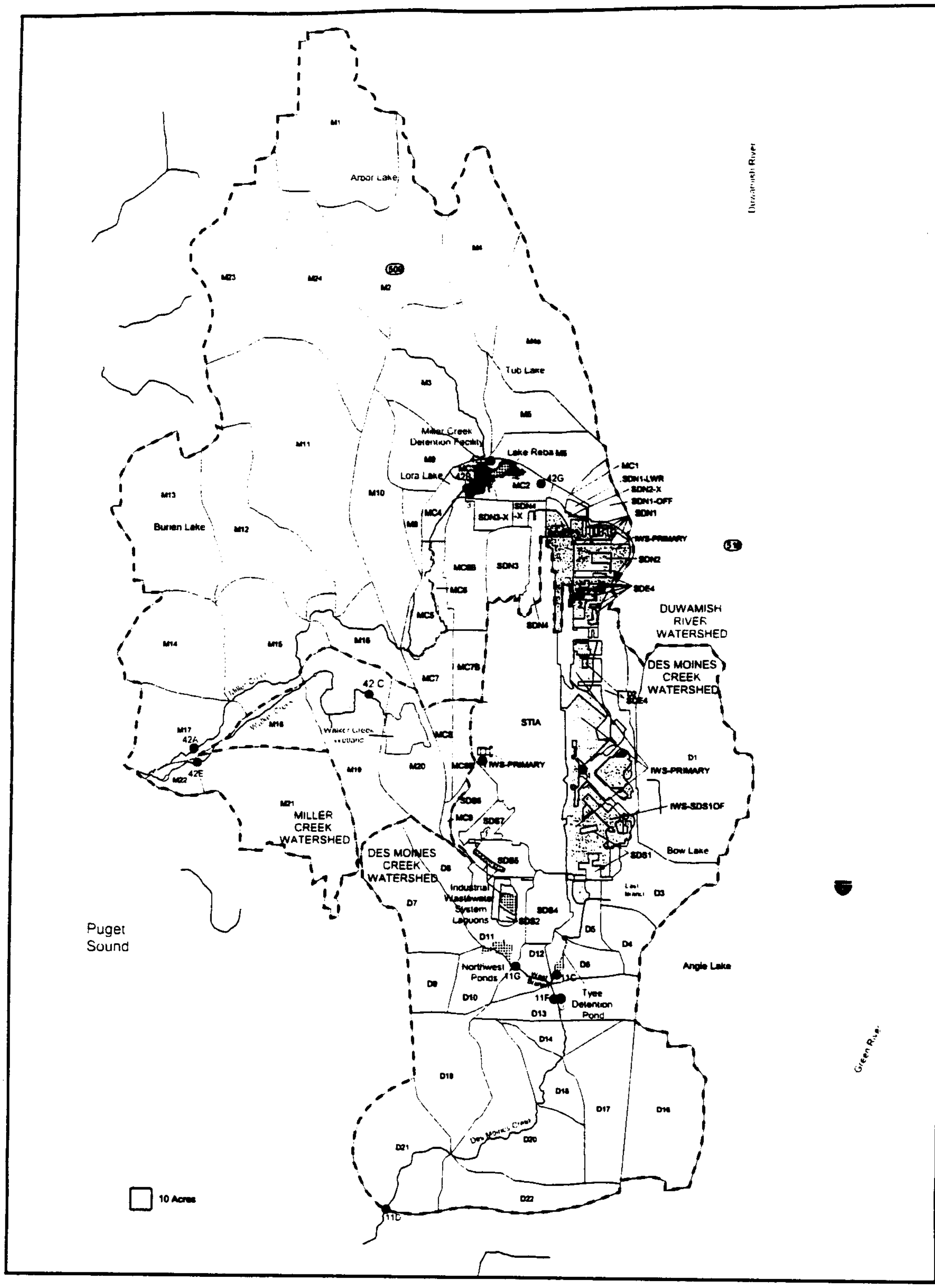
Stormwater
IWS
Groundwater

DM1 —Subbasin ID
R34 —Routing Reach Number

COPY 8 Summation of upstream flow

Figure B1-1
Des Moines Creek
HSPF Model Schematic
Sheet 2

AR 046988



July 2001
556-2912-001 (28)

Roads
Existing (1994) Drainage Subbasins
STIA Area (see note)
Constructed Water Features
IWS Drainage Area
Subwatershed Boundary
Watershed Boundary
Rivers
Water Bodies
Detention Facilities (existing)
Des Moines Creek Watershed

N
1000 0 1000 2000 Feet
1:36,000

Figure B1-2
Des Moines Creek Watershed Existing Conditions

AR 046989

- Land use acreage has been recomputed for the airport facilities and the area south of the airport, to South 200th Street. The process for updating the land use is discussed later in this Appendix. The resulting land use is summarized in the Table B1-1 provided at the end of this Appendix. Land use for the area within the Des Moines Creek basin, east of the airport and south of South 200th Street, was modified primarily so that the percentage of impervious area within those subbasins was consistent with Basin Plan values. Those impervious percentages were subsequently reduced for the subbasins south of South 200th Street as part of the calibration process.

- Assumptions about groundwater contributions to base flow have been modified, based on the regional groundwater study, discussed below. Figure B1-3 identifies the areas contributing groundwater to Des Moines Creek and the direction of groundwater flow.

- PERLND categories were not separated by slope, consistent with the Basin Plan model.

- Only the surface flow component of runoff is routed to airport subbasin discharge points. Interflow is routed to downstream discharge points, since runoff from airport subbasins is collected in the STIA stormwater drainage system (SDS) and it is assumed that runoff that becomes interflow cannot be collected in the SDS system. Groundwater from the majority of airport subbasins is routed to the Walker Creek drainage basin, as identified in Figure B1-3.

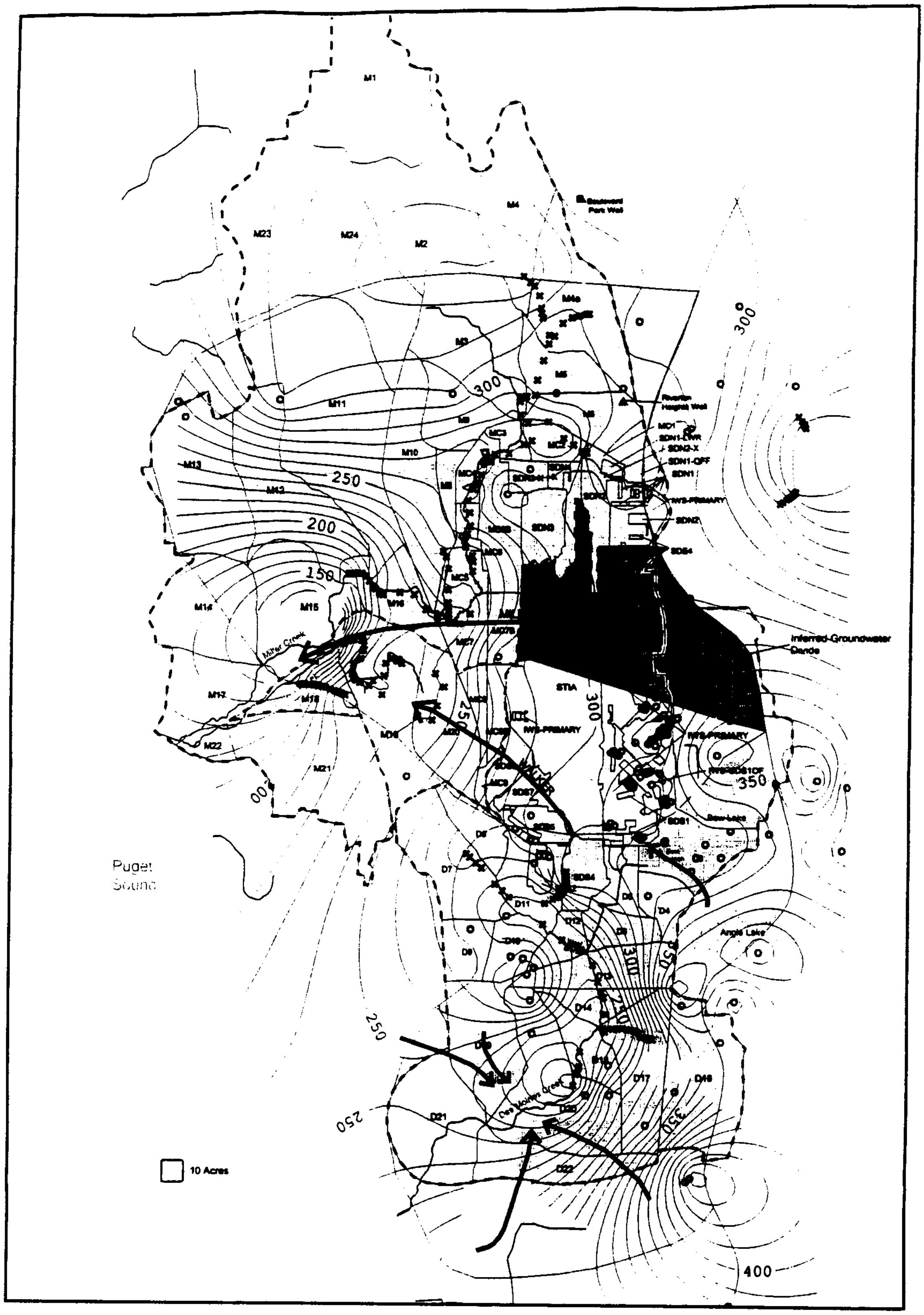
- FTABLES were not modified since they appear to have been previously reviewed by King County, as indicated by comment lines inserted in the calibration input file for the November 1999 SMP.

1.2 SUBBASIN BOUNDARIES, LAND USE, AND SOILS DATA

Subbasin boundaries, land use, and soils data used to develop the previous FEIS and draft SMP basin models were checked against available information sources. Additional data representing 1994 conditions in the STIA subbasin areas were used since land use changes may have occurred since development of earlier versions of the model. The land use information is presented for the STIA subbasin areas later in this Appendix. Figure B1-4 shows the STIA subbasins and the subbasins that comprise the remainder of the Des Moines Creek watershed.

Land use data for subbasins within the STIA area of analysis (Figure B1-4) were compiled using the ArcView 3.2 GIS coverage of airport land use from 1994 aerial photography. Data were developed for the 1994 base year drainage basin boundaries, soil, vegetation, and impervious surfaces. Land use was categorized as shown in Figure B1-4. Soil type was categorized as shown in Figure B1-5. Soil classification was obtained from mapping by the U.S. Geological Survey (Waldron 1962). Soil Conservation Service soil maps do not contain coverage of the area near STIA. Impervious area for the 1994 aerial photo coverage was digitized (Figure B1-6).

The STIA subbasin land use and soil/vegetation information used in the 1994 HSPF model was calculated using ARC/INFO GIS algorithms. The map layers of 1994 impervious areas, 1994 land use codes, 1994 soil codes, existing slope codes and lake areas were combined with the 1994 drainage subbasins using the mathematical concept of identity. A tabular file was output from the



Source: Water bodies derived from USGS hydrography data. Ground water contours from Seattle-Tacoma International Airport Ground Water Study. Associated Earth Sciences, Inc., and S. S. Papadopulos & Assoc., 1999

Note: STIA Subbasin GIS coverage obtained where conditions may change between 1994 and other conditions; subbasin boundaries shown outside of STIA area are for illustration and reference only

July 2001
556-2912-001 (28)

N

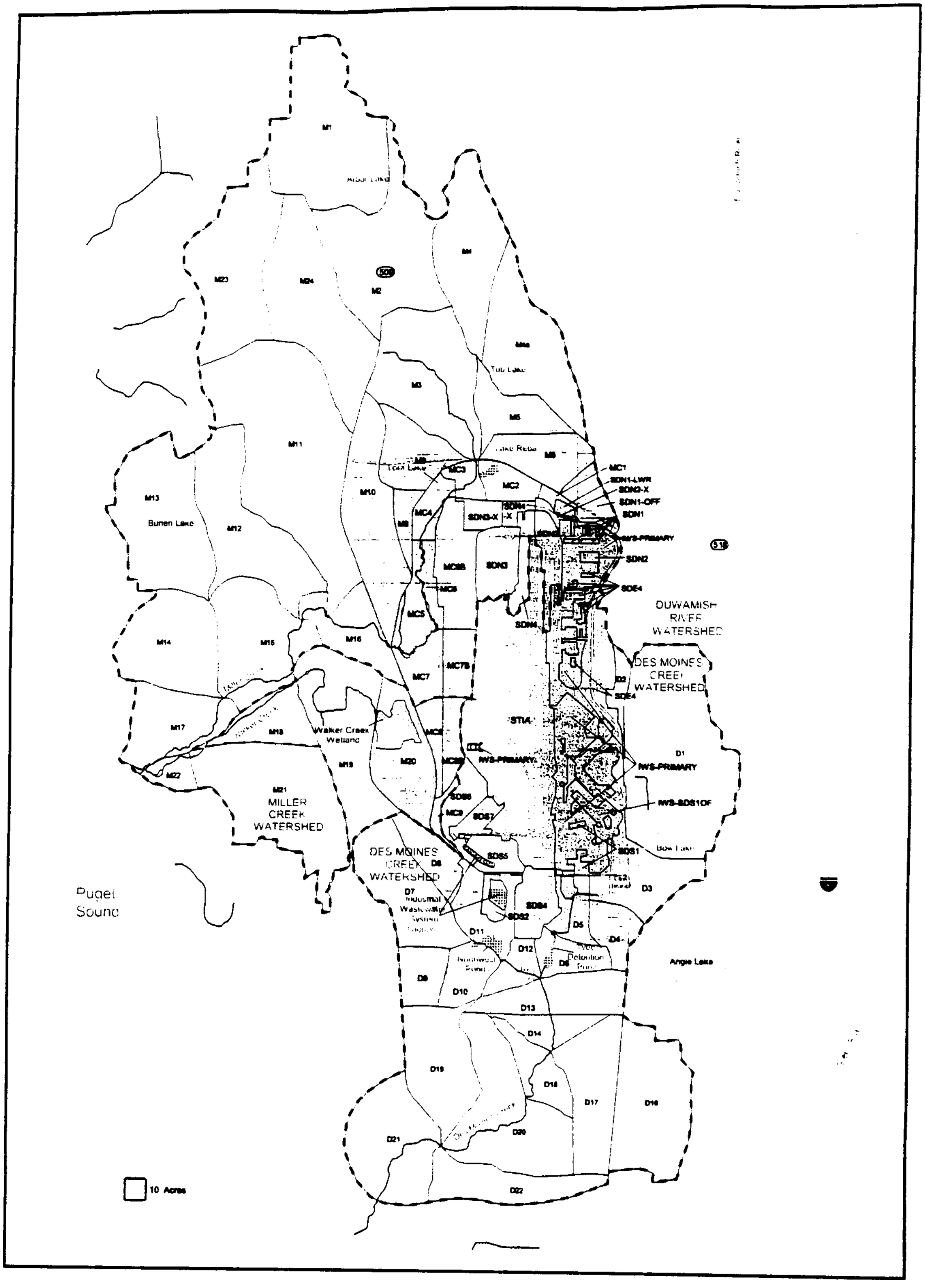
1000 0 1000 2000 Feet

1:36,000

- Existing (1994) Drainage Subbasins
- STIA Area (see note)
- Watershed Boundary
- Subwatershed Boundaries
- Rivers
- Roads
- Water Bodies
- Noncontiguous Miller Creek groundwater area
- Noncontiguous Walker Creek groundwater area
- Contiguous Miller/Walker groundwater area
- Noncontiguous Des Moines Creek groundwater area
- Contiguous Des Moines Creek groundwater area
- Ground water elevation contour (10 ft. interval) for shallow (C1) aquifer
- Data Point (e.g. monitoring well)
- Wells
- Locations where ground water elevation intersects stream channel
- General ground water flow direction

Figure B1-3 Groundwater Flow Direction and Boundaries

AR 046991



July 2001
556-2912-001 (28)

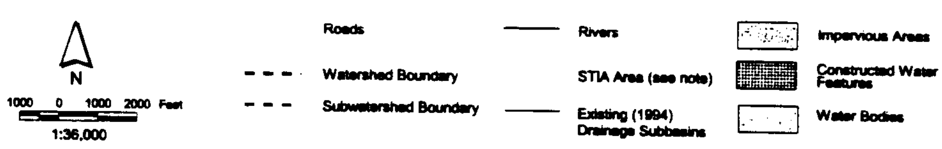
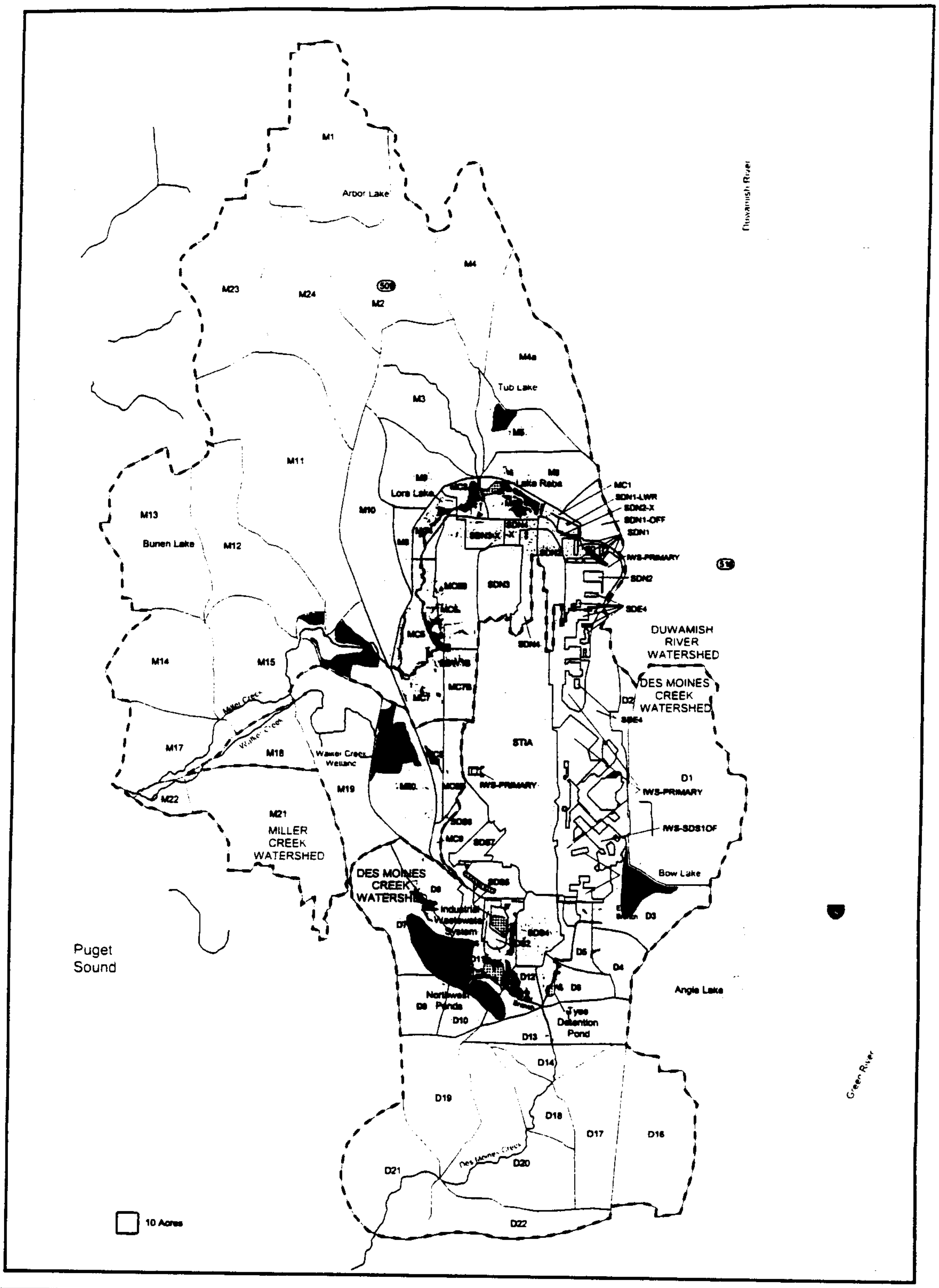


Figure B1-6
STIA Drainage Subbasins and 1994 Impervious Areas

AR 046992



July 2001
556-2912-001 (28)

N

1000 0 1000 2000 Feet

1:36,000

Roads

Existing (1994) Drainage Subbasins

STIA Area (see note)

Watershed Boundary

Subwatershed Boundary

Rivers

Water Bodies

Constructed Water Features

Soils:

Till

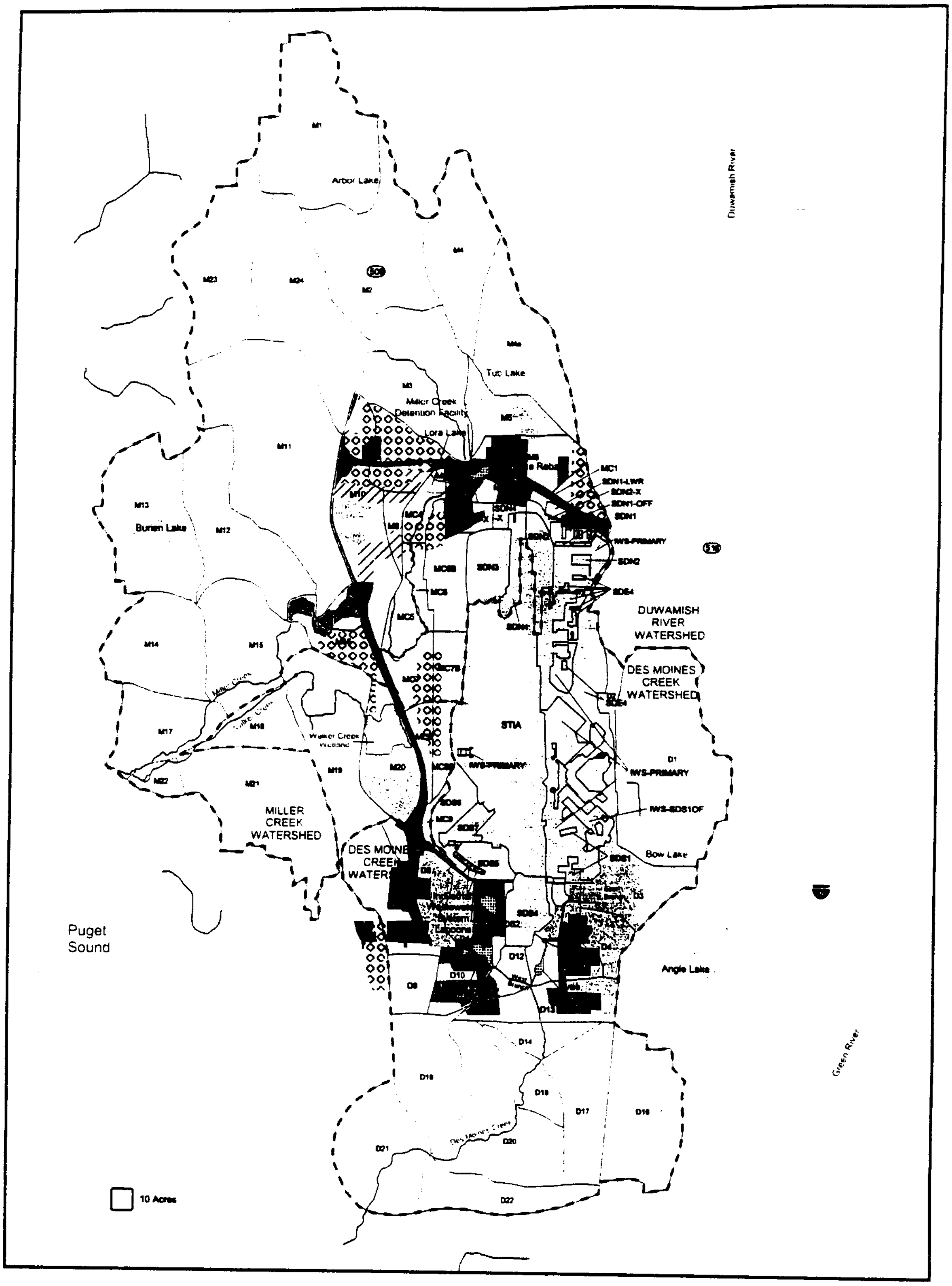
Wetland

Outwash

Lacustrine

Figure B1-5 STIA Drainage Subbasins and 1994 Soils

AR 046993



Paramatrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File: K:\Gis\2912\Arcview\Seatac-sptlns_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hydrography data. Estimated wetland boundaries are based on field reconnaissance by Paramatrix, Inc.
Land use data interpreted from 1993 STIA aerial photograph (Walker and Assoc. 1993).
Note: Subbasin boundaries shown outside of STIA area are for illustration and reference only.

July 2001
556-2912-001 (28)

N

1000 0 1000 2000 Feet

1:36,000

Roads

Existing (1994) Drainage Subbasins

STIA Area (see note)

Watershed Boundary

Subwatershed Boundary

Rivers

Water Bodies

Constructed Water Features

Detention Facilities (existing)

Sea-Tac Airport

Commercial

Open/Grass

Transportation

Low Density Residential

High Density Residential

Multi-Family Residential

Forest

Figure B1-4
STIA Drainage Subbasins and 1994 Land Use

resulting 1994 GIS map. This map was used to create the 1994 table used in the HSPF model. The 1994 report figures were also created using the 1994 GIS map data.

Table B1-1, at the end of this Appendix, summarizes the land use information (by subbasin) used for the model calibration based on 1994 watershed conditions. Existing impervious surfaces were assumed to be 100 percent effective for airport drainage to the SDS systems.

Subsequent to the GIS analysis examination of aerial photography identified 23.2 acres within SDS3 that should be categorized as impervious. The results primarily from construction of interconnecting taxiways, during the calibration period. The model was modified to incorporate this.

1.3 REGIONAL GROUNDWATER STUDY

In conjunction with an assessment of potential groundwater movement in the vicinity of STIA, the Port of Seattle commissioned a regional groundwater study to be performed by Associated Earth Sciences (AESI) and S.S. Papodopulos and Associates (AESI 1999). As part of that study, a groundwater model is being developed. At this time, preliminary results are available based on water well monitoring that indicate the transport direction of shallow and intermediate groundwater in the vicinity of Miller Creek.

Figure B1-3 shows the inferred direction of groundwater movement within the vicinity of the Des Moines Creek watershed. Note that much of the flow is directed toward a region in the lower portion of the creek just south of South 208th Street. Discharging groundwater occurs in this region as evidenced by the drawdown of the groundwater surface potentiometric lines. These form the shape of concentric ellipses in the discharge region shown in Figure B1-3. Other discharges occur upstream of this region where the stream intersects the base of the shallow aquifer layer, as identified by the green x's.

Figure B1-3 also depicts how the shallow aquifer groundwater elevation map was used to estimate the non-contiguous groundwater area contributing to Des Moines Creek. The map was superimposed with an outline of the subbasins used in the Des Moines Creek HSPF model. The approximate 512-acre area that is <u>not contiguous</u> with the surface water drainage topography was identified as three contributing "groundwater sheds" for Des Moines Creek.

1.4 CALIBRATION PROCESS AND RESULTS

Calibration of the model was performed using data from three flow gages:

- 11D – Des Moines Creek near the mouth.
- 11C – East branch of Des Moines Creek/Tyee Pond inflow.
- SDS3.

The locations of the Des Moines Creek flow monitoring gages are shown in Figure B1-1. The location of the SDS3 gage is south of subbasin SDS3, between SDS-2 and SDS4.

Parameter value adjustments were made initially to match the total simulated runoff volume with the total flow monitoring volume, within the standard criteria of 10 percent. After a good volume calibration was achieved, parameter values were adjusted to achieve proper simulation of base flows. Finally, detailed storm hydrographs were calibrated, primarily by adjustment of the IRC parameter.

The flow duration curves and hydrographs included at the end of this appendix summarize the results of the calibration at all three locations. For purposes of comparison, additional graphs are included for the following alternative parameter value sets:

- U.S. Geological Survey Regional Calibration Parameters.
- Des Moines Creek Basin Plan parameters. The results of this scenario do not reflect the actual Basin Plan model, but rather the model parameter set in the current calibration model, for comparison.
- HSPF Model Used in Preparation of the November 1999 draft SMP.

Table B1-2 lists parameter values for the calibrated model and the three scenarios mentioned above.

Table B1-2. Parameter value sets.

		Value			
Parameter	**Category**	**Calibration**	**U.S. Geological Survey Regional[1]**	**Basin Plan**	**11/99 draftSMP[1]**
LZSN	Till Forest	4.5	4.5	4.5	4.5
	Till Grass	4.5	4.5	4.5	4.5
	Outwash Forest	5.0	5.0	5.0	5.0
	Outwash Grass	5.0	5.0	5.0	5.0
INFILT	Till Forest	0.2	0.08	0.2	0.2
	Till Grass	0.075	0.03	0.075	0.075
	Outwash Forest	2.0	2.0	2.0	2.0
	Outwash Grass	0.8	0.8	0.8	0.8
KVARY	Till Forest	0.5	0.5	0.5	0.5
	Till Grass	0.5	0.5	0.5	0.5
	Outwash Forest	0.3	0.3	0.3	0.3
	Outwash Grass	0.3	0.3	0.3	0.3
INFEXP	Till Forest	2.0	2.0	2.0	2.0
	Till Grass	2.0	2.0	2.0	2.0
	Outwash Forest	2.0	2.0	2.0	2.0
	Outwash Grass	2.0	2.0	2.0	2.0
DEEPFR	Till Forest	0.55	-	0.7	0.6
	Till Grass	0.55	-	0.7	0.6
	Outwash Forest	0.55	-	0.7	0.6
	Outwash Grass	0.55	-	0.7	0.6
BASETP	Till Forest	0.0	0.0	0.0	0.0
	Till Grass	0.0	0.0	0.0	0.0

Table B1-2. Parameter value sets (continued).

Parameter	Category	Value			
		Calibration	U.S. Geological Survey Regional[1]	Basin Plan	11/99 draftSMP[1]
	Outwash Forest	0.0	0.0	0.0	0.0
	Outwash Grass	0.0	0.0	0.0	0.0
UZSN	Till Forest	0.50	0.50	0.50	0.50
	Till Grass	0.25	0.25	0.25	0.25
	Outwash Forest	0.50	0.50	0.50	0.50
	Outwash Grass	0.50	0.50	0.50	0.50
AGWRC	Till Forest	0.996	0.996	0.996	0.996
	Till Grass	0.996	0.996	0.996	0.996
	Outwash Forest	0.996	0.996	0.996	0.996
	Outwash Grass	0.996	0.996	0.996	0.996
INTFW	Till Forest	3.0	6.0	3.0	3.0
	Till Grass	3.0	6.0	3.0	3.0
	Outwash Forest	0.0	0.0	0.0	0.0
	Outwash Grass	0.0	0.0	0.0	0.0
LZETP	Till Forest	0.70	0.70	0.70	0.70
	Till Grass	0.25	0.25	0.25	0.25
	Outwash Forest	0.70	0.70	0.70	0.70
	Outwash Grass	0.25	0.25	0.25	0.25
IRC	Till Forest	0.50	0.50	0.25	0.25
	Till Grass	0.50	0.50	0.25	0.25
	Outwash Forest	0.70	0.70	0.35	0.35
	Outwash Grass	0.70	0.70	0.35	0.35
AGWETP	Till Forest	0.0	0.0	0.0	0.0
	Till Grass	0.0	0.0	0.0	0.0
	Outwash Forest	0.0	0.0	0.0	0.0
	Outwash Grass	0.0	0.0	0.0	0.0

1 Since the calibration model does not distinguish between slope categories, parameter values for moderate slopes were input for comparison.

Parameter values summarized in Table B1-2 generally show consistency among the four parameter value sets. Calibration INFILT values for till soils are higher than USGS values but are consistent with Basin Plan values.

Table B1-3 compares monitored runoff to simulated total runoff volume near the mouth of the Creek for all four scenarios. The results indicate that the best overall volume match at this location is achieved using the calibration and Basin Plan model.

Table B1-3. Comparison of monitored and simulated runoff volume at the mouth of Des Moines Creek.

Scenario	Simulated Volume % Difference vs Monitored Volume
Calibrated Model	3%
U.S. Geological Survey Parameters	15%
Basin Plan Parameters	-3%
11/99 draft SMP Model	4%

Comparison of the flow duration curves and hydrographs for the four parameter value sets, near the mouth of Des Moines Creek shows that the calibration file provides the best overall match of peak flows. The other three parameter value sets over simulate peak flows at this location. The calibrated model and the Basin Plan parameters provide the best overall match of base flows near the mouth.

Comparison of hydrographs at SDS3 also shows that the calibration file provides the best overall match of peak flows. The other three parameter value sets over simulate peak flows at this location as well. Examination of the hydrographs indicates that a much better overall match occurs—assuming that only surface runoff is collected in the SDS and conveyed to the monitored discharge point.

Comparison of flow duration curves and hydrographs at the Tyee Pond inflow indicate that all four parameter value sets underestimate both peaks and base flow. Repeated efforts at parameter value and impervious percentage adjustment failed to result in significant improvement of the calibration at this location. Attempts at increasing Tyee Pond simulated peaks and base flow consistently resulted in a poor calibration near the mouth of the creek. Refer to Calibration Issues, below, for further discussion about flow monitoring at this location.

1.5 CALIBRATION ISSUES

1.5.1 Tyee Pond Inflow Calibration

Although a good calibration was achieved at the mouth, the Tyee pond inflow is under simulating both volume and large peaks. However, a reasonable match is achieved for smaller peak flows. INFILT & IRC were lowered in an attempt to match peaks, with only limited improvement at Tyee Pond, but resulting in a poor calibration near the mouth. Parameters were therefore left at their previous values. This appears to be a hydraulic routing or flow monitoring data problem that can not necessarily be solved by parameter adjustment. Comparison of monitored peak flows at Tyee Pond inflow versus the creek mouth, for the March 23, 1995 storm show that the Tyee Pond inflow peak (~ 62 cfs) is actually higher than the peak flow near the mouth (~ 57 cfs).

According to the Basin Plan, Des Moines Creek has a base flow of approximately 0.55 cfs near the mouth. Flow monitoring data at the Tyee Pond inflow location indicates a base flow of approximately 0.35 cfs. The land use contributing to the east branch of the creek at Tyee Pond is so heavily urbanized that it seems unlikely that enough rainfall can get into groundwater to support 0.35 cfs base flow. If the flow monitoring data is correct at both locations, then 18 percent of the basin pervious area is contributing 64 percent of the creek base flow near the mouth. Additionally, much more outwash soil is located in the west and downstream subbasins which contributes a much larger portion of rainfall to the groundwater supply and subsequently the base flow.

1.5.2 SDS3 Calibration

For SDS3/airport subbasins, preexisting airport fill is modeled as till soil since the underlaying soil is till. Results using Basin Plan model parameters indicate that total simulated runoff volumes are 11 percent greater than recorded volumes. Receding limbs of the hydrographs did not decrease nearly as rapidly as recorded data. Since runoff from SDS3 is collected in a piped system, simulations were performed assuming that only surface runoff discharges from the subbasin through the SDS piping. This produced a much better match with receding limbs.

Since only surface runoff is routed to airport subbasin discharge points, interflow is routed to Des Moines Creek, downstream of the SDS3 collection system. Mapping provided as part of the regional groundwater study referenced in Section 3.4 was utilized for determination of interflow routing. Des Moines Creek subbasins located in the eastern portion of the airport, including interflow from IWS subbasin pervious areas, were routed to Bow Lake. Interflow from SDS3 was routed to Northwest Ponds inflow.

Flow monitoring data from the SDS3 gage has not been observed to exceed approximately 61 cfs for the three largest storms during the calibration period. Since the flow-monitoring gage is at the end of a long pipe with a tee outlet, it is possible that the capacity of that structure is approximately 61 cfs. Parametrix staff observed flow from the discharge pipe to be pulsating during a large storm event, a potential indicator of air binding. Additionally, the upstream manholes on the discharge pipe had to be sealed due to surcharging; further evidence that capacity is reached.

Total simulated volume is only 78 percent of monitored volume;[1] however, SDS3 flow monitoring also indicates a consistent base flow of approximately 0.5 cfs. Since runoff is collected and discharged through a piped system, it is unknown what phenomenon could produce this base flow. One explanation is that the flow monitoring device will not register zero flow. This could account for the undersimulation of total volume at the gage.

Gage 11D (Near Mouth)

According to a discussion with King County staff gage 11D, is believed to be accurate up to approximately 200 cfs. Above 200 cfs a downstream flow restriction creates a backwater at the gage location. Under this condition, small increases in stream flow create larger increases in stage at the gage location. As a result the gage is believed to overestimate flows above 200 cfs.

---

[1] Calibration results for the period October 1, 1989 through September 20, 1996 showed the total simulated volume to be 97 percent of the monitored volume.

2. REFERENCES

Associated Earth Sciences, Inc., and S.S. Papadopulos and Associates, Inc. 1999. Seattle-Tacoma International Airport groundwater study. Conceptual flow model boundary presentation. Prepared for Port of Seattle.

Earth Tech, Inc. 1997. City of SeaTac Surface Water Plan. Earth Tech, Inc., Bellevue, Washington. Prepared for City of SeaTac, SeaTac, Washington.

King County Department of Natural Resources. 1997. Des Moines Creek Basin Plan.

Montgomery Water Group, Inc. 1995. Hydrologic modeling study for Sea-Tac Airport Master Plan Update EIS. Appendix G.

Parametrix, Inc. 1999. Preliminary comprehensive stormwater management master plan. Prepared for Port of Seattle.

DES MOINES CREEK HSPF CALIBRATION MODEL INPUT FILE

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  ***  HSPF MODEL OF DES MOINES CREEK
  ***  PARAMETRIX JUNE, 2000
  ***  Revised to include King County comments (March 2001)
  ***  1994 BASE CONDITION/CALIBRATION MODEL
  ***  REVISE AIRPORT PERLND = 30% IMP. ASSUMPTION
  ***  ADD 23.2 AC OF IMPERVIOUS TO SDS 3 THAT WERE LEFT OUT
  ***
  DES MOINES CREEK BASIN HSPF MODEL
  START       1948/10/01 00:00  END    1996/09/30 24:00
  START       1992/01/01 00:00  END    1996/09/30 24:00***
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  RESUME     0 RUN     1
END GLOBAL

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MESSU       24    DM94R.MES
WDM         25    Dmcalib.WDM
END FILES

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      PERLND      26
      PERLND      34
      PERLND      44
      PERLND      54
      PERLND      65
      PERLND      66
      PERLND      67
      PERLND      68
      IMPLND      14
      COPY        50
      COPY        51
      COPY        52
      COPY        53
      COPY        54
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      RCHRES     361
      RCHRES      36
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      RCHRES      39
***   COPY        20
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      COPY         9
      RCHRES       4
      RCHRES     364
      RCHRES     365
      RCHRES     366
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  Copy-opn                                                                  ***
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END COPY

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   26       TGM- TILL GR MOD          1     1    1    1   60    0
   34       OF - OUTWASH FOR          1     1    1    1   60    0
   44       OG - OUTWASH GR           1     1    1    1   60    0
   54       SA - WETLANDS             1     1    1    1   60    0
   65       GW - TILL FOR MOD         1     1    1    1   60    0
   66       GW - TILL GR MOD          1     1    1    1   60    0
   67       GW - OUTWASH FOR          1     1    1    1   60    0
   68       GW - OUTWASH FOR          1     1    1    1   60    0

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  PRINT-INFO
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   26                     4.5000     0.0750    400.00    0.1000    0.5000    0.9960
   34                     5.0000     2.0000    200.00    0.0500    0.3000    0.9960
   44                     5.0000     0.8000    200.00    0.0500    0.3000    0.9960
   54                     4.0000     2.0000    200.00    0.0010    0.5000    0.9960
   65                     4.5000     0.2000    200.00    0.1000    0.5000    0.9960
   66                     4.5000     0.0750    400.00    0.1000    0.5000    0.9960
   67                     5.0000     2.0000    200.00    0.0500    0.3000    0.9960
   68                     5.0000     0.8000    200.00    0.0500    0.3000    0.9960

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   34                             2.0000    2.0000      0.55      0.00       0.0
   44                             2.0000    2.0000      0.55      0.00       0.0
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   65                             2.0000    2.0000      0.55      0.00       0.0
   66                             2.0000    2.0000      0.55      0.00       0.0
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  44          0.1000    0.5000    0.2500     0.000    0.7000    0.2500
  54          0.2000    3.0000    0.5000     1.000    0.7000    0.8000
  65          0.2000    0.5000    0.3500     3.000    0.5000    0.7000
  66          0.1000    0.2500    0.2500     3.000    0.5000    0.2500
  67          0.2000    0.5000    0.3500     0.000    0.7000    0.7000
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  34           0.078        0.    0.0010        0.     0.090     0.676     0.038
  44           0.051        0.    0.0040        0.     1.127     0.614     0.152
  54           0.051        0.    0.3330        0.     0.622     0.000     0.000
  65           0.078        0.    0.0010        0.     0.075     0.267     0.026
  66           0.051        0.    0.0350        0.     1.928     0.680     0.049
  67           0.078        0.    0.0010        0.     0.090     0.676     0.038
  68           0.051        0.    0.0040        0.     1.127     0.614     0.152

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  IWAT-PARM3
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  END IWAT-PARM3
  IWAT-STATE1
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    # -  #      RETS      SURS                                               ***
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END IMPLND

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  5     E.Branch above TyeeP    1    1    1    1    0    0    0
  7     DM7 & DM8 Conveyance    1    1    1    1    0    0    0
  9     DM9 Conveyance          1    1    1    1    0    0    0
 12     Lower W. Branch         1    1    1    1    0    0    0
 13     Confl. to 200th St.     1    1    1    1    0    0    0
 14     200th to Exec. Trib.    1    1    1    1    0    0    0
 17     Executel Tributary      1    1    1    1    0    0    0
 18     Exec.Confl. to 208th    2    1    1    1    0    0    0
 34     Bow Lake                2    1    1    1    0    0    1
 35     Pipe A Bow LK Outlet    1    1    1    1    0    0    0
 36     SDE-4 Combined Disch    1    1    1    1    0    0    0
 37     Pipe B 60" Intl Blvd    1    1    1    1    0    0    0
 38     Upper E. Branch         1    1    1    1    0    0    0
 39     SDS-1 Storm Only        1    1    1    1    0    0    0
 40     Tyee Pond               1    1    1    1    0    0    0
 41     SDS-2,5,6 & 7 Disch     1    1    1    1    0    0    0
 43     Northwest Ponds         2    1    1    1    0    0    1
 46     Executel Pond           1    1    1    1    0    0    0
 47     Pipe C Exec.Pond Dis    1    1    1    1    0    0    0
177     North Branch Ravine     1    1    1    1    0    0    0
193     Upper Ravine            1    1    1    1    0    0    0
198     Lower Ravine            1    1    1    1    0    0    0
360     SDE-4 NSPS              2    1    1    1    0    0    0
361     SDE-4 CSMPS             2    1    1    1    0    0    0
364     SDN-2 NCPS              2    1    1    1    0    0    0
365     SDN-2 NSMPS             2    1    1    1    0    0    0
366     OTF   SSMPS             2    1    1    1    0    0    0
390     SDS-1 IWS Overflow      2    1    1    1    0    0    0
400     IWS Lagoons             2    1    1    1    0    0    0
END GEN-INFO

ACTIVITY
  RCHRES *************** Active Sections *****************
  # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG                     ***
  1  400    1    0    0    0    0    0    0    0    0    0
END ACTIVITY
PRINT-INFO
  RCHRES *************** Printout Flags ****************** PIVL  PYR
  # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
  1  400    6    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO
HYDR-PARM1
  RCHRES  Flags for each HYDR Section                                         ***
  # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
          FG FG FG FG  possible  exit  *** possible  exit      possible  exit
          *  *  *  *   *  *  *  *  *       *  *  *  *  *          ***
  4   17   0  1  1  0   4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 18   34   0  1  1  0   4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 35   41   0  1  1  0   4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 43        0  1  1  0   4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 46  198   0  1  1  0   4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
360  400   0  1  1  0   4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
END HYDR-PARM1

HYDR-PARM2
  RCHRES                                                                      ***
  # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50          ***
<------><--------><--------><--------><--------><--------><-------->          ***
  4              4   0.530                               0.3
  5              5   0.380                               0.3
  7              7   0.341                               0.3
  9              9   0.189                               0.3
 12             12   0.273                               0.3
 13             13   0.218                               0.3
 14             14   0.218                               0.3
 17             17   0.246                               0.3
 18             18   0.303                               0.3
 34             34   0.208                               0.3
 35             35   0.123                               0.3
 36             36   0.100                               0.3
 37             37   0.381                               0.3
 38             38   0.142                               0.3
 39             39   0.100                               0.3
```

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  40            40   0.189                                  0.3
  41            41   0.530                                  0.3
  43            43   0.189                                  0.3
  46            46   0.047                                  0.3
  47            47   0.417                                  0.3
 177           177   0.407                                  0.3
 193           193   0.795                                  0.3
 198           198   0.631                                  0.3
 360           360   0.010                                  0.0
 361           361   0.010                                  0.0
 364           364   0.010                                  0.0
 365           365   0.010                                  0.0
 366           366   0.010                                  0.0
 390           390   0.010                                  0.0
 400           400   0.010                                  0.3
 END HYDR-PARM2

 HYDR-INIT
   RCHRES  Initial conditions for each HYDR section                                ***
   # -  # ***   VOL      Initial  value  of COLIND    Initial  value  of OUTDGT
          *** ac-ft      for each possible exit       for each possible exit
 <------><-------->      <---><---><---><---><---> *** <---><---><---><---><--->
   4    0.1                 4.0
   5    0.1                 4.0
   7    0.1                 4.0
   9    0.1                 4.0
  12    0.1                 4.0
  13    0.1                 4.0
  14    0.1                 4.0
  17    0.1                 4.0
  18    0.1                 4.0  5.0
  34    35.                 4.0  5.0
  35    0.0                 4.0
  36    0.0                 4.0
  37    0.0                 4.0
  38    0.0                 4.0
  39    0.0                 4.0
  40    0.0                 4.0
  41    0.0                 4.0
  43    0.7                 4.0  5.0
  46    0.0                 4.0
  47    0.0                 4.0
 177    0.0                 4.0
 193    0.0                 4.0
 198    0.0                 4.0
 360    0.0                 4.0  5.0
 361    0.0                 4.0  5.0
 364    0.0                 4.0  5.0
 365    0.0                 4.0  5.0
 366    0.0                 4.0  5.0
 390    0.0                 4.0  5.0
 400    0.0                 4.0  5.0
 END HYDR-INIT
END RCHRES

FTABLES

  FTABLE      4
*** SDS-3 OUTLET SWALE
 ROWS COLS ***
    7    4
***  DEPTH      AREA    VOLUME    OUTFLOW  OUTFLOW2                         ***
      (FT)    (ACRES) (ACRE-FT)    (CFS)     (CFS)
      .000      .000       0.0       0.0
      .500      .198       0.1       9.0
     1.000      .236       0.5      30.9
     2.000      .306       1.0     115.8
     3.000      .376       1.5     265.5
     4.000      .446       5.0     491.8
     5.000      .517      20.0     806.3
  END FTABLE  4

  FTABLE      5
*** (REACH 5:  THIS TABLE LOOKS OK)
*** EAST BRANCH ABOVE TYEE POND
 ROWS COLS ***
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```
   13     4
*** DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2                           ***
    (FT)    (ACRES)  (ACRE-FT)     (CFS)     (CFS)
    .000       .000       .000      .000
    .550       .290       .100     4.900
   1.100       .543       .200    20.800
   1.650       .609       .300    46.500
   2.200       .671       .400    80.000
   2.750       .732      0.500   118.700
   3.300       .778      0.600   159.500
   3.850       .819      0.700   198.400
   4.400       .849      0.801   231.900
   4.950       .866      1.000   252.900
   5.500       .865      1.200   253.000
   8.200       .973      1.500   400.000
  10.200      1.043      2.000   520.000
  END FTABLE  5

  FTABLE      7
*** DM7 & DM8 CONVEYANCE
 ROWS COLS ***
    8     4
*** DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2                           ***
    (FT)    (ACRES)  (ACRE-FT)     (CFS)     (CFS)
    .000       .000       .000      .000
    .500       .360       .120     6.200
   1.000       .416       .276    20.800
   2.000       .520       .694    75.400
   3.000       .626      1.252   168.700
   4.000       .732      1.950   306.900
   5.000       .836      2.790   496.100
   6.000       .942      3.768   742.300
  END FTABLE  7

  FTABLE      9
*** DM9 CONVEYANCE
 ROWS COLS ***
    8     4
*** DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2                           ***
    (FT)    (ACRES)  (ACRE-FT)     (CFS)     (CFS)
    .000        .00        0.0        .0
    .500        .20        0.7       9.7
   1.000        .23        3.1      32.6
   2.000        .29       14.9       118
   3.000        .35       38.4       265
   4.000        .41         77       482
   5.000        .47        135       778
   6.000        .52        214      1165
  END FTABLE  9

  FTABLE     12
*** LOWER WEST BRANCH
*** REVISED BASED ON HEC-RAS MODEL
 ROWS COLS ***
   13     4
*** DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2                           ***
    (FT)    (ACRES)  (ACRE-FT)     (CFS)     (CFS)
    .000       .000      0.000      .000
    .500       .291      0.030     0.150
   1.000       .346      0.260     6.600
   2.000       .450      0.430    14.100
   3.000       .554      0.650    25.000
   4.000       .656      1.180    50.000
   5.000       .753      2.170    75.000
   6.000       .796      3.820   100.000
   7.000       .837      8.820   150.000
   8.000       .837     16.200   200.000
   9.000       .837     27.920   250.000
  10.000       .837     33.530   350.000
  11.000       .837     35.380   450.000
  END FTABLE 12

  FTABLE     13
*** CONFLUENCE TO 200TH STREET
 ROWS COLS ***
    9     4
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*** DEPTH     AREA    VOLUME    OUTFLOW  OUTFLOW2              ***
     (FT)   (ACRES) (ACRE-FT)    (CFS)     (CFS)
     .000     .000      .000      .000
     .500     .153      .051     4.300
    1.000     .272      .132    14.400
    2.000     .317      .312    50.400
    3.000     .360      .544   109.600
    4.000     .404      .826   195.000
    5.000     .450     1.163   309.500
    6.000     .497     1.548   456.300
    7.000     .542     1.984   638.000
  END FTABLE 13

  FTABLE     14
*** 200TH STREET TO EXECUTEL TRIBUTARY
*** REACH 190 FROM TR-20/KING COUNTY BASIN PLAN MODEL:
 ROWS COLS ***
    5    4
*** DEPTH     AREA    VOLUME    OUTFLOW  OUTFLOW2              ***
     (FT)   (ACRES) (ACRE-FT)    (CFS)     (CFS)
    0.000    0.000     0.000     0.000
    0.900    0.70     0.4000     30.00
    1.800    0.80     1.1000    115.60
    2.700    1.10     2.1000    269.80
    4.200    1.30     4.3000    707.10
  END FTABLE 14

  FTABLE     17
*** EXECUTEL TRIBUTARY
 ROWS COLS ***
   10    4
*** DEPTH     AREA    VOLUME    OUTFLOW  OUTFLOW2              ***
     (FT)   (ACRES) (ACRE-FT)    (CFS)     (CFS)
     .000     .000      .000      .000
     .300     .169      .034     2.900
     .600     .192      .076     9.800
     .900     .215      .128    20.400
    1.200     .238      .189    35.100
    1.500     .259      .258    54.100
    1.800     .282      .336    77.700
    2.100     .303      .423   106.200
    3.100     .376      .779   245.000
    3.600     .412      .988   335.000
  END FTABLE 17

  FTABLE     18
*** CONFLUENCE WITH EXECUTEL TRIBUTARY TO 208TH STREET
*** REPRESENTS GW LOSS IN WETLAND BELOW 200TH
 ROWS COLS ***
   14    5
*** DEPTH     AREA    VOLUME    OUTFLOW  OUTFLOW2              ***
     (FT)   (ACRES) (ACRE-FT)    (CFS)     (CFS)
     .000     .000      .000      .000      0.00
     .500     .572      .191     7.300      0.00
    1.000     .799      .438    10.000      0.00
    2.000     .968     1.001    20.700      0.00
    3.000    1.155     1.727   100.000      0.00
    4.000    1.317     2.542   262.700      0.00
    5.000    1.478     3.475   400.300      0.00
    6.000    1.643     4.545   570.200      0.00
    7.000    1.791     5.688   774.400      0.00
    8.000    1.932     6.822  1015.100      0.00
    9.000    1.945     7.025  1294.500      0.00
   10.000    1.958     7.244  1614.500      0.00
   11.000    1.970     7.481  1977.000      0.00
   12.000    1.983     7.734  2384.700      0.00
  END FTABLE 18

  FTABLE     34
*** BOW LAKE
*** BASED ON ENTRANCE CONTROL FOR 36 INCH OUTLET PIPE
 ROWS COLS ***
    8    5
*** DEPTH     AREA    VOLUME    OUTFLOW  OUTFLOW2              ***
     (FT)   (ACRES) (ACRE-FT)    (CFS)     (CFS)
    0.000   14.000     0.000     0.000      0.00
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```
      1.000     14.000     14.000      7.000      0.00
      1.500     14.000     21.000     13.000      0.00
      2.000     14.000     28.000     17.000      0.00
      3.000     14.000     42.000     35.000      0.00
      4.000     14.000     56.000     49.000      0.00
      5.000     14.000     70.000     60.000      0.00
      6.000     14.000     84.000     70.000      0.00
  END FTABLE 34

  FTABLE     35
*** 36" BOW LAKE DISCHARGE PIPELINE (A)
*** STORAGE ELIMINATED FROM MONTGOMERY MODEL (DMH 1/4/96)
 ROWS COLS ***
   13    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                              ***
      (FT)   (ACRES) (ACRE-FT)     (CFS)     (CFS)
      .000      .000      .000      .000
      .300      .020     .0006     1.000
      .600      .026     .0026     4.200
      .900      .032     .0068     9.400
     1.200      .034     .0134    16.200
     1.500      .037     .0226    24.000
     1.800      .039     .0346    32.300
     2.100      .040     .0492    40.100
     2.400      .040     .0667    46.900
     2.700      .039     .0857    51.200
     3.000      .037     .1000    55.300
*** SURCHARGING- NEXT LINES ARE FICTITIOUS
     3.300      .038     .2500    60.300
     4.000      .038     .4000    80.000
  END FTABLE 35

*** REACH 36 HUGELY OVER-ATTENUATED FLOWS PROVIDING
*** 25.+ AC-FT OF STORAGE.  1/4/96 DISCUSSION WITH K. RITLAND
*** OF MONTGOMERY GROUP SUGGESTS TR-20 MODEL WAS MISINTERPRETED
*** IN DEVELOPMENT OF ORIGNINAL F-TABLE.  FOLLOWING TABLE IS CON-
*** SISTENT WITH TR-20 MODEL AND 5700 FOOT LENGTH.
*** NOTE: LENGTH SHORTENED TO 0.1 MILE (HSPF UNITS).  MORE CONSISTENT
*** WITH SDE-4 CONVEYANCE
  FTABLE     36
*** SDE-4 COMBINED DISCHARGE
 ROWS COLS ***
   11    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                              ***
      (FT)   (ACRES) (ACRE-FT)     (CFS)     (CFS)
      .000      .000      .000      .000
      .400      .343     0.090     2.200
      .800      .442     0.150     9.500
     1.200      .523     0.200    21.100
     1.600      .577     0.250    36.300
     2.000      .618     0.300    54.000
     2.400      .646     0.350    72.500
     2.800      .659     0.400    90.200
     3.200      .662     0.450   105.500
     3.600      .649     0.550   115.000
     4.000      .618     0.650   115.100
  END FTABLE 36

  FTABLE     37
*** 60" INTERNATIONAL BLVD PIPELINE (B)
*** (THIS ONE LOOKS OK, DMH 1/4/96)
 ROWS COLS ***
   13    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                              ***
      (FT)   (ACRES) (ACRE-FT)     (CFS)     (CFS)
      .000      .000      .000      .000
      .450      .134      .045     4.800
      .900      .190      .100    20.300
     1.350      .225      .150    45.400
     1.800      .249      .200    78.000
     2.250      .266      .250   115.900
     2.700      .271      .300   155.800
     3.150      .264      .350   193.800
     3.600      .251      .400   226.500
     4.050      .238      .450   247.000
     4.500      .234      .500   247.100
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      6.500       .185       .600   340.000
      8.500       .166       .700   415.000
  END FTABLE 37

  FTABLE     38
*** UPPER EAST BRANCH
*** VOLUMES CORRECTED 1/4/96 (PREVIOUSLY HUGE VOLUMES IN MONTGOMERY TABLE)
 ROWS COLS ***
    9    4
***  DEPTH       AREA    VOLUME    OUTFLOW  OUTFLOW2                      ***
      (FT)    (ACRES) (ACRE-FT)     (CFS)     (CFS)
      .000       .000      .000      .000
      .500       .176      .100     9.200
     1.000       .194     0.150    30.400
     2.000       .232     0.200   105.800
     3.000       .271     0.250   228.900
     4.000       .310     0.350   405.800
     5.000       .349     0.450   642.700
     6.000       .387     0.600   945.700
     7.000       .426     0.800  1320.700
  END FTABLE 38

*** AGAIN, IS THE STORAGE REALISTIC IN THIS TABLE, REACH 39
*** VOLUMES ARE WAY TOO HIGH TO BE CONSISTENT WITH TR-20
*** STORAGE IN MONTGOMERY MODEL HAS BEEN ELIMINATED (DMH  1/4/96)
  FTABLE     39
*** SDS-1 DISCHARGE
 ROWS COLS ***
   11    4
***  DEPTH       AREA    VOLUME    OUTFLOW  OUTFLOW2                      ***
      (FT)    (ACRES) (ACRE-FT)     (CFS)     (CFS)
      .000       .000      .000      .000
      .250       .020      .030     2.200
      .500       .027      .035     9.400
      .750       .031      .042    21.000
     1.000       .035      .049    36.000
     1.250       .039     0.056    53.600
     1.500       .039     0.064    72.000
     1.750       .041     0.074    89.500
     2.000       .041     0.084   104.700
     2.250       .041     0.094   114.200
     2.500       .038     0.100   114.300
  END FTABLE 39

  FTABLE     40
*** TYEE POND
*** BASED ON TYEE POND AS-BUILTS AND AUTOMATED GATE OPERATION MANUAL
*** K RITLAND 2/4/98
 ROWS COLS ***
   20    4
***  DEPTH       AREA    VOLUME    OUTFLOW  OUTFLOW2                      ***
      (FT)    (ACRES) (ACRE-FT)     (CFS)     (CFS)
      0.00       0.00      0.00      0.00
      0.90       0.01      0.01     10.00
      1.65       0.02      0.02     20.00
      3.11       0.07      0.07     30.00
      4.56       0.22      0.29     40.00
      6.02       0.63      0.89     50.00
      7.48       0.88      2.02     60.00
      8.62       1.06      3.18     70.00
      9.79       1.18      4.29     80.00
     10.88       1.34      5.83     90.00
     11.99       1.48      7.20    100.00
     13.12       1.69      9.17    110.00
     15.13       2.04     12.90    120.00
     16.10       2.20     14.92    124.10
     16.30       2.24     15.40    129.65
     16.57       2.28     15.88    150.36
     16.64       2.32     16.36    155.00
     16.80       2.36     16.84    208.74
     17.03       2.40     17.32    293.59
     17.26       2.43     17.79    428.11
  END FTABLE 40

  FTABLE     41
*** SDS-2,5,6 & 7 DISCHARGE
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  ROWS COLS ***
     7    4
 ***  DEPTH       AREA    VOLUME    OUTFLOW   OUTFLOW2                           ***
      (FT)     (ACRES)  (ACRE-FT)    (CFS)      (CFS)
      .000       .000         0.0        0.0
      .500       .198         0.1        9.0
     1.000       .236         0.5       30.9
     2.000       .306         1.0      115.8
     3.000       .376         1.5      265.5
     4.000       .446         5.0      491.8
     5.000       .517        20.0      806.3
  END FTABLE 41

  FTABLE      43
 *** NORTHWEST PONDS
 *** BASED ON KING COUNTY BASIN PLANNING MODEL (DAVID HARTLEY, 12/16/98)
  ROWS COLS ***
    17    5
 ***  DEPTH       AREA    VOLUME    OUTFLOW   OUTFLOW2                           ***
      (FT)     (ACRES)  (ACRE-FT)    (CFS)      (CFS)
     0.000     12.000       0.000      0.000      0.00
     0.100     12.000      18.800      0.000      0.00
     1.000     12.000      24.000      0.200      0.00
     2.000     12.000      30.000      0.500      0.00
     3.000     12.000      37.000      1.000      0.00
     3.500     13.000      41.000      5.000      0.00
     4.000     13.000      45.700     15.000      0.00
     4.500     13.000      51.000     35.000      0.00
     5.000     14.000      56.500    150.000      0.00
     5.500     14.000      62.800    200.000      0.00
     6.000     14.000      69.000    300.000      0.00
     6.500     14.000      83.500    350.000      0.00
     7.000     15.000      99.900    400.000      0.00
     8.000     17.000      119.00    500.000      0.00
     9.000     20.000      141.50    550.000      0.00
    10.000     23.000      180.00    600.000      0.00
    11.000     27.000      200.00    650.000      0.00
  END FTABLE 43

  FTABLE      46
 *** EXECUTEL POND
  ROWS COLS ***
    20    4
 ***  DEPTH       AREA    VOLUME    OUTFLOW   OUTFLOW2                           ***
      (FT)     (ACRES)  (ACRE-FT)    (CFS)      (CFS)
      .000       .000        .000       .000
     1.000       .080        .080     24.420
     2.000       .230        .310     34.540
     3.000       .393        .703     42.300
     3.500       .494        .950     45.690
     4.000       .508       1.204     48.850
     4.500       .532       1.470     51.810
     5.000       .540       1.740     54.610
     5.500       .540       2.010     57.280
     6.000       .580       2.300     59.820
     6.500       .600       2.600     62.270
     7.000       .600       2.900     64.620
     7.500       .600       3.200     66.900
     8.000       .620       3.510     69.100
     8.500       .640       3.830     71.200
     9.000       .740       4.200     82.220
    10.000       .650       4.850    119.830
    11.000       .720       5.570    169.000
    12.000       .750       6.320    250.900
    13.000      1.000       7.320    500.900
  END FTABLE 46

  FTABLE      47
 *** EXECUTEL POND DISCHARGE PIPELINE (C)
  ROWS COLS ***
    11    4
 ***  DEPTH       AREA    VOLUME    OUTFLOW   OUTFLOW2                           ***
      (FT)     (ACRES)  (ACRE-FT)    (CFS)      (CFS)
      .000       .000        .000       .000
      .350       .069        .020      4.600
      .700       .096        .056     19.200
```

```
    1.050      .112      .099    42.800
    1.400      .124      .150    73.400
    1.750      .125      .203   109.000
    2.100      .121      .240   146.600
    2.450      .110      .264   182.400
    2.800      .096      .284   213.200
    3.150      .090      .290   232.400
    3.500      .088      .293   232.600
  END FTABLE 47

  FTABLE    177
*** NORTH BRANCH RAVINE
 ROWS COLS ***
   14    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                            ***
     (FT)    (ACRES) (ACRE-FT)     (CFS)     (CFS)
     .000      .000      .000        .0
     .500      .572      .191       7.3
    1.000      .799      .438      23.2
    2.000      .968     1.001      75.7
    3.000     1.155     1.727     155.1
    4.000     1.317     2.542     262.7
    5.000     1.478     3.475     400.3
    6.000     1.643     4.545     570.2
    7.000     1.791     5.688     774.4
    8.000     1.932     6.822    1015.1
    9.000     1.945     7.025    1294.5
   10.000     1.958     7.244    1614.5
   11.000     1.970     7.481    1977.0
   12.000     1.983     7.734    2384.7
  END FTABLE177

  FTABLE    193
*** UPPER RAVINE
 ROWS COLS ***
   14    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                            ***
     (FT)    (ACRES) (ACRE-FT)     (CFS)     (CFS)
     0.00      0.00      0.00       0.0
     0.35      0.72      0.75       7.8
     0.70      0.72      1.51      23.5
     1.05      0.72      2.28      44.3
     1.40      0.72      3.03      68.2
     1.75      0.72      3.81      95.8
     2.10      0.72      4.56     125.2
     2.45      0.75      5.36     169.0
     2.80      0.89      6.30     171.5
     3.15      1.00      7.35     247.6
     3.50      1.08      8.49     332.7
     3.85      1.21      9.75     396.5
     4.20      1.32     11.13     521.2
     4.55      1.41     12.60     655.5
  END FTABLE193

  FTABLE    198
 ROWS COLS ***
*** LOWER RAVINE
*** ROUGH ESTIMATE BASED ON FIELD VISIT OF 12/20/95
*** NEED A 2 FT CONTOUR SURVEY TO IMPROVE DEPTH STORAGE INFO
*** FLOW WAS 6 TO 7 CFS WITH DEPTH OF 8"
*** NEAR OUTLET.
*** DRIVE WHICH REPRESENTS A RESTRICTION ACCORDING TO OBSERVATION
*** CULVERT HYDRAULICS SHOULD BE ANALYSED ALSO.
    8    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                            ***
     (FT)    (ACRES) (ACRE-FT)     (CFS)     (CFS)
     0.00      0.00      0.00       0.0
     1.00      0.50      0.80      10.0
     2.00      0.55      1.30      25.0
     3.00      0.60      1.80      50.0
     5.00      0.70      2.50     100.0
*** SUBMERGENCE OF CULVERT
    10.00      2.50     12.00     245.0
*** OVERBANK STORAGE
*** FLOWS BASED ON 243', .03 D-W FACTOR, PLUS LOSS OF 1. VELOCITY HEAD
    15.00     10.00     40.00     325.0
```

```
    20.00      11.00      90.00      390.0
  END FTABLE198

  FTABLE     360
*** NORTH SATELLITE PUMP STATION (SDE-4) (INSTALLED IN 1995)                ***
 ROWS COLS
    5    5                                                                  ***
     DEPTH       AREA     VOLUME      (IWS)      (SDS)                      ***
      (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)
        .0        1.0        .00       0.00       0.00
      1.00        1.0        .01       4.79       0.00
      2.00        1.0        .02       4.79       0.00
      3.00        1.0        .03       4.79      25.00
      4.00        1.0        .04       4.79      50.00
  END FTABLE360

  FTABLE     361
*** CENTRAL SNOWMELT PUMP STATION (SDE-4) (INSTALLED IN 1998)               ***
 ROWS COLS
    5    5                                                                  ***
     DEPTH       AREA     VOLUME      (IWS)      (SDS)                      ***
      (FT)    (ACRES)  (ACRE-FT)   ( FT3/S)   ( FT3/S)
        .0        1.0        .00       0.00       0.00
      1.00        1.0        .01       1.67       0.00
      2.00        1.0        .02       1.67       0.00
      3.00        1.0        .03       1.67      25.00
      4.00        1.0        .04       1.67      50.00
  END FTABLE361

  FTABLE     364
*** NORTH CARGO PUMP STATION (SDN-2) (INSTALLED IN OCTOBER 1997)            ***
 ROWS COLS
    5    5                                                                  ***
     DEPTH       AREA     VOLUME      (IWS)      (SDN)                      ***
      (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)
        .0       1.00        .00       0.00       0.00
      1.00       1.00        .01       6.13       0.00
      2.00       1.00        .02       6.13       0.00
      3.00       1.00        .03       6.13      25.00
      4.00       1.00        .04       6.13      50.00
  END FTABLE364

  FTABLE     365
*** NORTH SNOWMELT PUMP STATION (SDN-2) (INSTALLED IN LATE 1997/1998)       ***
 ROWS COLS
    5    5                                                                  ***
     DEPTH       AREA     VOLUME      (IWS)      (SDN)                      ***
      (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)
        .0       1.00        .00       0.00       0.00
      1.00       1.00        .01       1.67       0.00
      2.00       1.00        .02       1.67       0.00
      3.00       1.00        .03       1.67      25.00
      4.00       1.00        .04       1.67      50.00
  END FTABLE365

  FTABLE     366
*** SOUTH SNOWMELT (OLYMPIC TANK FARM) PUMP STATION (INSTALLED IN LATE 1997/1998)
 ROWS COLS                                                                  ***
    5    5                                                                  ***
     DEPTH       AREA     VOLUME      (IWS)      (SDS)                      ***
      (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)
        .0       1.00        .00       0.00       0.00
      1.00       1.00        .01       1.67       0.00
      2.00       1.00        .02       1.67       0.00
      3.00       1.00        .03       1.67      25.00
      4.00       1.00        .04       1.67      50.00
  END FTABLE366

  FTABLE     390
*** IWS OVERFLOW TO SDS-1
*** BASED ON SYMONDS MEMO 1/6/98, FROM WATERWORKS MODELING
 ROWS COLS                                                                  ***
    7    5                                                                  ***
     DEPTH       AREA     VOLUME      (IWS)      (SDS)                      ***
      (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)
        .0        .00       .000        .00        .00
```

```
     1.00        .20       .001      4.70      0.00
     1.50        .20       .002      4.90      0.50
     2.00        .20       .003      5.60      3.00
     2.50        .23       .004      5.65      4.40
     3.00        .23       .005      5.70      6.30
     4.00        .23       .006      6.00     12.00
  END FTABLE390

  FTABLE    400                                                  ***
 ROWS COLS            IWS LAGOONS
*** OUTFLOW1 =  2/4 MGD OUTPUT OF TREATED EFFLUENT TO SOUND
*** OUTFLOW2 =  OVERFLOW TO NORTHWEST PONDS
    9    5
   DEPTH      AREA    VOLUME  IWS - PS  OVERFLOW                 ***
    (FT)   (ACRES) (ACRE-FT)     (CFS)     (CFS)                 ***
      .0       0.0       .00      0.00       .00
     2.0       7.0      20.0      3.09      0.00
     4.0       7.0      34.0      3.09      0.00
     6.0       7.5      48.0      3.09      0.00
     8.0       8.0      63.0      6.19      0.00
    10.0       8.0      79.0      6.19      0.00
*** THREAT OF OVERFLOW, THEN PLANT INCREASES TREATMENT RATE, BUT
*** LOSES TREATMENT EFFICIENCY IN ORDER TO AVOID DISCHARGE TO
*** DES MOINES CREEK SYSTEM
    11.5       8.0      90.5     11.00      0.00
    11.6       8.0      91.0     11.00    100.00
    11.7       8.0      91.5     11.00    300.00
  END FTABLE400
END FTABLES


EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGLZERO               PERLND  14  68 EXTNL  PREC
WDM      2 PREC     ENGLZERO               IMPLND  14     EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  34     EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  40     EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  43     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8        PERLND  14 440 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO    0.8        IMPLND  14 140 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO    0.8        RCHRES  34     EXTNL  POTEV
WDM      1 EVAP     ENGLZERO    0.8        RCHRES  43     EXTNL  POTEV
WDM      1 EVAP     ENGLZERO    0.8        RCHRES  40     EXTNL  POTEV
END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
*******************************************************************************
*** TO WDM ONLY FOR WATER BALANCE CALIBRATION
COPY     50 OUTPUT MEAN   1     12.1       WDM     50 TAET      ENGL      REPL
COPY     51 OUTPUT MEAN   1     12.1       WDM     51 IMPE      ENGL      REPL
COPY     52 OUTPUT MEAN   1                WDM     52 UZS       ENGL      REPL
COPY     53 OUTPUT MEAN   1                WDM     53 LZS       ENGL      REPL
COPY     54 OUTPUT MEAN   1                WDM     54 AGWS      ENGL      REPL
*******************************************************************************

*** SDS
*******************************************************************************
*** SDE-4 (TOTAL)
RCHRES   36 HYDR   RO                      WDM     21 FLOW      ENGL      REPL
*******************************************************************************
*** SDS-1 (TOTAL)
RCHRES   39 HYDR   RO                      WDM     22 FLOW      ENGL      REPL
*******************************************************************************
*** SDS-3 RUNWAY (NO DETENTION)
COPY     42 OUTPUT MEAN   1     12.1       WDM     23 FLOW      ENGL      REPL
*******************************************************************************
*** SDS-3A TAXIWAY VAULT
COPY     20 OUTPUT MEAN   1     12.1 ***   WDM     24 FLOW      ENGL      REPL
*******************************************************************************
*** SDS-7 3RD RUNWAY VAULT
COPY      3 OUTPUT MEAN   1     12.1 ***   WDM     26 FLOW      ENGL      REPL
*******************************************************************************
*** SDS-4
```

```
COPY    10 OUTPUT MEAN   1     12.1          WDM     28 FLOW      ENGL      REPL
********************************************************************************

*** IWS
********************************************************************************
*** IWS TREATMENT INFLOW TOTAL
COPY     8 OUTPUT MEAN   1     12.1          WDM     32 FLOW      ENGL      REPL
********************************************************************************
*** IWS LAGOON OUTFLOW TO PUGET SOUND
RCHRES 400 HYDR    O     1                   WDM     33 FLOW      ENGL      REPL
********************************************************************************
*** IWS LAGOON OVERFLOW TO NORTHWEST PONDS
RCHRES 400 HYDR    O     2                   WDM     34 FLOW      ENGL      REPL
********************************************************************************

*** WEST BRANCH
********************************************************************************
*** NORTHWEST PONDS
RCHRES  43 HYDR    RO                        WDM     31 FLOW      ENGL      REPL
********************************************************************************
*** LOWER WEST BRANCH
RCHRES  12 HYDR    RO                        WDM     35 FLOW      ENGL      REPL
********************************************************************************

*** EAST BRANCH
********************************************************************************
*** BOW LAKE OUTFLOW
RCHRES  35 HYDR    RO                        WDM     36 FLOW      ENGL      REPL
********************************************************************************
*** EXISTING UPPER EAST BRANCH (FUTURE SASA DETENTION SITE)
RCHRES  38 HYDR    RO                        WDM     37 FLOW      ENGL      REPL
********************************************************************************
*** TYEE INFLOW (GAUGE 11C)
RCHRES   5 HYDR    RO                        WDM     38 FLOW      ENGL      REPL
********************************************************************************
*** TYEE OUTFLOW
RCHRES  40 HYDR    RO                        WDM     39 FLOW      ENGL      REPL
********************************************************************************

*** MAIN STEM
********************************************************************************
*** BELOW CONFLUENCE AT TYEE GOLF COURSE WEIR (GAUGE 11F)
COPY     5 OUTPUT MEAN   1     12.1          WDM     40 FLOW      ENGL      REPL
********************************************************************************
*** BELOW CONFLUENCE AT SOUTH 200TH STREET
RCHRES  13 HYDR    RO                        WDM     41 FLOW      ENGL      REPL
********************************************************************************
*** LOWER DES MOINES CREEK NEAR MOUTH (GAUGE 11D)
RCHRES 198 HYDR    RO                        WDM     42 FLOW      ENGL      REPL
********************************************************************************
*** S200TH ST
COPY   100 OUTPUT MEAN   1   0.000343        WDM     73 AGWO      ENGL AGGR REPL
COPY   100 OUTPUT MEAN   2   0.000417        WDM     74 PETM      ENGL AGGR REPL
COPY   100 OUTPUT MEAN   3   0.000417        WDM     75 SAET      ENGL AGGR REPL
COPY   100 OUTPUT MEAN   4                   WDM     76 IMPE      ENGL AGGR REPL

END EXT TARGETS
                                                                             ***
NETWORK
***        <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>        <-MEMBER->
<NAME>   # <NAME>   TEM STRG<-FACTOR->STRG <NAME>   #   # <-GRP> <NAME> # # ***
********************************************************************************
********************************************************************************
*** TO WDM ONLY FOR WATER BALANCE CALIBRATION
PERLND  16 PWATER TAET          21.898       COPY    50      INPUT  MEAN   1
PERLND  26 PWATER TAET          82.595       COPY    50      INPUT  MEAN   1
PERLND  34 PWATER TAET          21.522       COPY    50      INPUT  MEAN   1
PERLND  44 PWATER TAET          53.793       COPY    50      INPUT  MEAN   1
PERLND  54 PWATER TAET           5.520       COPY    50      INPUT  MEAN   1
********************************************************************************
IMPLND  14 IWATER IMPEV         97.745       COPY    51      INPUT  MEAN   1
********************************************************************************
PERLND  16 PWATER UZS           21.898       COPY    52      INPUT  MEAN   1
PERLND  26 PWATER UZS           82.595       COPY    52      INPUT  MEAN   1
PERLND  34 PWATER UZS           21.522       COPY    52      INPUT  MEAN   1
PERLND  44 PWATER UZS           53.793       COPY    52      INPUT  MEAN   1
```

```
PERLND  54 PWATER UZS            5.520      COPY    52      INPUT  MEAN   1
*******************************************************************************
PERLND  16 PWATER LZS           21.898      COPY    53      INPUT  MEAN   1
PERLND  26 PWATER LZS           82.595      COPY    53      INPUT  MEAN   1
PERLND  34 PWATER LZS           21.522      COPY    53      INPUT  MEAN   1
PERLND  44 PWATER LZS           53.793      COPY    53      INPUT  MEAN   1
PERLND  54 PWATER LZS            5.520      COPY    53      INPUT  MEAN   1
*******************************************************************************
PERLND  16 PWATER AGWS          21.898      COPY    54      INPUT  MEAN   1
PERLND  26 PWATER AGWS          82.595      COPY    54      INPUT  MEAN   1
PERLND  34 PWATER AGWS          21.522      COPY    54      INPUT  MEAN   1
PERLND  44 PWATER AGWS          53.793      COPY    54      INPUT  MEAN   1
PERLND  54 PWATER AGWS           5.520      COPY    54      INPUT  MEAN   1
*******************************************************************************
*******************************************************************************
*** AIRPORT SUBBASINS
*******************************************************************************
*** (DM23) SDE-4
PERLND  26 PWATER SURO           4.631      RCHRES  36      EXTNL  IVOL
PERLND  26 PWATER IFWO           4.631      RCHRES  34      EXTNL  IVOL
IMPLND  14 IWATER SURO          10.205      RCHRES  36      EXTNL  IVOL
*******************************************************************************
*** (DM24) SDS-1
PERLND  26 PWATER SURO           0.123      RCHRES  39      EXTNL  IVOL
PERLND  26 PWATER IFWO           0.123      RCHRES  38      EXTNL  IVOL
IMPLND  14 IWATER SURO           0.915      RCHRES  39      EXTNL  IVOL
*******************************************************************************
*** (DM25) SDS-3A  TAXIWAY VAULT (to wdm only)
*** 1994 TARGET FLOW FOR FUTURE DETENTION FACILITY
PERLND  26 PWATER SURO           *****      COPY    20      INPUT  MEAN   1
PERLND  26 PWATER IFWO           *****      COPY     4      INPUT  MEAN   1
IMPLND  14 IWATER SURO           *****      COPY    20      INPUT  MEAN   1
*******************************************************************************
*** (DM25) SDS-7   3RD RUNWAY (to wdm only)
*** 1994 TARGET FLOW FOR FUTURE DETENTION FACILITY
PERLND  26 PWATER SURO           *****      COPY     3      INPUT  MEAN   1
PERLND  26 PWATER IFWO           *****      COPY     4      INPUT  MEAN   1
IMPLND  14 IWATER SURO           *****      COPY     3      INPUT  MEAN   1
*******************************************************************************
*** (DM25) SDS-3
***  Areas OF 26 AND 14 revised to incorporate King County comments
*** 1994 LAND USE ADJUSTED TO INCLUDE 23.2 ACRES OF RECENTLY CONSTRUCTED IMPERVIOUS
PERLND  26 PWATER SURO          21.496      COPY    42      INPUT  MEAN   1
PERLND  26 PWATER IFWO          21.496      RCHRES   4      EXTNL  IVOL
PERLND  54 PWATER SURO           0.039      COPY    42      INPUT  MEAN   1
PERLND  54 PWATER IFWO           0.039      RCHRES   4      EXTNL  IVOL
IMPLND  14 IWATER SURO          15.512      COPY    42      INPUT  MEAN   1
*******************************************************************************
*** (DM26) SDS-2,5,6,7
*** AGWO for PERLN 26 inserted to answer King County comment
PERLND  16 PWATER SURO           0.228      RCHRES  41      EXTNL  IVOL
PERLND  16 PWATER IFWO           0.228      RCHRES  43      EXTNL  IVOL
PERLND  16 PWATER AGWO           0.228      RCHRES  43      EXTNL  IVOL
PERLND  26 PWATER SURO           8.002      RCHRES  41      EXTNL  IVOL
PERLND  26 PWATER IFWO           8.002      RCHRES  43      EXTNL  IVOL
PERLND  26 PWATER AGWO           8.002      RCHRES  43      EXTNL  IVOL
PERLND  34 PWATER SURO           0.676      RCHRES  41      EXTNL  IVOL
PERLND  34 PWATER IFWO           0.676      RCHRES  43      EXTNL  IVOL
PERLND  34 PWATER AGWO           0.676      RCHRES  43      EXTNL  IVOL
PERLND  44 PWATER SURO           0.042      RCHRES  41      EXTNL  IVOL
PERLND  44 PWATER IFWO           0.042      RCHRES  43      EXTNL  IVOL
PERLND  44 PWATER AGWO           0.042      RCHRES  43      EXTNL  IVOL
PERLND  54 PWATER SURO           0.043      RCHRES  41      EXTNL  IVOL
PERLND  54 PWATER IFWO           0.043      RCHRES  43      EXTNL  IVOL
PERLND  54 PWATER AGWO           0.043      RCHRES  43      EXTNL  IVOL
IMPLND  14 IWATER SURO           1.096      RCHRES  41      EXTNL  IVOL
*******************************************************************************
*** (DM27) SDS-4
PERLND  26 PWATER SURO           0.755      COPY    10      INPUT  MEAN   1
PERLND  26 PWATER IFWO           0.755      COPY     5      INPUT  MEAN   1
PERLND  26 PWATER AGWO           0.755      COPY     5      INPUT  MEAN   1
PERLND  34 PWATER SURO           0.018      COPY    10      INPUT  MEAN   1
PERLND  34 PWATER IFWO           0.018      COPY     5      INPUT  MEAN   1
PERLND  34 PWATER AGWO           0.018      COPY     5      INPUT  MEAN   1
PERLND  44 PWATER SURO           2.406      COPY    10      INPUT  MEAN   1
PERLND  44 PWATER IFWO           2.406      COPY     5      INPUT  MEAN   1
```

```
PERLND  44 PWATER AGWO             2.406       COPY     5      INPUT  MEAN    1
IMPLND  14 IWATER SURO             1.614       COPY    10      INPUT  MEAN    1
********************************************************************************
*** SASA ROOFTOP (FUTURE)
IMPLND  14 IWATER SURO             *****       COPY    15      INPUT  MEAN    1
********************************************************************************

*** IWS SYSTEM PRIMARY SYSTEM AND PUMP STATIONS
*** (INCLUDING AREAS DIVERTED FROM MILLER CREEK BASIN)
********************************************************************************
*** I-1: NORTH CARGO PUMP STATION TO IWS (SDN-2)
*** OVERFLOW TO MILLER BASIN
*** INSTALLED IN OCTOBER 1997
PERLND  26 PWATER SURO             *****       RCHRES 364      EXTNL  IVOL
PERLND  26 PWATER IFWO             *****       RCHRES 364      EXTNL  IVOL
IMPLND  14 IWATER SURO             *****       RCHRES 364      EXTNL  IVOL
********************************************************************************
*** I-2: NORTH SNOWMELT PUMP STATION TO IWS (SDN-2)
*** INSTALLED IN LATE 1997/1998
PERLND  26 PWATER SURO             *****       RCHRES 365      EXTNL  IVOL
PERLND  26 PWATER IFWO             *****       RCHRES 365      EXTNL  IVOL
IMPLND  14 IWATER SURO             *****       RCHRES 365      EXTNL  IVOL
********************************************************************************
*** I-3: NORTH SATELLITE PUMP STATION TO IWS
*** OVERFLOW TO SDE-4
*** INSTALLED IN 1995
IMPLND  14 IWATER SURO             *****       RCHRES 360      EXTNL  IVOL
********************************************************************************
*** I-4: CENTRAL SNOWMELT PUMP STATION TO IWS
*** OVERFLOW TO SDE-4
*** INSTALLED IN 1998
IMPLND  14 IWATER SURO             *****       RCHRES 361      EXTNL  IVOL
********************************************************************************
*** I-5: SOUTH SNOWMELT (OLYMPIC TANK FARM) PUMP STATION TO IWS
*** OVERFLOW TO DES MOINES EAST BRANCH
*** INSTALLED IN LATE 1997/1998
IMPLND  14 IWATER SURO             *****       RCHRES 366      EXTNL  IVOL
********************************************************************************
*** I-6: IWS-510 DIVERSION TO IWS
*** OVERFLOW TO SDS-1
PERLND  26 PWATER SURO             0.036       RCHRES 390      EXTNL  IVOL
PERLND  26 PWATER IFWO             0.036       RCHRES  34      EXTNL  IVOL
IMPLND  14 IWATER SURO             2.738       RCHRES 390      EXTNL  IVOL
********************************************************************************
*** I-7: IWS - PRIMARY DIRECT PIPED
*** NO OVERFLOW TO SDS
PERLND  16 PWATER SURO             0.222       COPY    18      INPUT  MEAN    1
PERLND  16 PWATER IFWO             0.222       RCHRES  34      EXTNL  IVOL
PERLND  26 PWATER SURO             0.598       COPY    18      INPUT  MEAN    1
PERLND  26 PWATER IFWO             0.598       RCHRES  34      EXTNL  IVOL
PERLND  34 PWATER SURO             0.158       COPY    18      INPUT  MEAN    1
PERLND  34 PWATER IFWO             0.158       RCHRES  34      EXTNL  IVOL
PERLND  44 PWATER SURO             0.009       COPY    18      INPUT  MEAN    1
PERLND  44 PWATER IFWO             0.009       RCHRES  34      EXTNL  IVOL
IMPLND  14 IWATER SURO            19.966       COPY    18      INPUT  MEAN    1
********************************************************************************

*** EAST BRANCH OF CREEK
********************************************************************************
*** DM1
PERLND  16 PWATER SURO             0.860       RCHRES  34      EXTNL  IVOL
PERLND  16 PWATER IFWO             0.860       RCHRES  34      EXTNL  IVOL
PERLND  16 PWATER AGWO             0.238       RCHRES  34      EXTNL  IVOL
PERLND  26 PWATER SURO            11.078       RCHRES  34      EXTNL  IVOL
PERLND  26 PWATER IFWO            11.078       RCHRES  34      EXTNL  IVOL
PERLND  26 PWATER AGWO             3.069       RCHRES  34      EXTNL  IVOL
PERLND  34 PWATER SURO             0.599       RCHRES  34      EXTNL  IVOL
PERLND  34 PWATER IFWO             0.599       RCHRES  34      EXTNL  IVOL
PERLND  34 PWATER AGWO             0.166       RCHRES  34      EXTNL  IVOL
PERLND  44 PWATER SURO             7.697       RCHRES  34      EXTNL  IVOL
PERLND  44 PWATER IFWO             7.697       RCHRES  34      EXTNL  IVOL
PERLND  44 PWATER AGWO             2.132       RCHRES  34      EXTNL  IVOL
PERLND  54 PWATER SURO             1.176       RCHRES  34      EXTNL  IVOL
PERLND  54 PWATER IFWO             1.176       RCHRES  34      EXTNL  IVOL
PERLND  54 PWATER AGWO             0.326       RCHRES  34      EXTNL  IVOL
IMPLND  14 IWATER SURO            14.274       RCHRES  34      EXTNL  IVOL
```

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*******************************************************************************
*** DM2
PERLND  26 PWATER SURO              1.232      RCHRES  37      EXTNL   IVOL
PERLND  26 PWATER IFWO              1.232      RCHRES  37      EXTNL   IVOL
IMPLND  14 IWATER SURO              0.821      RCHRES  37      EXTNL   IVOL
*******************************************************************************
*** DM3
PERLND  26 PWATER PERO              4.077      RCHRES  38      EXTNL   IVOL
PERLND  54 PWATER PERO              0.028      RCHRES  38      EXTNL   IVOL
IMPLND  14 IWATER SURO              6.205      RCHRES  38      EXTNL   IVOL
*******************************************************************************
*** DM4
PERLND  16 PWATER PERO              0.574      RCHRES  38      EXTNL   IVOL
PERLND  26 PWATER PERO              0.571      RCHRES  38      EXTNL   IVOL
PERLND  54 PWATER PERO              0.037      RCHRES  38      EXTNL   IVOL
IMPLND  14 IWATER SURO              3.234      RCHRES  38      EXTNL   IVOL
*******************************************************************************
*** DM5
PERLND  16 PWATER PERO              1.310      RCHRES   5      EXTNL   IVOL
PERLND  26 PWATER PERO              0.558      RCHRES   5      EXTNL   IVOL
PERLND  34 PWATER PERO              0.114      RCHRES   5      EXTNL   IVOL
PERLND  44 PWATER PERO              0.384      RCHRES   5      EXTNL   IVOL
PERLND  54 PWATER PERO              0.171      RCHRES   5      EXTNL   IVOL
IMPLND  14 IWATER SURO              1.156      RCHRES   5      EXTNL   IVOL
*******************************************************************************
*** DM6
PERLND  16 PWATER PERO              1.814      RCHRES  40      EXTNL   IVOL
PERLND  26 PWATER PERO              1.153      RCHRES  40      EXTNL   IVOL
PERLND  44 PWATER PERO              0.917      RCHRES  40      EXTNL   IVOL
PERLND  54 PWATER PERO              0.337      RCHRES  40      EXTNL   IVOL
IMPLND  14 IWATER SURO              0.354      RCHRES  40      EXTNL   IVOL
*******************************************************************************


*** WEST BRANCH OF CREEK
*******************************************************************************
*** DM7
PERLND  16 PWATER SURO              2.189      RCHRES   7      EXTNL   IVOL
PERLND  16 PWATER IFWO              2.189      RCHRES   7      EXTNL   IVOL
PERLND  16 PWATER AGWO              0.792      RCHRES   7      EXTNL   IVOL
PERLND  26 PWATER SURO              2.944      RCHRES   7      EXTNL   IVOL
PERLND  26 PWATER IFWO              2.944      RCHRES   7      EXTNL   IVOL
PERLND  26 PWATER AGWO              1.066      RCHRES   7      EXTNL   IVOL
PERLND  34 PWATER SURO              1.966      RCHRES   7      EXTNL   IVOL
PERLND  34 PWATER IFWO              1.966      RCHRES   7      EXTNL   IVOL
PERLND  34 PWATER AGWO              0.712      RCHRES   7      EXTNL   IVOL
PERLND  44 PWATER SURO              4.138      RCHRES   7      EXTNL   IVOL
PERLND  44 PWATER IFWO              4.138      RCHRES   7      EXTNL   IVOL
PERLND  44 PWATER AGWO              1.498      RCHRES   7      EXTNL   IVOL
PERLND  54 PWATER SURO              0.551      RCHRES   7      EXTNL   IVOL
PERLND  54 PWATER IFWO              0.551      RCHRES   7      EXTNL   IVOL
PERLND  54 PWATER AGWO              0.199      RCHRES   7      EXTNL   IVOL
IMPLND  14 IWATER SURO              2.397      RCHRES   7      EXTNL   IVOL
*******************************************************************************
*** DM8
PERLND  16 PWATER SURO              0.202      RCHRES   7      EXTNL   IVOL
PERLND  16 PWATER IFWO              0.202      RCHRES   7      EXTNL   IVOL
PERLND  16 PWATER AGWO              0.077      RCHRES   7      EXTNL   IVOL
PERLND  26 PWATER SURO              0.718      RCHRES   7      EXTNL   IVOL
PERLND  26 PWATER IFWO              0.718      RCHRES   7      EXTNL   IVOL
PERLND  26 PWATER AGWO              0.273      RCHRES   7      EXTNL   IVOL
PERLND  34 PWATER SURO              0.709      RCHRES   7      EXTNL   IVOL
PERLND  34 PWATER IFWO              0.709      RCHRES   7      EXTNL   IVOL
PERLND  34 PWATER AGWO              0.269      RCHRES   7      EXTNL   IVOL
PERLND  44 PWATER SURO              1.111      RCHRES   7      EXTNL   IVOL
PERLND  44 PWATER IFWO              1.111      RCHRES   7      EXTNL   IVOL
PERLND  44 PWATER AGWO              0.422      RCHRES   7      EXTNL   IVOL
PERLND  54 PWATER SURO              0.162      RCHRES   7      EXTNL   IVOL
PERLND  54 PWATER IFWO              0.162      RCHRES   7      EXTNL   IVOL
PERLND  54 PWATER AGWO              0.062      RCHRES   7      EXTNL   IVOL
IMPLND  14 IWATER SURO              2.332      RCHRES   7      EXTNL   IVOL
*******************************************************************************
*** DM9
PERLND  16 PWATER SURO              0.002      RCHRES   9      EXTNL   IVOL
PERLND  16 PWATER IFWO              0.002      RCHRES   9      EXTNL   IVOL
PERLND  16 PWATER AGWO              0.001      RCHRES   9      EXTNL   IVOL
PERLND  26 PWATER SURO              1.200      RCHRES   9      EXTNL   IVOL
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PERLND  26 PWATER IFWO           1.200      RCHRES   9      EXTNL  IVOL
PERLND  26 PWATER AGWO           0.524      RCHRES   9      EXTNL  IVOL
PERLND  34 PWATER SURO           0.016      RCHRES   9      EXTNL  IVOL
PERLND  34 PWATER IFWO           0.016      RCHRES   9      EXTNL  IVOL
PERLND  34 PWATER AGWO           0.007      RCHRES   9      EXTNL  IVOL
PERLND  44 PWATER SURO           3.039      RCHRES   9      EXTNL  IVOL
PERLND  44 PWATER IFWO           3.039      RCHRES   9      EXTNL  IVOL
PERLND  44 PWATER AGWO           1.328      RCHRES   9      EXTNL  IVOL
PERLND  54 PWATER SURO           0.010      RCHRES   9      EXTNL  IVOL
PERLND  54 PWATER IFWO           0.010      RCHRES   9      EXTNL  IVOL
PERLND  54 PWATER AGWO           0.004      RCHRES   9      EXTNL  IVOL
IMPLND  14 IWATER SURO           0.633      RCHRES   9      EXTNL  IVOL
********************************************************************************
*** DM10
PERLND  16 PWATER PERO           0.943      RCHRES  43      EXTNL  IVOL
PERLND  26 PWATER PERO           0.738      RCHRES  43      EXTNL  IVOL
PERLND  34 PWATER PERO           1.934      RCHRES  43      EXTNL  IVOL
PERLND  44 PWATER PERO           0.510      RCHRES  43      EXTNL  IVOL
PERLND  54 PWATER PERO           0.710      RCHRES  43      EXTNL  IVOL
IMPLND  14 IWATER SURO           0.185      RCHRES  43      EXTNL  IVOL
********************************************************************************
*** DM11
PERLND  16 PWATER PERO           0.321      RCHRES  43      EXTNL  IVOL
PERLND  26 PWATER PERO           0.514      RCHRES  43      EXTNL  IVOL
PERLND  34 PWATER PERO           1.028      RCHRES  43      EXTNL  IVOL
PERLND  44 PWATER PERO           0.466      RCHRES  43      EXTNL  IVOL
PERLND  54 PWATER PERO           1.036      RCHRES  43      EXTNL  IVOL
IMPLND  14 IWATER SURO           2.618      RCHRES  43      EXTNL  IVOL
********************************************************************************
*** DM12
PERLND  16 PWATER PERO           0.511      RCHRES  12      EXTNL  IVOL
PERLND  26 PWATER PERO           0.001      RCHRES  12      EXTNL  IVOL
PERLND  34 PWATER PERO           0.376      RCHRES  12      EXTNL  IVOL
PERLND  44 PWATER PERO           2.114      RCHRES  12      EXTNL  IVOL
PERLND  54 PWATER PERO           0.543      RCHRES  12      EXTNL  IVOL
********************************************************************************
*** DM13
PERLND  16 PWATER PERO           2.684      RCHRES  13      EXTNL  IVOL
PERLND  26 PWATER PERO           1.886      RCHRES  13      EXTNL  IVOL
PERLND  34 PWATER PERO           1.204      RCHRES  13      EXTNL  IVOL
PERLND  44 PWATER PERO           1.845      RCHRES  13      EXTNL  IVOL
PERLND  54 PWATER PERO           0.068      RCHRES  13      EXTNL  IVOL
IMPLND  14 IWATER SURO           1.978      RCHRES  13      EXTNL  IVOL
********************************************************************************

*** LOWER BASIN
********************************************************************************
*** DM14
PERLND  16 PWATER PERO           0.481      RCHRES  14      EXTNL  IVOL
PERLND  26 PWATER PERO           0.295      RCHRES  14      EXTNL  IVOL
PERLND  34 PWATER PERO           1.940      RCHRES  14      EXTNL  IVOL
PERLND  44 PWATER PERO           1.195      RCHRES  14      EXTNL  IVOL
IMPLND  14 IWATER SURO           0.340      RCHRES  14      EXTNL  IVOL
********************************************************************************

*** EXECUTEL TRIBUTARY
********************************************************************************
*** DM16 INFLOW TO EXECUTEL POND
PERLND  16 PWATER SURO           0.647      RCHRES  46      EXTNL  IVOL
PERLND  16 PWATER IFWO           0.647      RCHRES  46      EXTNL  IVOL
PERLND  16 PWATER AGWO           0.446      RCHRES  46      EXTNL  IVOL
PERLND  26 PWATER SURO           5.573      RCHRES  46      EXTNL  IVOL
PERLND  26 PWATER IFWO           5.573      RCHRES  46      EXTNL  IVOL
PERLND  26 PWATER AGWO           3.845      RCHRES  46      EXTNL  IVOL
PERLND  34 PWATER SURO           0.639      RCHRES  46      EXTNL  IVOL
PERLND  34 PWATER IFWO           0.639      RCHRES  46      EXTNL  IVOL
PERLND  34 PWATER AGWO           0.441      RCHRES  46      EXTNL  IVOL
PERLND  44 PWATER SURO           8.023      RCHRES  46      EXTNL  IVOL
PERLND  44 PWATER IFWO           8.023      RCHRES  46      EXTNL  IVOL
PERLND  44 PWATER AGWO           5.536      RCHRES  46      EXTNL  IVOL
PERLND  54 PWATER SURO           0.183      RCHRES  46      EXTNL  IVOL
PERLND  54 PWATER IFWO           0.183      RCHRES  46      EXTNL  IVOL
PERLND  54 PWATER AGWO           0.126      RCHRES  46      EXTNL  IVOL
IMPLND  14 IWATER SURO           4.249      RCHRES  46      EXTNL  IVOL
********************************************************************************
*** DM17
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PERLND  16 PWATER PERO          2.078      RCHRES  17      EXTNL  IVOL
PERLND  26 PWATER PERO          2.261      RCHRES  17      EXTNL  IVOL
PERLND  34 PWATER PERO          3.003      RCHRES  17      EXTNL  IVOL
PERLND  44 PWATER PERO          3.280      RCHRES  17      EXTNL  IVOL
IMPLND  14 IWATER SURO          2.655      RCHRES  17      EXTNL  IVOL
*******************************************************************************

*** MAINSTEM RAVINE
*******************************************************************************
*** DM18
PERLND  16 PWATER PERO          0.789      RCHRES  18      EXTNL  IVOL
PERLND  26 PWATER PERO          0.277      RCHRES  18      EXTNL  IVOL
PERLND  34 PWATER PERO          3.151      RCHRES  18      EXTNL  IVOL
PERLND  44 PWATER PERO          1.106      RCHRES  18      EXTNL  IVOL
PERLND  54 PWATER PERO          0.300      RCHRES  18      EXTNL  IVOL
IMPLND  14 IWATER SURO          0.296      RCHRES  18      EXTNL  IVOL
*******************************************************************************

*** NORTH BRANCH RAVINE
*******************************************************************************
*** DM19
PERLND  16 PWATER PERO          0.182      RCHRES 177      EXTNL  IVOL
PERLND  26 PWATER PERO          6.019      RCHRES 177      EXTNL  IVOL
PERLND  34 PWATER PERO          0.167      RCHRES 177      EXTNL  IVOL
PERLND  44 PWATER PERO          5.552      RCHRES 177      EXTNL  IVOL
IMPLND  14 IWATER SURO          2.617      RCHRES 177      EXTNL  IVOL
*******************************************************************************
*** DM20
PERLND  16 PWATER PERO          4.007      RCHRES 193      EXTNL  IVOL
PERLND  26 PWATER PERO          6.624      RCHRES 193      EXTNL  IVOL
PERLND  34 PWATER PERO          2.784      RCHRES 193      EXTNL  IVOL
PERLND  44 PWATER PERO          4.602      RCHRES 193      EXTNL  IVOL
PERLND  54 PWATER PERO          0.116      RCHRES 193      EXTNL  IVOL
IMPLND  14 IWATER SURO          3.714      RCHRES 193      EXTNL  IVOL
*******************************************************************************

*** LOWER MAINSTEM
*******************************************************************************
*** DM21
PERLND  16 PWATER PERO          2.143      RCHRES 198      EXTNL  IVOL
PERLND  26 PWATER PERO          6.306      RCHRES 198      EXTNL  IVOL
PERLND  34 PWATER PERO          1.429      RCHRES 198      EXTNL  IVOL
PERLND  44 PWATER PERO          4.205      RCHRES 198      EXTNL  IVOL
IMPLND  14 IWATER SURO          3.091      RCHRES 198      EXTNL  IVOL
*******************************************************************************
*** DM22
PERLND  16 PWATER PERO          0.381      RCHRES 198      EXTNL  IVOL
PERLND  26 PWATER PERO          4.654      RCHRES 198      EXTNL  IVOL
PERLND  34 PWATER PERO          0.218      RCHRES 198      EXTNL  IVOL
PERLND  44 PWATER PERO          2.620      RCHRES 198      EXTNL  IVOL
PERLND  54 PWATER PERO          0.016      RCHRES 198      EXTNL  IVOL
IMPLND  14 IWATER SURO          1.972      RCHRES 198      EXTNL  IVOL
*******************************************************************************

*** NONCONTIGUOUS GROUNDWATER BASINS
*******************************************************************************
*** G1
PERLND  16 PWATER AGWO          2.833      RCHRES   5      EXTNL  IVOL
PERLND  26 PWATER AGWO          9.917      RCHRES   5      EXTNL  IVOL
*******************************************************************************
*** G2
PERLND  16 PWATER AGWO          0.417      RCHRES 193      EXTNL  IVOL
PERLND  26 PWATER AGWO          1.333      RCHRES 193      EXTNL  IVOL
*******************************************************************************
*** G3
PERLND  16 PWATER AGWO          5.083      RCHRES 193      EXTNL  IVOL
PERLND  26 PWATER AGWO         17.667      RCHRES 193      EXTNL  IVOL
PERLND  34 PWATER AGWO          1.167      RCHRES 193      EXTNL  IVOL
PERLND  44 PWATER AGWO          4.250      RCHRES 193      EXTNL  IVOL
*******************************************************************************
*******************************************************************************

*** CHANNEL NETWORK LINKAGES ***
*******************************************************************************

*** DICHARGE TO IWS LAGOONS
```
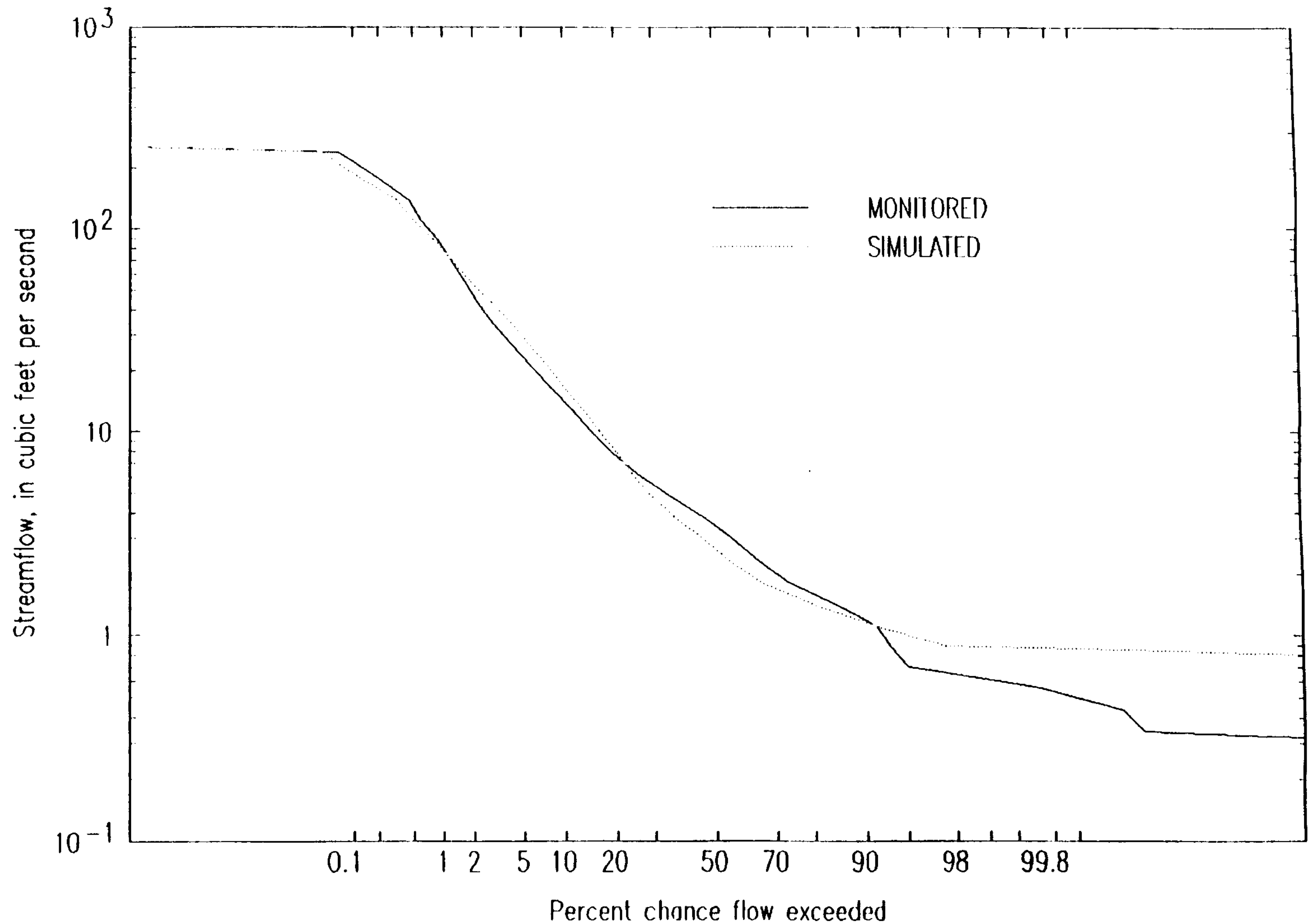
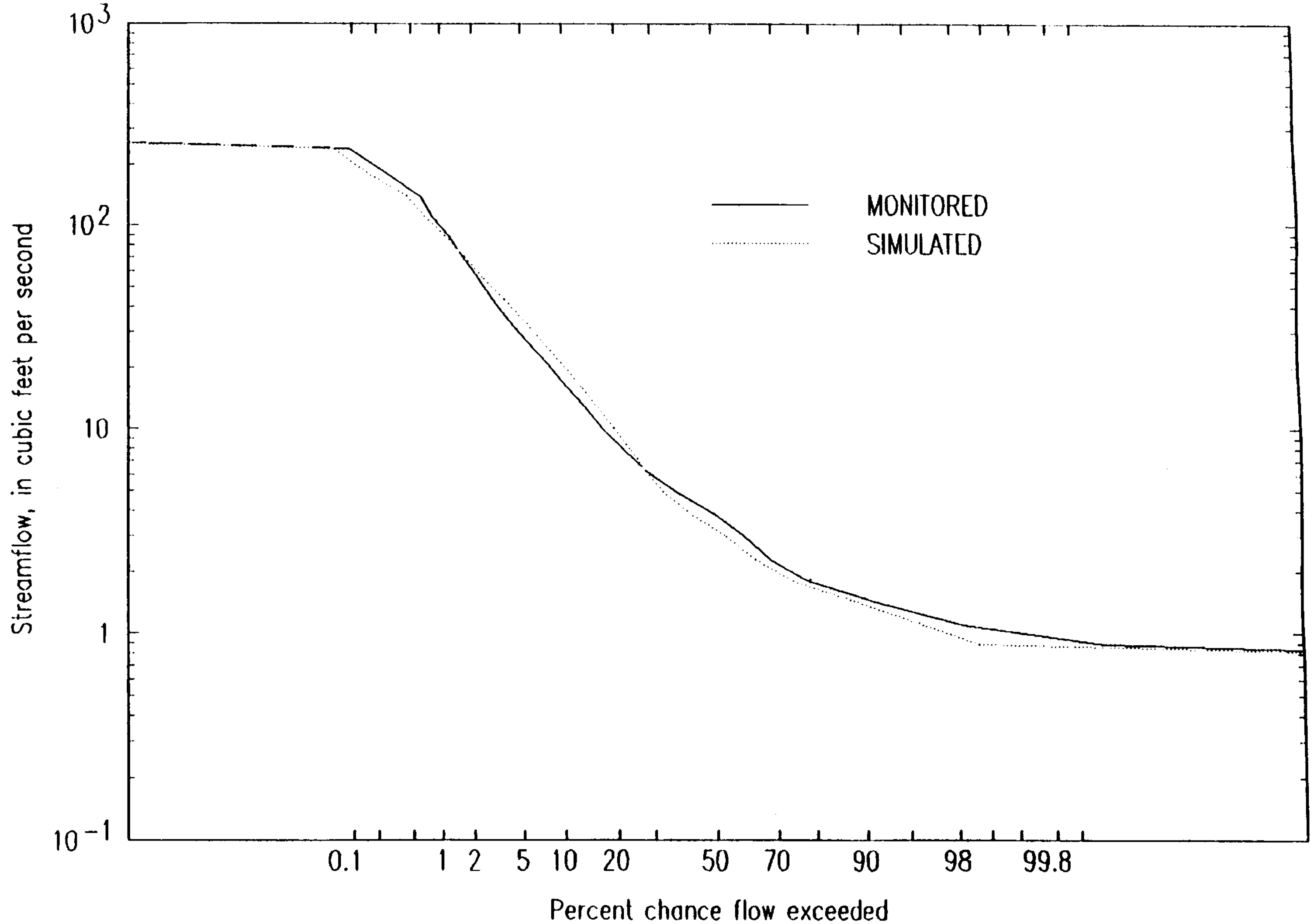

```
**************************************************************************************
RCHRES 360 HYDR   OVOL   1                 COPY      8      INPUT  MEAN    1
RCHRES 361 HYDR   OVOL   1                 COPY      8      INPUT  MEAN    1
RCHRES 364 HYDR   OVOL   1                 COPY      8      INPUT  MEAN    1
RCHRES 365 HYDR   OVOL   1                 COPY      8      INPUT  MEAN    1
RCHRES 366 HYDR   OVOL   1                 COPY      8      INPUT  MEAN    1
RCHRES 390 HYDR   OVOL   1                 COPY      8      INPUT  MEAN    1
COPY    18 OUTPUT MEAN   1                 COPY      8      INPUT  MEAN    1
COPY     8 OUTPUT MEAN   1                 RCHRES 400       EXTNL  IVOL
**************************************************************************************

*** PUMP STATION OVERFLOW TO SDS
**************************************************************************************
RCHRES 360 HYDR   OVOL   2                 RCHRES  36       EXTNL  IVOL
RCHRES 361 HYDR   OVOL   2                 RCHRES  36       EXTNL  IVOL
RCHRES 366 HYDR   OVOL   2                 RCHRES   5       EXTNL  IVOL
RCHRES 390 HYDR   OVOL   2                 RCHRES  39       EXTNL  IVOL
**************************************************************************************

*** OVERFLOW OF IWS LAGOONS TO SDS
**************************************************************************************
RCHRES 400 HYDR   OVOL   2                 COPY      4      INPUT  MEAN    1
**************************************************************************************

*** EAST BRANCH OF CREEK
**************************************************************************************
RCHRES  34 HYDR   OVOL   1                 RCHRES  35       EXTNL  IVOL
RCHRES  35 HYDR   ROVOL  1                 RCHRES  37       EXTNL  IVOL
RCHRES  36 HYDR   ROVOL  1                 RCHRES  37       EXTNL  IVOL
COPY    15 OUTPUT MEAN   1       ***       RCHRES  38       EXTNL  IVOL
RCHRES  37 HYDR   ROVOL  1                 RCHRES  38       EXTNL  IVOL
RCHRES  38 HYDR   ROVOL  1                 RCHRES   5       EXTNL  IVOL
RCHRES  39 HYDR   ROVOL  1                 RCHRES   5       EXTNL  IVOL
RCHRES   5 HYDR   ROVOL  1                 RCHRES  40       EXTNL  IVOL
RCHRES  40 HYDR   ROVOL  1                 COPY      5      INPUT  MEAN    1
**************************************************************************************


*** WEST BRANCH OF CREEK
**************************************************************************************
COPY    42 OUTPUT MEAN   1                 COPY      9      INPUT  MEAN    1
COPY     9 OUTPUT MEAN   1                 RCHRES    4      EXTNL  IVOL
RCHRES  41 HYDR   ROVOL  1                 COPY      4      INPUT  MEAN    1
RCHRES   4 HYDR   ROVOL  1                 COPY      4      INPUT  MEAN    1
RCHRES   7 HYDR   ROVOL  1                 COPY      4      INPUT  MEAN    1
RCHRES   9 HYDR   ROVOL  1                 COPY      4      INPUT  MEAN    1
COPY     4 OUTPUT MEAN   1                 RCHRES  43       EXTNL  IVOL
RCHRES  43 HYDR   OVOL   1                 RCHRES  12       EXTNL  IVOL
COPY    10 OUTPUT MEAN   1                 COPY      5      INPUT  MEAN    1
RCHRES  12 HYDR   ROVOL  1                 COPY      5      INPUT  MEAN    1
**************************************************************************************

*** MAINSTEM BELOW CONFLUENCE OF E. AND W. BRANCH
**************************************************************************************
*** MAINSTEM ABOVE EXECUTEL TRIBUTARY
COPY     5 OUTPUT MEAN   1                 RCHRES  13       EXTNL  IVOL
RCHRES  13 HYDR   ROVOL  1                 RCHRES  14       EXTNL  IVOL
RCHRES  14 HYDR   ROVOL  1                 COPY     48      INPUT  MEAN    1
**************************************************************************************
*** EXECUTEL TRIBUTARY
RCHRES  46 HYDR   ROVOL  1                 RCHRES  47       EXTNL  IVOL
RCHRES  47 HYDR   ROVOL  1                 RCHRES  17       EXTNL  IVOL
RCHRES  17 HYDR   ROVOL  1                 COPY     48      INPUT  MEAN    1
**************************************************************************************
*** MAINSTEM FROM HEAD OF RAVINE TO NORTH BRANCH CONFLUENCE
COPY    48 OUTPUT MEAN   1                 RCHRES  18       EXTNL  IVOL
RCHRES  18 HYDR   OVOL   1                 RCHRES 193       EXTNL  IVOL
RCHRES 193 HYDR   ROVOL  1                 COPY      1      INPUT  MEAN    1
**************************************************************************************
*** NORTH BRANCH RAVINE TO MAINSTEM
RCHRES 177 HYDR   ROVOL  1                 COPY      1      INPUT  MEAN    1
**************************************************************************************
*** MAINSTEM FROM NORTH BRANCH CONFLUENCE TO PARK BELOW MVD CULVERT
COPY     1 OUTPUT MEAN   1                 RCHRES 198       EXTNL  IVOL
**************************************************************************************
```

```
END NETWORK

SCHEMATIC
<-Source->                    <--Area-->     <-Target->   MBLK    ***
<Name>   #                    <-factor->     <Name>   #   Tbl#    ***
*** PERLND AGWO, AET & PET TO COPY BLOCK
*** areas from HSPFmodel-MillerCreekAreas-DesMoines Landuse June19.xls, 2006basins areas
PERLND  14                        34.17      COPY   100     13
PERLND  16                       184.81      COPY   100     13
PERLND  18                         7.44      COPY   100     13
PERLND  24                       512.17      COPY   100     13
PERLND  26                       597.32      COPY   100     13
PERLND  28                         4.64      COPY   100     13
PERLND  34                       265.34      COPY   100     13
PERLND  44                       667.34      COPY   100     13
PERLND  54                        66.23      COPY   100     13
PERLND  65                       100.00      COPY   100     13
PERLND  66                       347.00      COPY   100     13
PERLND  67                        14.00      COPY   100     13
PERLND  68                        51.00      COPY   100     13

*** IMPLND AET TO COPY BLOCK
*** just one IMPLND, so don't need to weight by area
IMPLND  14                                   COPY   100     14
END SCHEMATIC

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->      <Target>      <-Grp> <-Member->***
<Name>            <Name> # #<-factor->      <Name>               <Name> # #***
  MASS-LINK       13
PERLND     PWATER AGWO                      COPY          INPUT  MEAN   1
PERLND     PWATER PET                       COPY          INPUT  MEAN   2
PERLND     PWATER TAET                      COPY          INPUT  MEAN   3
  END MASS-LINK   13

  MASS-LINK       14
IMPLND     IWATER IMPEV                     COPY          INPUT  MEAN   4
  END MASS-LINK   14

END MASS-LINK

END RUN
```

DES MOINES CREEK
CALIBRATED MODEL HYDROGRAPHS

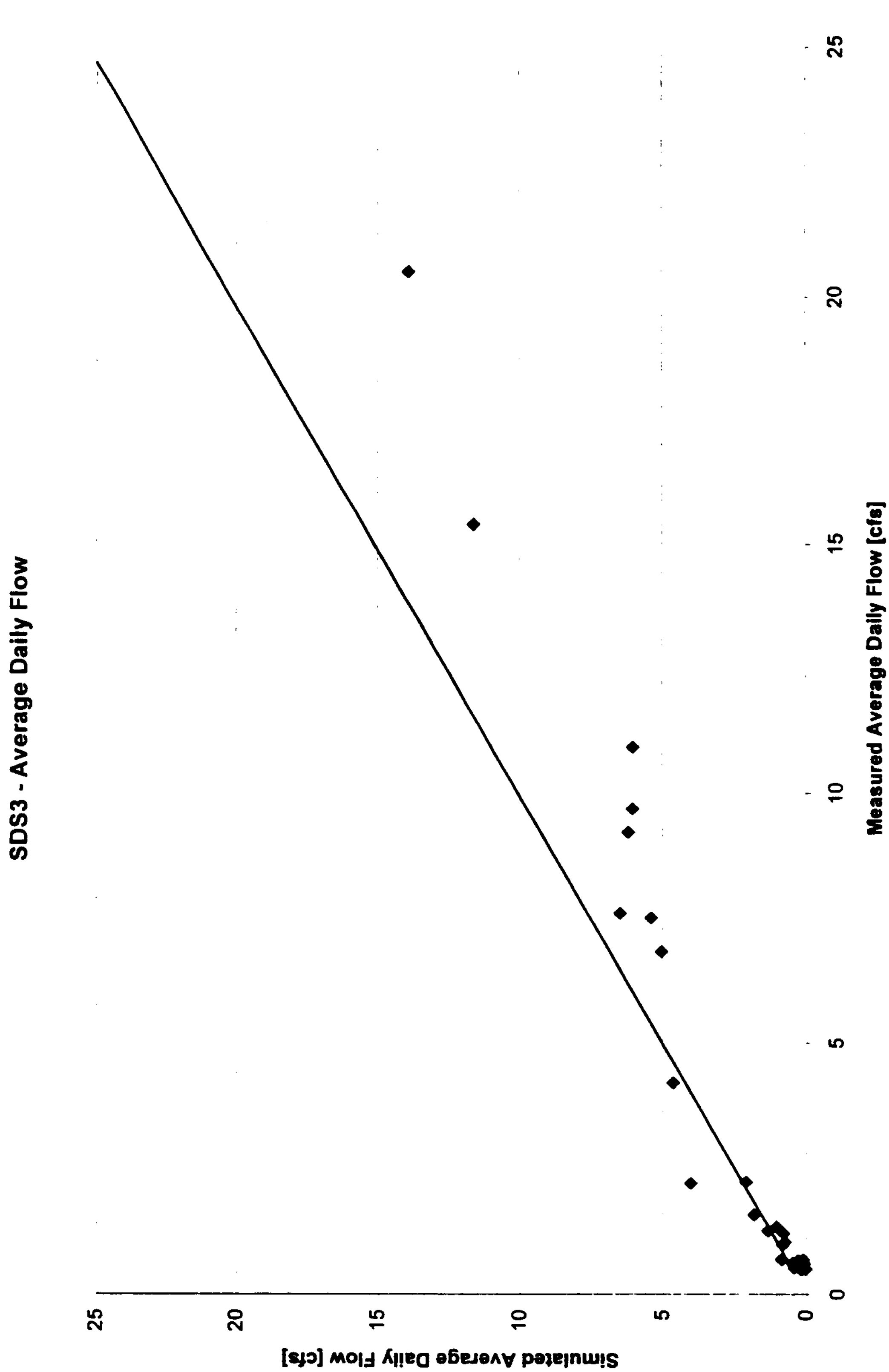


CALIBRATED VS MONITORED VALUES NEAR MOUTH



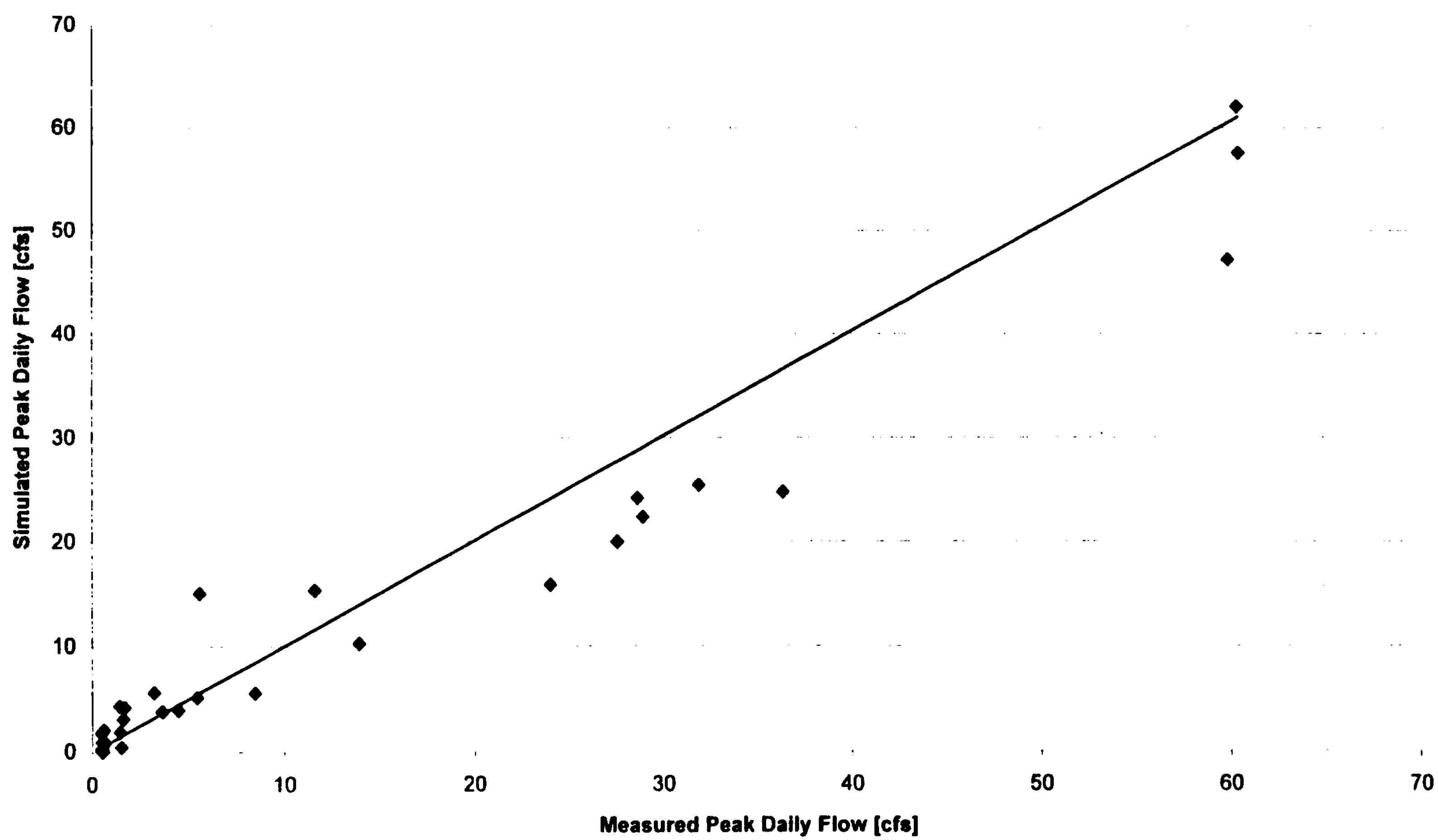
CALIBRATED VS MONITORED VALUES NEAR MOUIH

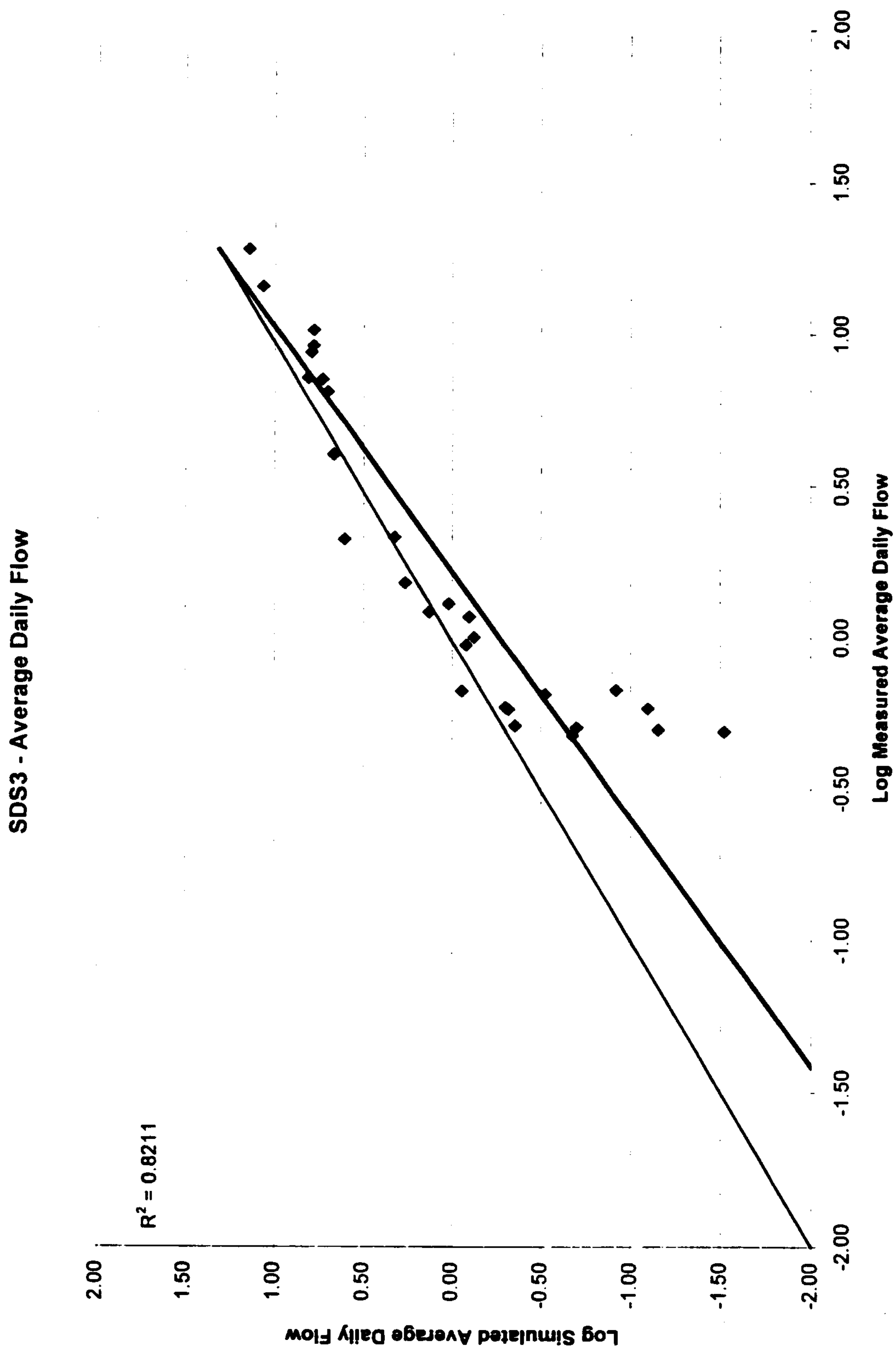
10-1-94 9-30-96

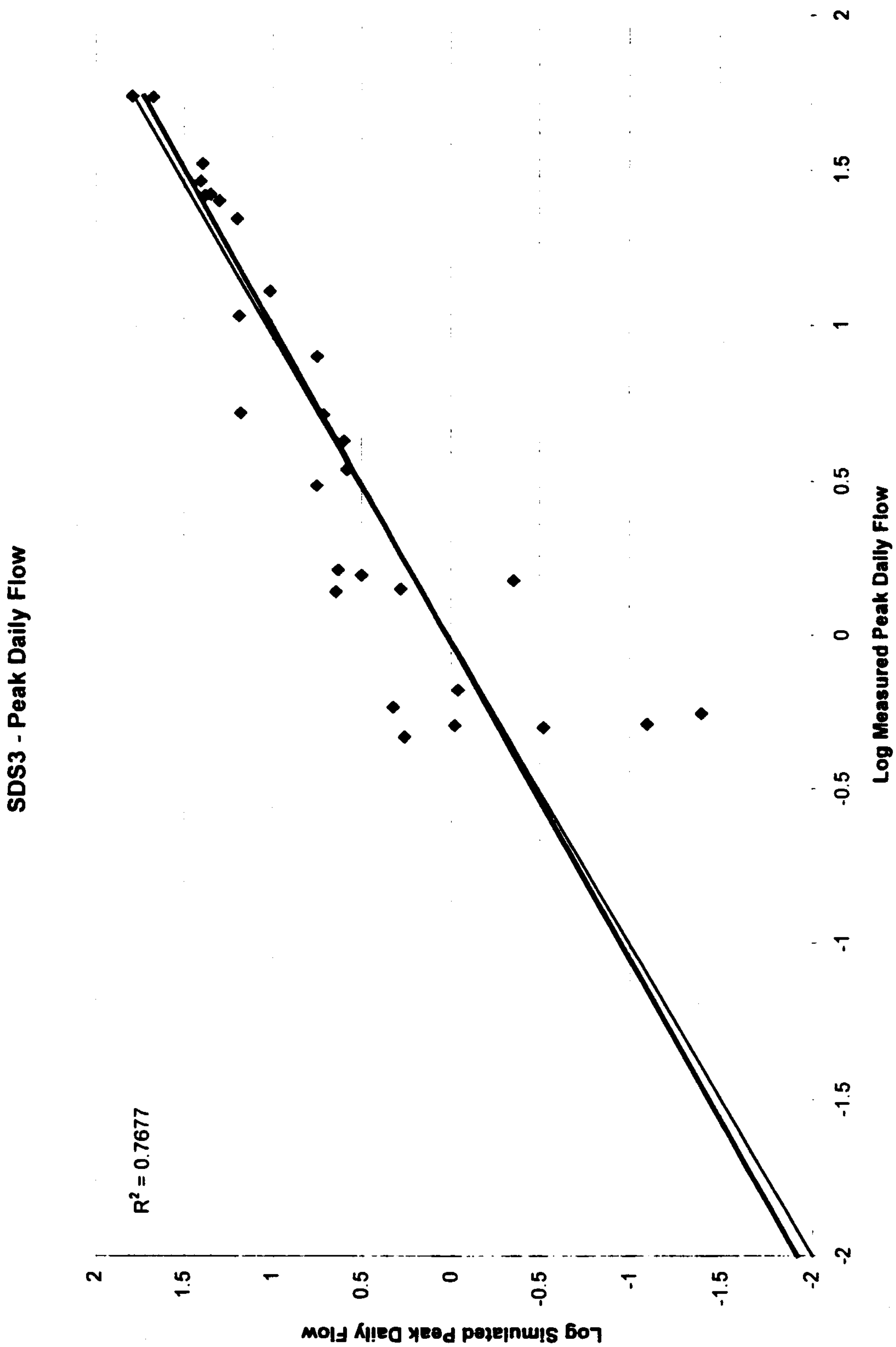


July 2001
556-2912-001 (28)

SDS3 - Daily Peak Flow

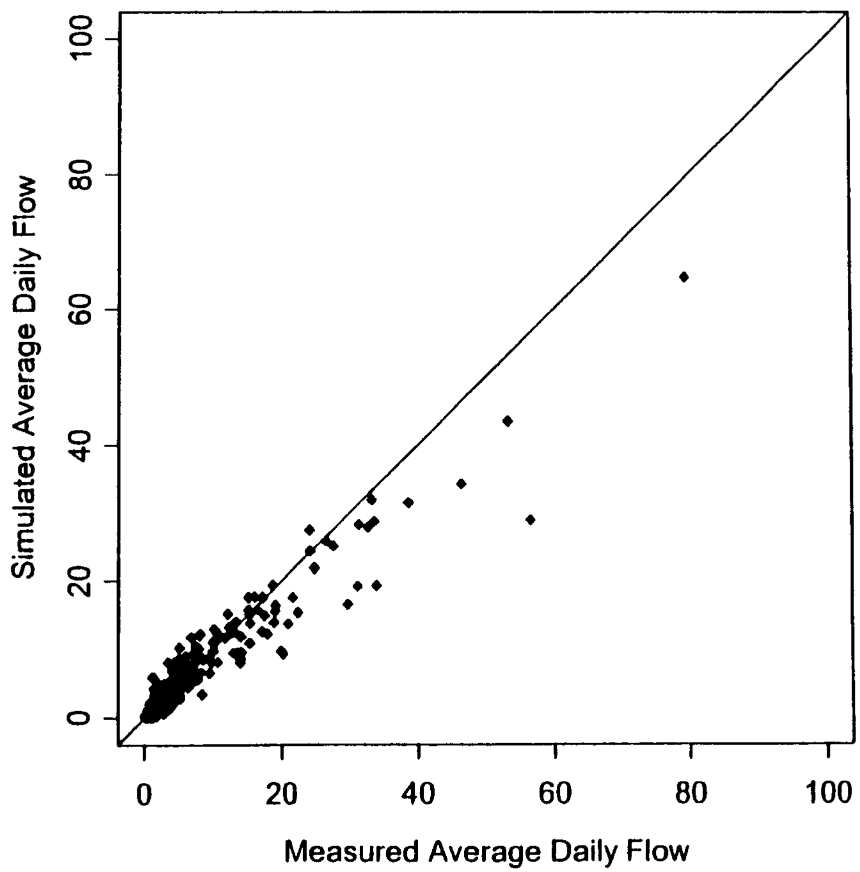



SDS3 - Average Daily Flow
R² = 0.8211
Log Simulated Average Daily Flow
Log Measured Average Daily Flow
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00

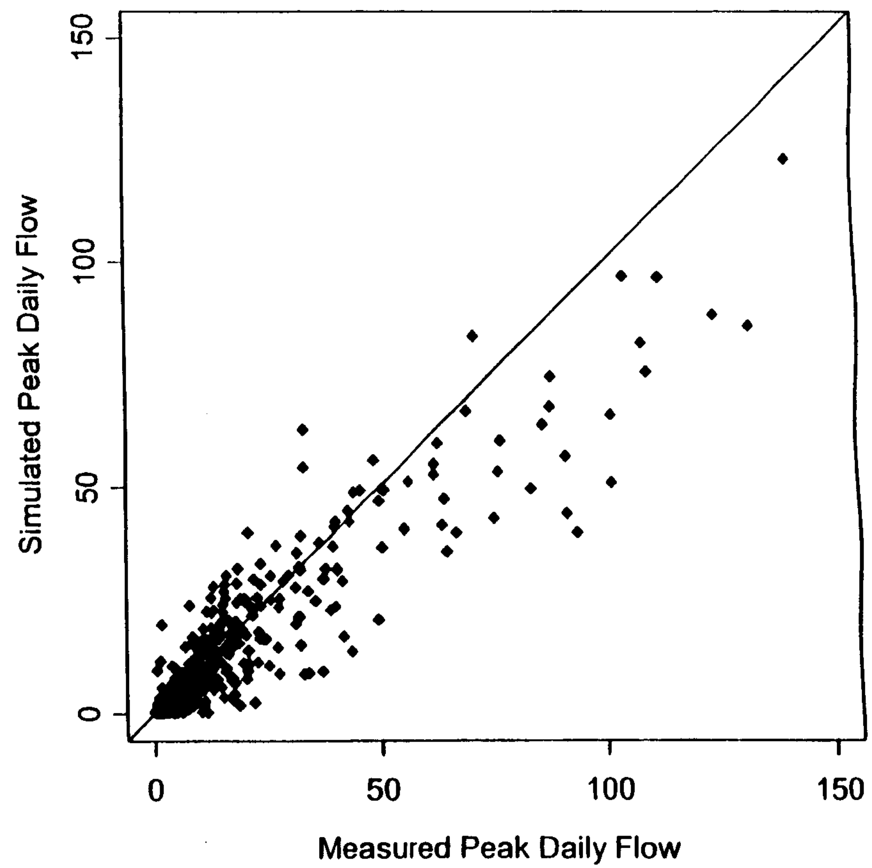


SDS3 - Peak Daily Flow
R^2 = 0.7677
Log Simulated Peak Daily Flow
Log Measured Peak Daily Flow
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2

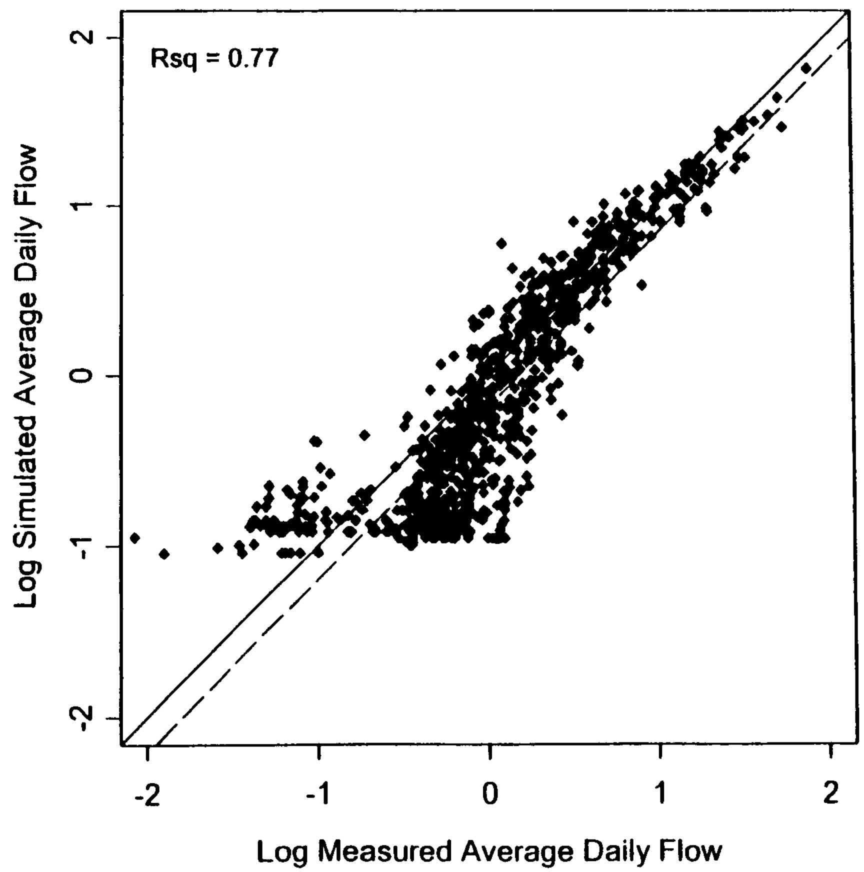
Tyee - Daily Average Flow



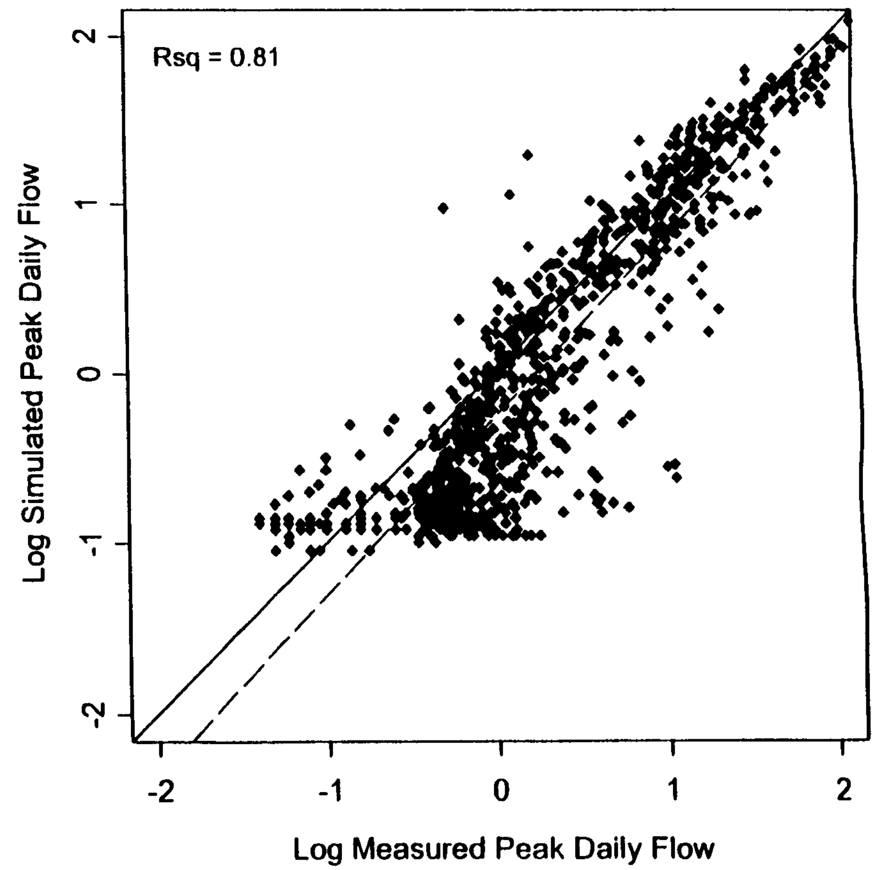
Tyee - Daily Peak Flow

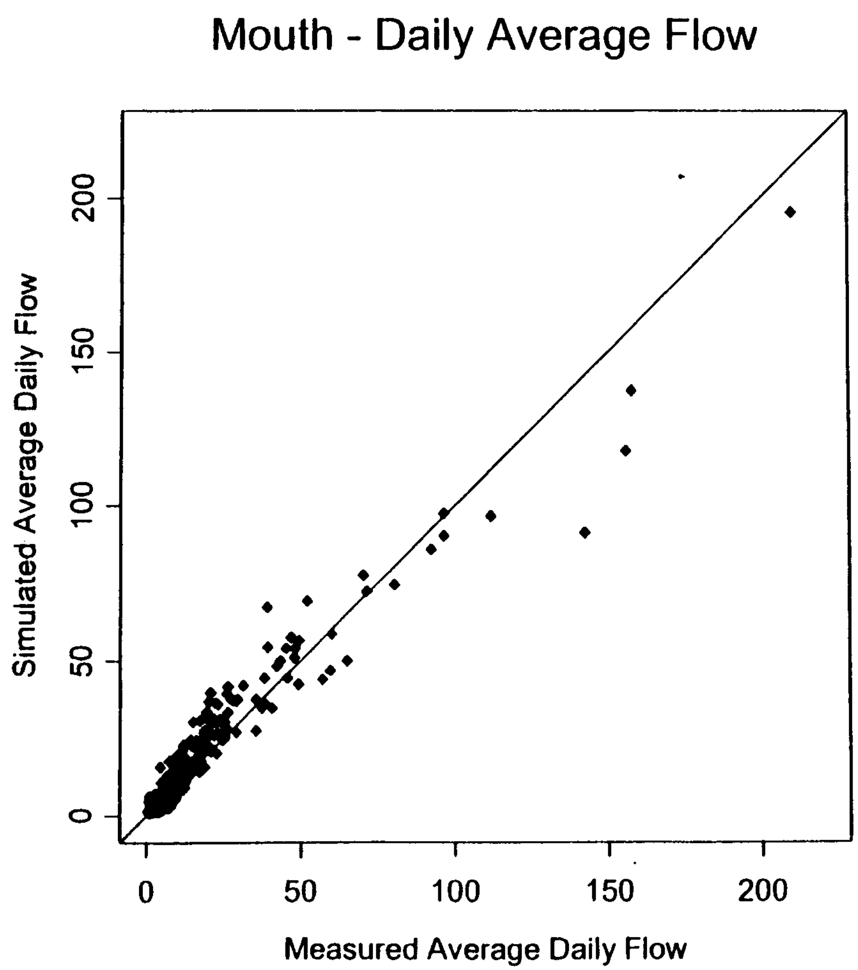


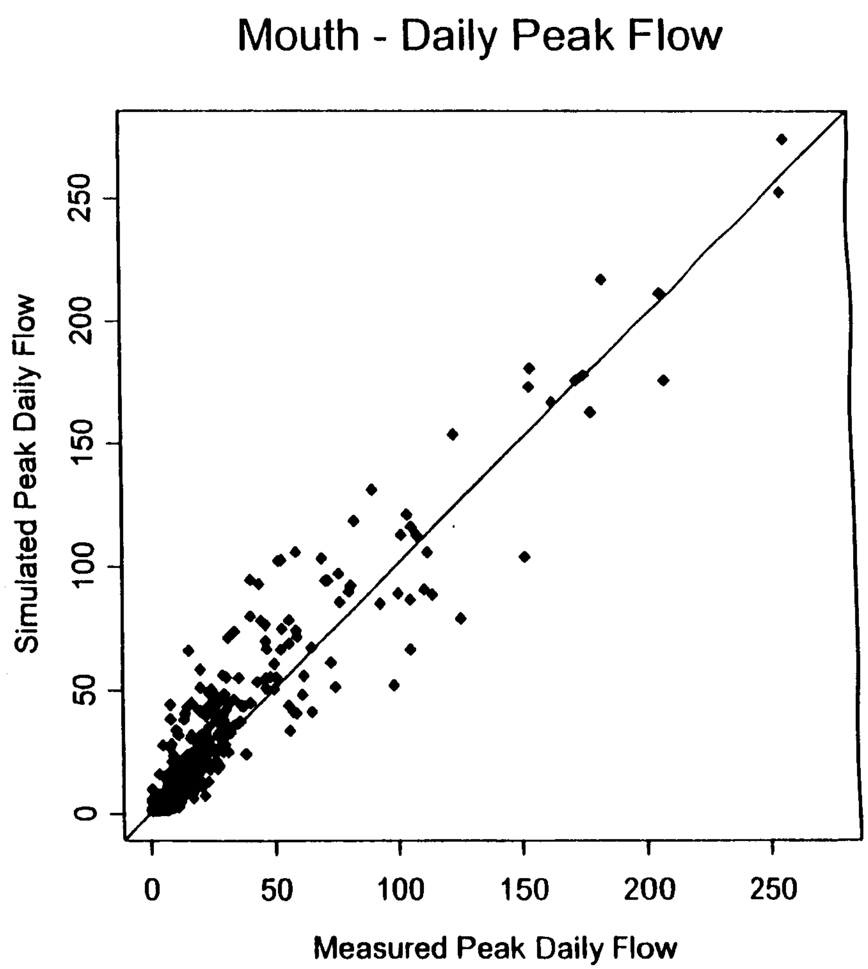
Tyee - Daily Average Flow



Tyee - Daily Peak Flow

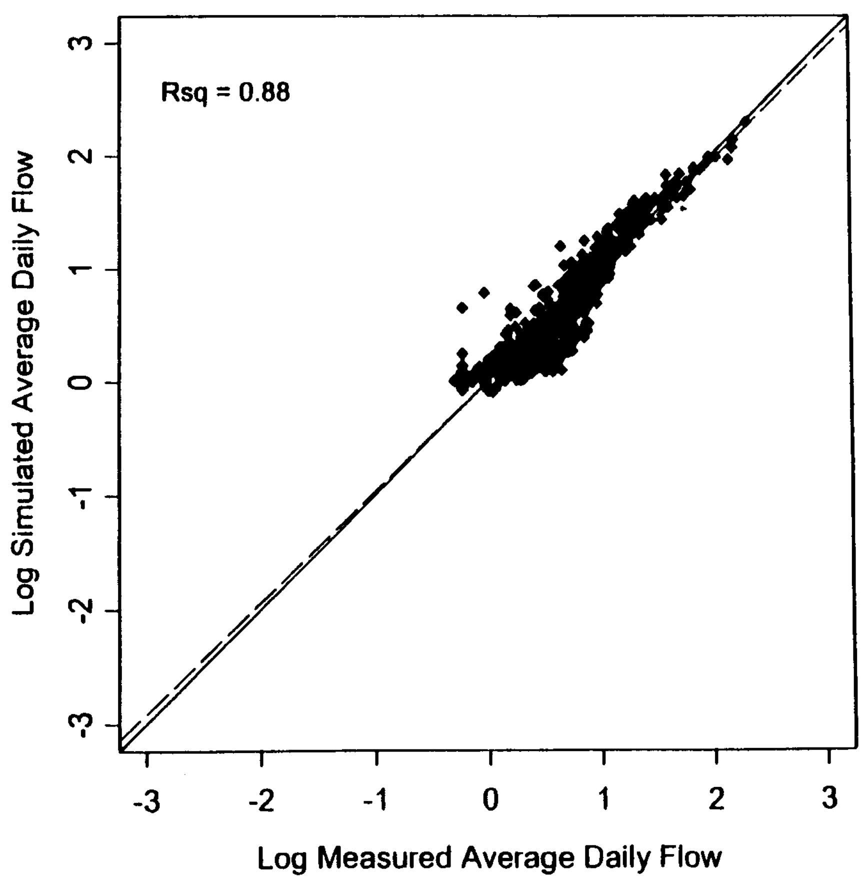



Mouth - Daily Average Flow
Simulated Average Daily Flow
Measured Average Daily Flow
0
50
100
150
200

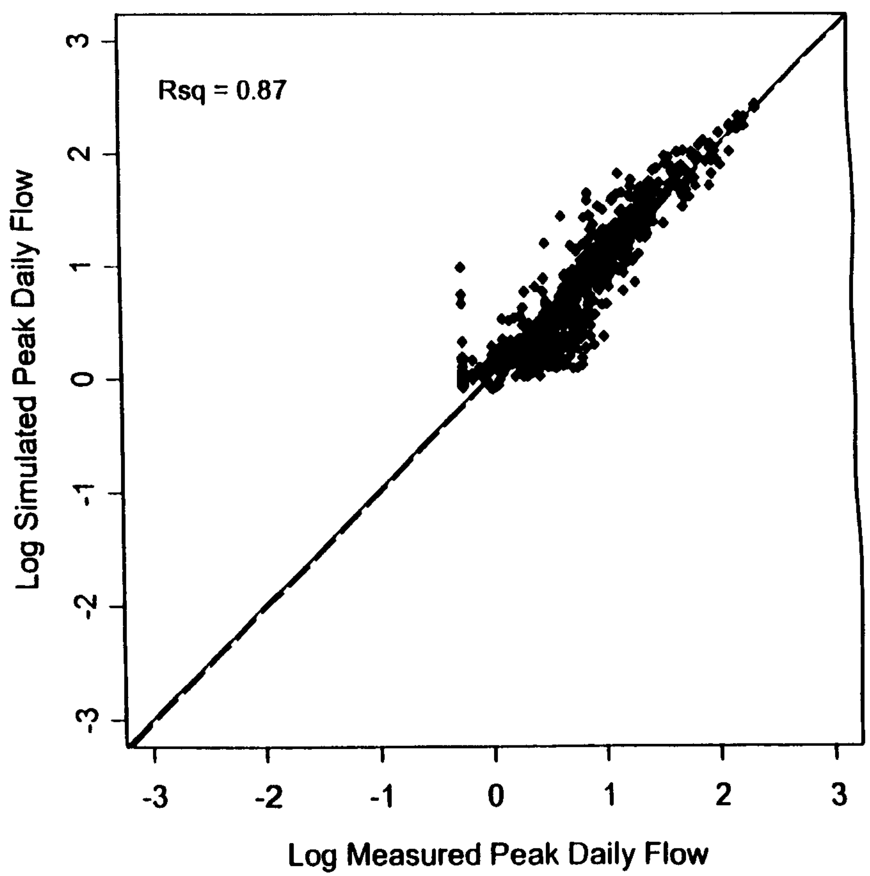

Mouth - Daily Peak Flow
Simulated Peak Daily Flow
Measured Peak Daily Flow
0
50
100
150
200
250

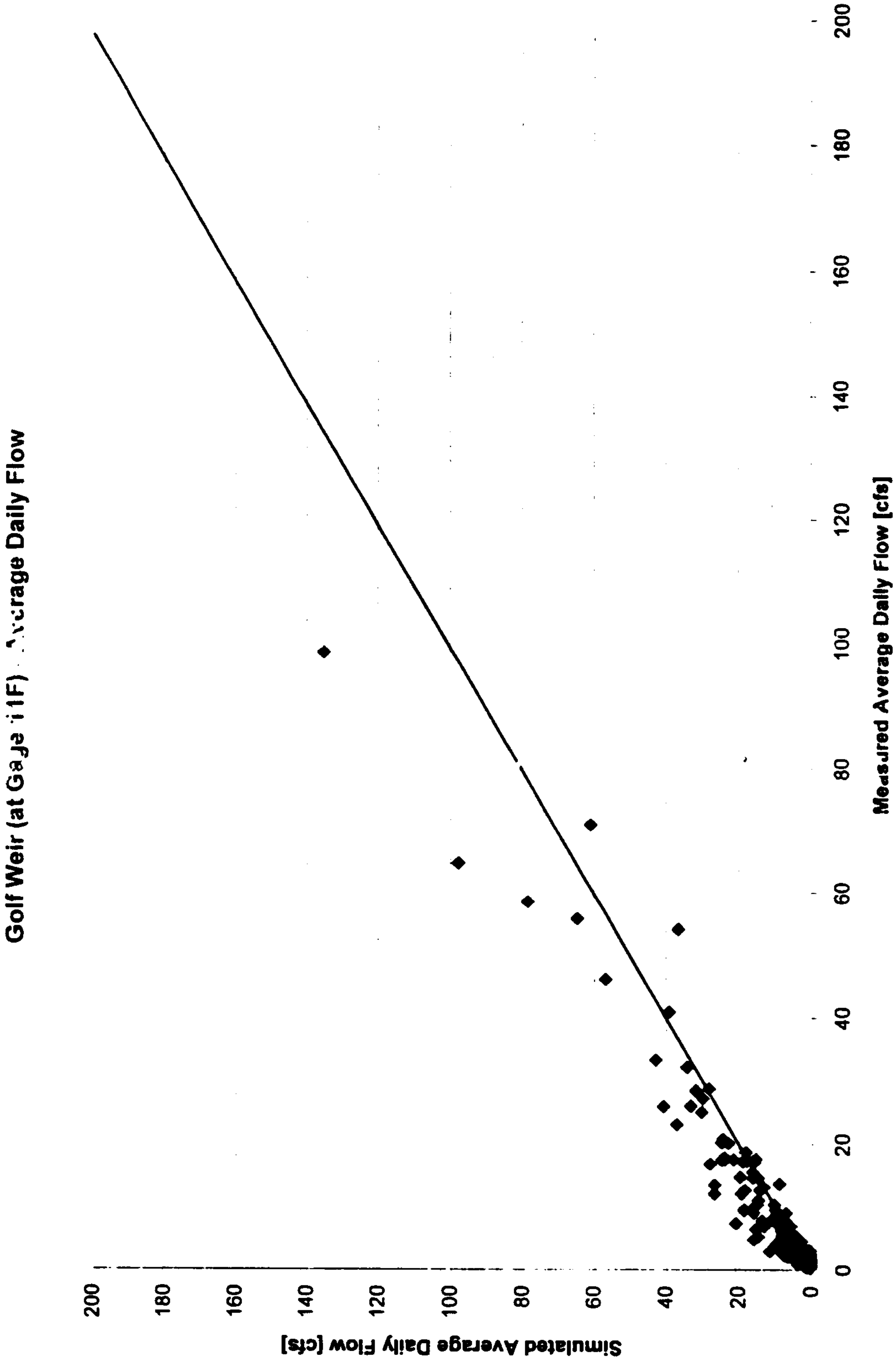
AR 047032

Mouth - Daily Average Flow

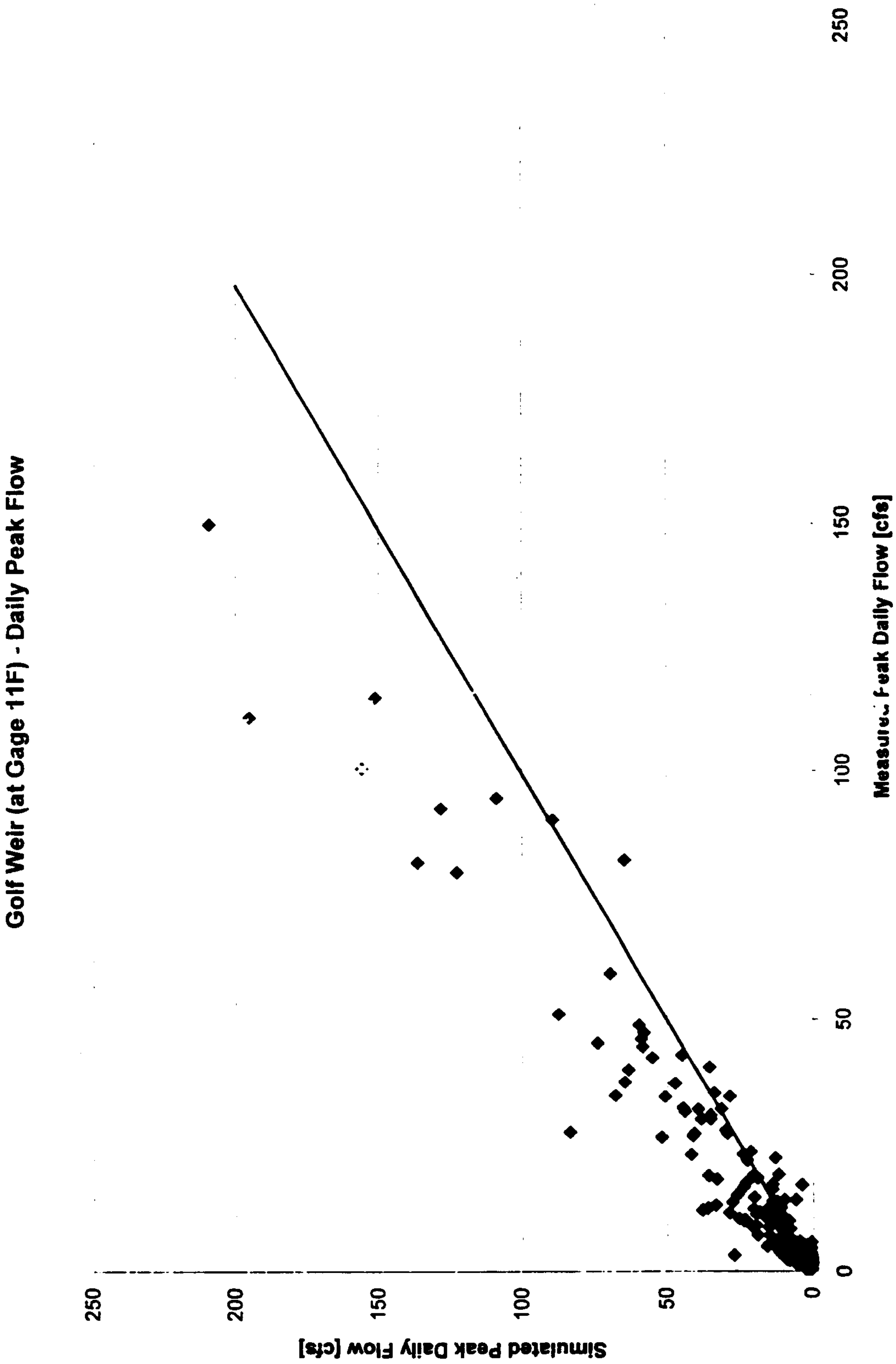


Mouth - Daily Peak Flow

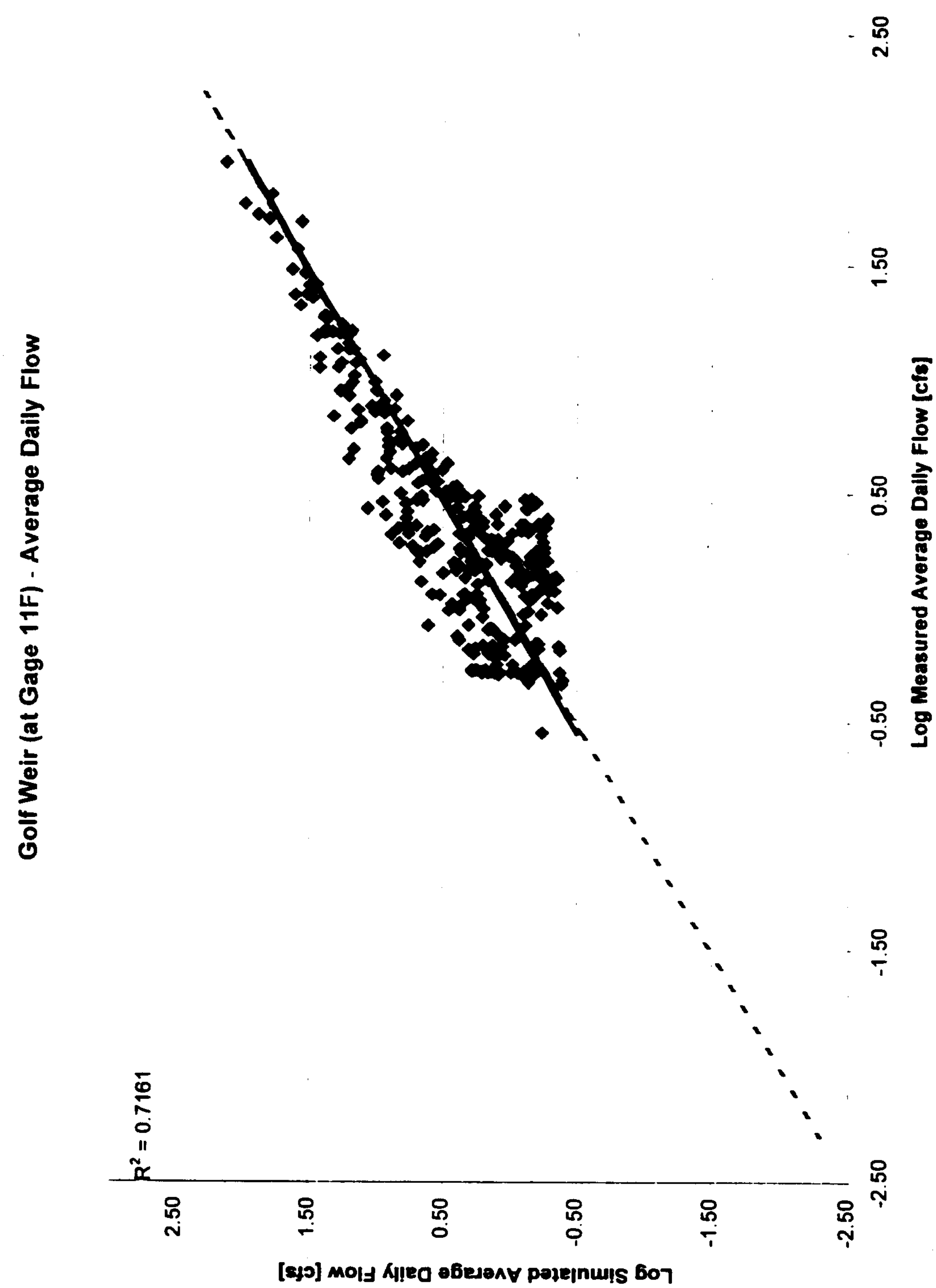




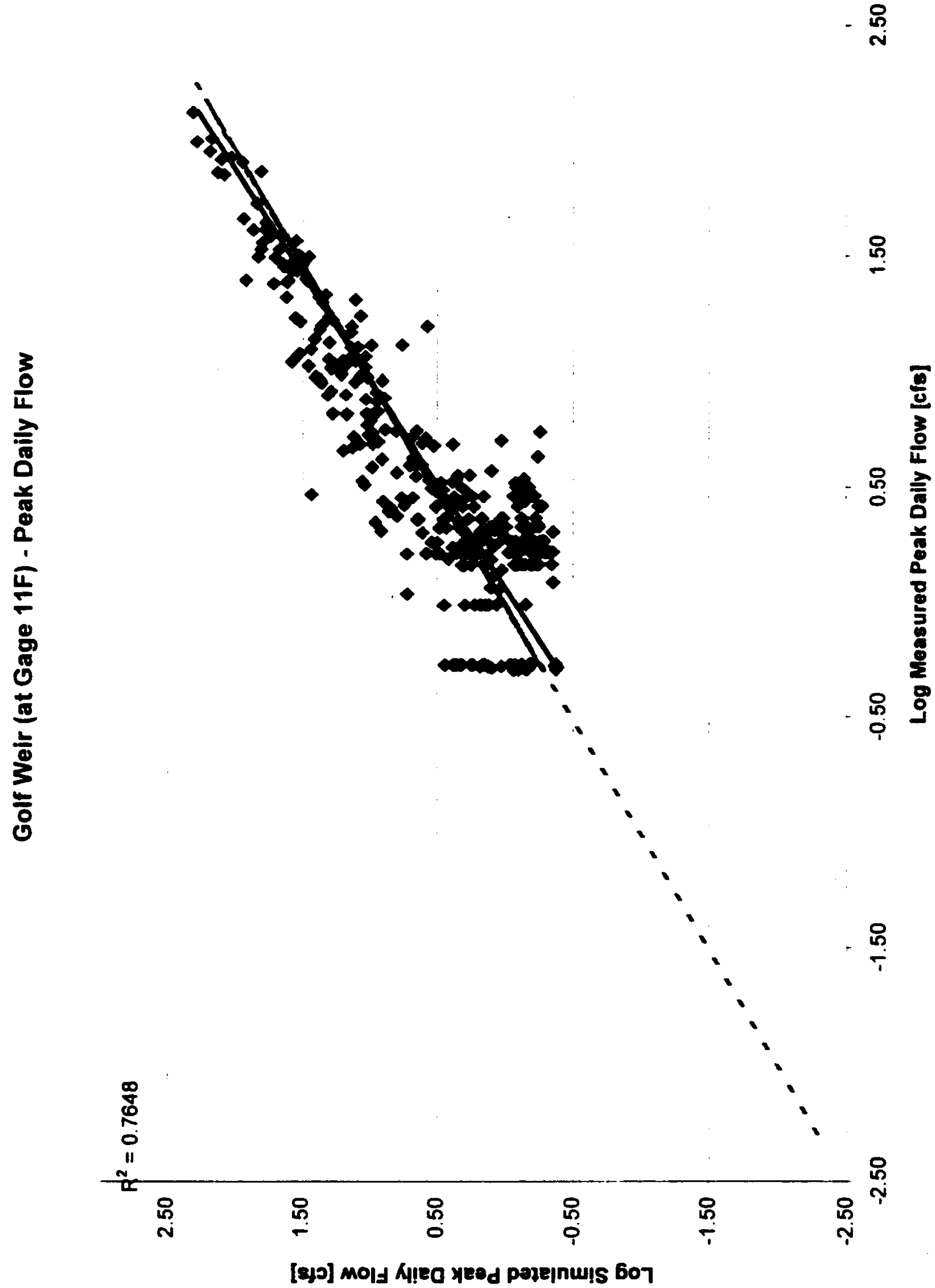
Golf Weir (at Gage 11F) Average Daily Flow
Simulated Average Daily Flow [cfs]
Measured Average Daily Flow [cfs]
0
20
40
60
80
100
120
140
160
180
200



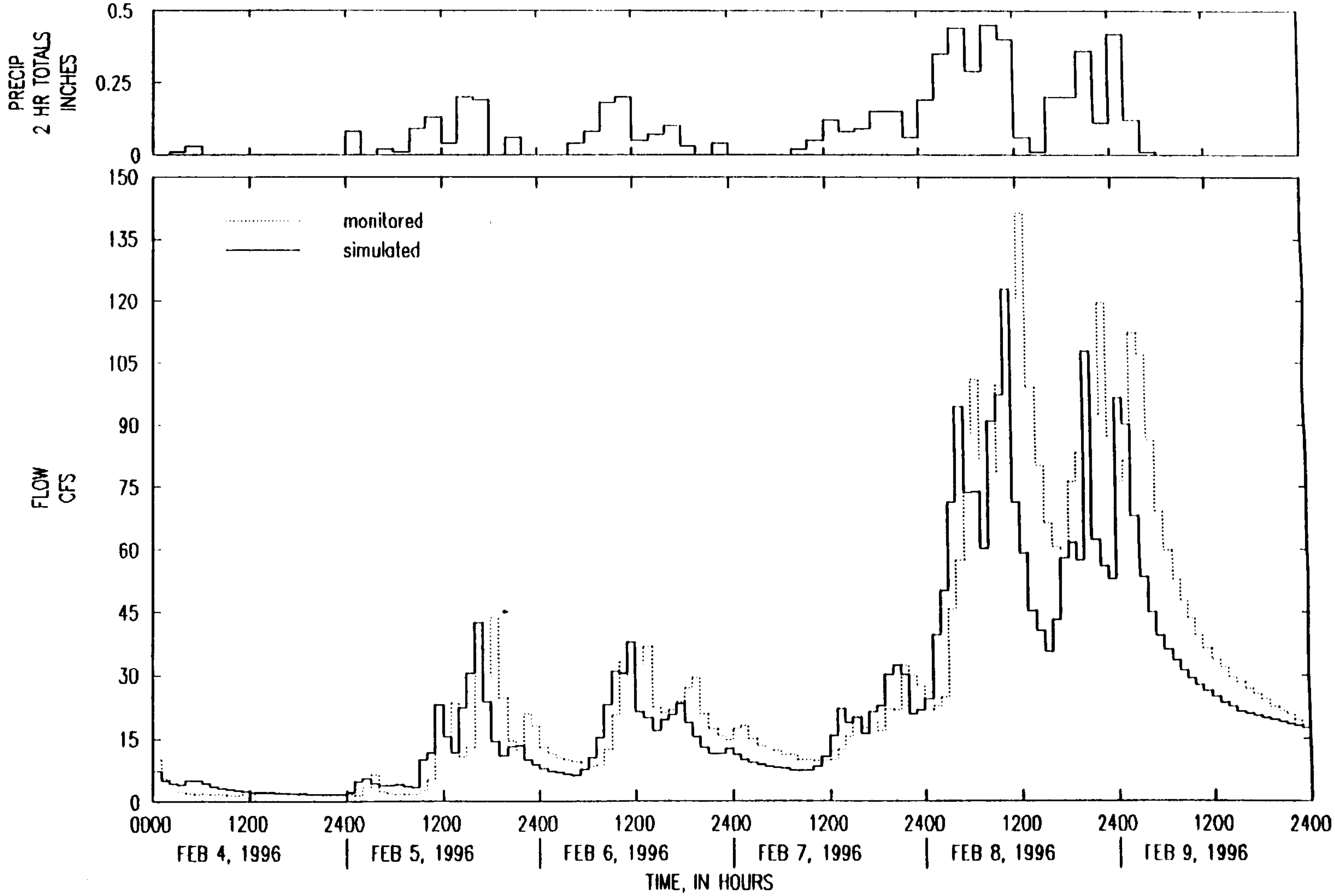
July 2001
556-2912-001 (28)



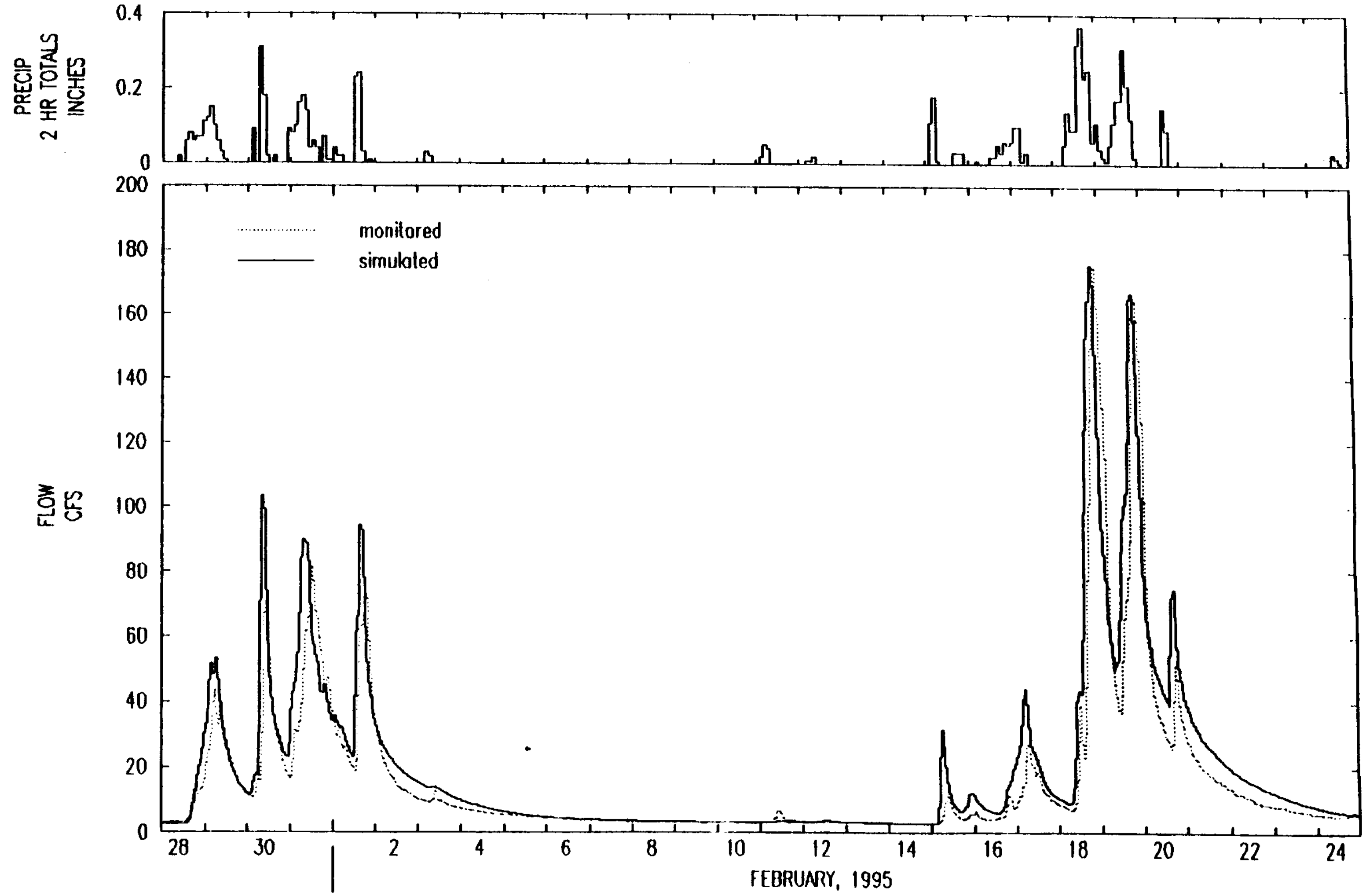
Golf Weir (at Gage 11F) - Average Daily Flow
R² = 0.7161
2.50
1.50
0.50
-0.50
-1.50
-2.50
Log Simulated Average Daily Flow [cfs]
-2.50
-1.50
-0.50
0.50
1.50
2.50
Log Measured Average Daily Flow [cfs]



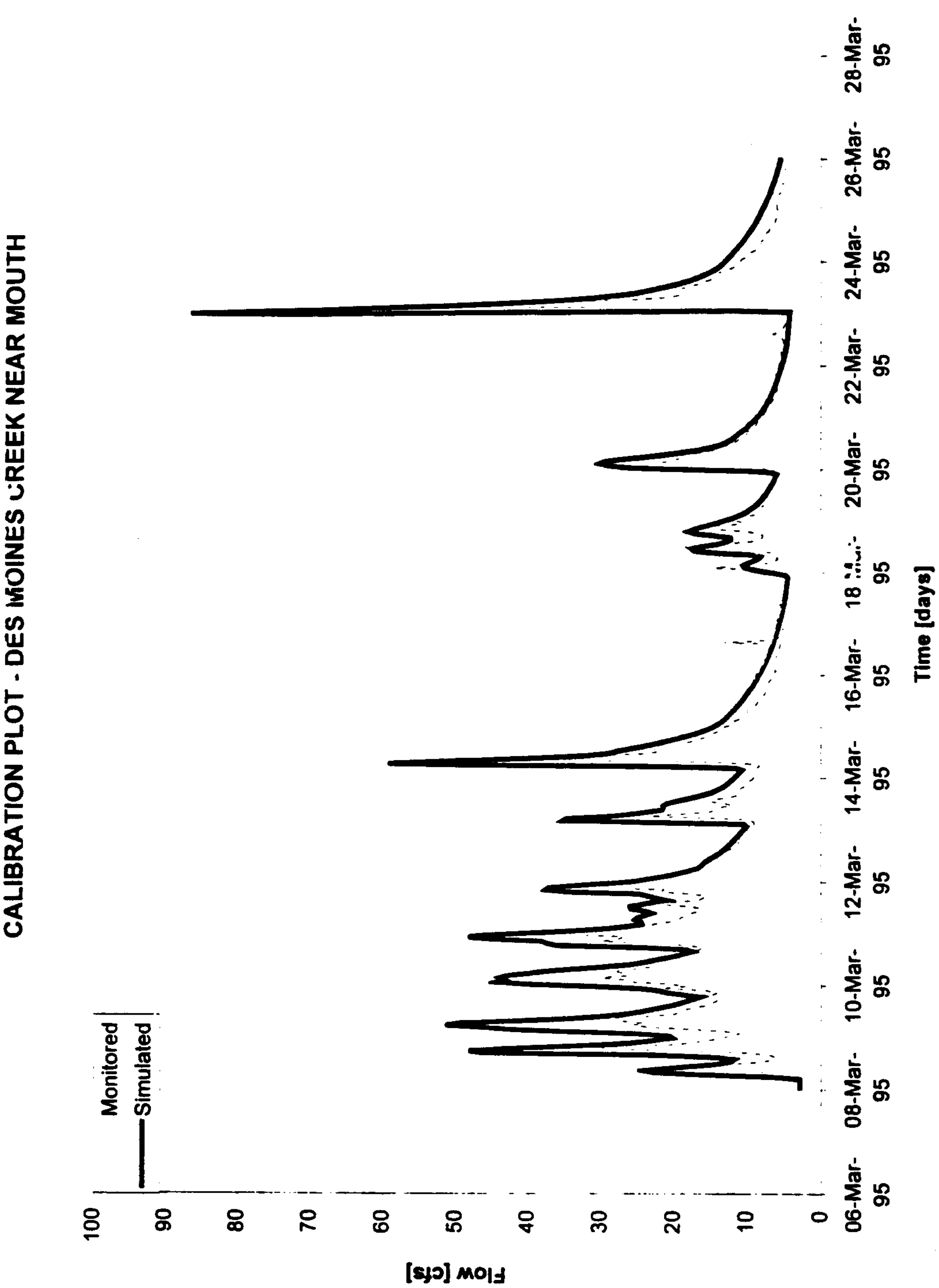
Golf Weir (at Gage 11F) - Peak Daily Flow
R^2 = 0.7648
Log Simulated Peak Daily Flow [cfs]
Log Measured Peak Daily Flow [cfs]
2.50
1.50
0.50
-0.50
-1.50
-2.50



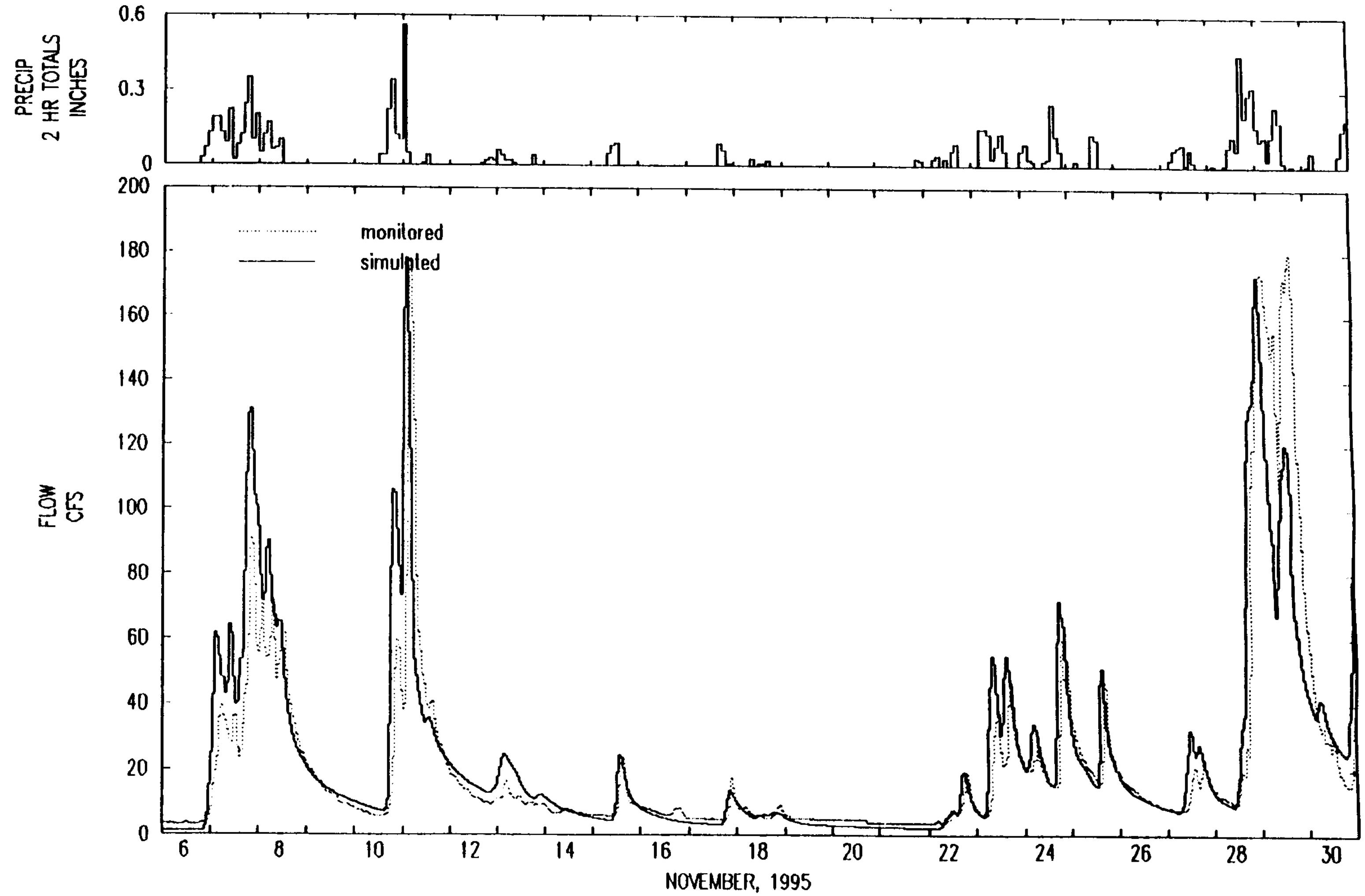
DES MOINES CREEK
CALIBRATION PLOT
TYEE POND INFLOW



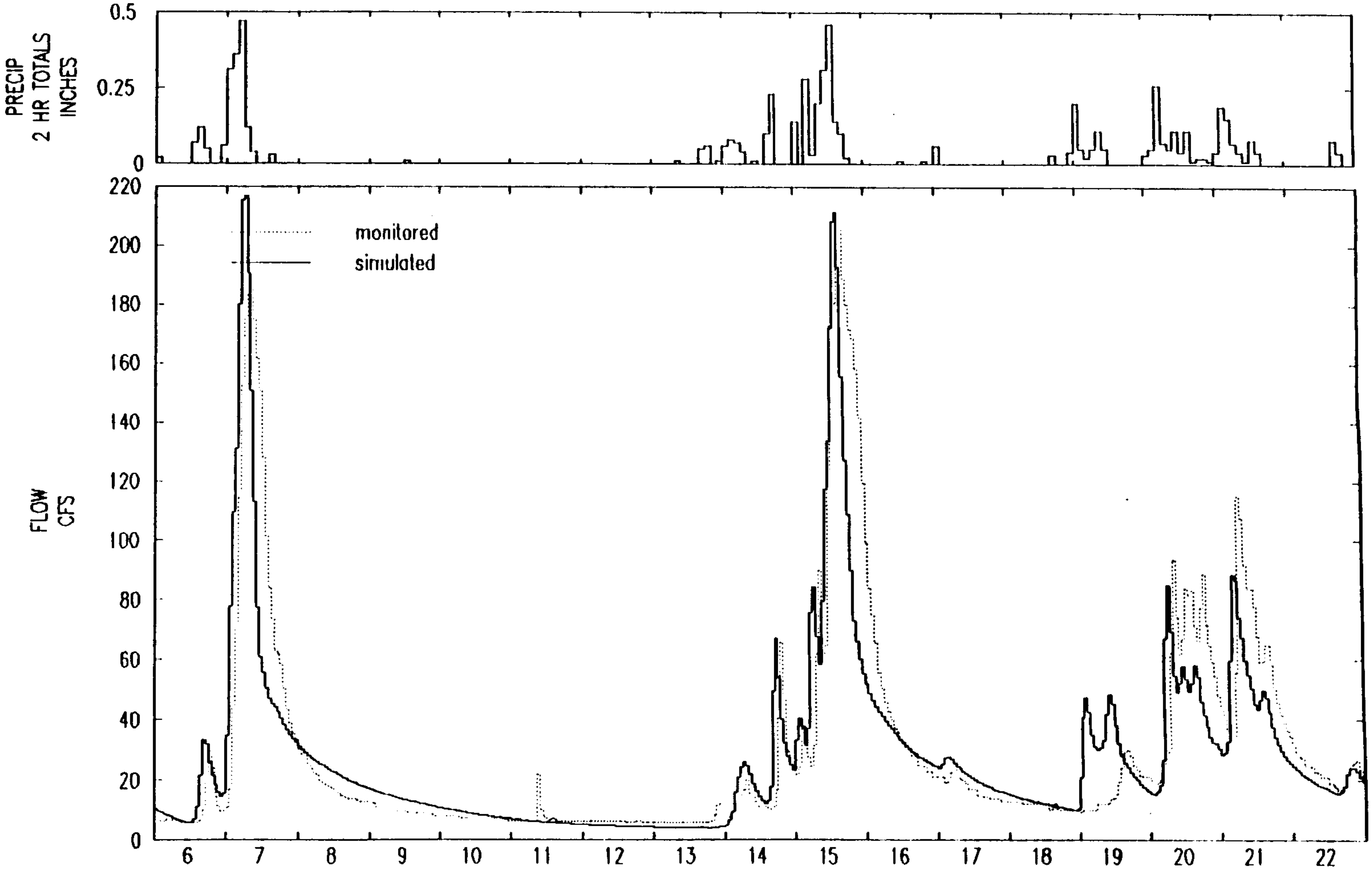
DES MOINES CREEK
CALIBRATION PLOT
NEAR MOUTH



CALIBRATION PLOT - DES MOINES CREEK NEAR MOUTH
Monitored
Simulated
Flow [cfs]
100
90
80
70
60
50
40
30
20
10
0
06-Mar-95
08-Mar-95
10-Mar-95
12-Mar-95
14-Mar-95
16-Mar-95
20-Mar-95
22-Mar-95
24-Mar-95
26-Mar-95
28-Mar-95
Time [days]

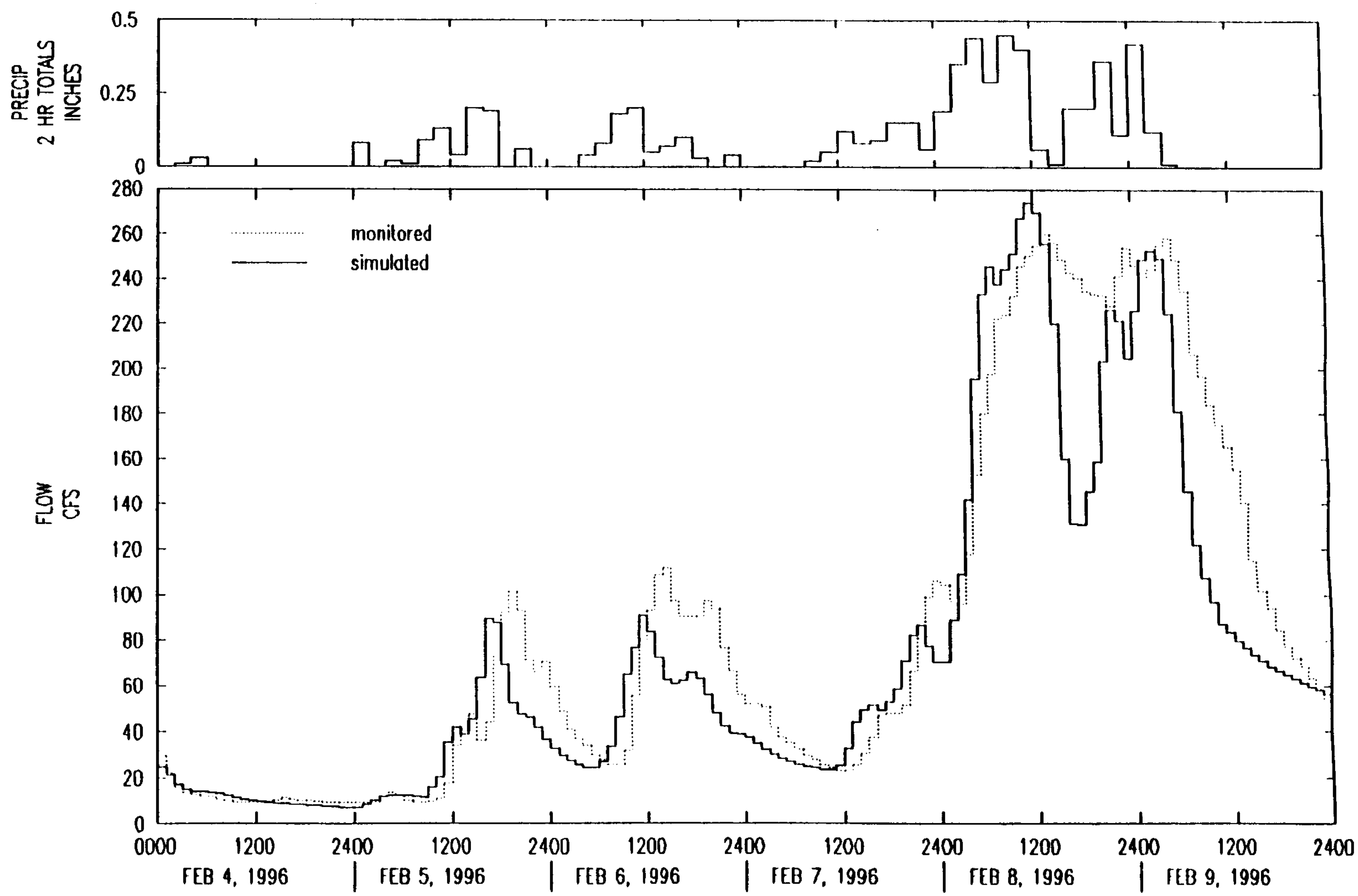


DES MOINES CREEK
CALIBRATION PLOT
NEAR MOUTH

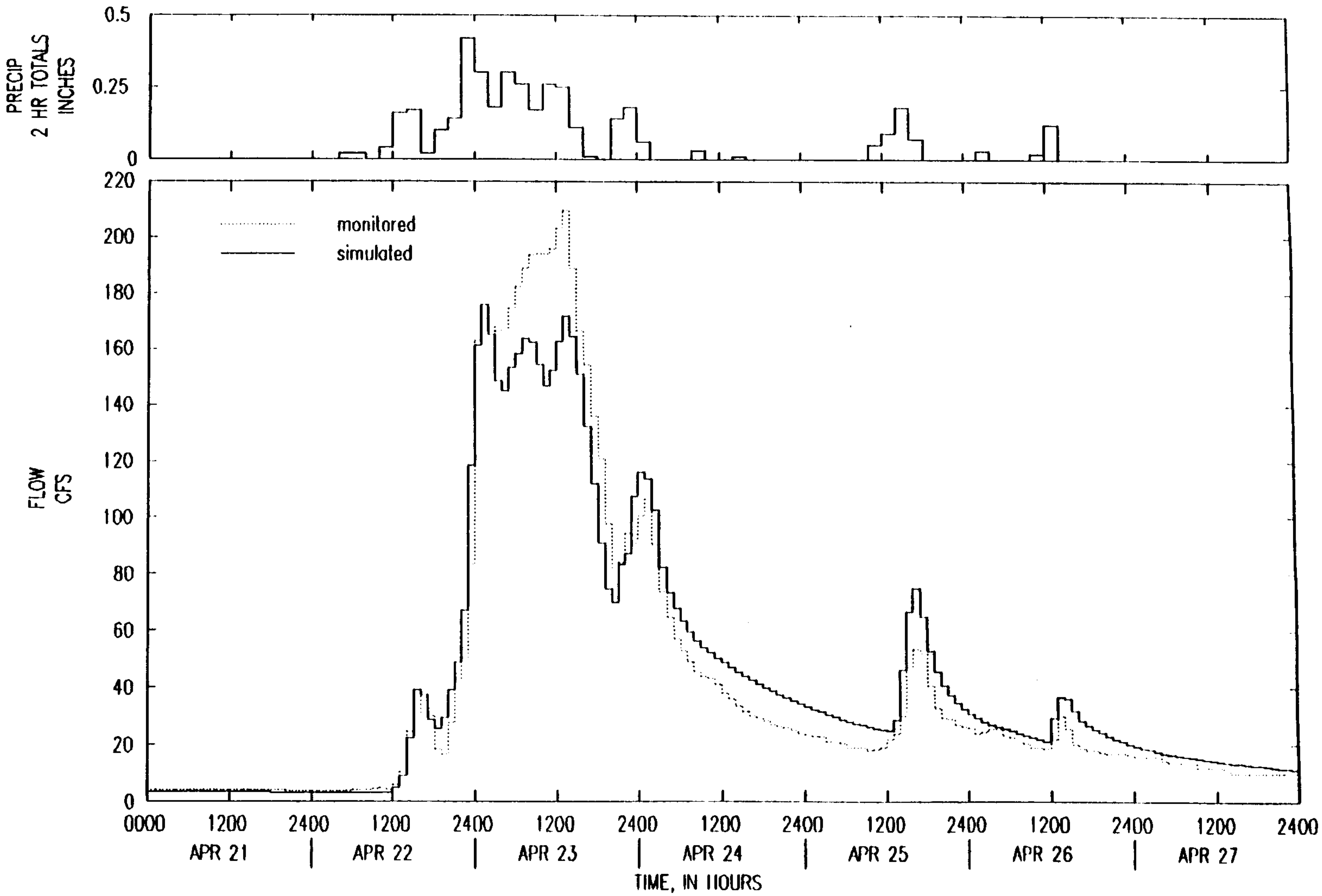


JANUARY, 1996
TIME, IN DAYS
DES MOINES CREEK
CALIBRATION PLOT
NEAR MOUTH

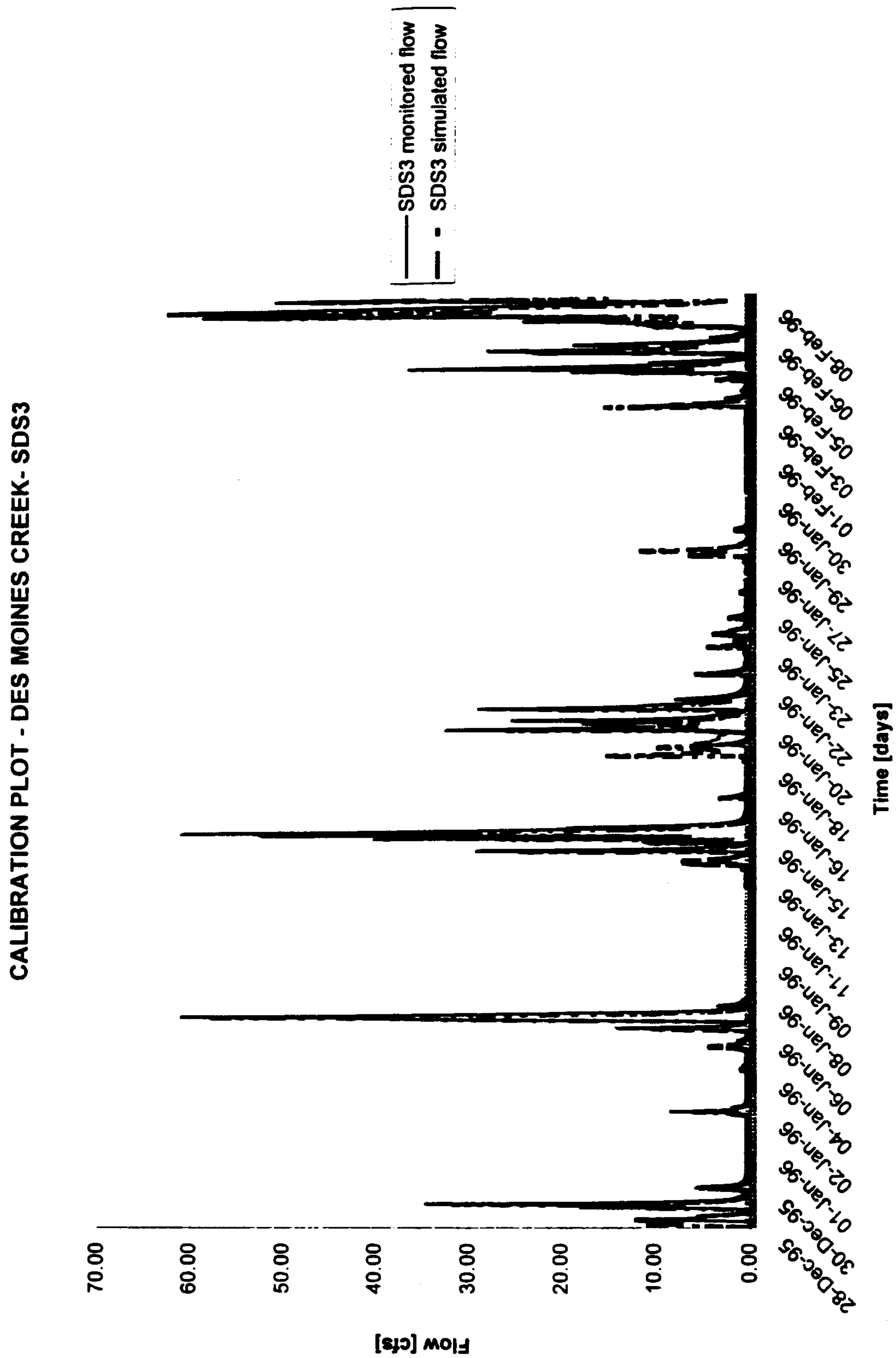
AR 047042

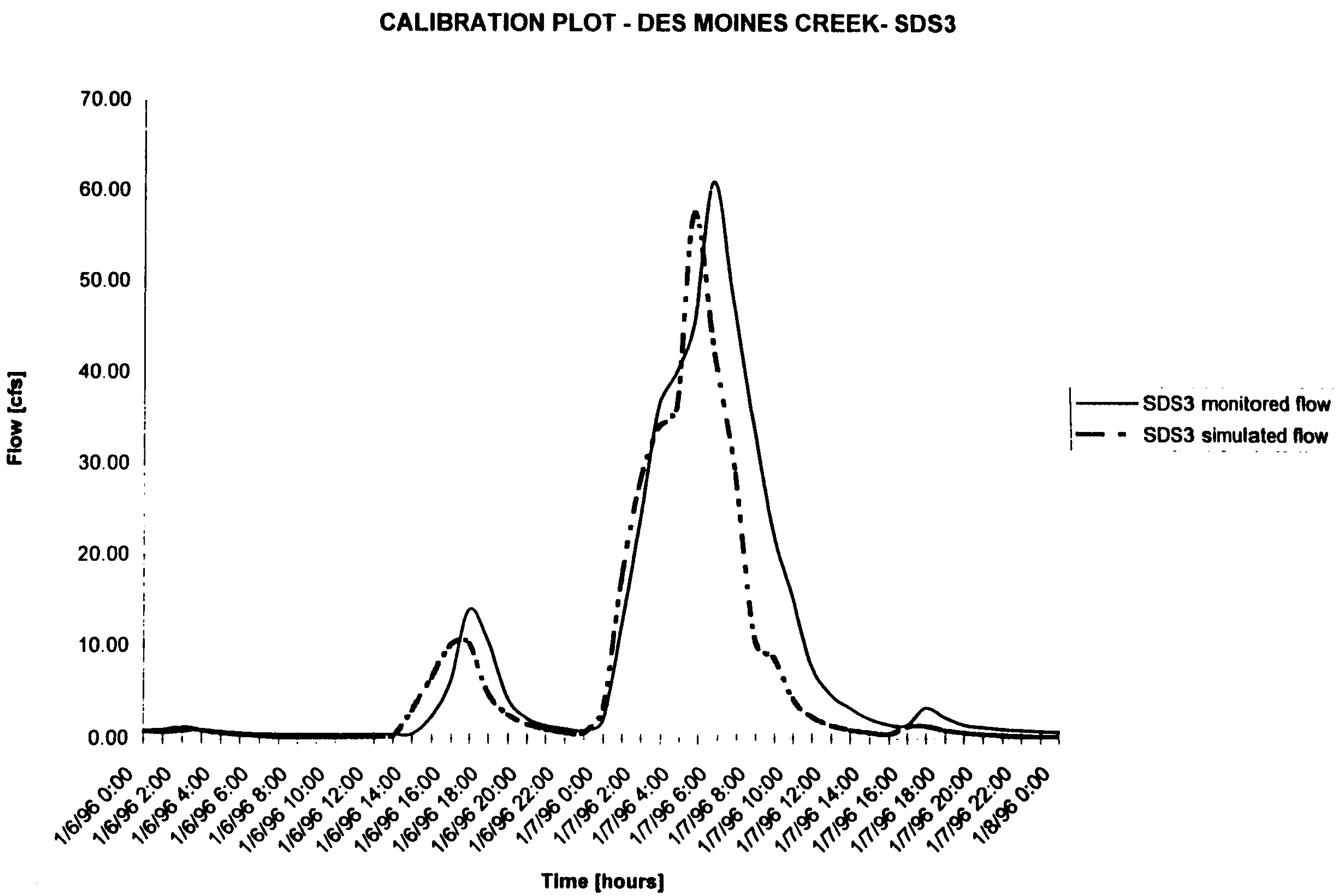


DES MOINES CREEK
CALIBRATION PLOT
NEAR MOUTH

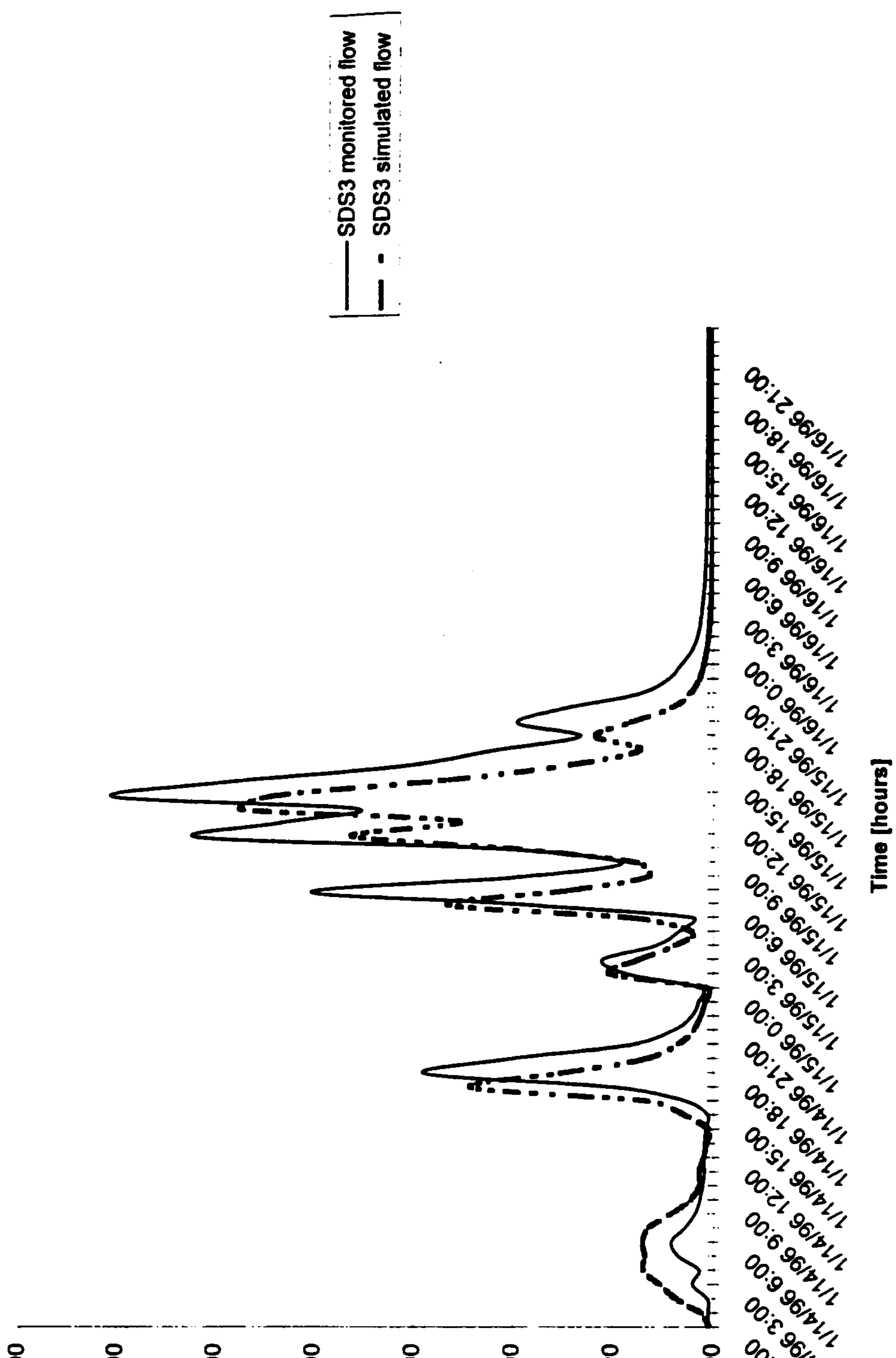


DES MOINES CREEK
CALIBRATION PLOT
NEAR MOUTH

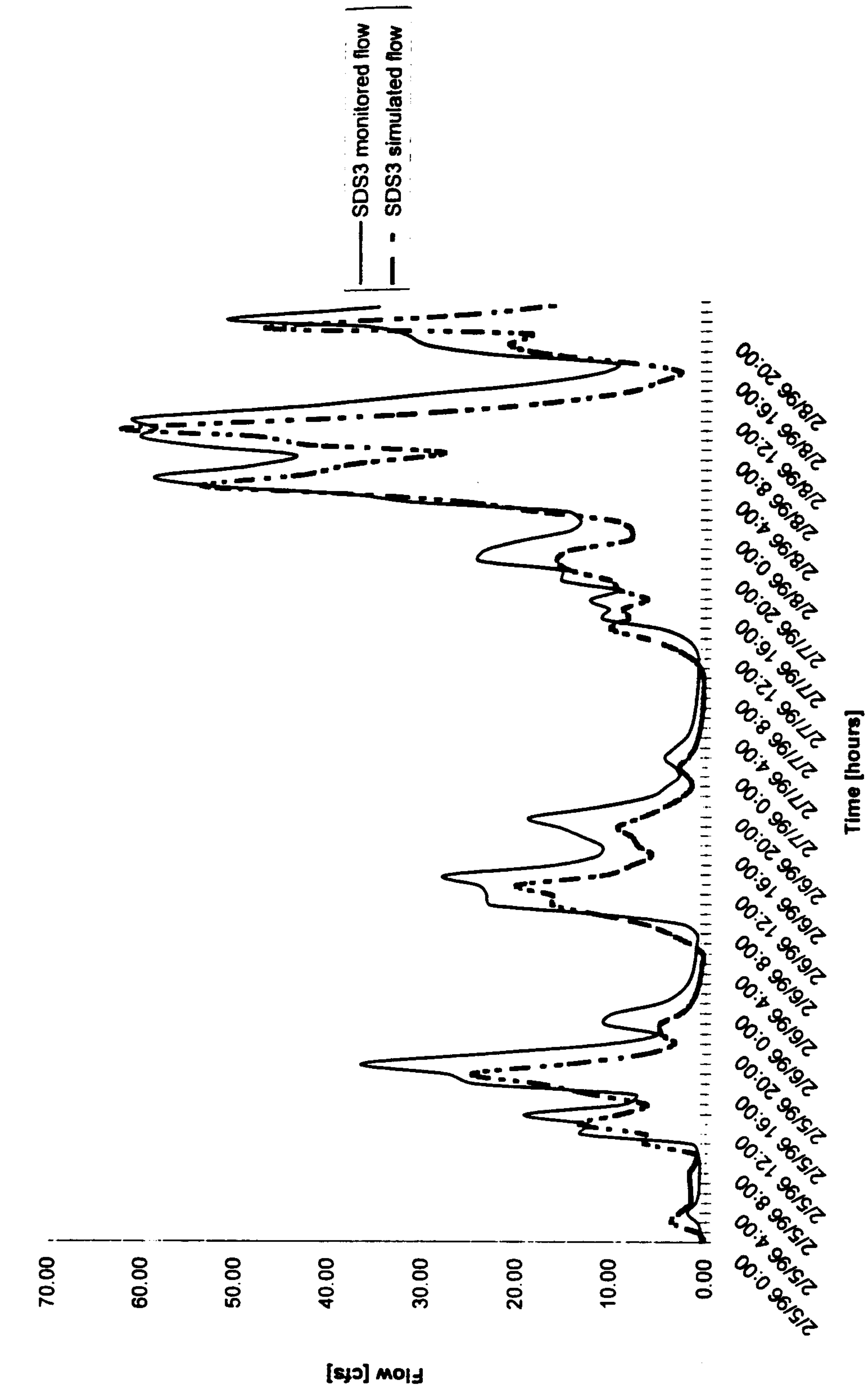

CALIBRATION PLOT - DES MOINES CREEK- SDS3
SDS3 monitored flow
SDS3 simulated flow
Flow [cfs]
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
28-Dec-95
30-Dec-95
01-Jan-96
02-Jan-96
04-Jan-96
06-Jan-96
08-Jan-96
09-Jan-96
11-Jan-96
13-Jan-96
15-Jan-96
16-Jan-96
18-Jan-96
20-Jan-96
22-Jan-96
23-Jan-96
25-Jan-96
27-Jan-96
29-Jan-96
30-Jan-96
01-Feb-96
03-Feb-96
05-Feb-96
06-Feb-96
08-Feb-96
Time [days]

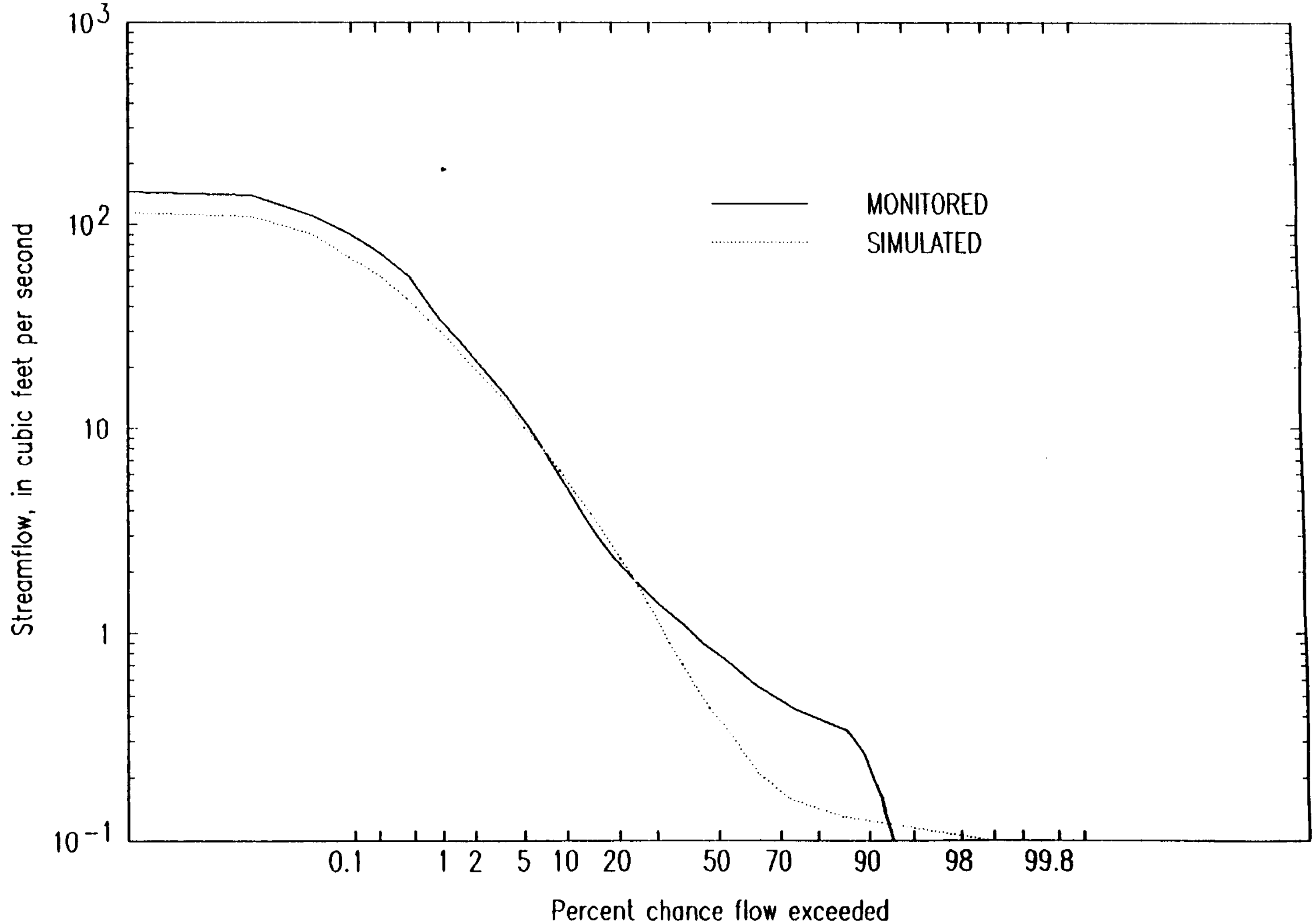

CALIBRATION PLOT - DES MOINES CREEK- SDS3
Flow [cfs]
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1/6/96 0:00
1/6/96 2:00
1/6/96 4:00
1/6/96 6:00
1/6/96 8:00
1/6/96 10:00
1/6/96 12:00
1/6/96 14:00
1/6/96 16:00
1/6/96 18:00
1/6/96 20:00
1/6/96 22:00
1/7/96 0:00
1/7/96 2:00
1/7/96 4:00
1/7/96 6:00
1/7/96 8:00
1/7/96 10:00
1/7/96 12:00
1/7/96 14:00
1/7/96 16:00
1/7/96 18:00
1/7/96 20:00
1/7/96 22:00
1/8/96 0:00
Time [hours]
SDS3 monitored flow
SDS3 simulated flow

CALIBRATION PLOT - DES MOINES CREEK - SDS3

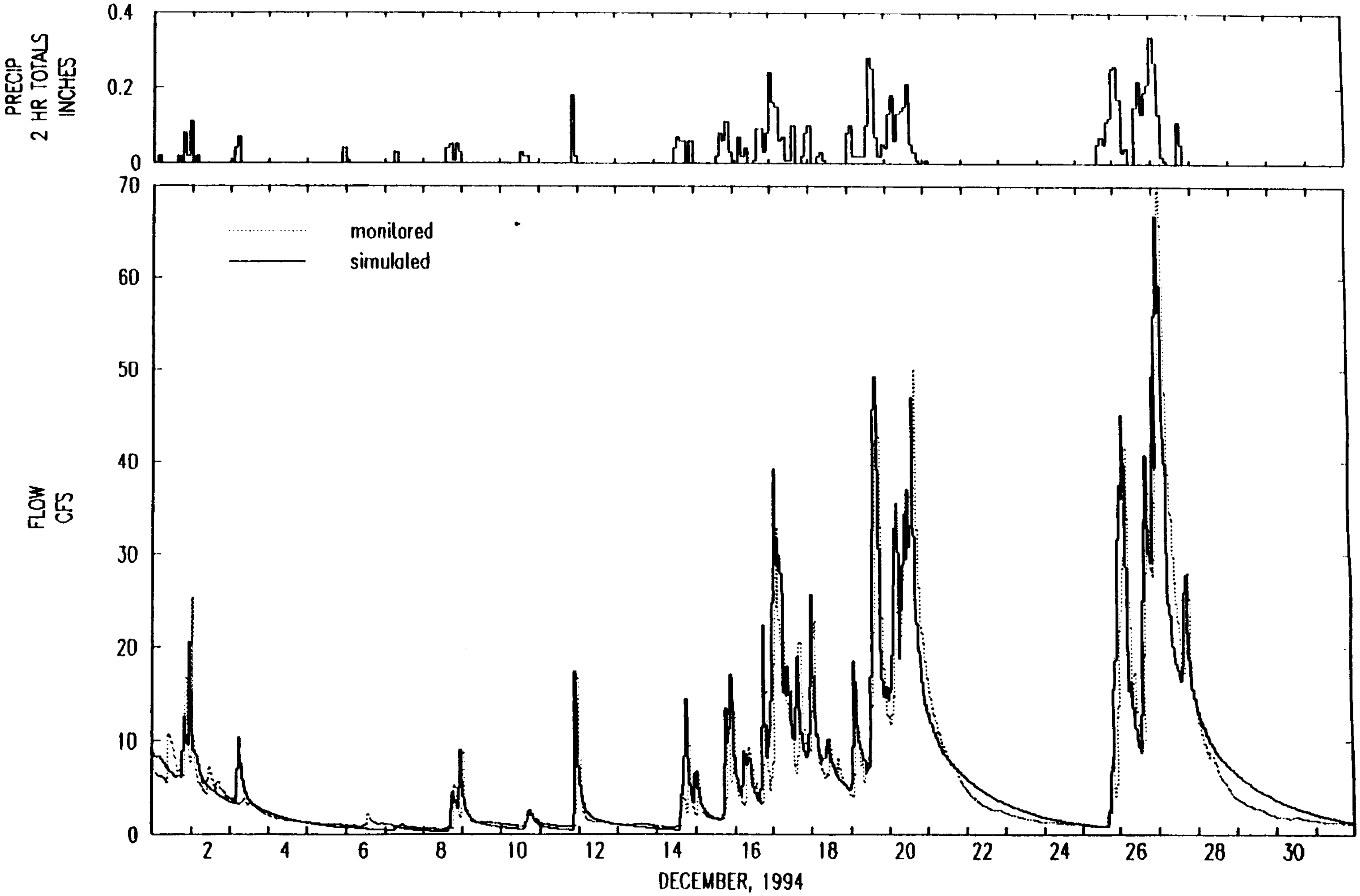


CALIBRATION PLOT - DES MOINES CREEK - SDS3

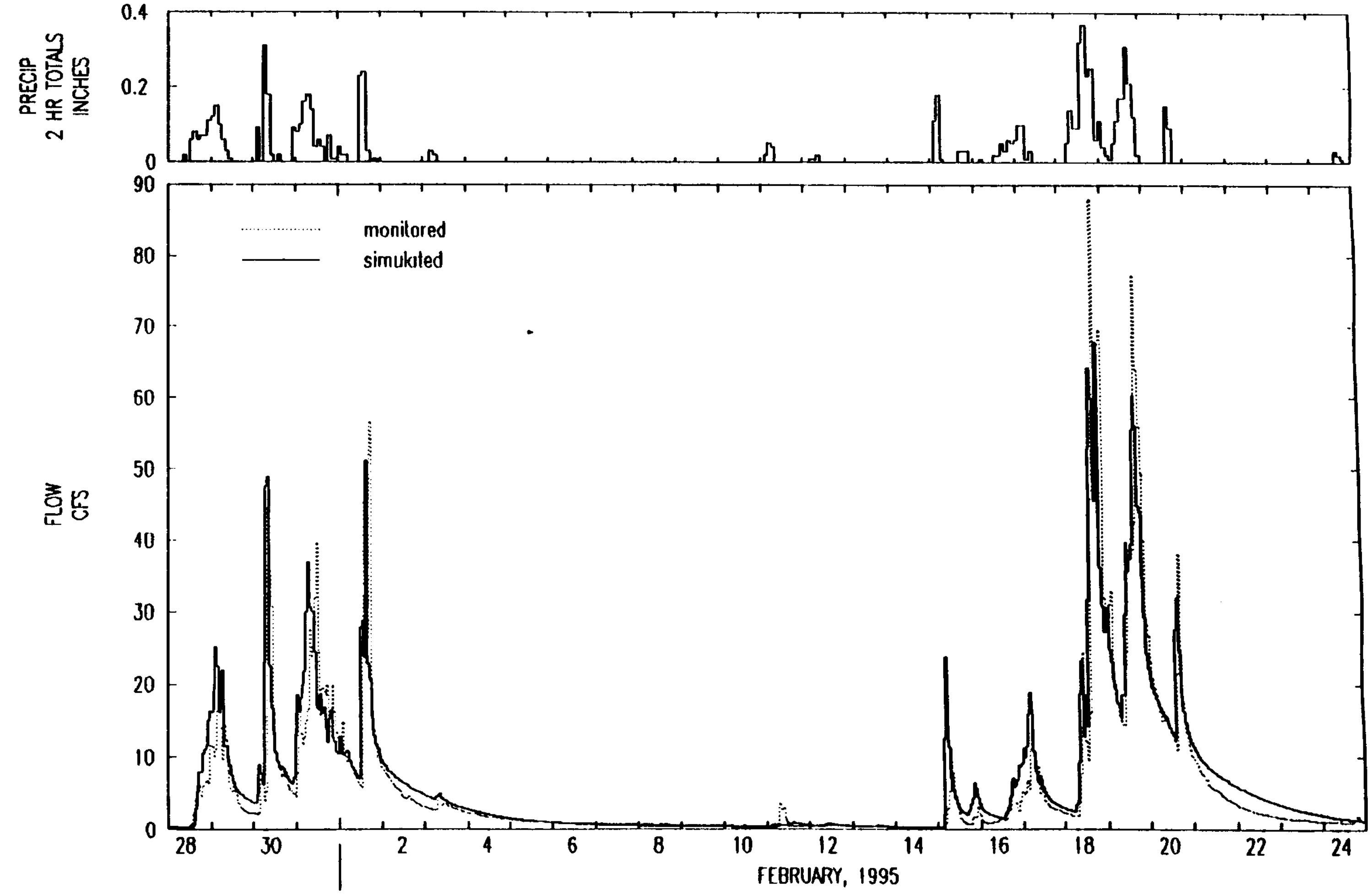




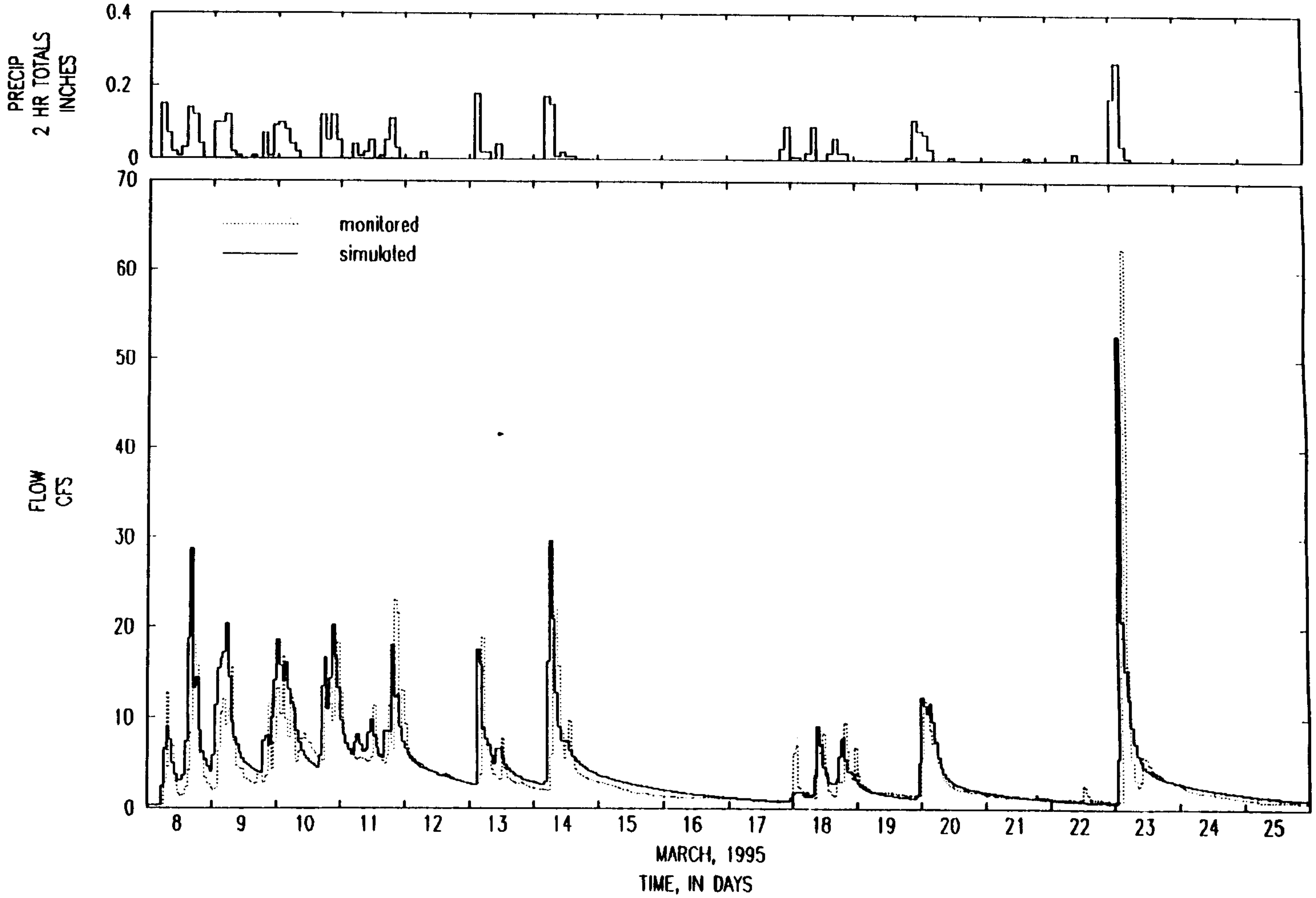
CALIBRATED VS MONITORED VALUES AT TYEE POND INFLOW



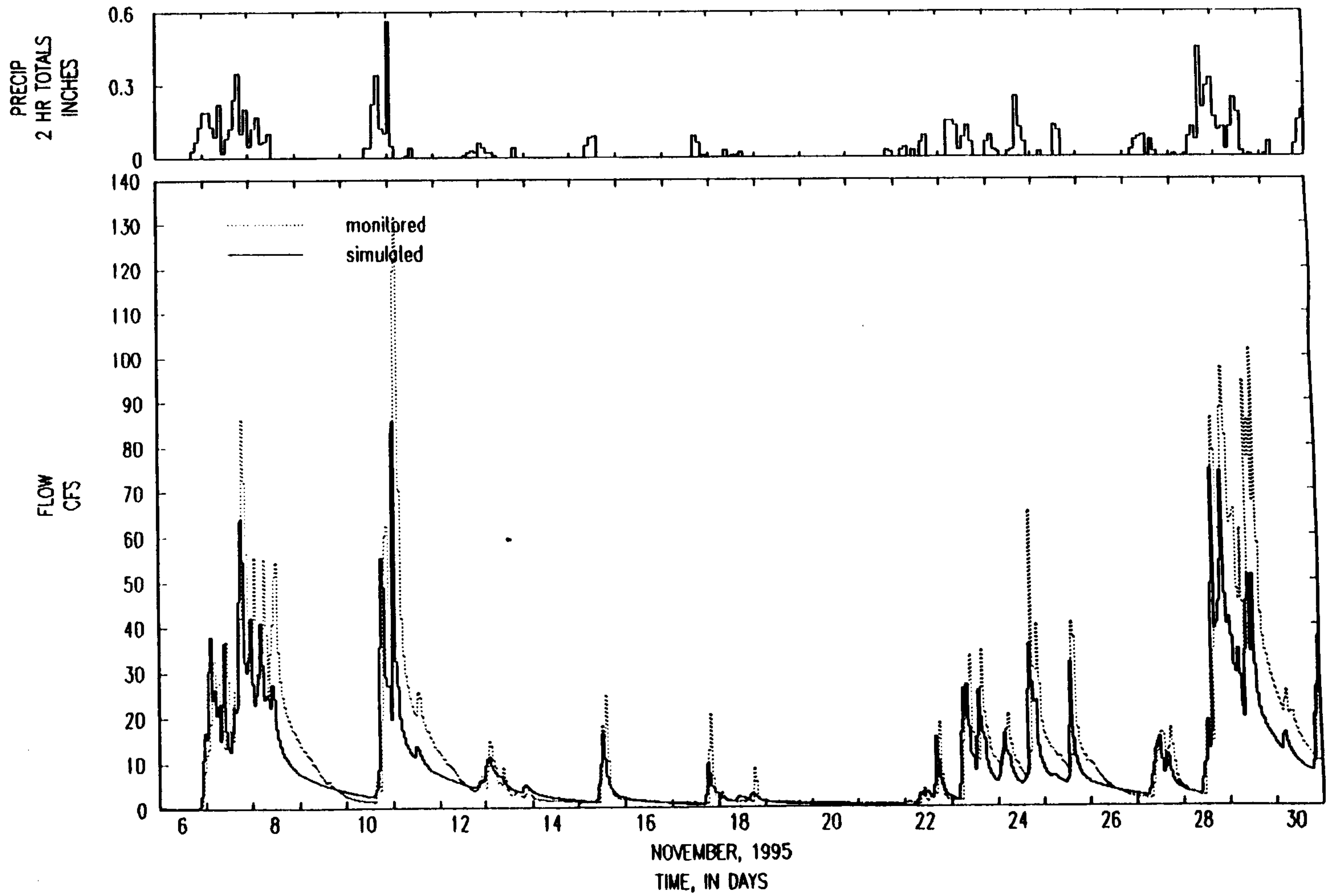
DES MOINES CREEK
CALIBRATION PLOT
TYEE POND INFLOW



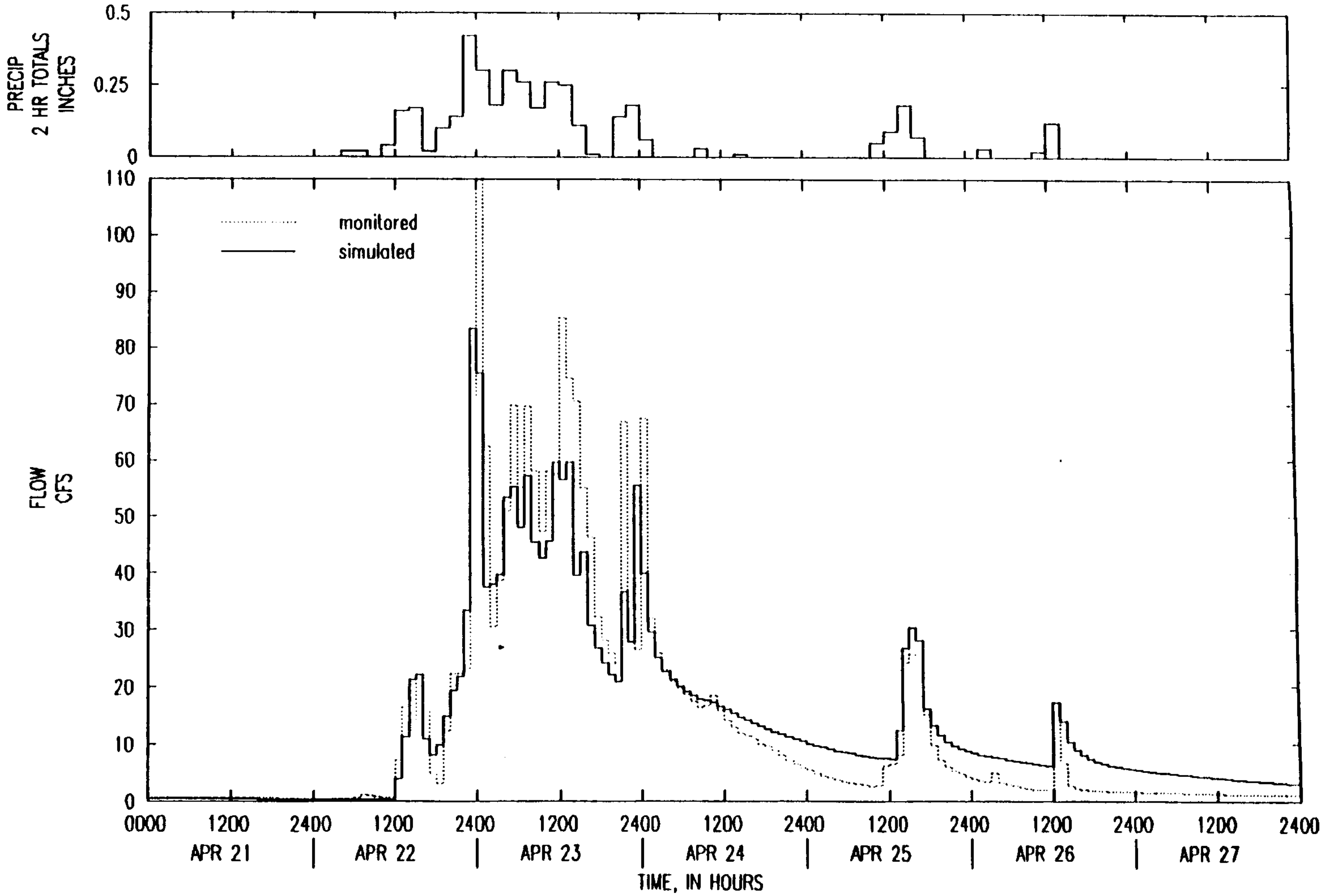
DES MOINES CREEK
CALIBRATION PLOT
TYEE POND INFLOW



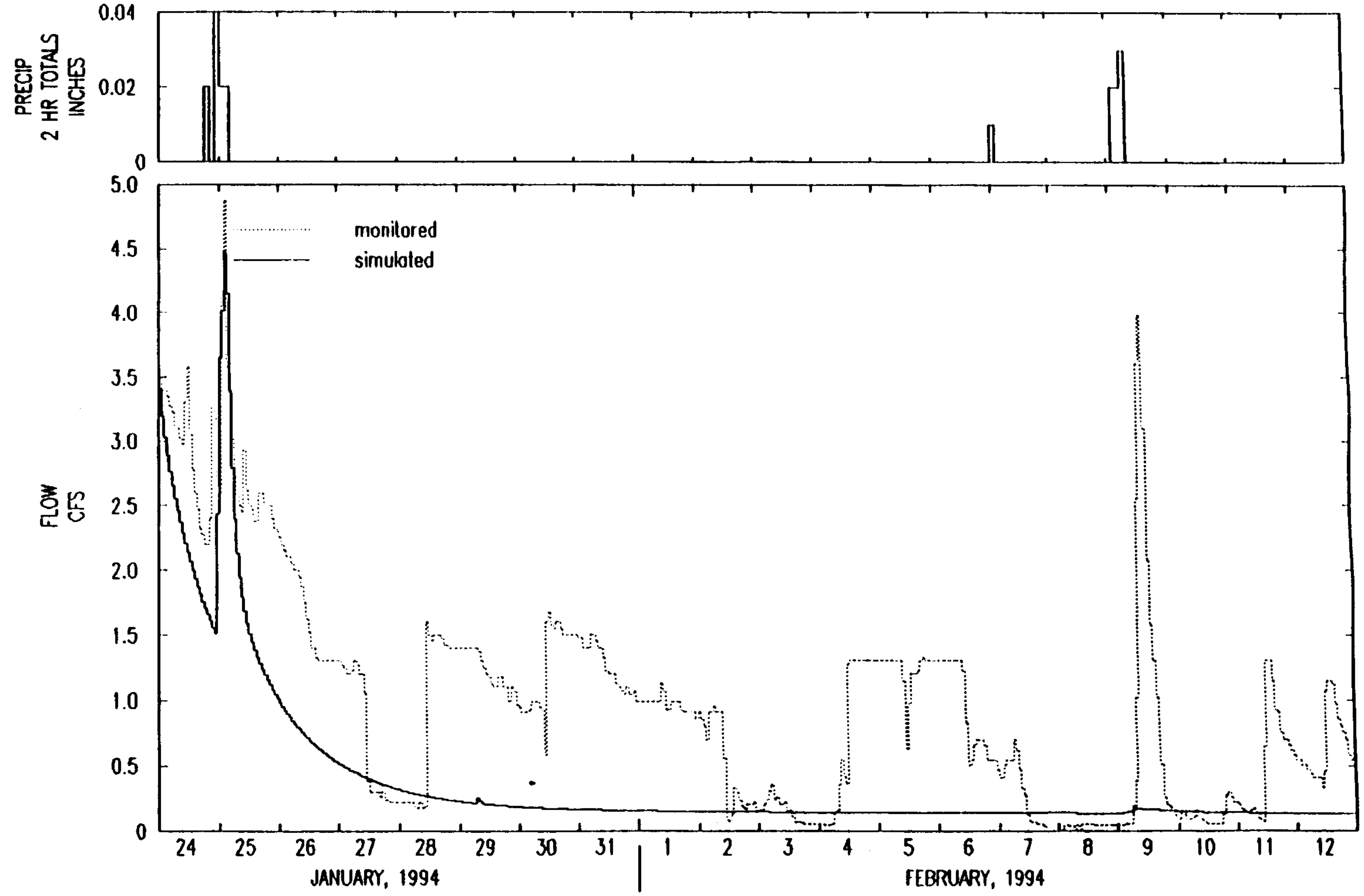
DES MOINES CREEK
CALIBRATION PLOT
TYEE POND INFLOW



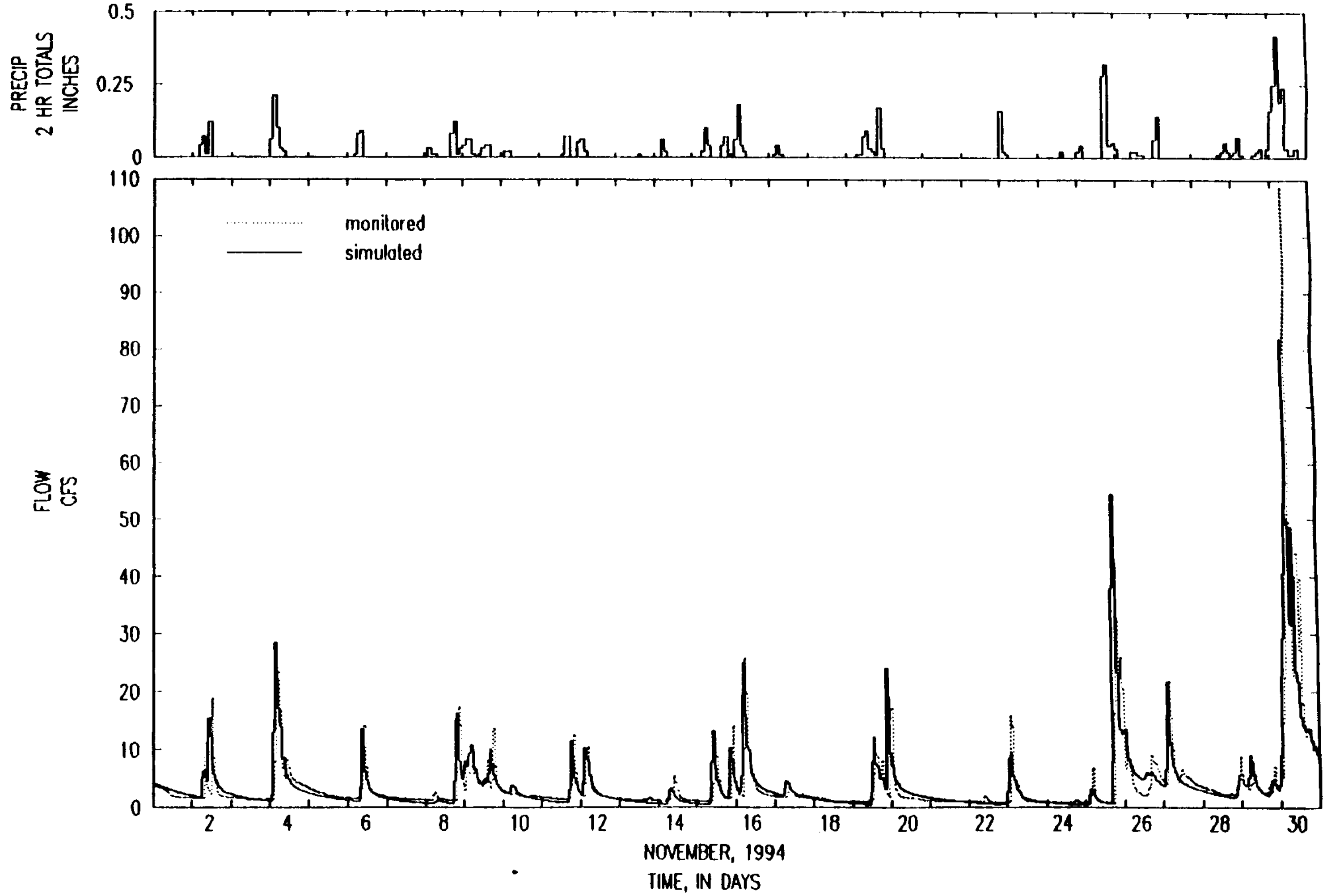
DES MOINES CREEK
CALIBRATION PLOT
TYEE POND INFLOW



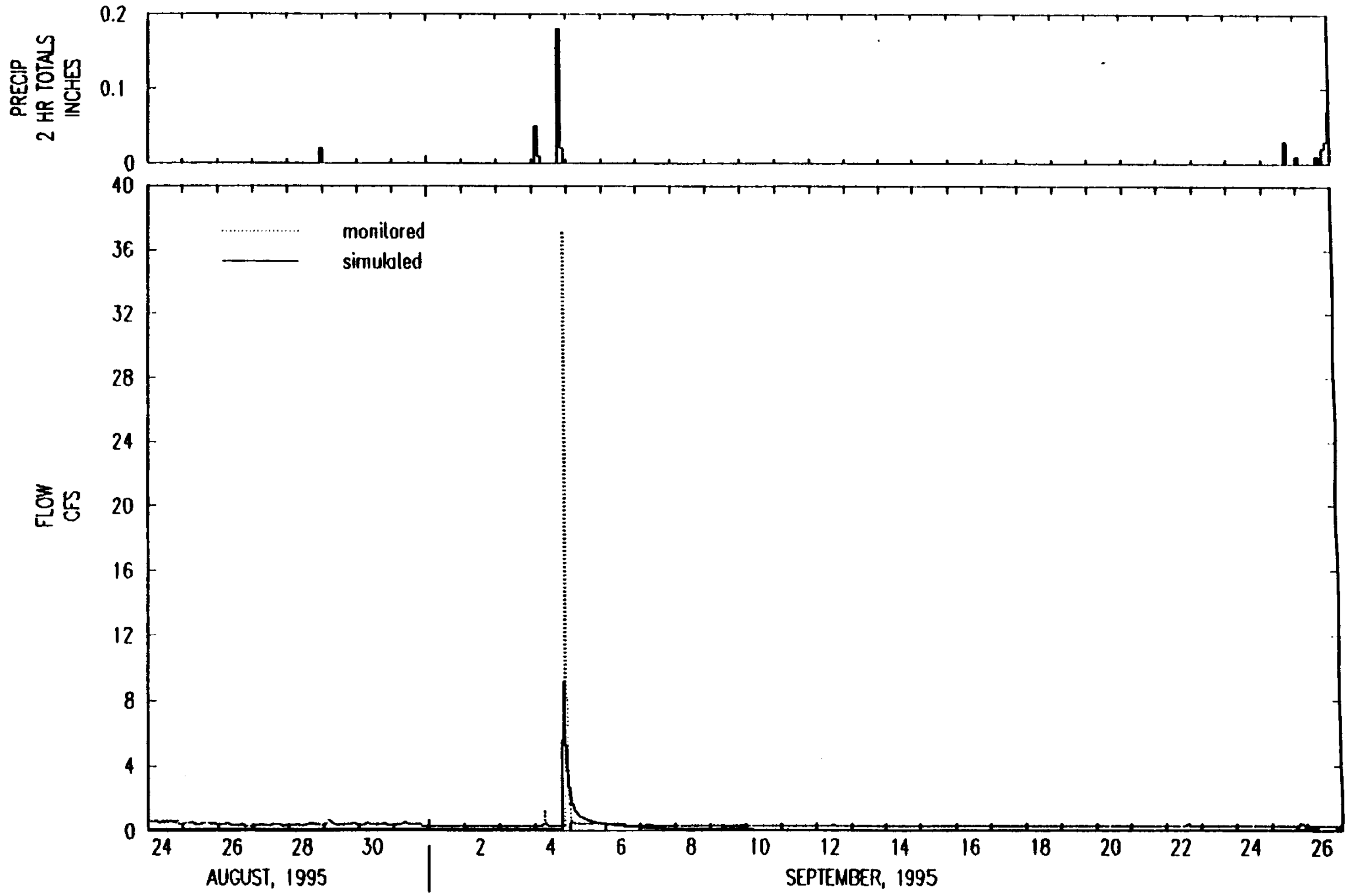
DES MOINES CREEK
CALIBRATION PLOT
TYEE POND INFLOW



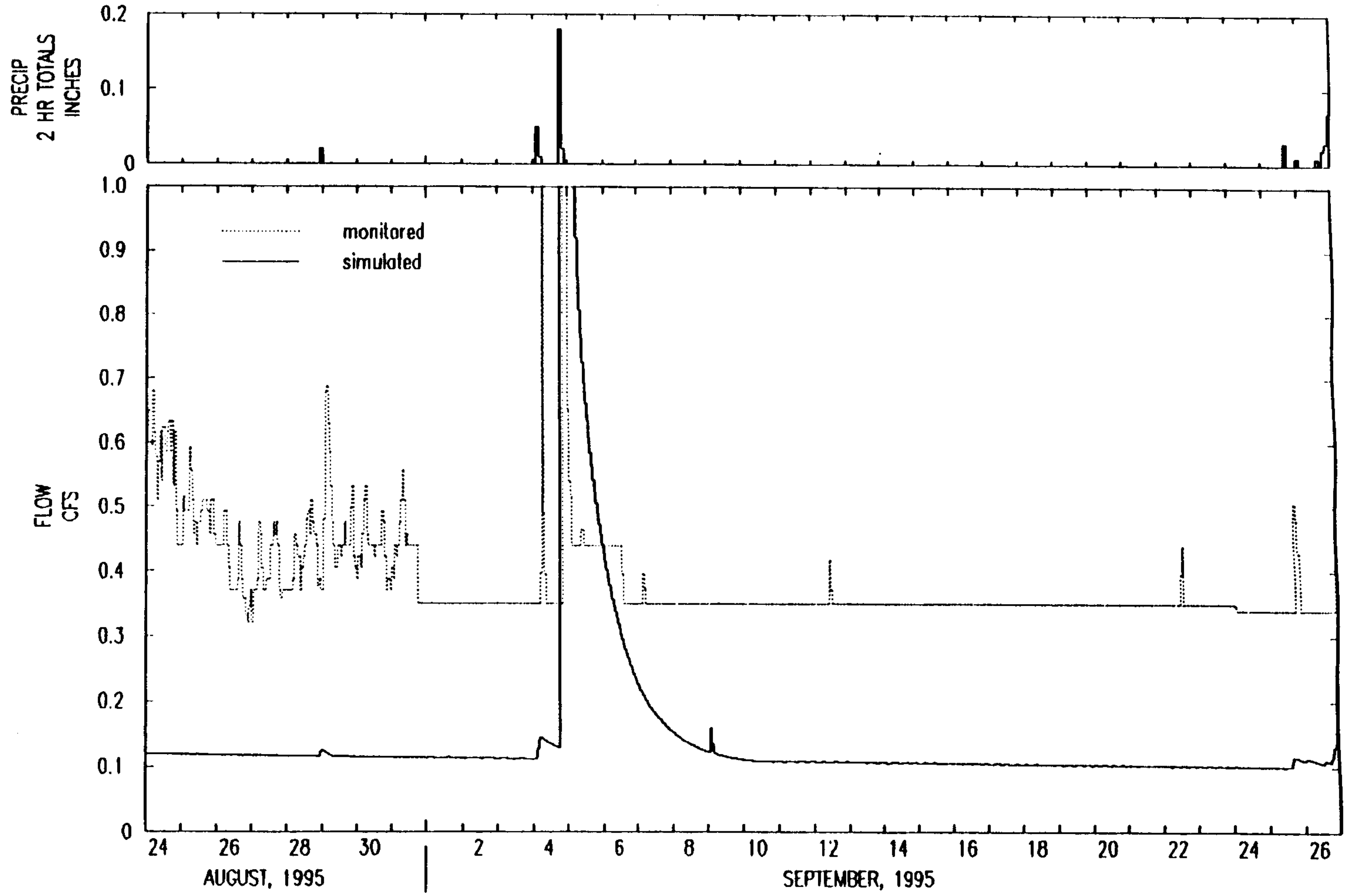
DES MOINES CREEK
CALIBRATION PLOT
TYEE POND INFLOW



DES MOINES CREEK
CALIBRATION PLOT
TYEE POND INFLOW

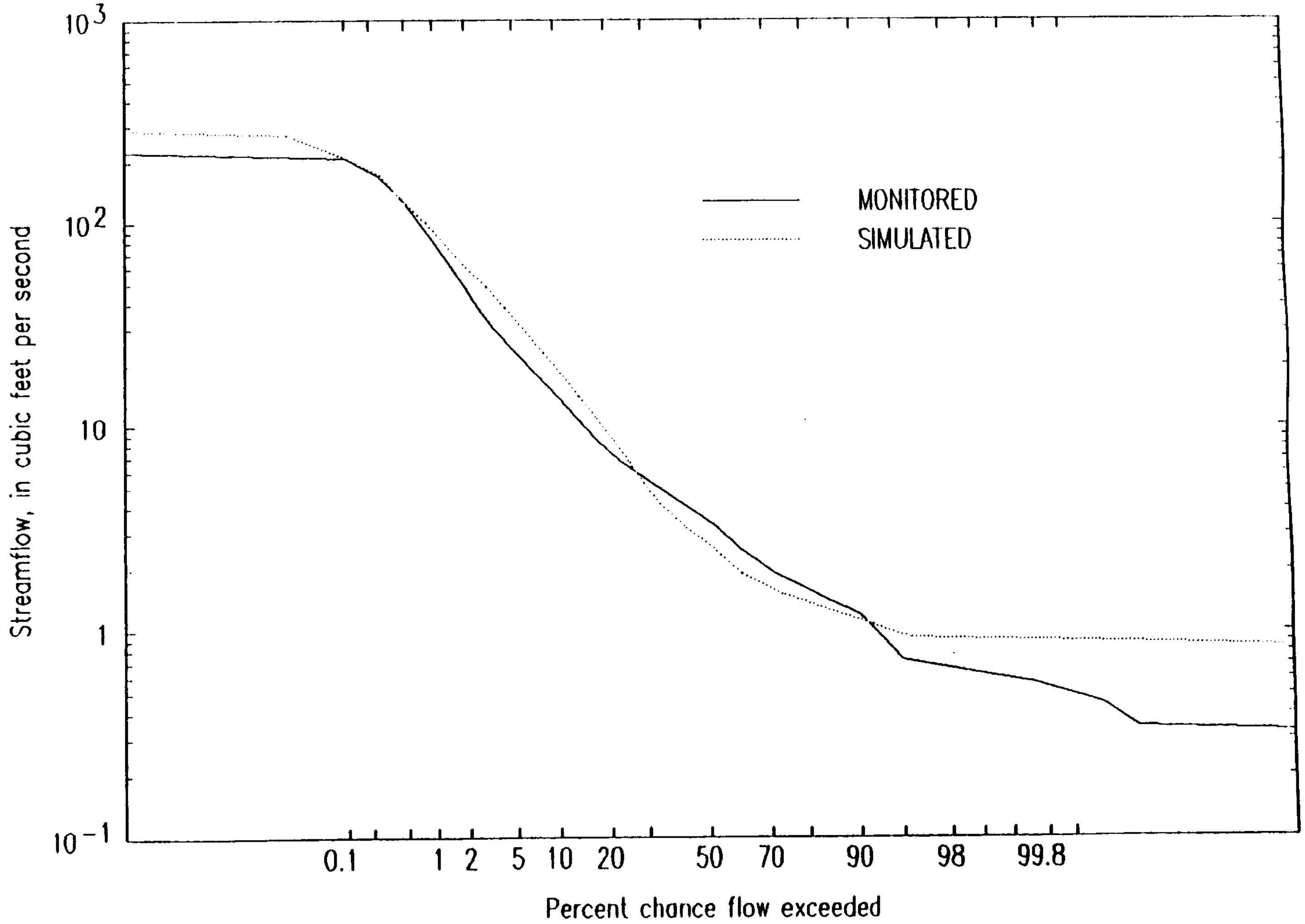


DES MOINES CREEK
CALIBRATION PLOT
TYEE POND INFLOW

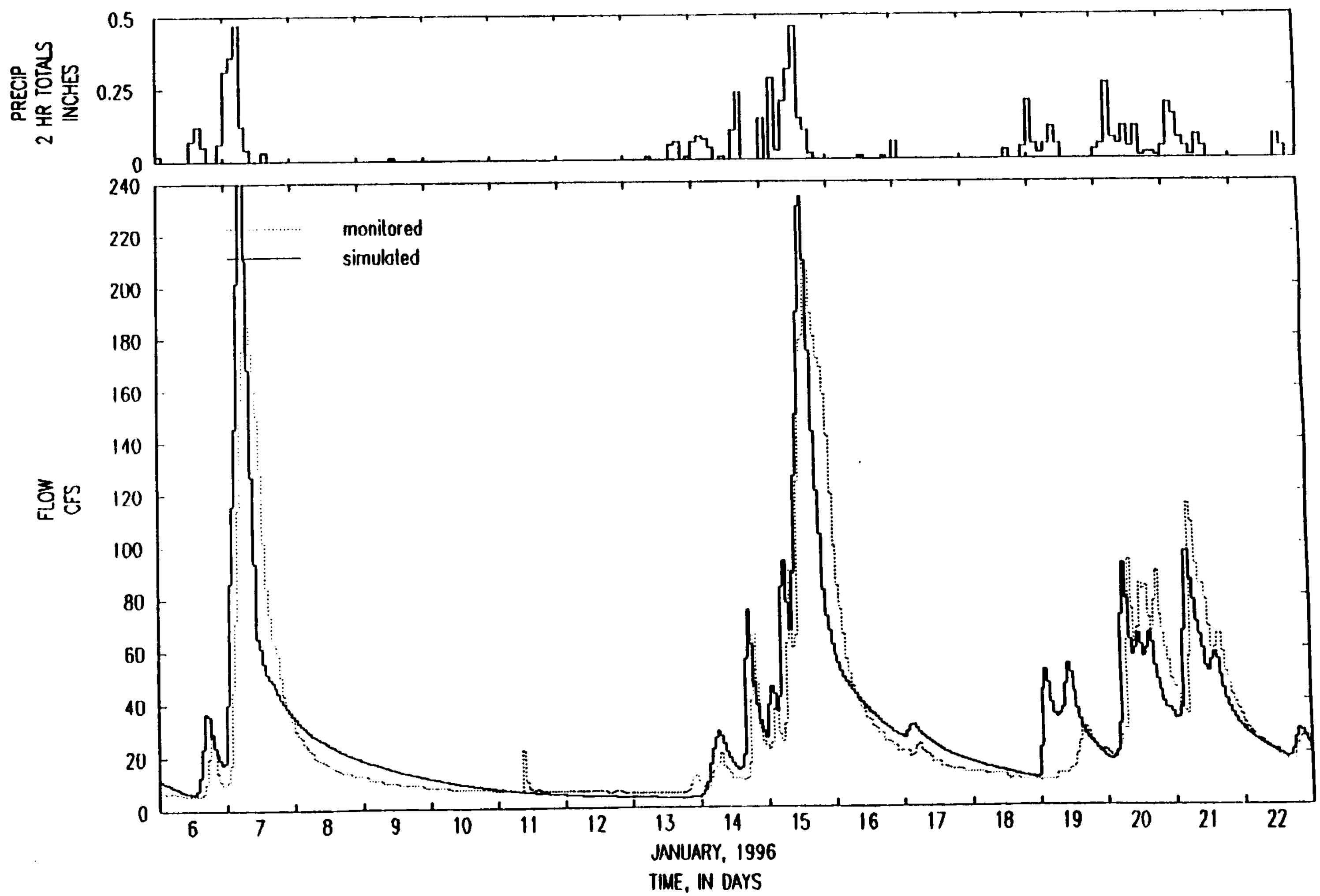


DES MOINES CREEK
CALIBRATION PLOT
TYEE POND INFLOW

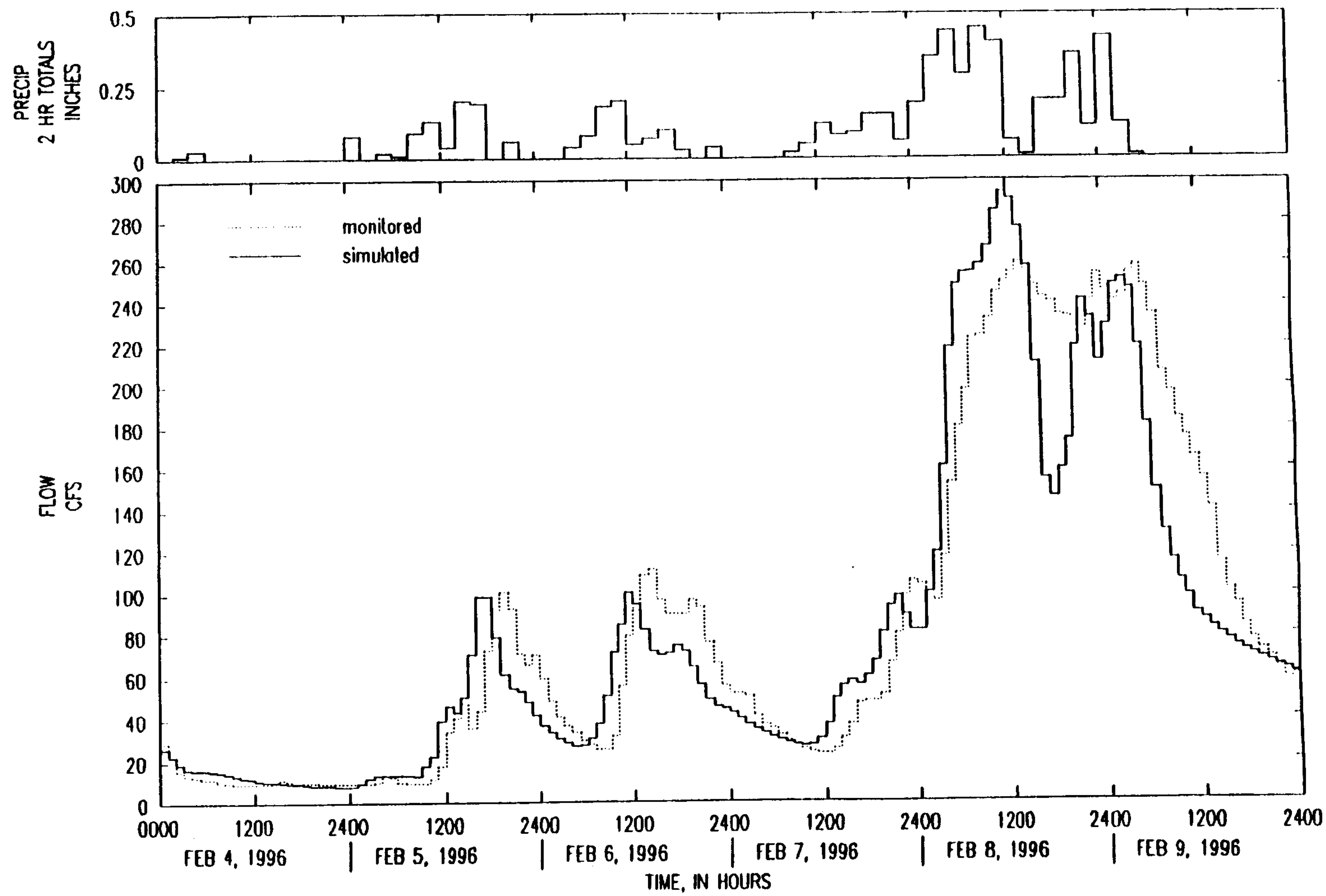
U.S. GEOLOGICAL SURVEY
PARAMETER VALUE HYDROGRAPHS



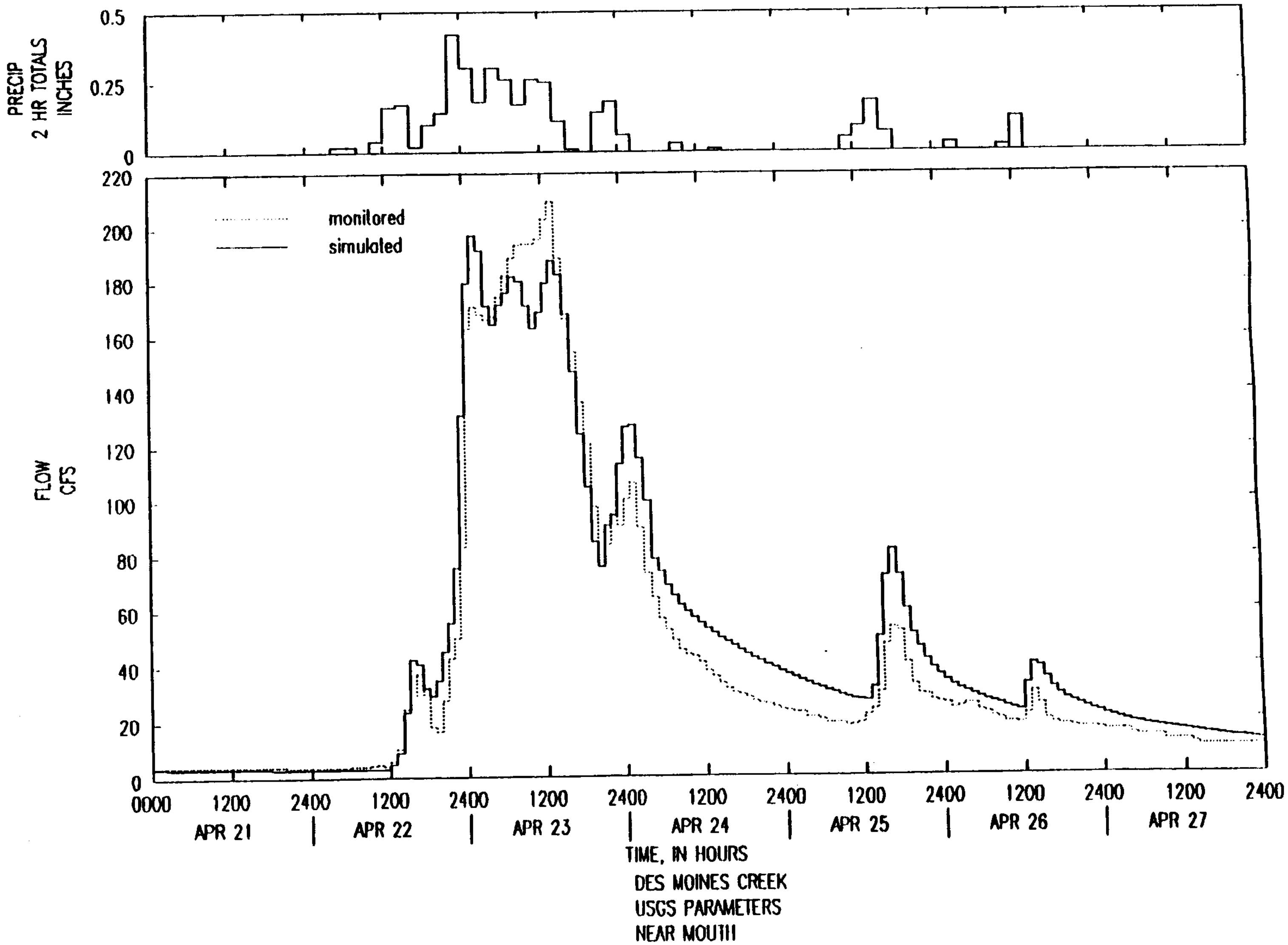
USGS VS MONITORED VALUES NEAR MOUTH

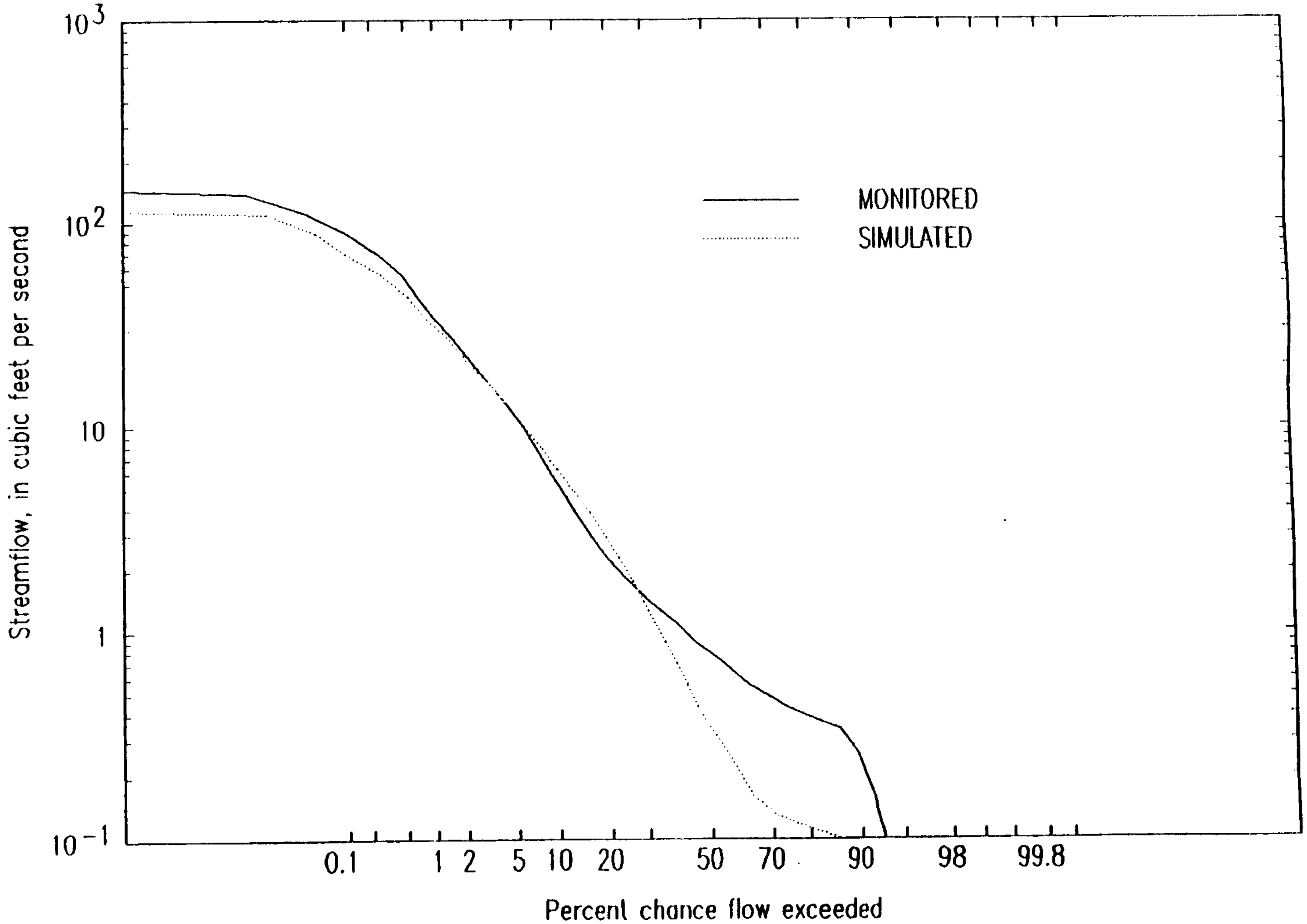


DES MOINES CREEK
USGS PARAMETERS
NEAR MOUTH

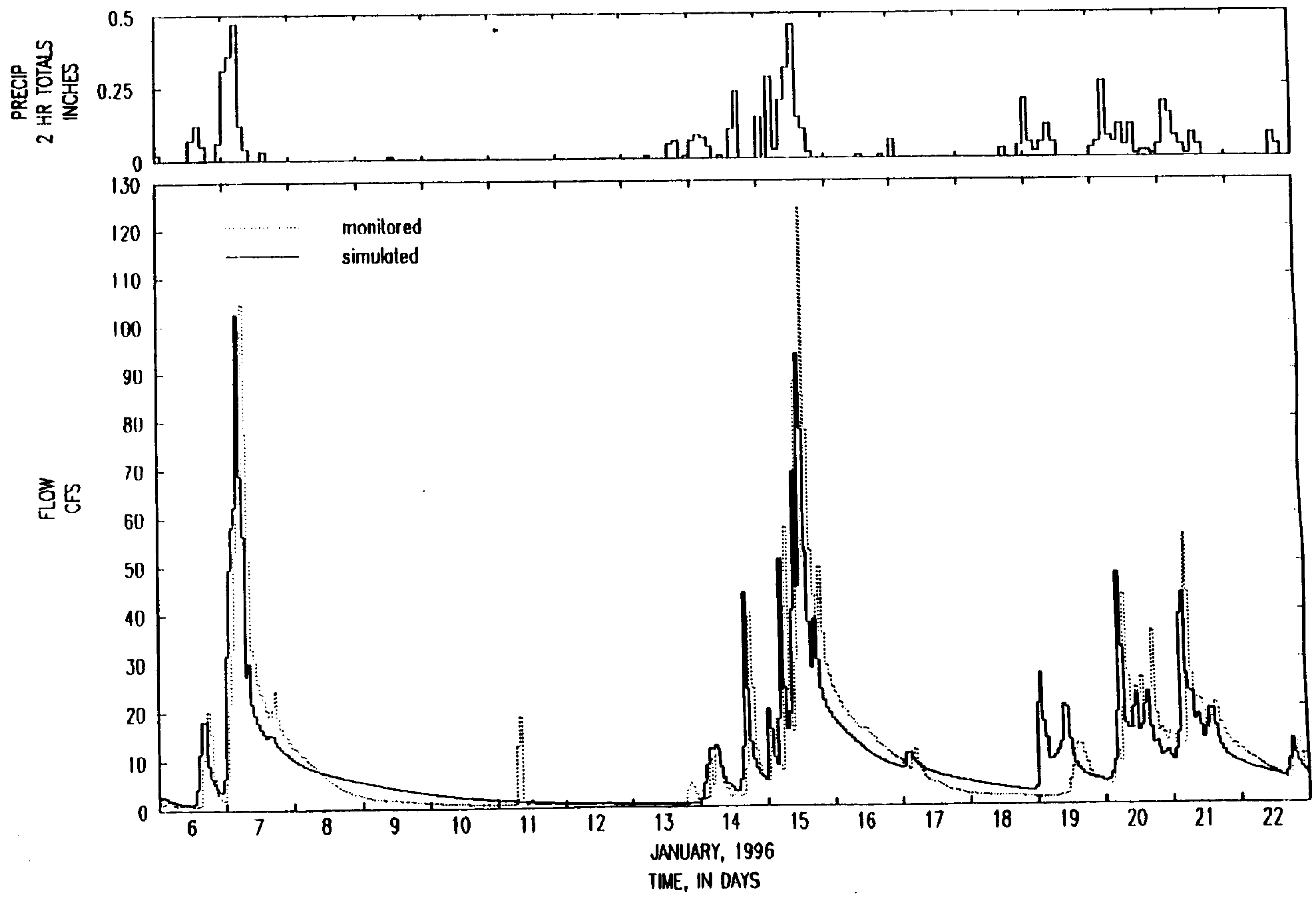


DES MOINES CREEK
USGS PARAMETERS
NEAR MOUTH

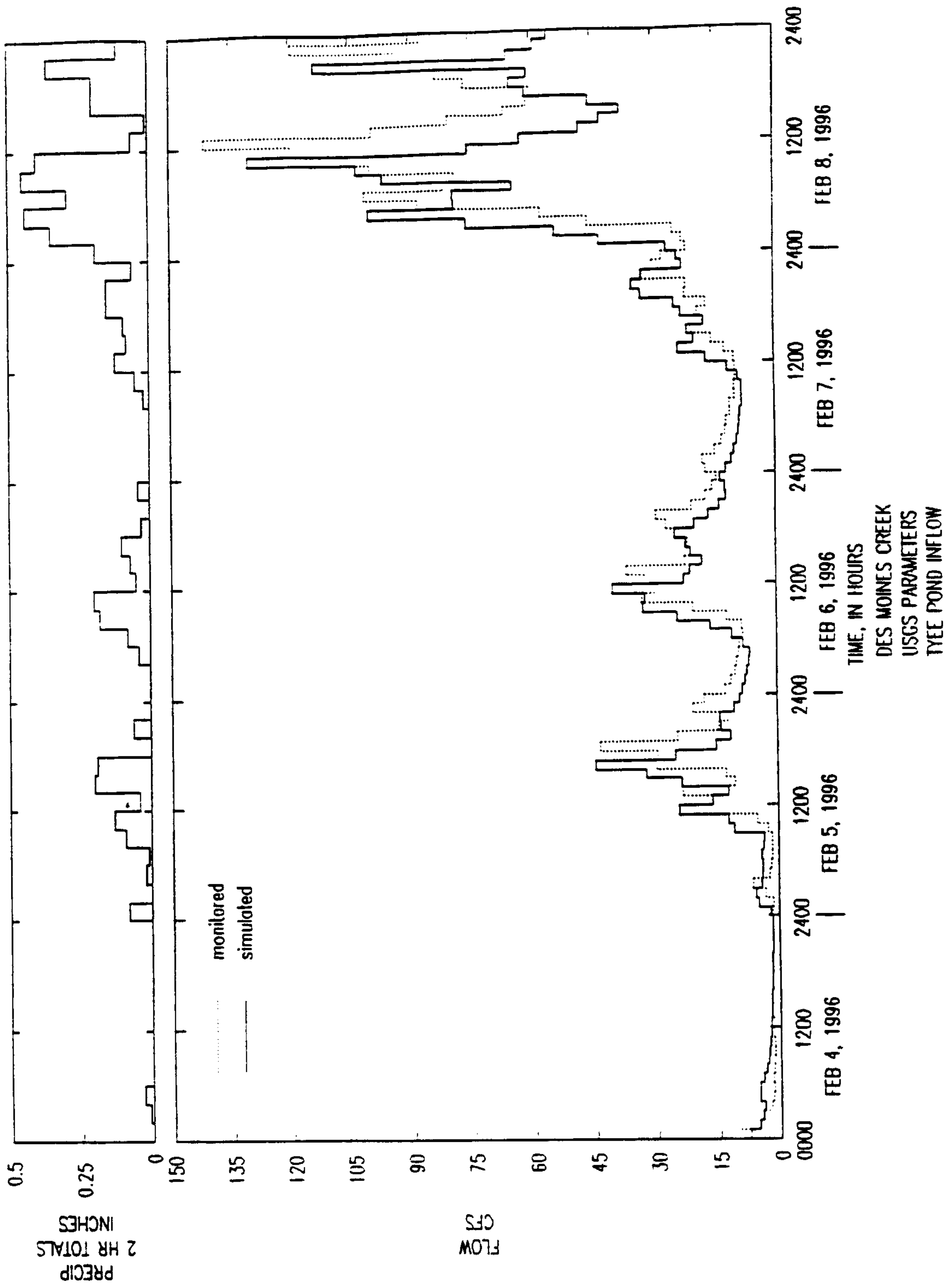

PRECIP
2 HR TOTALS
INCHES
0.5
0.25
0
FLOW
CFS
220
200
180
160
140
120
100
80
60
40
20
0
monitored
simulated
0000
1200
2400
APR 21
APR 22
APR 23
APR 24
APR 25
APR 26
APR 27
TIME, IN HOURS
DES MOINES CREEK
USGS PARAMETERS
NEAR MOUTH



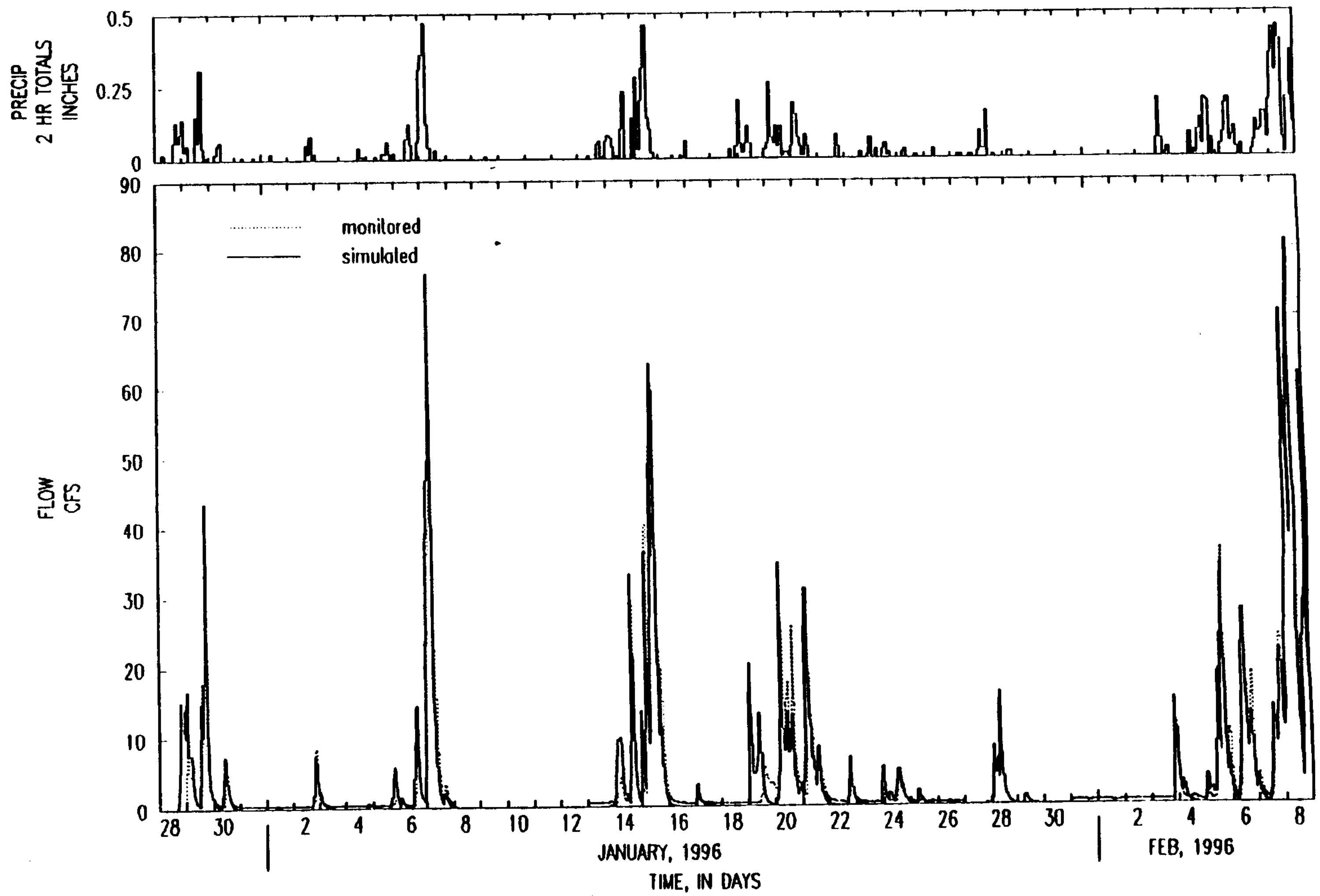
USGS VS MONITORED VALUES AT TYEE POND INFLOW



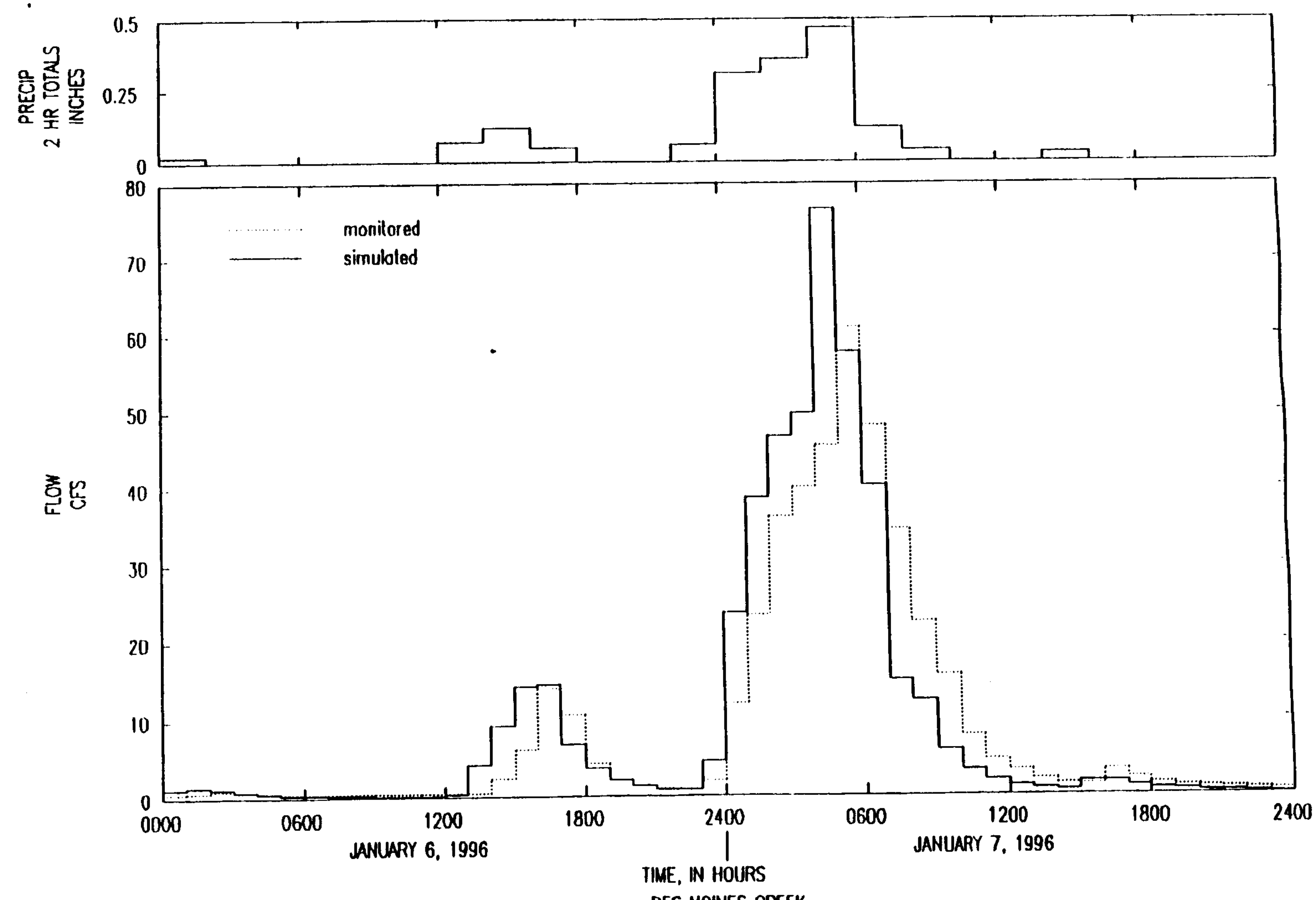
DES MOINES CREEK
USGS PARAMETERS
TYEE POND INFLOW



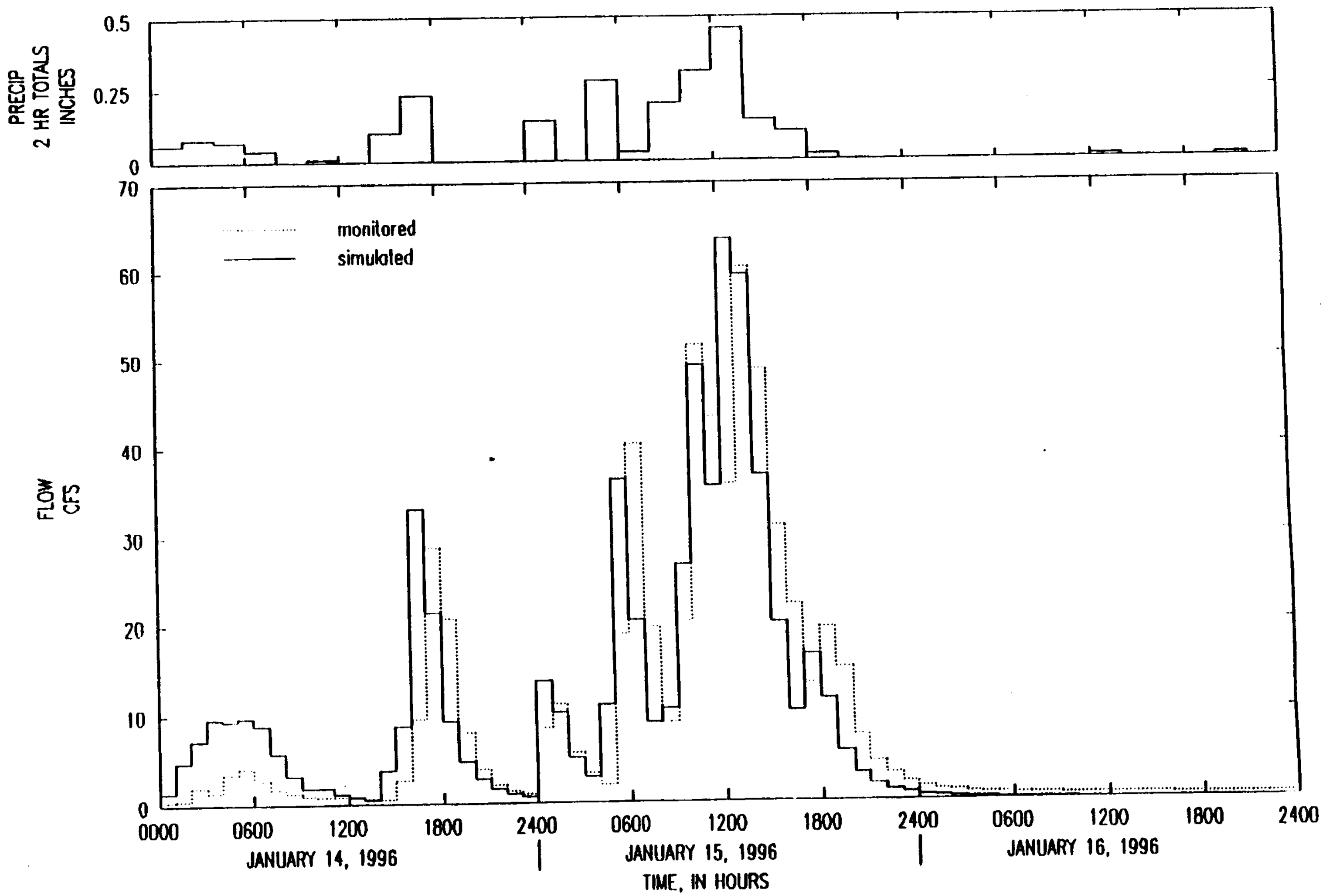
PRECIP
2 HR TOTALS
INCHES
0.5
0.25
0
FLOW
CFS
150
135
120
105
90
75
60
45
30
15
0
0000
1200
2400
FEB 4, 1996
FEB 5, 1996
FEB 6, 1996
FEB 7, 1996
FEB 8, 1996
monitored
simulated
TIME, IN HOURS
DES MOINES CREEK
USGS PARAMETERS
TYEE POND INFLOW



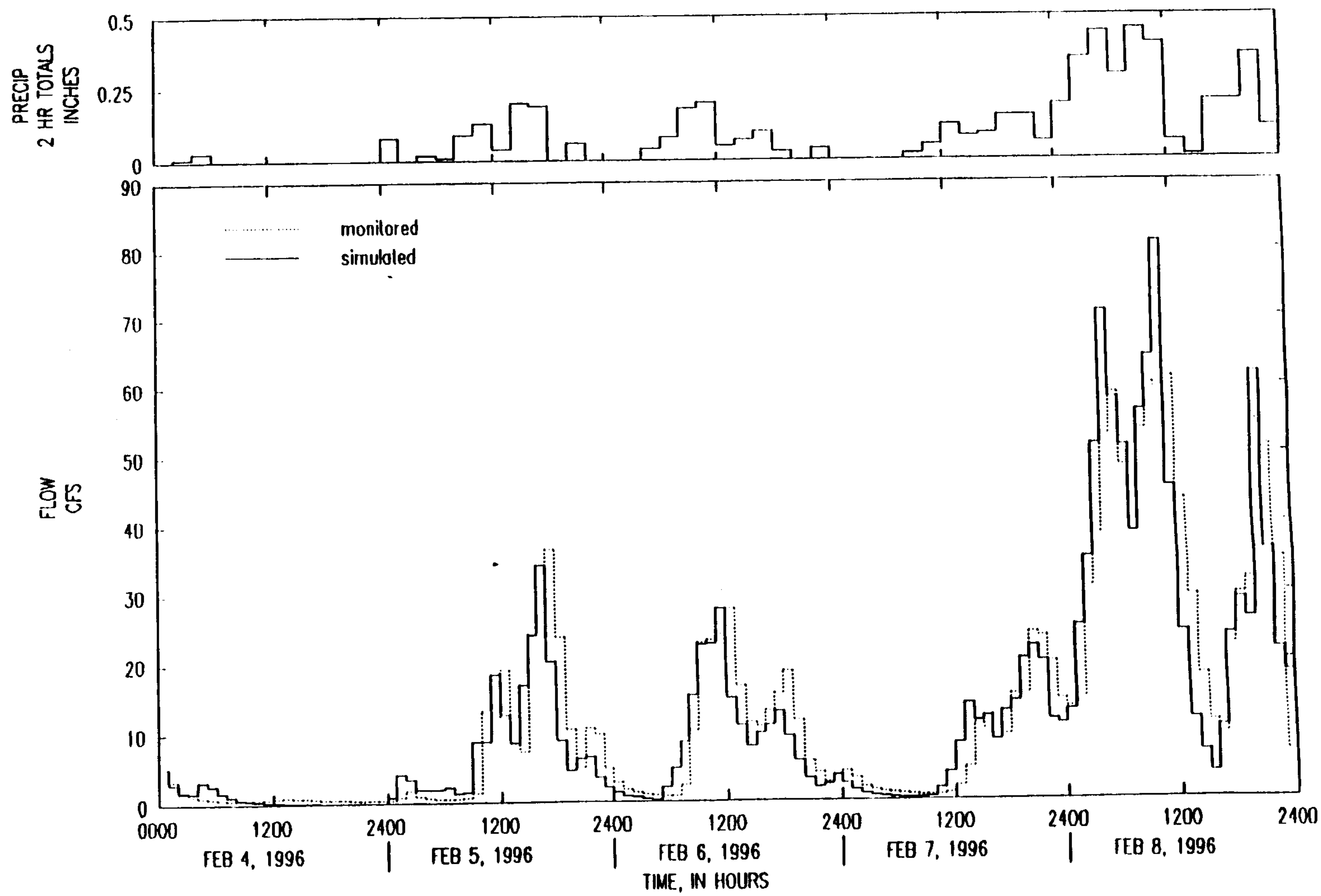
DES MOINES CREEK
USGS PARAMETERS
SDS 3



DES MOINES CREEK
USGS PARAMETERS
SDS 3

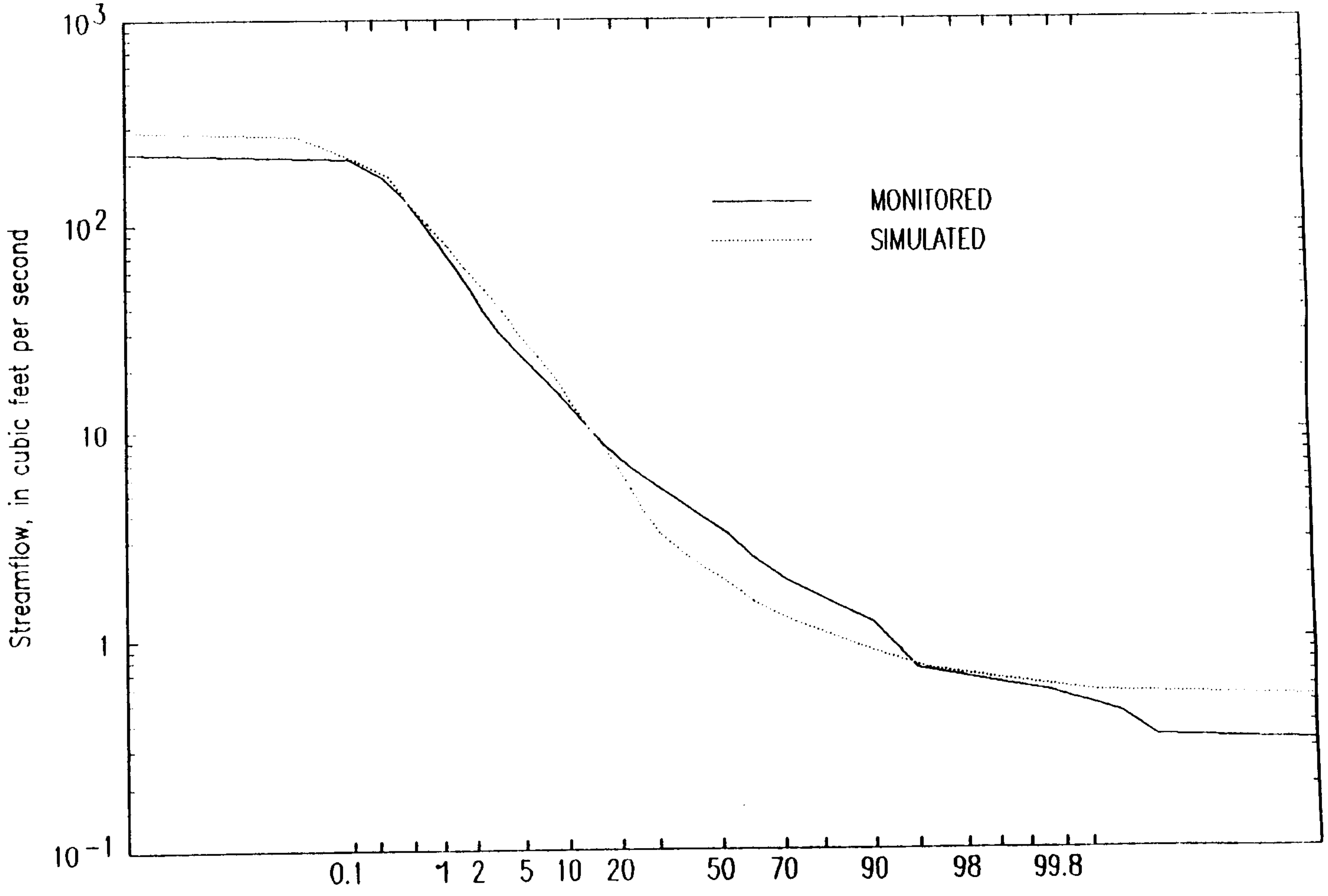


DES MOINES CREEK
USGS PARAMETERS
SDS 3

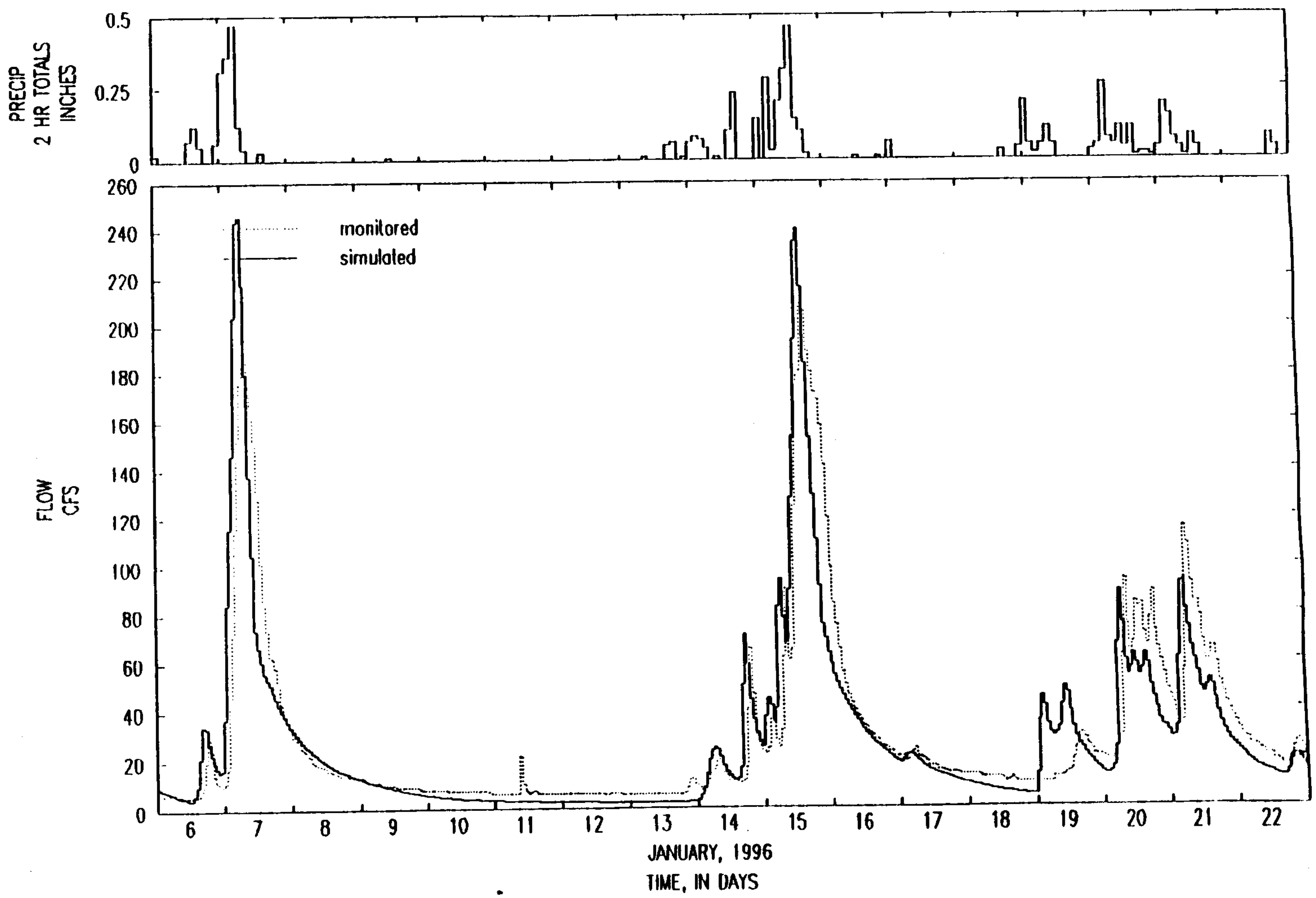


DES MOINES CREEK
USGS PARAMETERS
SDS 3

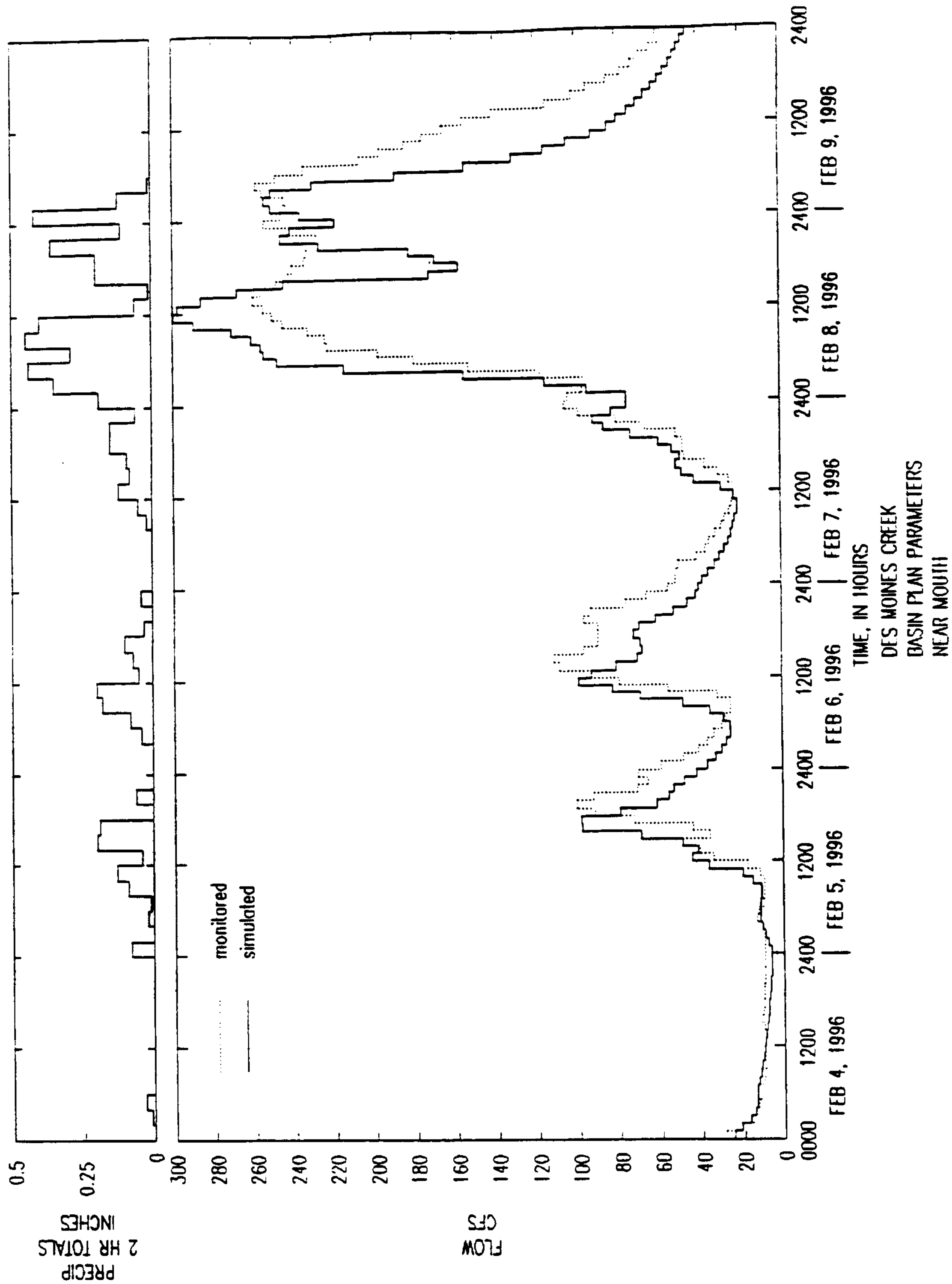
DES MOINES CREEK BASIN PLAN
PARAMETER VALUE HYDROGRAPHS



BASIN PLAN PARAMETERS VS MONITORED DATA NEAR MOUTH

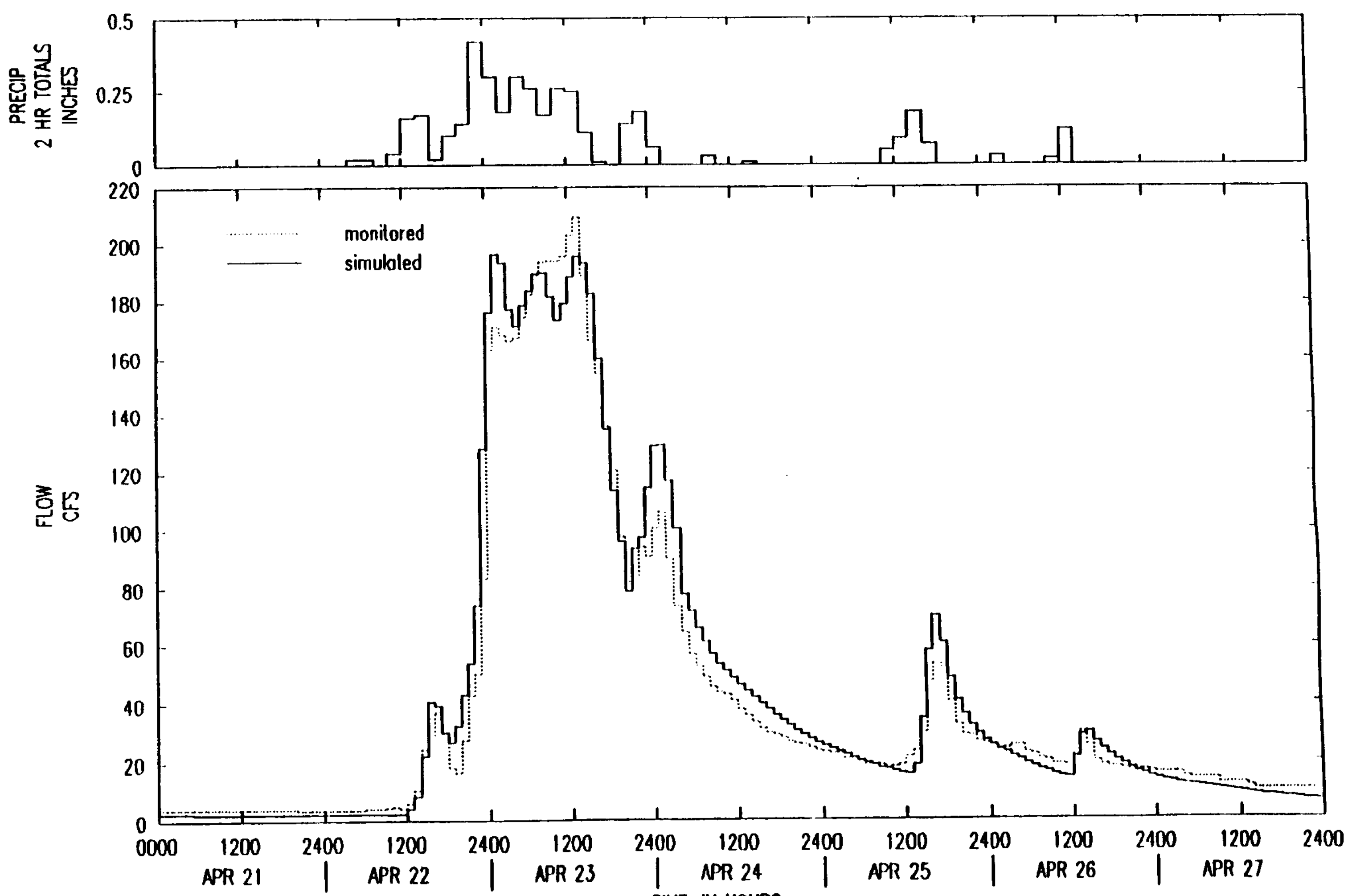


DES MOINES CREEK
BASIN PLAN PARAMETERS
NEAR MOUTH

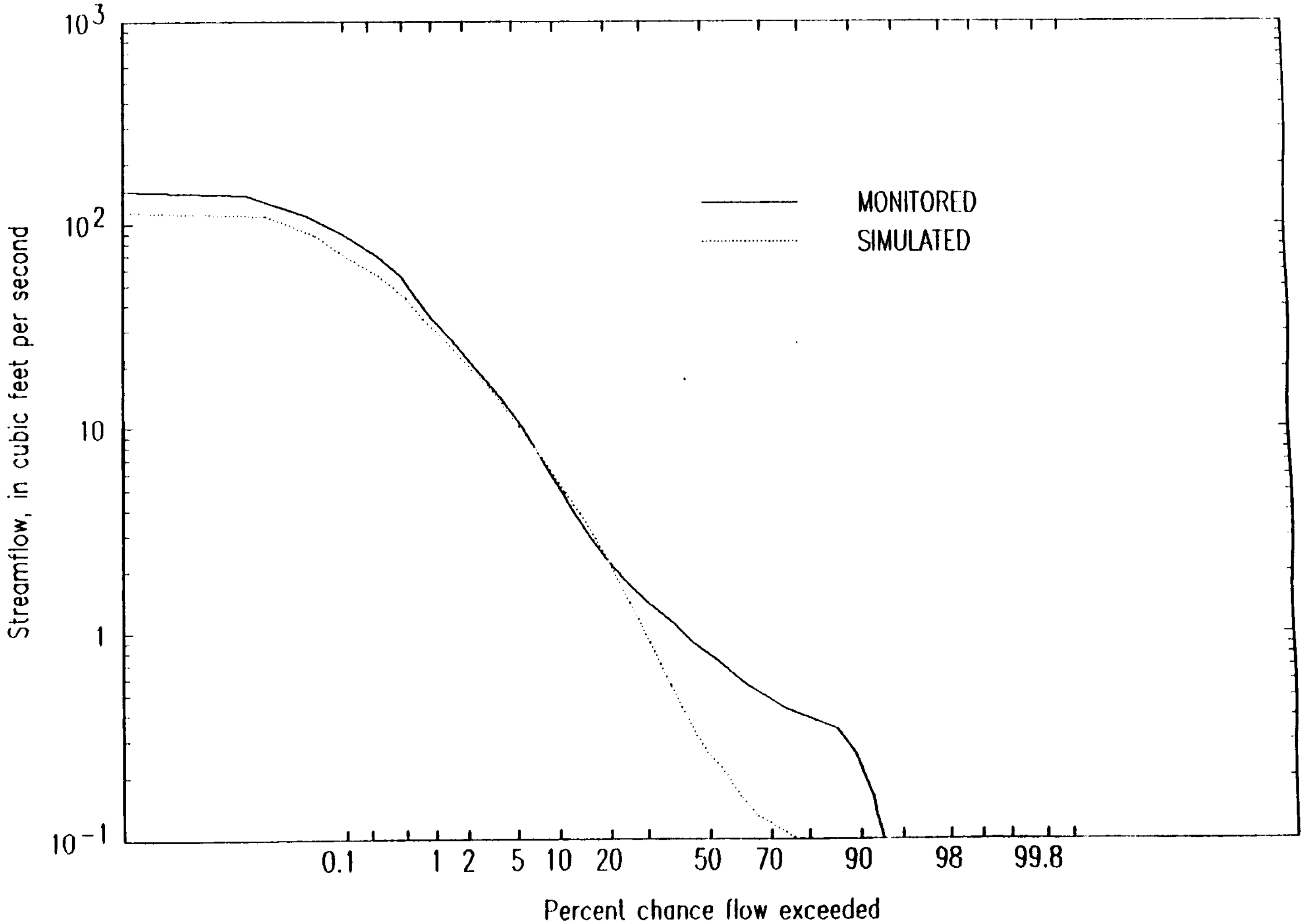


PRECIP
2 HR TOTALS
INCHES
0.5
0.25
0
FLOW
CFS
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
monitored
simulated
0000
1200
FEB 4, 1996
2400
1200
FEB 5, 1996
2400
1200
FEB 6, 1996
2400
1200
FEB 7, 1996
2400
1200
FEB 8, 1996
2400
1200
FEB 9, 1996
2400
TIME, IN HOURS
DES MOINES CREEK
BASIN PLAN PARAMETERS
NEAR MOUTH

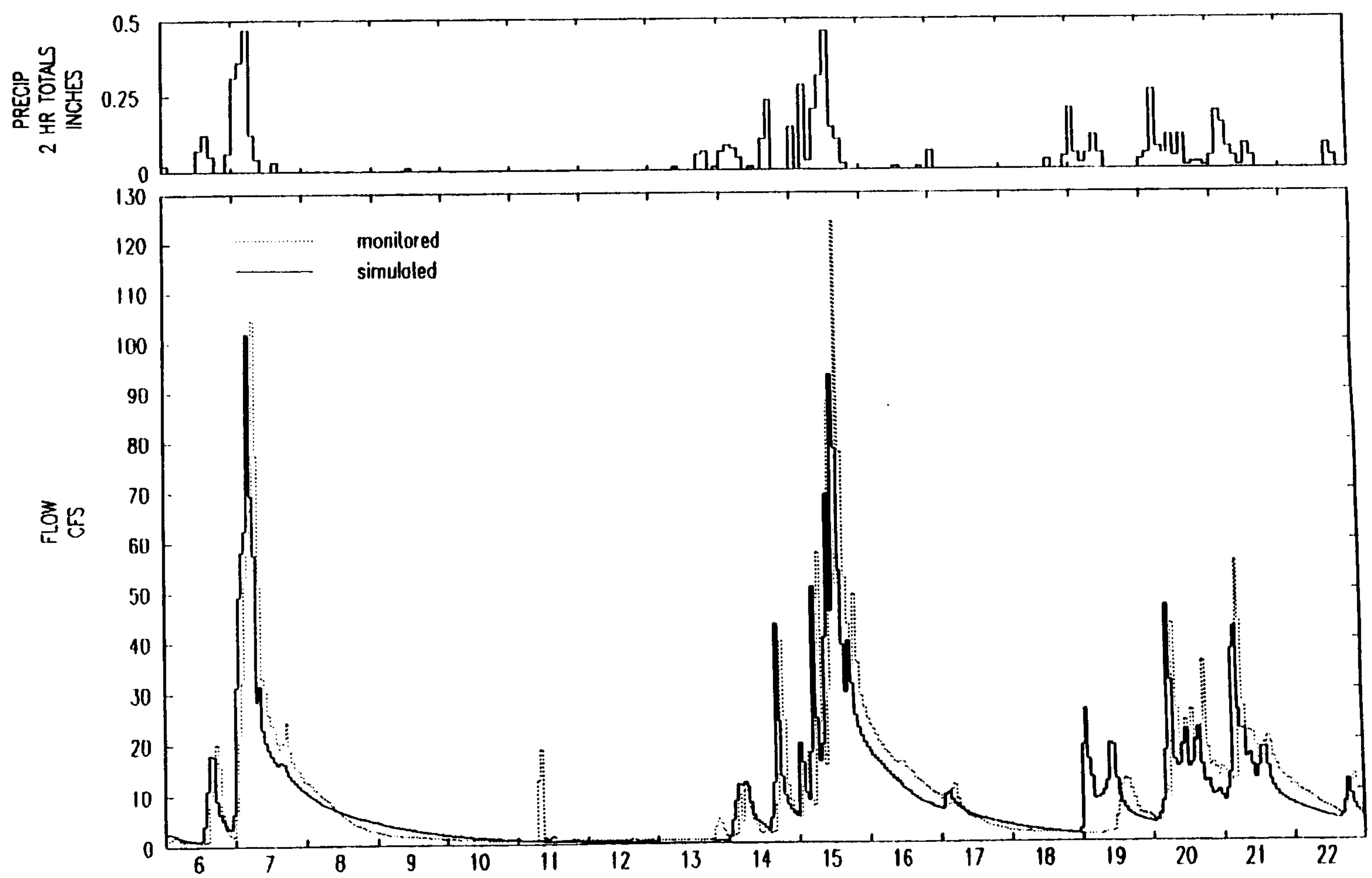
AR 047074



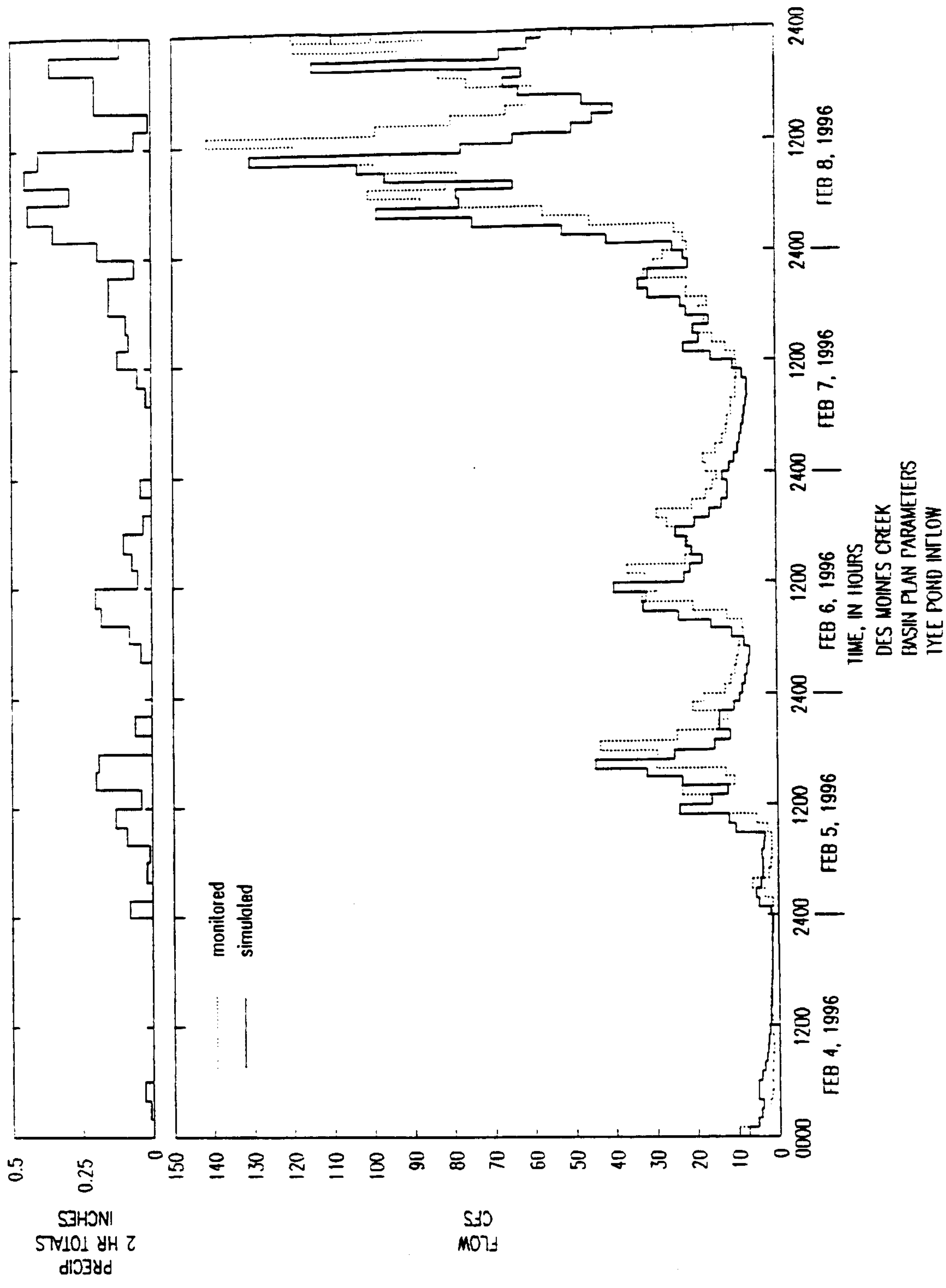
DES MOINES CREEK
BASIN PLAN PARAMETERS
NEAR MOUTH



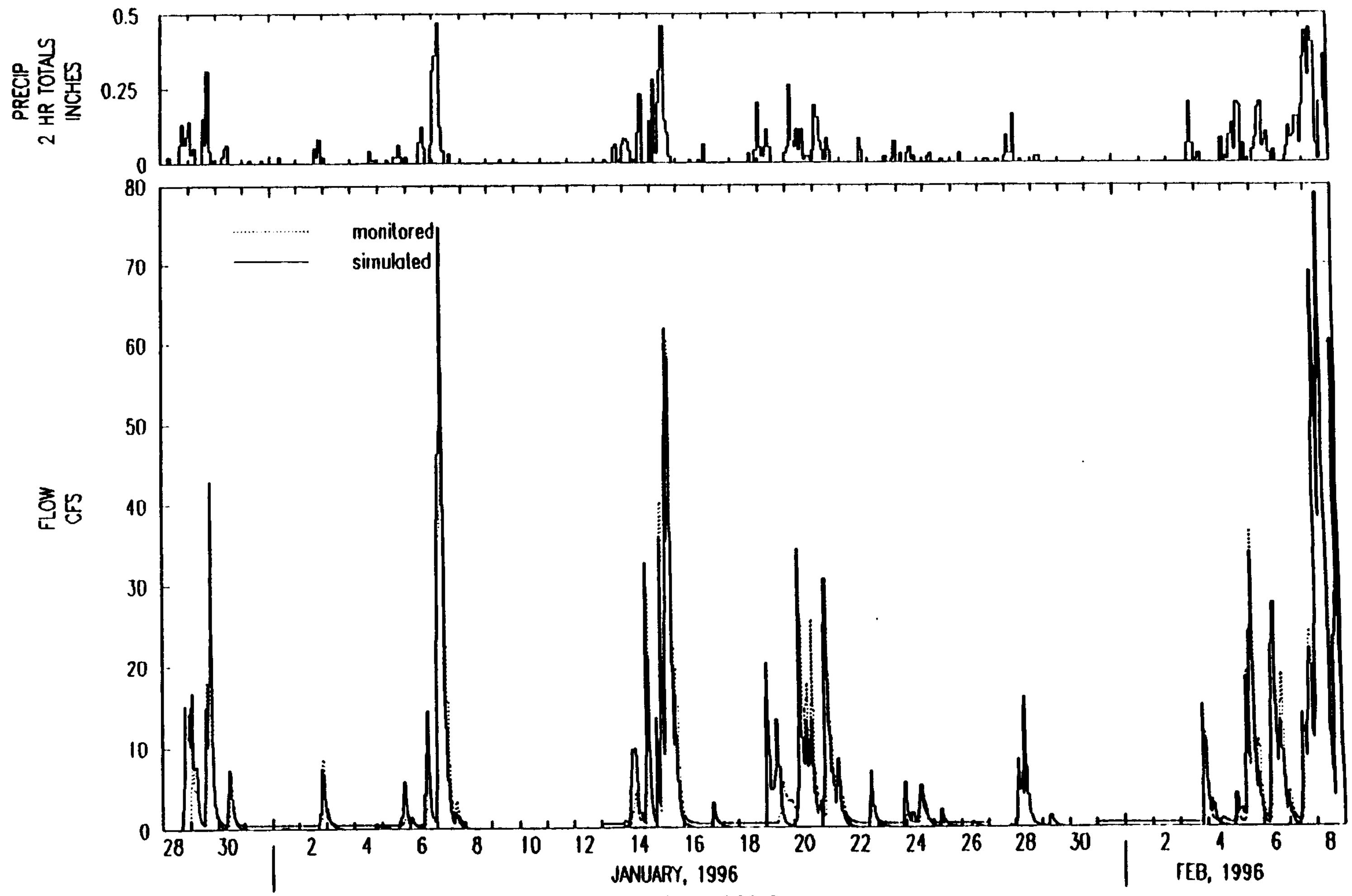
BASIN PLAN PARAMETERS VS MONITORED VALUES AT TYEE POND INFLOW



DES MOINES CREEK
BASIN PLAN PARAMETERS
TYEE POND INFLOW

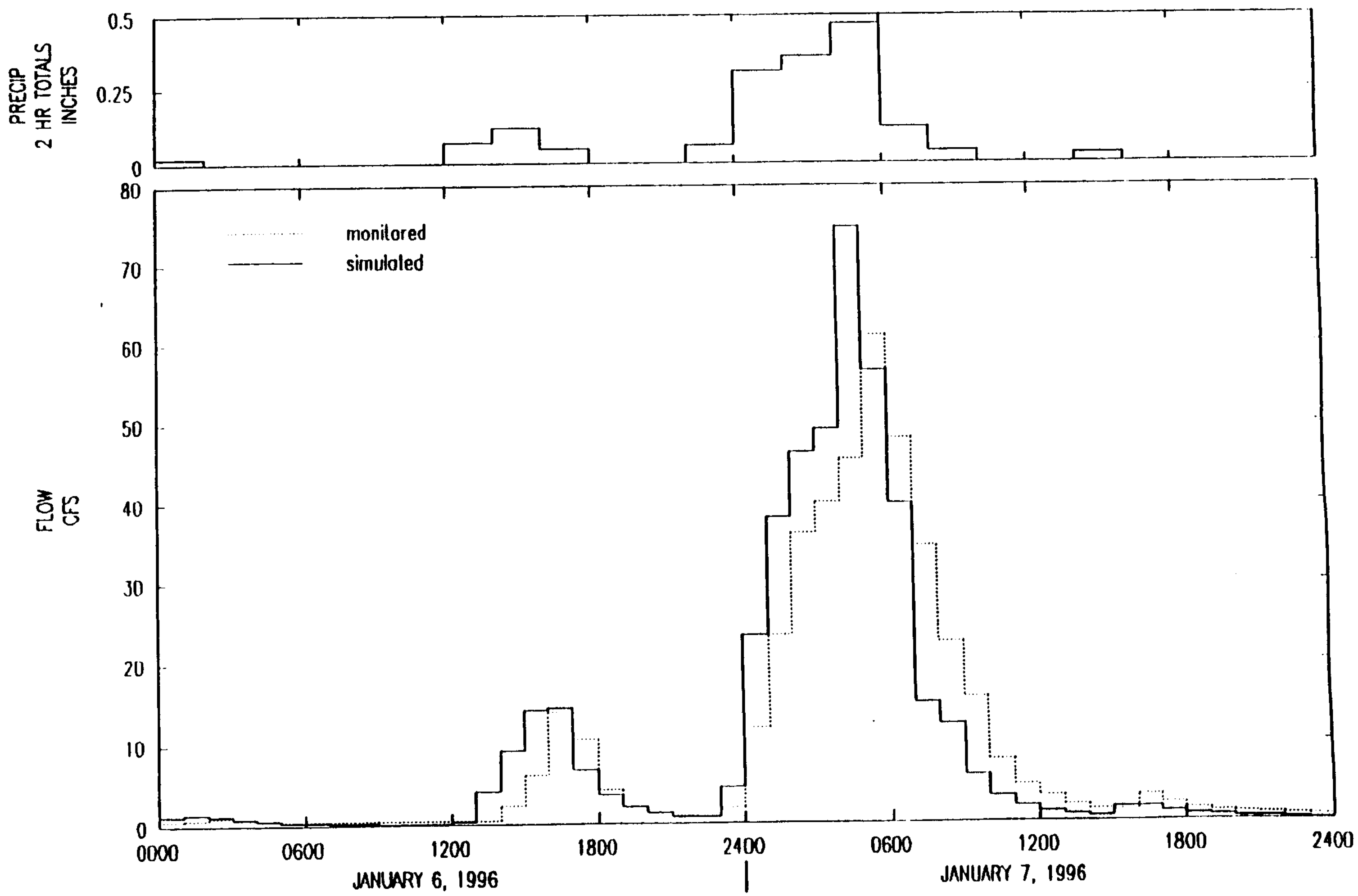


PRECIP
2 HR TOTALS
INCHES
FLOW
CFS
monitored
simulated
FEB 4, 1996
FEB 5, 1996
FEB 6, 1996
FEB 7, 1996
FEB 8, 1996
TIME, IN HOURS
DES MOINES CREEK
BASIN PLAN PARAMETERS
TYEE POND INFLOW

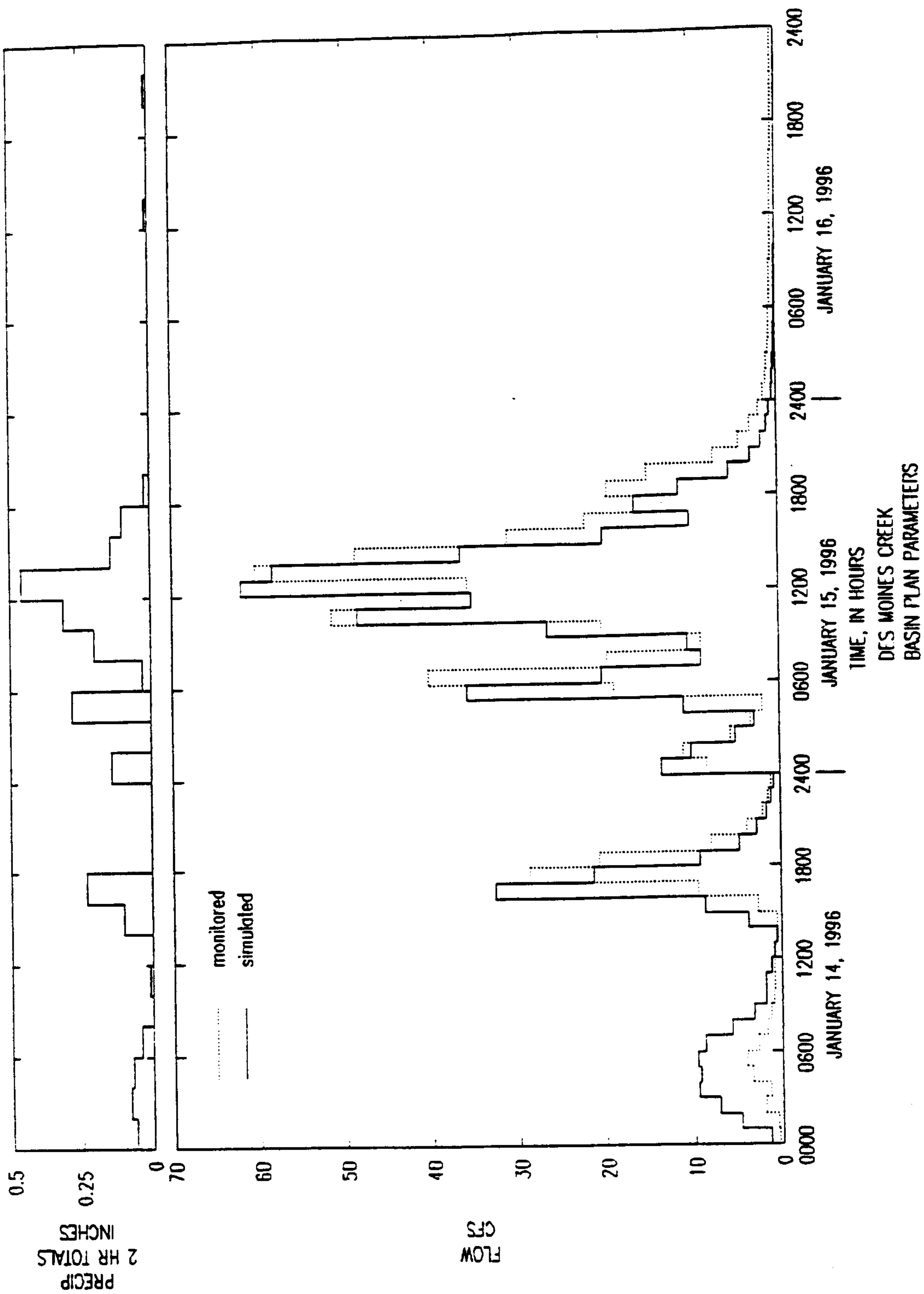


DES MOINES CREEK
BASIN PLAN PARAMETERS
SDS 3

AR 047079

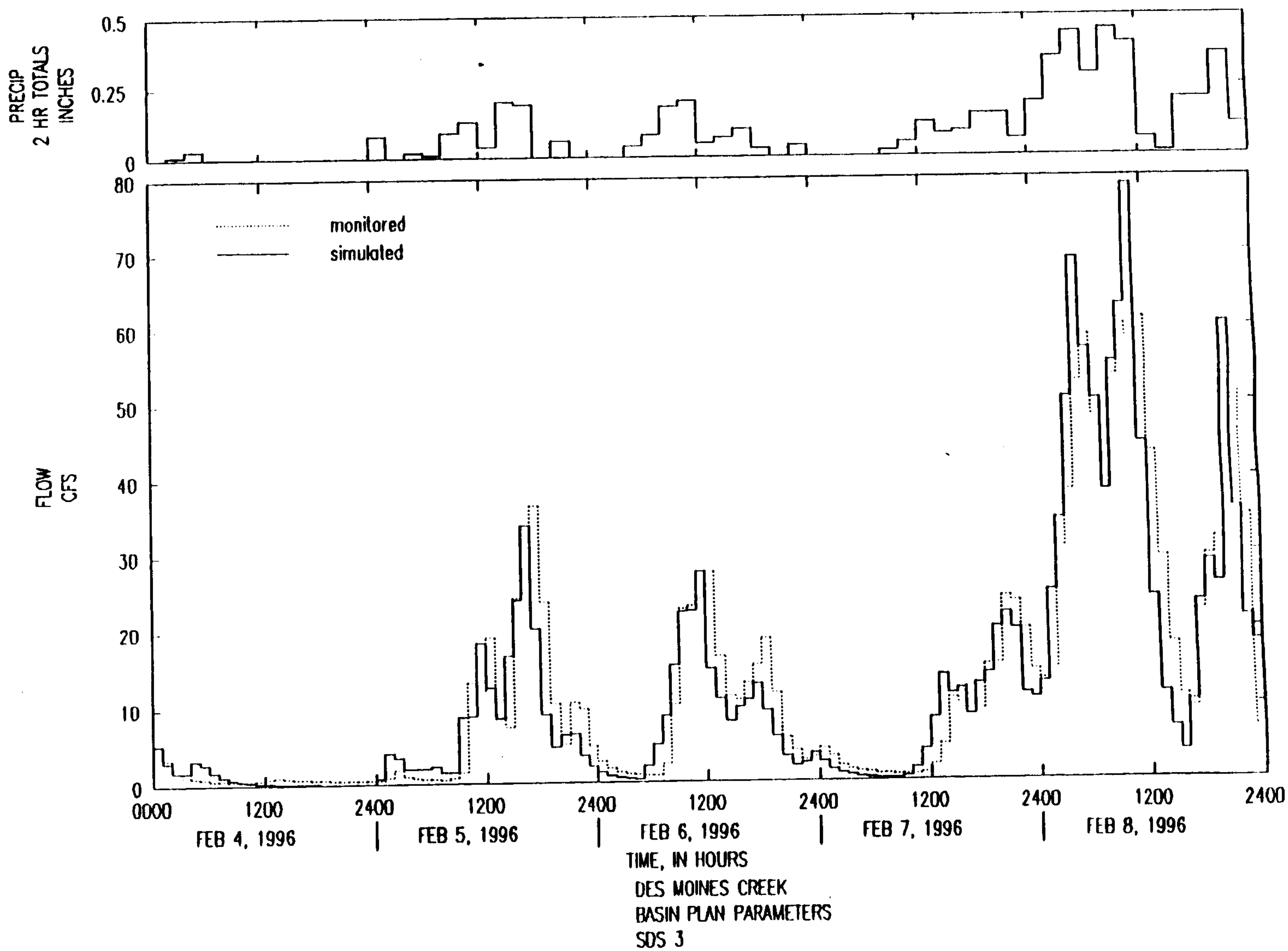


DES MOINES CREEK
BASIN PLAN PARAMETERS
SDS 3

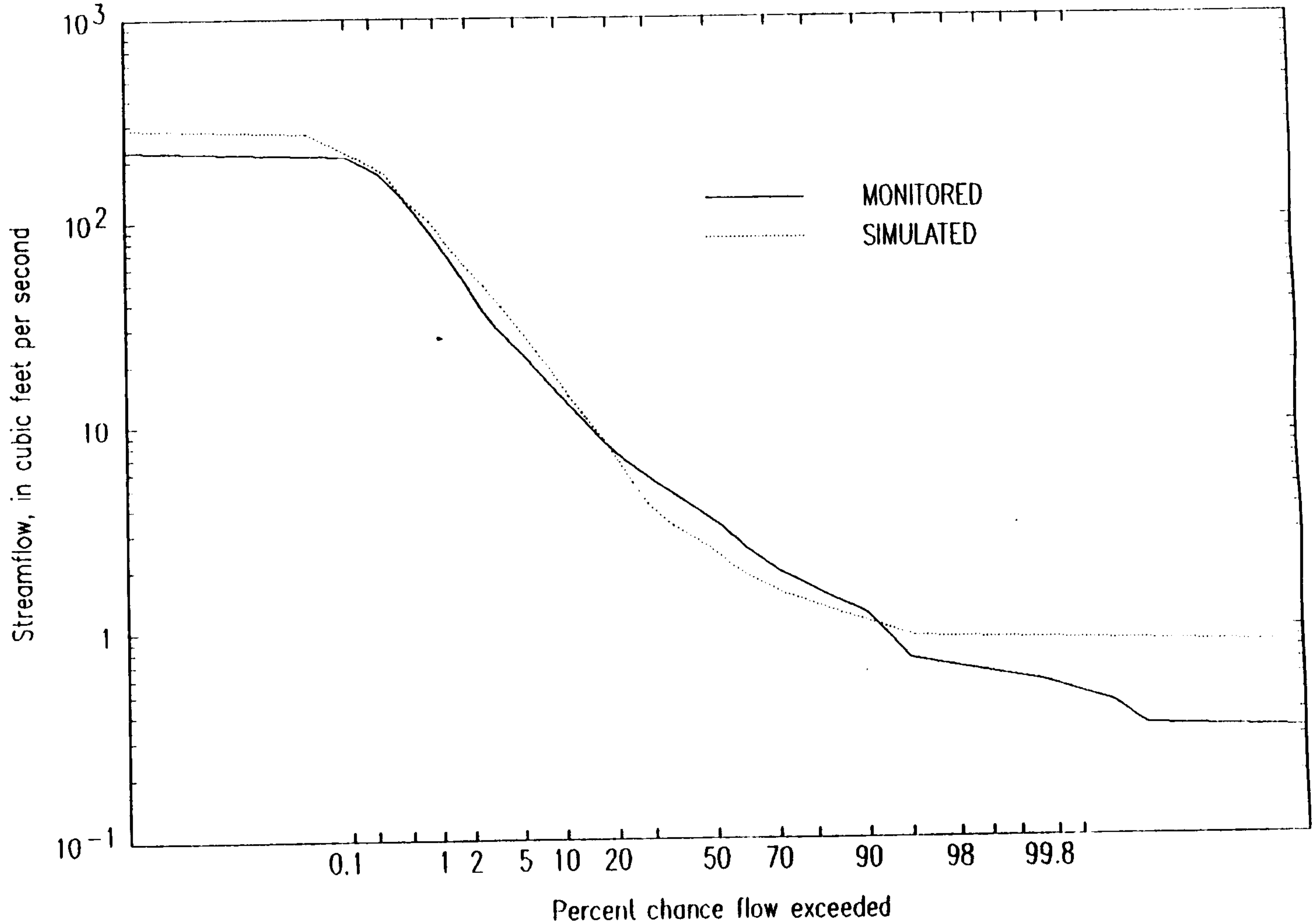


PRECIP
2 HR TOTALS
INCHES
0.5
0.25
0
FLOW
CFS
70
60
50
40
30
20
10
0
monitored
simulated
0000
0600
1200
1800
2400
0600
1200
1800
2400
0600
1200
1800
2400
JANUARY 14, 1996
JANUARY 15, 1996
JANUARY 16, 1996
TIME, IN HOURS
DES MOINES CREEK
BASIN PLAN PARAMETERS
SDS 3

AR 047081


PRECIP
2 HR TOTALS
INCHES
0.5
0.25
0
FLOW
CFS
80
70
60
50
40
30
20
10
0
monitored
simulated
0000
1200
2400
1200
2400
1200
2400
1200
2400
1200
2400
FEB 4, 1996
FEB 5, 1996
FEB 6, 1996
FEB 7, 1996
FEB 8, 1996
TIME, IN HOURS
DES MOINES CREEK
BASIN PLAN PARAMETERS
SDS 3

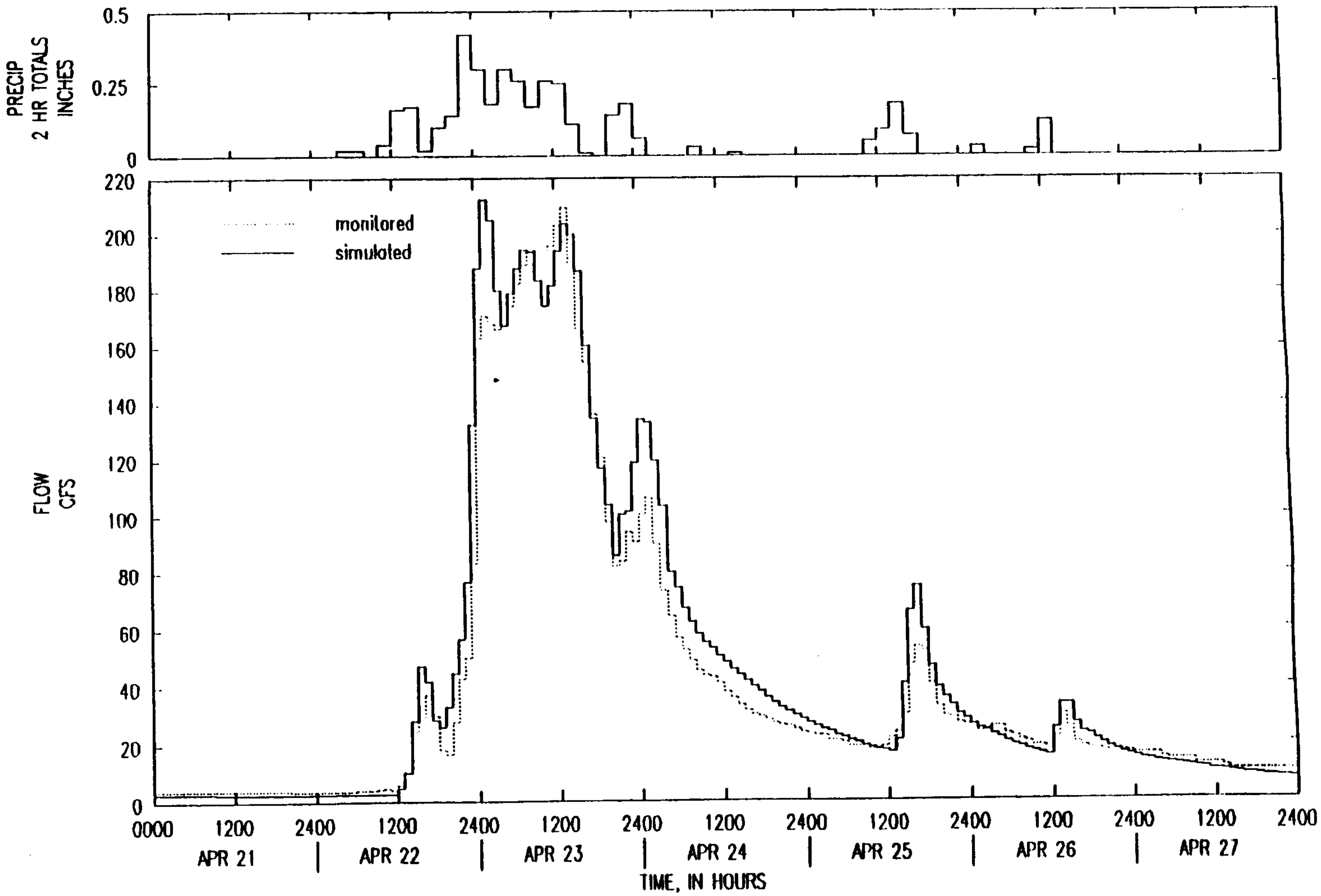
NOVEMBER 1999 SMP
DES MOINES CREEK MODEL HYDROGRAPHS



NOV. 1999 SMP VERSION OF 1994 CONDITIONS MODEL

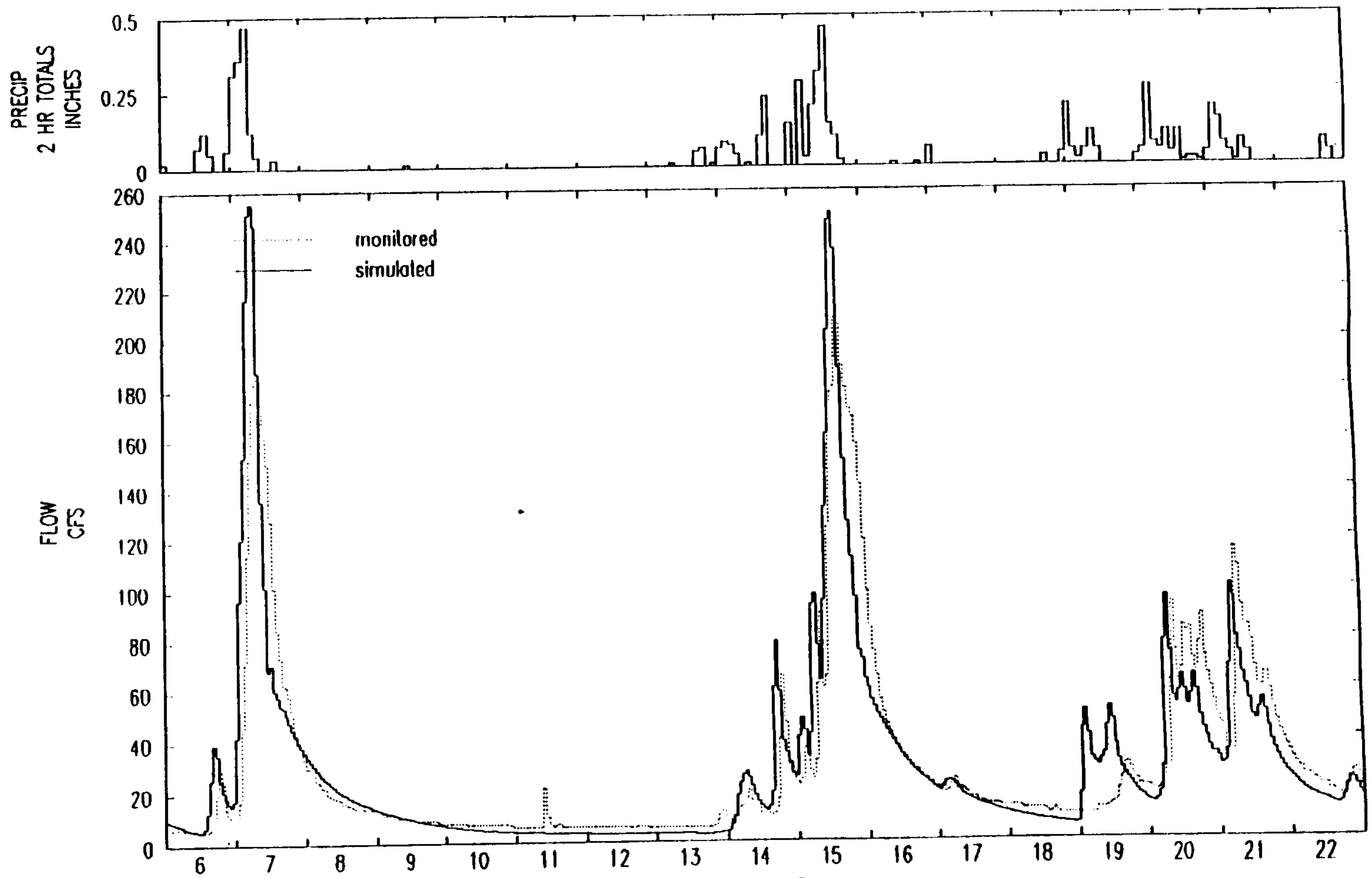
Near Mouth

AR 047084

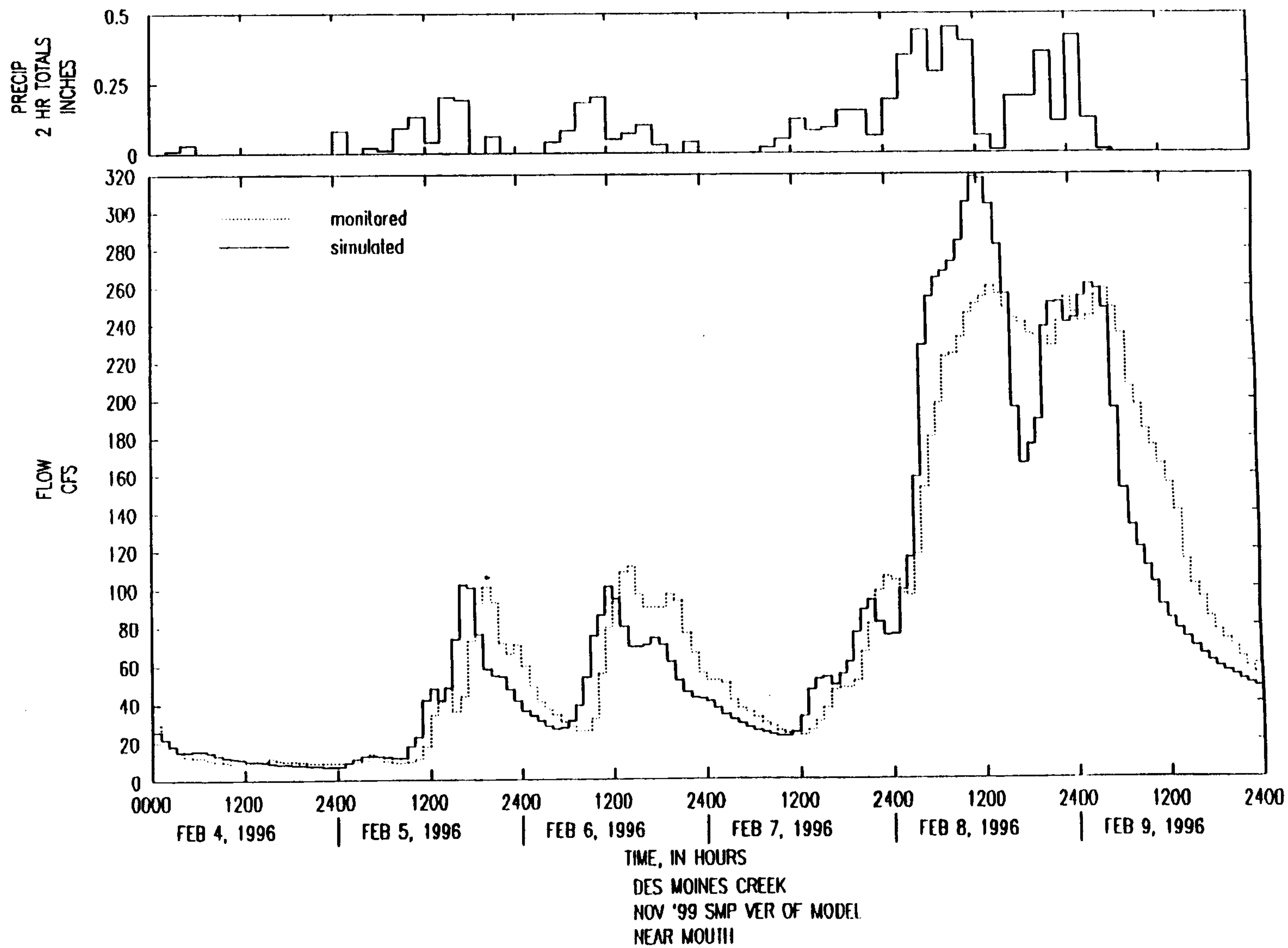


DES MOINES CREEK
NOV '99 SMP VER OF MODEL
NEAR MOUTH

AR 047085



JANUARY, 1996
TIME, IN DAYS
DES MOINES CREEK
NOV '99 SMP VER OF MODEL
NEAR MOUTH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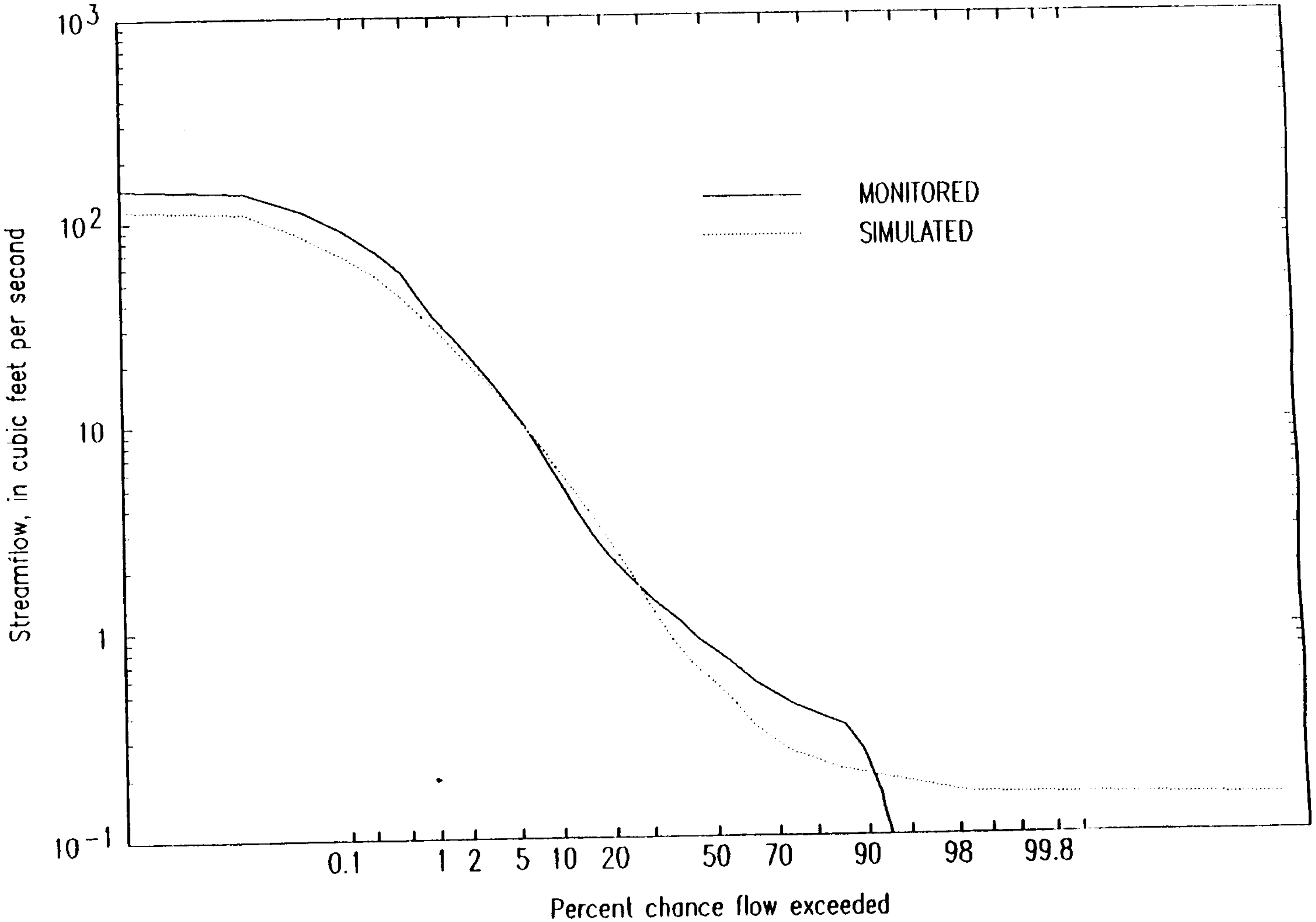
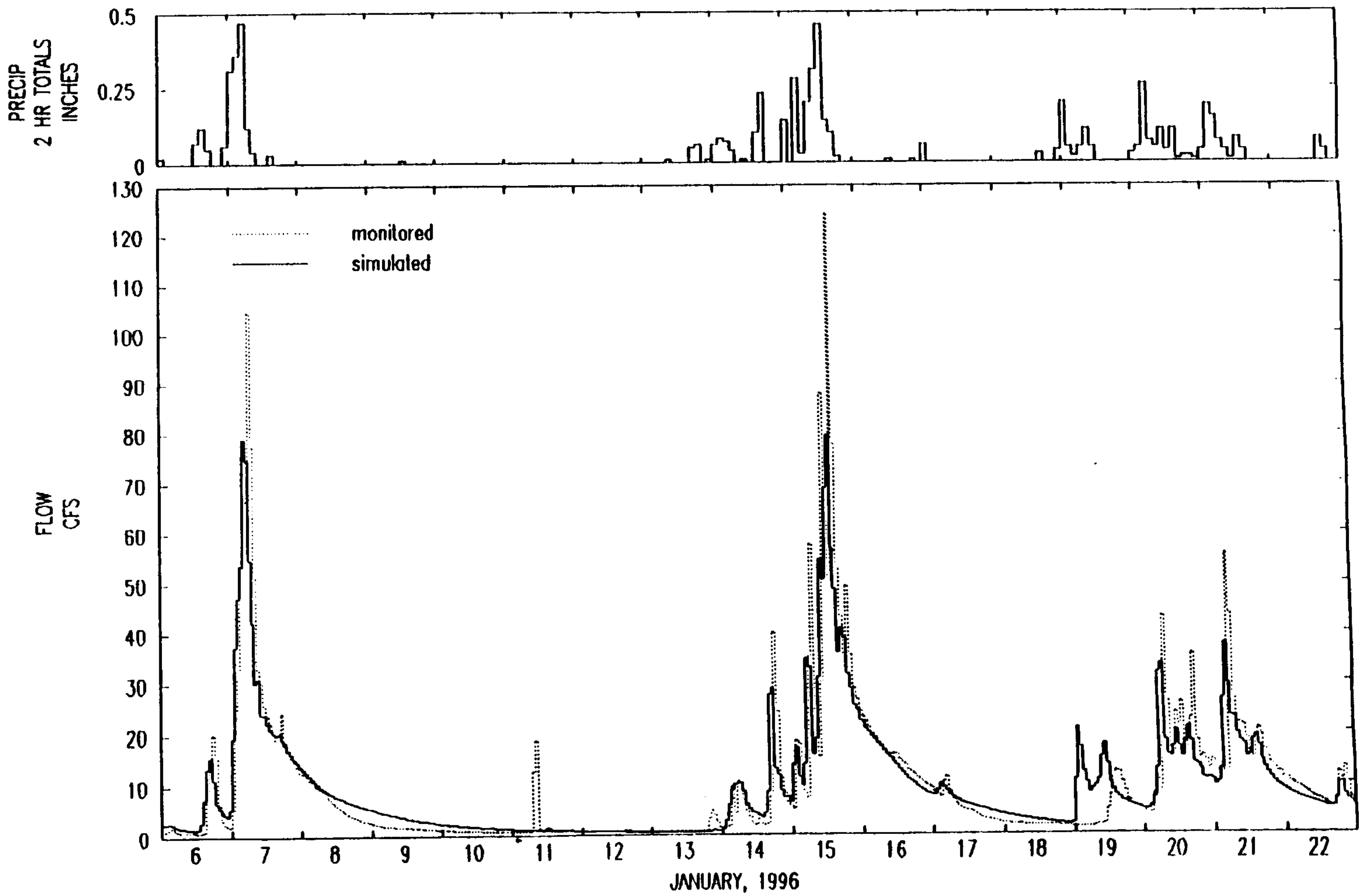
2 HR TOTALS
INCHES
0.5
0.25
0
FLOW
CFS
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
monitored
simulated
0000
1200
2400
1200
2400
1200
2400
1200
2400
1200
2400
1200
2400
FEB 4, 1996
FEB 5, 1996
FEB 6, 1996
FEB 7, 1996
FEB 8, 1996
FEB 9, 1996
TIME, IN HOURS
DES MOINES CREEK
NOV '99 SMP VER OF MODEL
NEAR MOUTH

AR 047087

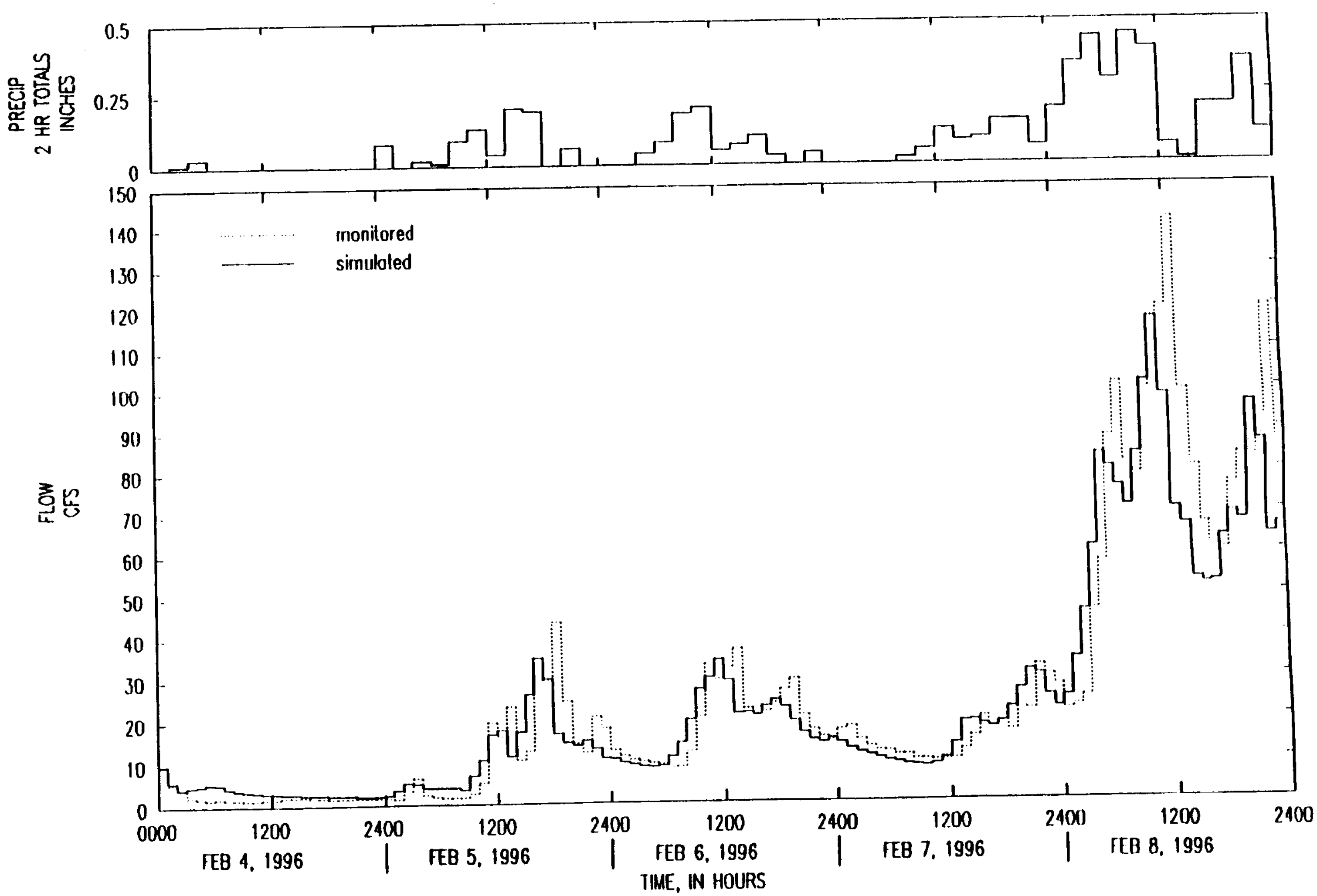


NOV. 1999 SMP VERSION OF 1994 CONDITIONS MODEL @ TYEE POND INFLOW

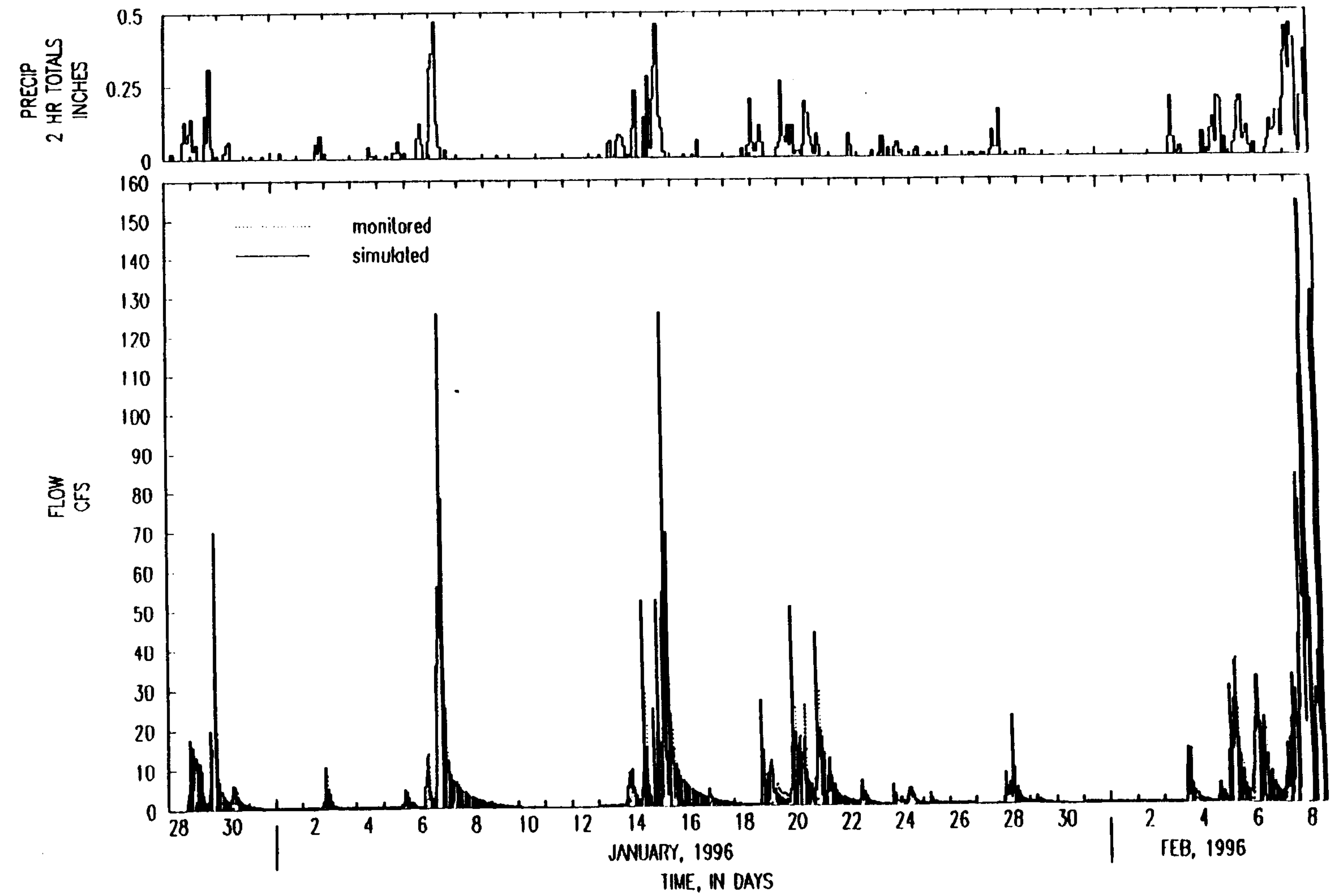


DES MOINES CREEK
NOV '99 SMP VER OF MODEL
TYEE POND INFLOW

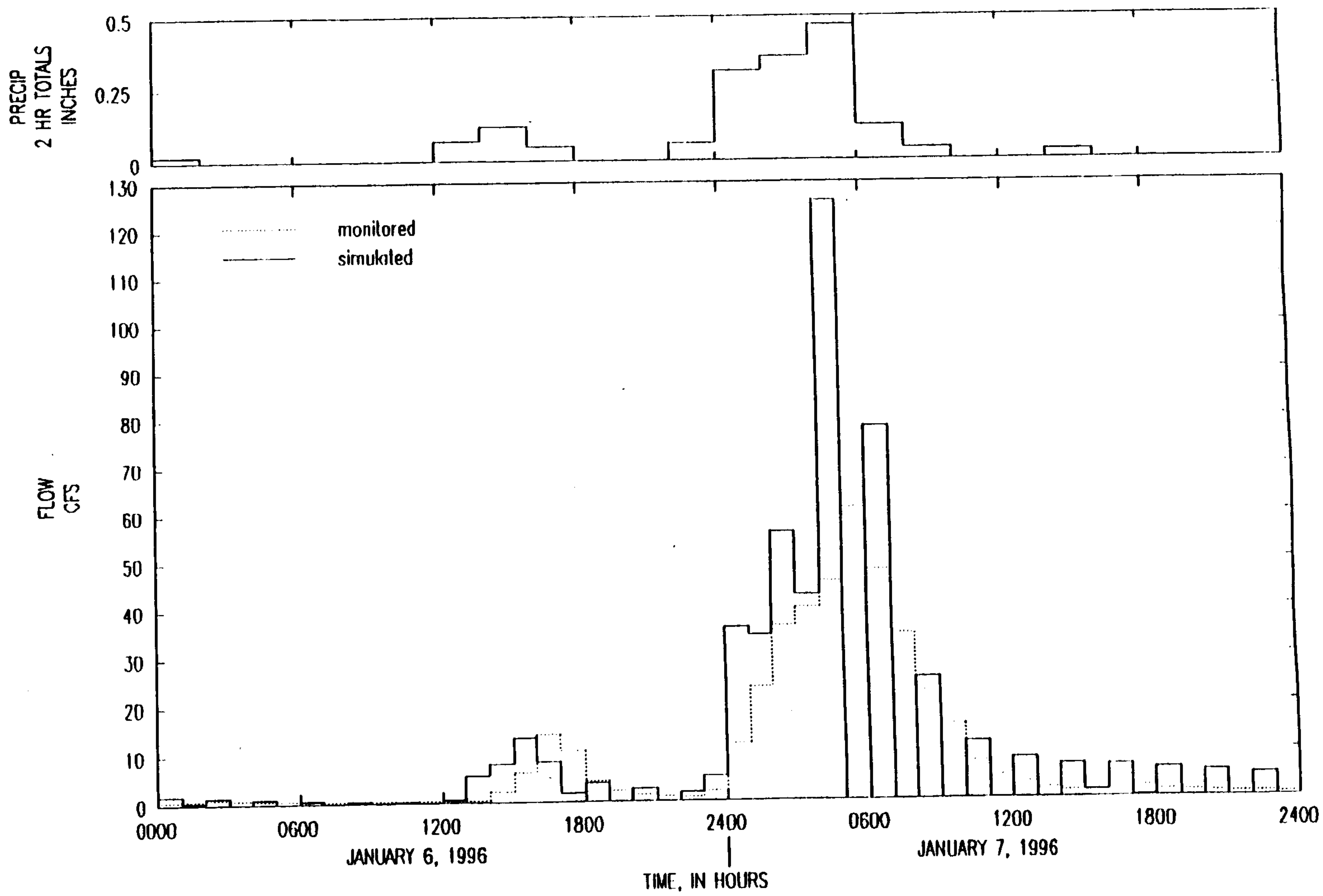
AR 047089



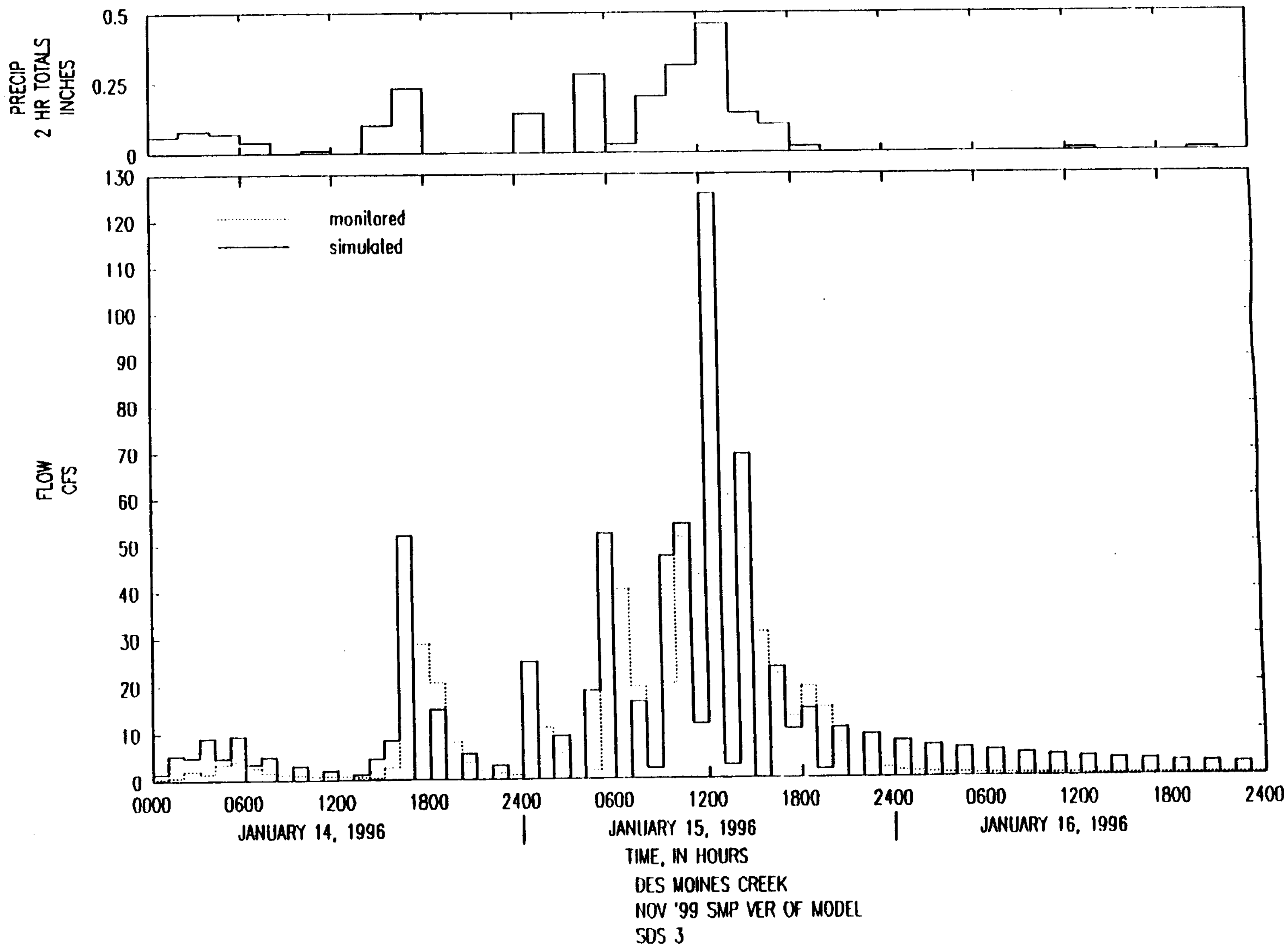
DES MOINES CREEK
NOV '99 SMP VER OF MODEL
TYEE POND INFLOW



DES MOINES CREEK
NOV '99 SMP VER OF MODEL
SDS 3



DES MOINES CREEK
NOV '99 SMP VER OF MODEL
SDS 3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INCHES
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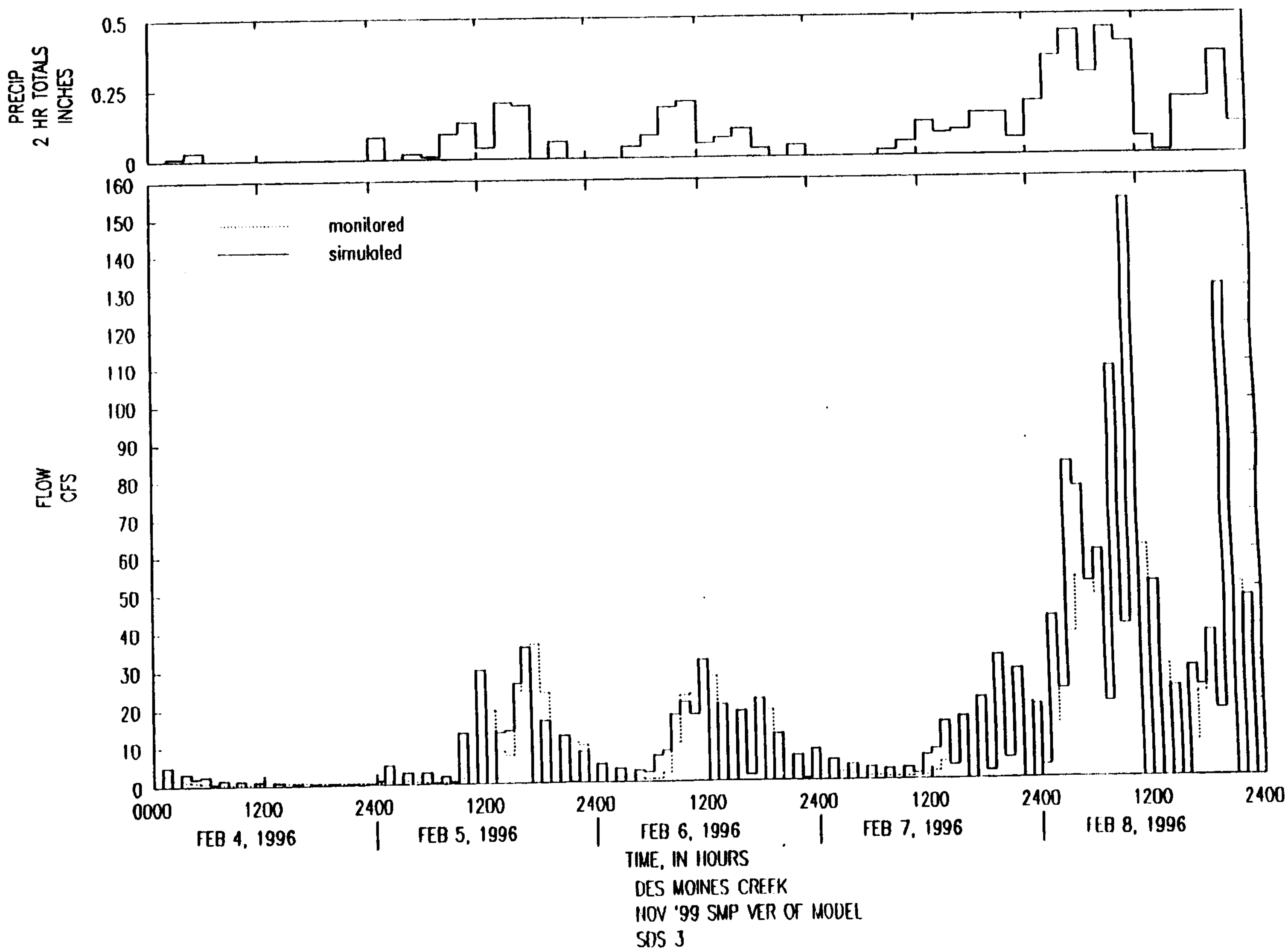
0.25
0
FLOW
CFS
130
120
110
100
90
80
70
60
50
40
30
20
10
0
monitored
simulated
0000
0600
1200
1800
2400
0600
1200
1800
2400
0600
1200
1800
2400
JANUARY 14, 1996
JANUARY 15, 1996
JANUARY 16, 1996
TIME, IN HOURS
DES MOINES CREEK
NOV '99 SMP VER OF MODEL
SDS 3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2 HR TOTALS
INCHES
0.5
0.25
0
FLOW
CFS
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
monitored
simulated
0000
1200
FEB 4, 1996
2400
1200
FEB 5, 1996
2400
1200
FEB 6, 1996
2400
1200
FEB 7, 1996
2400
1200
FEB 8, 1996
2400
TIME, IN HOURS
DES MOINES CREEK
NOV '99 SMP VER OF MODEL
SDS 3

Table B1-1. Des Moines Creek Subbasin Parameters - 1994 Base Condition

Land Use			Sub-basin Areas (acres)															
		% of total basin	Bow Lake		East Branch										West Branch (NW Ponds)			
			DM-1[b]		DM-2[b]		DM-3[a]		DM-4		DM-5		DM-6		DM-7		DM-8	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
AP	TGF	0%					1.18	-	-	-	0.16	-	-	-	-	-	-	-
	TGM	0%					0.74	-	-	-	1.64	-	-	-	-	-	-	-
	LAC	0%					0.76	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%					-	-	-	-	-	-	-	-	-	-	-	-
	OGM	0%					-	-	-	-	-	-	-	-	-	-	-	-
C	TGF	85%					3.95	22.40	3.44	19.51	0.04	0.22	0.61	3.46	-	-	1.86	10.53
	TGM	85%					3.42	19.36	3.41	19.30	1.64	9.32	0.10	0.54	-	-	-	-
	TGS	85%					-	-	-	-	-	-	0.04	0.25	-	-	-	-
	LAC	85%					4.29	24.33	-	-	-	-	-	-	2.14	12.15	-	-
	OGF	85%					-	-	-	-	0.02	0.10	-	-	0.65	3.68	2.27	12.89
	OGM	85%					-	-	-	-	0.75	4.24	-	-	0.07	0.39	-	-
TR	TGF	30%					-	-	-	-	-	-	-	-	-	-	6.12	2.62
	OGF	30%					-	-	-	-	-	-	-	-	-	-	0.68	0.29
	OGM	30%					-	-	-	-	-	-	-	-	-	-	-	-
MF	TGF	47%					-	-	-	-	-	-	-	-	-	-	-	-
	TGM	47%					-	-	-	-	-	-	-	-	-	-	-	-
	OGF	47%					-	-	-	-	-	-	-	-	-	-	-	-
	OGM	47%					-	-	-	-	-	-	-	-	-	-	-	-
	OGS	47%					-	-	-	-	-	-	-	-	-	-	-	-
HD	TGF	30%					9.67	4.15	-	-	-	-	-	-	0.96	0.41	-	-
	TGM	30%					0.43	0.19	-	-	-	-	-	-	-	-	-	-
	LAC	30%					1.39	0.59										
LD	TGF	13%					14.66	2.19	-	-	-	-	-	-	26.29	3.93	0.64	0.09
	TGM	13%					7.21	1.08	-	-	-	-	-	-	-	-	-	-
	TGS	13%					-	-	-	-	-	-	-	-	-	-	-	-
	LAC	13%					1.21	0.18	-	-	-	-	-	-	5.93	0.89	-	-
	OGF	13%					-	-	-	-	-	-	-	-	37.32	5.58	10.38	1.55
	OGM	13%					-	-	-	-	-	-	-	-	11.53	1.72	-	-
	OGS	13%					-	-	-	-	-	-	-	-	0.09	0.01	-	-
G	TGF	0%					-	-	-	-	2.04	-	5.06	-	-	-	-	-
	TGM	0%					-	-	-	-	1.18	-	8.03	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%					-	-	-	-	2.10	-	11.00	-	-	-	-	-
	OGM	0%					-	-	-	-	1.74	-	-	-	-	-	-	-

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Table B1-1. Des Moines Creek Subbasin Parameters - 1994 Base Condition

Land Use			Sub-basin Areas (acres)															
		% of total basin	Bow Lake		East Branch										West Branch (NW Ponds)			
			DM-1[b]		DM-2[b]		DM-3[a]		DM-4		DM-5		DM-6		DM-7		DM-8	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%					-	-	2.67	-	1.57	-	9.72	-	4.21	-	2.42	-
	TFM	0%					-	-	4.22	-	14.15	-	9.72	-	-	-	-	-
	TFS	0%					-	-	-	-	-	-	2.33	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	22.06	-	-	-
	OFF	0%					-	-	-	-	0.05	-	-	-	15.36	-	8.51	-
	OFM	0%					-	-	-	-	1.31	-	-	-	8.23	-	-	-
--	SA	0%					0.33		0.44		2.05		4.05		6.61		1.94	
	Lake		12.19		-		-		-		-		0.03		-		-	
	Other						0.03		0.02		0.07		0.00		0.11		0.11	
Basin total:			-		-		49.26	74.46	14.17	38.81	30.44	13.88	50.66	4.25	141.46	28.76	34.83	27.99
PERLND areas:																		
(14)	TFF		-		-		-		2.67		1.57		9.72		4.21		2.42	
(16)	TFM		10.32		-		-		4.22		14.15		9.72		-		-	
(18)	TFS		-		-		-		-		-		2.33		-		-	
(24)	TGF		-		-		29.47		3.44		2.23		5.67		27.25		8.62	
(26)	TGM		132.94		14.78		11.80		3.41		4.46		8.13		-		-	
(28)	TGS		-		-		-		-		-		0.04		-		-	
	LAC						7.66		-		-		-		30.13		-	
(34)	OF		7.19		-		-		-		1.36		-		23.59		8.51	
(44)	OG		92.36		-		-		-		4.61		11.00		49.66		13.34	
(54)	SA		14.11		-		0.33		0.44		2.05		4.05		6.61		1.94	
	subtotal:		256.92		14.78		49.26		14.17		30.44		50.66		141.46		34.83	
IMPLND areas:																		
	EIA			171.29		9.85		74.46		38.81		13.88		4.25		28.76		27.99
Basin total:			428.21		24.64		123.72		52.98		44.32		54.91		170.22		62.81	
Percent Impervious				40.0%		40.0%		60.2%		73.3%		31.3%		7.7%		16.9%		44.6%

	DM-1[b]	DM-2[b]	DM-3[a]	DM-4	DM-5	DM-6	DM-7	DM-8
NETWORK FACTORS								
PERLND 16 (TF)	0.860	-	-	0.574	1.310	1.814	2.189	0.202
PERLND 26 (TG)	11.078	1.232	4.077	0.571	0.558	1.153	2.944	0.718
PERLND 34 (OF)	0.599	-	-	-	0.114	-	1.966	0.709
PERLND 44 (OG)	7.697	-	-	-	0.384	0.917	4.138	1.111
PERLND 54 (SA)	1.176	-	0.028	0.037	0.171	0.337	0.551	0.162
IMPLND 14 (EIA)	14.274	0.821	6.205	3.234	1.156	0.354	2.397	2.332
SUM	35.684	2.053	10.310	4.415	3.694	4.576	14.185	5.234

[a] - land use is extrapolated

[b] - areas prorated to new subbasin total areas from previous version of model.

: shaded subbasins included in the STIA subbasin characteristics evaluation area.

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Table B1-1. Des Moines Creek Subbasin Parameters - 1994 Base Condition

Land Use			Sub-basin Areas (acres)															
		% of total basin	West Branch (NW Ponds)						Upper Main				Lower Main Stem					
			DM-9		DM-10		DM-11		DM-12		DM-13[a]		DM-14[b]		DM-16[b]		DM-17[b]	
Land	Soil	equal to		Effective		Effective		Effective		Effective		Effective		Effective		Effective		Effective
Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
AP	TGF	0%	-	-	-	-	-	-	-	-	-	-						
	TGM	0%	-	-	-	-	-	-	-	-	-	-						
	LAC	0%	-	-	-	-	-	-	-	-	-	-						
	OGF	0%	-	-	-	-	-	-	-	-	-	-						
	OGM	0%	-	-	-	-	-	-	-	-	-	-						
C	TGF	85%	-	-	-	-	1.36	7.71	-	-	3.61	20.48						
	TGM	85%	-	-	-	-	-	-	-	-	0.37	2.11						
	TGS	85%	-	-	-	-	-	-	-	-	0.16	0.89						
	LAC	85%	-	-	-	-	1.12	6.35	-	-	-	-						
	OGF	85%	-	-	-	-	2.89	16.38	-	-	-	-						
	OGM	85%	-	-	-	-	-	-	-	-	-	-						
TR	TGF	30%	-	-	-	-	2.27	0.97	-	-	-	-						
	OGF	30%	-	-	-	-	-	-	-	-	-	-						
	OGM	30%	-	-	-	-	-	-	-	-	-	-						
MF	TGF	47%	-	-	-	-	-	-	-	-	-	-						
	TGM	47%	-	-	-	-	-	-	-	-	-	-						
	OGF	47%	-	-	-	-	-	-	-	-	-	-						
	OGM	47%	-	-	-	-	-	-	-	-	-	-						
	OGS	47%	-	-	-	-	-	-	-	-	-	-						
HD	TGF	30%	-	-	-	-	-	-	-	-	0.06	0.02						
	TGM	30%	-	-	-	-	-	-	-	-	-	-						
	LAC	30%																
LD	TGF	13%	10.26	1.53	6.33	0.95	-	-	-	-	-	-						
	TGM	13%	2.89	0.43	-	-	-	-	-	-	-	-						
	TGS	13%	-	-	-	-	-	-	-	-	-	-						
	LAC	13%	1.25	0.19	2.50	0.37	-	-	-	-	-	-						
	OGF	13%	8.69	1.30	0.67	0.10	-	-	-	-	1.47	0.22						
	OGM	13%	26.74	4.00	5.39	0.81	-	-	-	-	0.04	0.01						
	OGS	13%	1.04	0.16	-	-	-	-	-	-	-	-						
G	TGF	0%	-	-	-	-	1.41	-	-	-	9.54	-						
	TGM	0%	-	-	-	-	-	-	-	-	8.89	-						
	LAC	0%	-	-	0.02	-	-	-	0.01	-	-	-						
	OGF	0%	-	-	0.06	-	2.70	-	23.44	-	18.28	-						
	OGM	0%	-	-	0.00	-	-	-	1.94	-	4.34	-						

Table B1-1. Des Moines Creek Subbasin Parameters - 1994 Base Condition

Land Use			Sub-basin Areas (acres)															
			West Branch (NW Ponds)						Upper Main				Lower Main Stem					
		% of total basin	DM-9		DM-10		DM-11		DM-12		DM-13[a]		DM-14[b]		DM-16[b]		DM-17[b]	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%	-	-	0.18	-	3.13	-	-	-	5.95	-						
	TFM	0%	-	-	-	-	-	-	-	-	20.98	-						
	TFS	0%	-	-	-	-	-	-	-	-	5.28	-						
	LAC	0%	0.02	-	11.14	-	0.73	-	6.13	-	0.00	-						
	OFF	0%	-	-	8.78	-	12.33	-	0.02	-	0.02	-						
	OFM	0%	0.19	-	14.43	-	-	-	4.49	-	14.43	-						
–	SA	0%	0.12		8.52		12.43		6.51		0.82							
	Lake		-		0.96		5.33		0.63		0.85		-		0.44		-	
	Other		0.02		0.06		0.02		-		0.06							
Basin total:			51.20	7.60	58.02	2.23	40.37	31.42	42.53	-	92.25	23.73	-		-		-	
PERLND areas:																		
(14)	TFF		-		0.18		3.13		-		5.95		-		-		-	
(16)	TFM		-		-		-		-		20.98		5.78		7.76		24.93	
(18)	TFS		-		-		-		-		5.28		-		-		-	
(24)	TGF		10.26		6.33		5.04		-		13.21		-		-		-	
(26)	TGM		2.89		-		-		-		9.26		3.54		66.87		27.13	
(28)	TGS		-		-		-		-		0.16		-		-		-	
	LAC		1.27		13.66		1.85		6.14		0.00							
(34)	OF		0.19		23.21		12.33		4.51		14.45		23.28		7.67		36.04	
(44)	OG		36.47		6.12		5.59		25.37		22.14		14.34		96.28		39.36	
(54)	SA		0.12		8.52		12.43		6.51		0.82		-		2.19		-	
	subtotal:		51.20		58.02		40.37		42.53		92.25		46.94		180.77		127.45	
IMPLND areas:																		
	EIA			7.60		2.23		31.42		-		23.73		4.08		50.99		31.86
Basin total:			58.80		60.24		71.79		42.53		115.98		51.02		231.75		159.31	
Percent impervious				12.9%		3.7%		43.8%		0.0%		20.5%		8.0%		22.0%		20.0%

	DM-9	DM-10	DM-11	DM-12	DM-13[a]	DM-14[b]	DM-16[b]	DM-17[b]
NETWORK FACTORS								
PERLND 16 (TF)	0.002	0.943	0.321	0.511	2.684	0.481	0.647	2.078
PERLND 26 (TG)	1.200	0.738	0.514	0.001	1.886	0.295	5.573	2.261
PERLND 34 (OF)	0.016	1.934	1.028	0.376	1.204	1.940	0.639	3.003
PERLND 44 (OG)	3.039	0.510	0.466	2.114	1.845	1.195	8.023	3.280
PERLND 54 (SA)	0.010	0.710	1.036	0.543	0.068	-	0.183	-
IMPLND 14 (EIA)	0.633	0.185	2.618	-	1.978	0.340	4.249	2.655
SUM	4.900	5.020	5.983	3.544	9.665	4.252	19.313	13.276

[a] - land use is extrapolated
[b] - areas prorated to new subbasin total areas from previous version of model.
shaded subbasins included in the STIA subbasin characteristics evaluation area.

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Table B1-1. Des Moines Creek Subbasin Parameters - 1994 Base Condition

Land Use			Sub-basin Areas (acres)															
			Lower Main Stem										SDS Basins					
		% of total basin	DM-18[b]		DM-19[b]		DM-20[b]		DM-21[b]		DM-22[b]		SDE-4		SDS-1		SDS-3	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
AP	TGF	0%											43.19	114.48			236.45	170.63
	TGM	0%											1.11	2.93	0.00	7.41	21.50	15.52
	LAC	0%											0.01	0.04				
	OGF	0%																
	OGM	0%																
C	TGF	85%											1.30	3.36	1.16	2.85		
	TGM	85%											0.07	0.18	0.30	0.72		
	TGS	85%																
	LAC	85%											0.20	0.52				
	OGF	85%																
	OGM	85%																
TR	TGF	30%																
	OGF	30%																
	OGM	30%																
MF	TGF	47%																
	TGM	47%																
	OGF	47%																
	OGM	47%																
	OGS	47%																
HD	TGF	30%																
	TGM	30%																
	LAC	30%																
LD	TGF	13%																
	TGM	13%																
	TGS	13%																
	LAC	13%																
	OGF	13%																
	OGM	13%																
	OGS	13%																
G	TGF	0%											9.69	0.84				
	TGM	0%																
	LAC	0%																
	OGF	0%																
	OGM	0%																

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Table B1-1. Des Moines Creek Subbasin Parameters - 1994 Base Condition

Land Use			Sub-basin Areas (acres)															
			Lower Main Stem										SDS Basins					
		% of total basin	DM-18[b]		DM-19[b]		DM-20[b]		DM-21[b]		DM-22[b]		SDE-4		SDS-1		SDS-3	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%																
	TFM	0%																
	TFS	0%																
	LAC	0%																
	OFF	0%																
	OFM	0%																
--	SA	0%															0.47	
	Lake		-		-		-		-		-							
	Other												0.08		0.00		0.06	
Basin total:			-		-		-		-		-		55.57	122.46	1.48	10.98	258.42	186.14
PERLND areas:																		
(14)	TFF		-		-		-		-		-							
(16)	TFM		9.47		2.19		48.08		25.72		4.58							
(18)	TFS		-		-		-		-		-						-	
(24)	TGF		-		-		-		-		-		54.17		1.18		236.45	
(26)	TGM		3.32		72.22		79.49		75.68		55.85		1.18		0.30		21.50	
(28)	TGS		-		-		-		-		-						-	
	LAC												0.22					
(34)	OF		37.81		2.00		33.40		17.14		2.62						-	
(44)	OG		13.27		66.63		55.22		50.46		31.44						-	
(54)	SA		3.60		-		1.39		-		0.19						0.47	
	subtotal:		67.48		143.04		217.58		168.99		94.67		55.57		[illegible]		258.42	
IMPLND areas:																		
	EIA			3.55		31.40		44.56		37.10		23.67		122.46		10.98		186.14
Basin total:			71.03		174.44		262.14		206.09		118.34		178.03	[illegible]	12.46		444.56	
Percent Impervious				5.0%		18.0%		17.0%		18.0%		20.0%		68.8%		88.1%		41.9%

	DM-18[b]	DM-19[b]	DM-20[b]	DM-21[b]	DM-22[b]	SDE-4	SDS-1	SDS-3
NETWORK FACTORS								
PERLND 16 (TF)	0.789	0.182	4.007	2.143	0.381	[illegible]	[illegible]	[illegible]
PERLND 26 (TG)	0.277	6.019	6.624	6.306	4.654	4.631	0.123	21.496
PERLND 34 (OF)	3.151	0.167	2.784	1.429	0.218		-	
PERLND 44 (OG)	1.106	5.552	4.602	4.205	2.620			
PERLND 54 (SA)	0.300	-	0.116	-	0.016			0.039
IMPLND 14 (EIA)	0.296	2.617	3.714	3.091	1.972	10.205	0.915	15.512
SUM	5.919	14.537	21.845	17.174	9.862	14.836	1.038	37.047

[a] - land use is extrapolated

[b] - areas prorated to new subbasin total areas from previous version of model.

shaded subbasins included in the STIA subbasin characteristics evaluation area.

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Table B1-1. Des Moines Creek Subbasin Parameters - 1994 Base Condition

Land Use			Sub-basin Areas (acres)							
			SDS Basins				IWS Basins			
		% of total basin	SDS-4		SDS-2,5,6,7		PRIMARY		SDS1OF	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
AP	TGF	0%	6.15	16.93	59.48	11.31	6.00	186.47	0.28	21.17
	TGM	0%					1.09	33.92	0.15	11.62
	LAC	0%					0.03	0.98		
	OGF	0%	9.96	11.22			0.03	0.91		
	OGM	0%	0.82	0.92			0.07	2.26		
C	TGF	85%			0.13	0.18	0.08	1.13	0.00	0.02
	TGM	85%					0.01	0.38	0.00	0.04
	TGS	85%								
	LAC	85%								
	OGF	85%			0.51	0.51				
	OGM	85%								
TR	TGF	30%	0.01		0.21	0.36	0.00	0.08		
	OGF	30%								
	OGM	30%					0.00	0.45		
MF	TGF	47%								
	TGM	47%								
	OGF	47%								
	OGM	47%								
	OGS	47%								
HD	TGF	30%								
	TGM	30%								
	LAC	30%								
LD	TGF	13%								
	TGM	13%								
	TGS	13%								
	LAC	13%								
	OGF	13%								
	OGM	13%								
	OGS	13%								
G	TGF	0%	2.89	0.04	38.22	0.81	0.01	5.82		
	TGM	0%								
	LAC	0%								
	OGF	0%	16.02	0.22			0.01	4.69		
	OGM	0%	2.07	0.03			0.00	2.53		

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Table B1-1. Des Moines Creek Subbasin Parameters - 1994 Base Condition

Land Use			Sub-basin Areas (acres)									
			SDS Basins				IWS Basins					
		% of total basin equal to EIA	SDS-4		SDS-2,5,6,7		PRIMARY		SDS1OF			
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious		
F	TFF	0%			2.73	0.01	2.66					
	TFM	0%							-	-		
	TFS	0%							-	-		
	LAC	0%				-			-	-		
	OFF	0%	0.22		8.12	0.02	1.89		-	-		
	OFM	0%										
-	SA	0%	0.00		0.52		0.00		-			
	Lake						6.65					
	Other		0.04		0.12		0.02		0.00			
Basin total:			38.15	19.37	107.91	13.15	11.84	239.59	0.43	32.85	Total	Percent
PERLND areas:												
(14)	TFF				2.73		2.66		-		35.24	0.96%
(16)	TFM				-		-		-		187.89	5.10%
(18)	TFS				-		-		-		7.61	0.21%
(24)	TGF		9.05		96.03		6.04		0.28		514.73	13.97%
(26)	TGM						1.10		0.15		596.00	16.18%
(28)	TGS						-				0.20	0.01%
	LAC						0.03				60.95	1.65%
(34)	OF		0.22		8.12		1.89				265.54	7.21%
(44)	OG		28.87		0.51		0.11				663.13	18.00%
(54)	SA		0.00		10.52		0.00				66.33	1.80%
	subtotal:		38.15		107.91		11.84		0.43		2397.61	65.09%
IMPLND areas:												
	EIA			19.37		13.15		239.59		32.85	1286.03	34.91%
Basin total:			57.52		121.06		251.43		33.28		3683.64	100.00%
Percent Impervious				33.7%		10.9%		95.3%		98.7%		
			SDS-4		SDS-2,5,6,7		PRIMARY		SDS1OF		Total	Percent
NETWORK FACTORS												
PERLND 16 (TF)					0.228		0.222				22.57	7.35%
PERLND 26 (TG)			0.755		8.002		0.598		0.036		94.32	30.73%
PERLND 34 (OF)			0.018		0.676		0.158				22.13	7.21%
PERLND 44 (OG)			2.406		0.042		0.009				55.26	18.00%
PERLND 54 (SA)			0.000		0.043		0.000		-		5.53	1.80%
IMPLND 14 (EIA)			1.614		1.096		19.966		2.738		107.17	34.91%
SUM			4.793		10.088		20.953		2.774		306.97	100.00%

[a] - land use is extrapolated

[b] - areas prorated to new subbasin total areas from previous version of model.

shaded subbasins included in the STIA subbasin characteristics evaluation area.

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MILLER/WALKER CREEK HSPF MODEL CALIBRATION REPORT

VOLUME 3—APPENDIX B2

Prepared for

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December 2000
556-2912-001 (28)

AR 047103

CERTIFICATE OF ENGINEER

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned.

(affix seal here)

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Douglas Beyerlein, P.E., Senior Engineer

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1. INTRODUCTION

As part of Parametrix's study of the drainage impacts of the proposed Seattle-Tacoma International Airport (STIA) Master Plan Update (MPU) on both Walker and Miller Creeks, the Environmental Protection Agency's Hydrological Simulation Program – FORTRAN (HSPF) model was used to simulate the hydrology of the study area. Information resulting from this computer simulation effort will be used to evaluate the hydrologic impacts of urbanization in the watershed.

This report discusses the calibration effort for both the Walker and Miller Creek HSPF models. The calibration team consisted of Joe Brascher (Aqua Terra) and Dave Harms (formerly of Parametrix). Every aspect of each model was reviewed by the team, and the best possible data were used.

The calibration period consisted of water-years 1993 through 1996. Simulated streamflow volumes over the calibration period were within 10 percent of recorded volumes. Some difficulty was encountered in matching the magnitude of simulated streamflow peaks with recorded streamflow peaks. Sixty-five calibration runs were performed for Miller Creek and 21 calibration runs were performed for Walker Creek in an effort to match the magnitude of the recorded streamflow peaks. The best possible match for the given data has been achieved. Investigation of the recorded streamflow data at both gage sites for Miller Creek and both gage sites for Walker Creek demonstrates possible errors as a result of gage malfunctions and shifting control situations. The team concluded that these errors may have contributed to the inability to match observed streamflows with simulated streamflows.

2. CALIBRATION

2.1 HYDROMETEORLOGIC DATA

Two streamflow gages located in the Miller Creek watershed and two streamflow gages located in the Walker Creek watershed were used in the calibration effort (Figure B2-1). Data for the streamflow gages were collected by the King County Department of Natural Resources. The calibration period covered water-years 1993 through 1996. The team selected this time period because it is believed to contain the most reliable data. However, the observed data from these water-years still contained several gaps. The dates of the missing data are listed in Table B2-1.

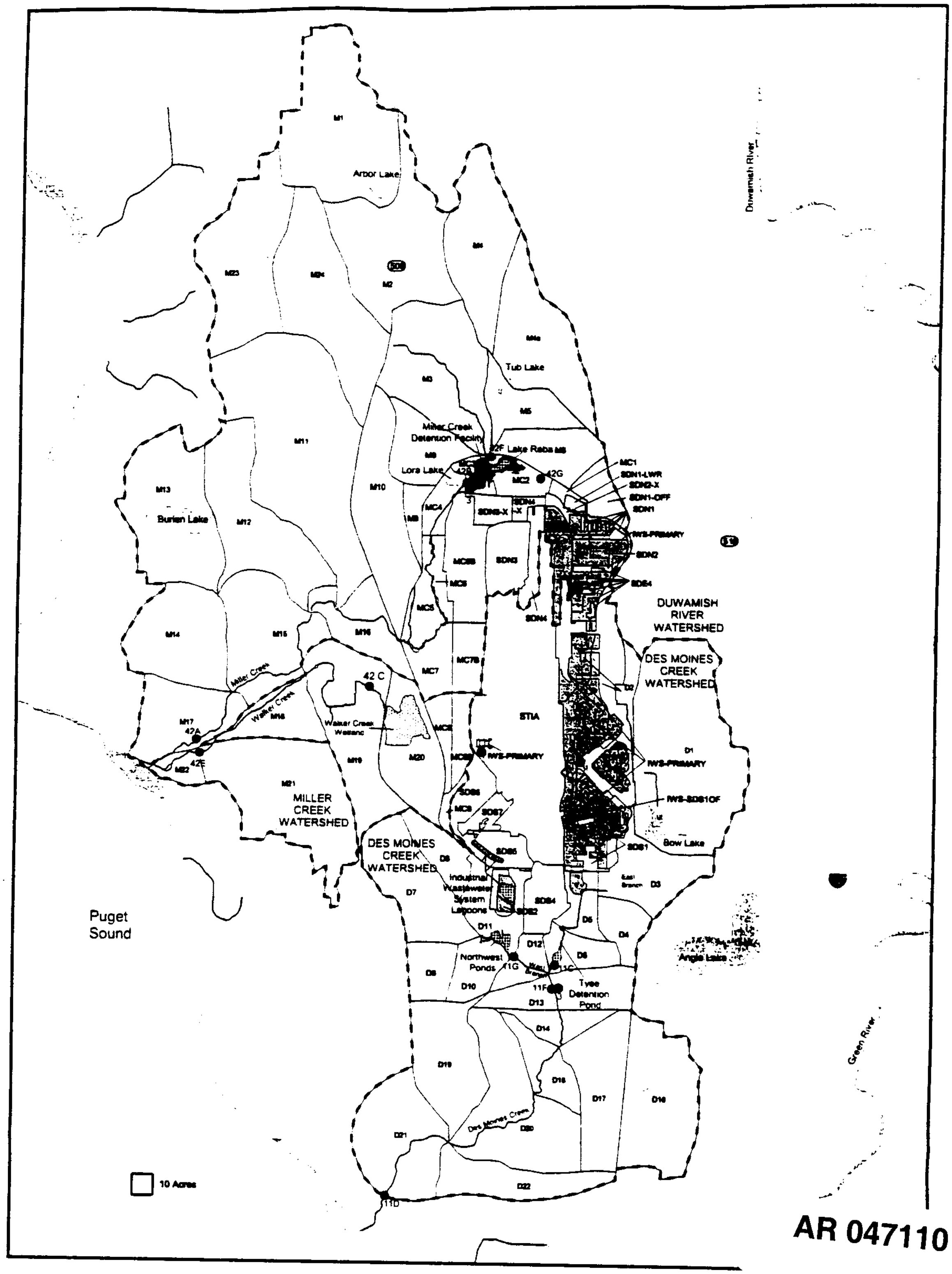
Table B2-1. Dates of missing records at Miller and Walker Creek gages.

		# obs
RDF		
	10/1/92 1:00 – 10/15/92 17:00	352
	11/23/93 16:00 – 12/29/93 13:00	861
	9/17/94 3:00 – 10/14/94 1:00	646
	12/5/94 14:00 – 1/3/95 14:00	696
SR518		
	10/1/92 1:00 – 11/24/92 17:00	1312
	11/23/93 17:00 – 12/16/93 16:00	551
	11/28/94 16:00 – 1/3/95 16:00	864
Walker Creek		
	2/2/93 16:00 – 3/18/93 14:00	1054
	5/23/94 9:00 – 6/27/94 11:00	842
Mouth of Miller Creek		
	10/1/92 1:00 – 10/8/92 15:00	182
	12/2/93 12:00 – 12/29/93 15:00	651
	11/29/94 13:00 – 12/30/94 10:00	741
	6/21/95 17:00 – 10/1/95 0:00	2431

2.2 PRECIPITATION RECORD

Precipitation data for the calibration period of 10/1/92 - 8/30/96 were hourly records taken at STIA. Due to the proximity to the Miller Creek watershed, these data can be used without any modifications.

The 46-month period of rainfall record was selected from the 49 years of record at STIA for the calibration period since this represented a wide range of precipitation conditions. The average annual rainfall for the 49 years of record was 38.3 inches. For the period of record, 1993 had the third lowest annual rainfall total (28.8 inches) and 1996 had the second highest annual rainfall total (50.7 inches). By comparison, the 1994 annual rainfall total was 3.5 inches below average, and the 1995 annual rainfall total was 4.3 inches above average. Therefore, the time interval between 1993 and 1996 provided a range of precipitation conditions for calibration at a time when the land use could be accurately estimated.



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July 2001
556-2912-001 (28)

Roads
Existing (1994) Drainage Subbasins
STIA Area (see note)
Constructed Water Features
IWS Drainage Area
Subwatershed Boundary
Watershed Boundary
Rivers
Water Bodies
Detention Facilities (existing)

N
1000 0 1000 2000 Feet
1:36,000

Figure B2-1
Map of Basins with Gage Locations

2.3 EVAPORATION DATA

Daily evaporation data recorded at the Washington State Research and Extension Center gage at Puyallup have been used for this modeling effort. These data have been appended starting in water-year 1992 by King County monthly average evaporation data.

2.4 SOILS

Both the Miller and Walker Creek watersheds contain a mixture of glacial till, outwash, and wetland soils. Consideration was given to separating out an additional soil/geology type to represent non-typical glacial till soils that are present in both the Miller and Walker Creek watersheds. These glacial till soils are characterized by unusually deep layers of permeable material overlaying the till layer. U.S. Geological Survey (USGS) regional parameters for till soils are based on the assumption that the impermeable layer of till is underneath a few feet of highly permeable soil. Investigation of available soils data conducted by Parametrix staff indicated that there are areas within the Miller Creek basin where the impermeable till layer is beneath a much deeper layer of highly permeable soil – over 20 feet of depth. Since the till layer presumably is at approximately the same elevation throughout the basin (considering how it was formed), overall runoff volume should not be affected by the depth of permeable material over it. The depth of permeable material would have an impact on flow attenuation. Since the areas of deep till (greater than 20 feet deep) are spread throughout the basin and not located within one specific area, the team believes that the resulting calibration parameter values for till soils are average values representative of the basin as a whole and not biased toward a certain portion of the basin.

2.5 MODEL PARAMETERS

The HSPF regional parameters were used as a starting point for the calibration of both the Miller and Walker Creek watershed models. Based upon our professional judgment, changes were made to the PERLND parameters to better reflect the hydrology of the watershed. A complete listing of the HSPF model parameters for Miller and Walker Creeks is provided in Tables B2-2 and B2-3.

2.6 LAND USE DATA

The land use data for this model were taken from the Environmental Impact Statement prepared several years earlier. The source of these data is believed to be Montgomery Water Group. Since there is uncertainty about the original source of the land use data, and spot verification of land use indicated sizable discrepancies from observable data such as aerial photography, it was decided to use the latest version of King County Department of Natural Resources' land use for the calibration period. The King County land use is based on 1994 aerial photos. Soils data were obtained from King County for similar reasons. When King County's land use data were input to the model, a consistent drop in impervious area for the subbasins was observed (Tables B2-4 through B2-7). Model calibration using this data also did not distinguish between separate slope categories.

Table B2-2. **Miller Creek PERLND parameter values: July 2000 calibration.**

PERLND #	PERLND Type	LZSN	INFILT	LSUR	SLSUR	KVARY	AGWRC	INFEXP	INFILD	DEEPFR	BASETP
16	TFM	9.0	0.32	400	0.100	0.5	0.996	2	2	0.33	0
26	TGM	9.0	0.12	400	0.100	0.5	0.996	2	2	0.33	0
34	OF	10.0	2.00	400	0.050	0.3	0.996	2	2	0.33	0
44	OG	10.0	0.80	400	0.050	0.3	0.996	2	2	0.33	0
54	SAT	8.0	2.00	100	0.001	0.5	0.996	10	2	0.33	0

PERLND #	PERLND Type	AGWETP	CEPSC	UZSN	NSUR	INTFW	IRC	LZETP
16	TFM	0.0	0.2	0.75	0.35	9.0	0.7	0.70
26	TGM	0.0	0.1	0.38	0.25	9.0	0.7	0.25
34	OF	0.0	0.2	0.75	0.35	0.0	0.7	0.70
44	OG	0.0	0.1	0.75	0.25	0.0	0.7	0.25
54	SAT	0.7	0.1	2.25	0.50	1.0	0.7	0.80

Table B2-3. **Walker Creek PERLND parameter values: July 2000 calibration.**

PERLND #	PERLND Type	LZSN	INFILT	LSUR	SLSUR	KVARY	AGWRC	INFEXP	INFILD	DEEPFR	BASETP
16	TFM	4.5	0.08	400	0.100	0.5	0.996	2	2	0	0
26	TGM	4.5	0.03	400	0.100	0.5	0.996	2	2	0	0
34	OF	5.0	2.00	400	0.050	0.3	0.996	2	2	0	0
44	OG	5.0	0.80	400	0.050	0.3	0.996	2	2	0	0
54	SAT	4.0	2.00	100	0.001	0.5	0.996	10	2	0	0
64	Des Moines TGF	4.5	0.12	400	0.100	0.5	0.999	2	2	0	0

PERLND #	PERLND Type	AGWETP	CEPSC	UZSN	NSUR	INTFW	IRC	LZETP
16	TFM	0.0	0.2	0.50	0.35	2.0	0.15	0.70
26	TGM	0.0	0.1	0.25	0.25	2.0	0.15	0.25
34	OF	0.0	0.2	0.50	0.35	0.0	0.50	0.70
44	OG	0.0	0.1	0.50	0.25	0.0	0.50	0.25
54	SAT	0.7	0.1	3.00	0.50	1.0	0.70	0.80
64	Des Moines TGF	0.0	0.1	0.25	0.25	3.0	0.50	0.25

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Table B2-4. Miller Creek subbasin characteristics - 1994 base condition (STIA basins).

Land Use			Sub-basin Areas (acres)													
															MC-1 to MC-7	
		% of total basin equal to EIA	M-5		M-6		M-8		M-9		M-10		M-16		MC-1	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMM	Qvr	85%	0.53	3.01	-	-	-	-	-	-	5.35	30.34	0.02	0.12	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.46	2.60	-	-
	Qvt	85%	2.18	12.34	0.23	1.31	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	-	-	0.03	-	-	-	-	-	-	-	-	-	0.10	-
	Qvr	0%	-	-	3.44	-	-	-	3.83	-	11.34	-	7.22	-	3.73	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	3.48	-	-	-
	Qvt	0%	-	-	-	-	-	-	0.36	-	4.32	-	-	-	-	-
	Qw	0%	-	-	0.01	-	-	-	0.01	-	-	-	-	-	-	-
	TIA	100%	-	-	-	4.79	-	-	-	7.21	-	16.75	-	5.32	-	0.09
MF	Qvr	47%	0.62	0.55	-	-	6.68	5.92	5.13	4.55	19.97	17.71	1.19	1.06	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	0.20	0.17	-	-
HD	Qvr	15%	-	-	-	-	0.48	0.08	46.38	8.18	6.98	1.23	15.22	2.69	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	16.63	2.94	-	-
	Qvt	15%	-	-	5.92	1.05	-	-	13.96	2.46	19.60	3.46	-	-	-	-
	Qw	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	0.16	0.01	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	0.01	0.00	-	-
	Qvr	4%	9.67	0.40	-	-	14.21	0.59	1.26	0.05	51.59	2.15	5.78	0.24	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	9.37	0.39	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	8.02	0.33	-	-	-	-
	Qw	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	-	-	0.18	-	-	-	-	-	-	-	-	-	0.07	-
	Qvr	0%	39.22	-	9.95	-	0.84	-	0.10	-	-	-	1.98	-	4.48	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	0.00	-	-	-
	Qvt	0%	8.11	-	34.71	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	0.47	-	-	-	-	-	-	-	-	-	-	-	-	-
F	M	0%	-	-	0.06	-	-	-	-	-	-	-	1.17	-	-	-

Table B2-4. Miller Creek subbasin characteristics - 1994 base condition (STIA basins).

Land Use			Sub-basin Areas (acres)													
															MC-1 to MC-7	
		% of total basin equal to EIA	M-5		M-6		M-8		M-9		M-10		M-16		MC-1	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Impervious	Pervious	Effective Impervious
	Qu	0%	-	-	-	-	-	-	-	-	-	-	0.77	-	-	-
	Qvr	0%	-	-	21.75	-	-	-	0.05	-	-	-	19.26	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	9.76	-	-	-
	Qvt	0%	-	-	10.60	-	-	-	4.94	-	4.15	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	10.27		0.80		-		-		-		-		0.27	
	Lake		0.44		-		-		-		-		-		-	
	Mcrk-df		-		0.07		-		-		-		-		-	
	Other		-		0.01		-		-		0.00		-		-	
Basin total:			71.07	16.31	87.70	7.14	22.21	6.60	76.02	22.46	131.32	71.97	92.69	15.54	8.65	0.09
PERLND areas:																
(16)	Till-Forest		-		10.66		-		4.94		4.15		10.93		-	
(26)	Till-Grass		10.29		41.08		-		14.32		31.94		30.30		0.17	
(34)	Outwash-Forest		-		21.75		-		0.05		-		20.03		-	
(44)	Outwash-Grass		50.04		13.39		22.21		56.70		95.23		31.42		8.21	
(54)	Wetland		10.74		0.82		-		0.01		-		-		0.27	
	subtotal:		71.07		87.70		22.21		76.02		131.32		92.69		8.65	
IMPLND areas:																
	EIA			16.31		7.14		6.60		22.46		71.97		15.54		0.09
Basin total:			87.38		94.85		28.80		98.48		203.30		108.23		8.74	
Percent Impervious:				18.7%		7.5%		22.9%		22.8%		35.4%		14.4%		1.1%

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Table B2-4. Miller Creek subbasin characteristics - 1994 base condition (STIA basins).

Land Use			Sub-basin Areas (acres)													
			MC-1 to MC-7												SDS Basins	
		% of total basin equal to	MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		SDN-1	
Land Use	Soil Type	EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.47	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	1.73	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.17	-
	TIA	100%	-	-	-	-	-	-	-	-	-	-	-	-	-	7.08
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	2.55	-	1.32	-	-	-	-	-	-	-	0.02	-	0.78	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	0.22	-	0.43	-	-	-	-	-	-	-	-	-	0.03	-
	TIA	100%	-	0.27	-	0.01	-	-	-	-	-	-	-	-	-	1.22
MF	Qvr	47%	-	-	-	-	0.07	0.06	0.71	0.63	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	7.87	1.39	0.30	0.05	1.54	0.27	3.54	0.62	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	-	-	-	-	-	-	-	-	12.49	2.20	-	-
	Qw	15%	-	-	-	-	0.90	0.16	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	2.55	0.11	3.43	0.14	30.04	1.25	16.21	0.68	25.23	1.05	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	0.08	0.00	-	-
	Qvt	4%	-	-	-	-	-	-	13.49	0.56	-	-	0.05	0.00	-	-
	Qw	4%	-	-	-	-	0.33	0.01	-	-	-	-	-	-	-	-
OG	M	0%	0.62	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	7.88	-	1.16	-	5.95	-	-	-	-	-	4.74	-	0.86	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	0.04	-	1.50	-
	Qw	0%	0.56	-	0.05	-	7.41	-	-	-	-	-	-	-	-	-
F	M	0%	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table B2-4. Miller Creek subbasin characteristics - 1994 base condition (STIA basins).

Land Use			Sub-basin Areas (acres)													
			MC-1 to MC-7												SDS Basins	
		% of total basin equal to EIA	MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		SDN-1	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	6.72	-	5.44	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	4.17	-	1.28	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	10.30		0.52		5.77		5.95		6.54		4.16		-	
	Lake		2.98		-		3.35		0.64		0.40		0.24		-	
	Mcrk-df		7.00		13.17		-		-		-		-		-	
	Other		-		-		-		-		-		-		-	
Basin total:			33.11	0.27	12.75	0.11	31.73	1.77	50.50	2.50	24.29	0.95	50.34	3.88	5.54	8.29
PERLND areas:																
(16)	Till-Forest		0.08		-		-		-		-		-		-	
(26)	Till-Grass		0.64		-		-		13.49		-		12.66		3.23	
(34)	Outwash-Forest		6.72		5.44		-		-		-		-		-	
(44)	Outwash-Grass		10.43		5.03		17.32		31.06		17.75		33.53		2.11	
(54)	Wetland		15.25		2.28		14.41		5.95		6.54		4.16		0.20	
	subtotal:		33.11		12.75		31.73		50.50		24.29		50.34		5.54	
IMPLND areas:																
	EIA			0.27		0.11		1.77		2.50		0.95		3.88		8.29
Basin total:			33.38		12.87		33.50		53.00		25.24		54.23		13.84	
Percent impervious:				0.8%		0.9%		5.3%		4.7%		3.8%		7.2%		59.9%

Table B2-4. Miller Creek subbasin characteristics - 1994 base condition (STIA basins).

Land Use			Sub-basin Areas (acres)													
			SDS Basins													
		% of total basin equal to EIA	SDN1-LWR		SDN1-OFF		SDN-2		SDN-2X		SDN-3		SDN-3X		SDN-4	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	8.43	-	-	-	7.17	-	-	-	19.66	-
	Qvr	0%	-	-	-	-	1.02	-	-	-	0.00	-	-	-	0.02	-
	Qvt	0%	-	-	-	-	-	-	-	-	18.87	-	-	-	0.06	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	33.22	-	-	-	15.82	-	-	-	2.61
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	-	-	0.68	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	0.10	-	3.28	-	-	-	0.10	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	1.76	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	1.63	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	0.38	-	7.88	-	-	-	0.28	-	-	-	-	-	-
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	20.51	3.62	-	-	-	-	-	-	-	-	-	-
	Qw	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	-	-	0.00	-	1.98	-	1.37	-	0.21	-	-	-	4.70	-
	Qvr	0%	4.87	-	0.33	-	2.02	-	5.74	-	0.00	-	5.34	-	3.16	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	6.17	-	-	-	-	-	23.53	-	5.17	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table B2-4. Miller Creek subbasin characteristics - 1994 base condition (STIA basins).

Land Use			Sub-basin Areas (acres)													
			SDS Basins													
		% of total basin equal to EIA	SDN1-LWR		SDN1-OFF		SDN-2		SDN-2X		SDN-3		SDN-3X		SDN-4	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	13.64	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	0.65	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	0.07		0.04		-		-		-		0.57		-	
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		-		0.04		-		-		-		-		-	
Basin total:			5.04	0.38	34.41	11.50	13.45	33.22	7.21	0.28	49.79	15.82	25.38	-	27.62	2.61
PERLND areas:																
(16)	Till-Forest		-		-		-		-		-		0.65		-	
(26)	Till-Grass		-		29.12		10.41		1.37		49.79		5.17		24.43	
(34)	Outwash-Forest		-		-		-		-		-		13.64		-	
(44)	Outwash-Grass		4.97		3.62		3.04		5.84		0.00		5.34		3.19	
(54)	Wetland		0.07		1.67		-		-		-		0.57		-	
	subtotal:		5.04		34.41		13.45		7.21		49.79		25.38		27.62	
IMPLND areas:																
	EIA			0.38		11.50		33.22		0.28		15.82		-		2.61
Basin total:			5.42		45.90		46.67		7.49		65.62		25.38		30.23	
Percent impervious:				7.0%		25.0%		71.2%		3.7%		24.1%		0.0%		8.6%

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Table B2-4. Miller Creek subbasin characteristics - 1994 base condition (STIA basins).

Land Use			Sub-basin Areas (acres) SDS Basins									
		% of total basin equal to EIA	SDN-4X		MC-6B		MC-7B		Total		Percent of Total	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	1.29	-	0.82	-	4.92	-	42.29	-	3.39%	0.00%
	Qvr	0%	0.65	-	-	-	-	-	2.17	-	0.17%	0.00%
	Qvt	0%	-	-	-	-	0.46	-	21.13	-	1.69%	0.00%
	Qw	0%	-	-	-	-	-	-	0.17	-	0.01%	0.00%
	TIA	100%	-	0.00	-	-	-	0.66	-	59.40	0.00%	4.76%
COMM	Qvr	85%	-	-	-	-	-	-	5.91	33.48	0.47%	2.68%
	Qvrl	85%	-	-	-	-	-	-	0.46	2.60	0.04%	0.21%
	Qvt	85%	-	-	-	-	-	-	2.41	13.65	0.19%	1.09%
TRANS	M	0%	-	-	-	-	-	-	0.83	-	0.07%	0.00%
	Qvr	0%	-	-	-	-	-	-	37.71	-	3.02%	0.00%
	Qvrl	0%	-	-	-	-	-	-	3.48	-	0.28%	0.00%
	Qvt	0%	-	-	-	-	-	-	6.43	-	0.52%	0.00%
	Qw	0%	-	-	-	-	-	-	2.33	-	0.19%	0.00%
	TIA	100%	-	-	-	-	-	-	-	44.19	0.00%	3.54%
MF	Qvr	47%	-	-	-	-	-	-	34.37	30.48	2.76%	2.44%
	Qvrl	47%	-	-	-	-	-	-	0.20	0.17	0.02%	0.01%
HD	Qvr	15%	-	-	12.21	2.15	0.89	0.16	95.41	16.84	7.65%	1.35%
	Qvrl	15%	-	-	-	-	-	-	16.63	2.94	1.33%	0.24%
	Qvt	15%	-	-	-	-	6.81	1.20	79.29	13.99	6.36%	1.12%
	Qw	15%	-	-	-	-	-	-	0.90	0.16	0.07%	0.01%
LD	M	4%	-	-	-	-	-	-	0.16	0.01	0.01%	0.00%
	Qu	4%	-	-	-	-	-	-	0.01	0.00	0.00%	0.00%
	Qvr	4%	-	-	23.70	0.99	2.44	0.10	186.09	7.75	14.92%	0.62%
	Qvrl	4%	-	-	-	-	-	-	9.45	0.39	0.76%	0.03%
	Qvt	4%	-	-	-	-	-	-	21.56	0.90	1.73%	0.07%
	Qw	4%	-	-	-	-	-	-	0.33	0.01	0.03%	0.00%
OG	M	0%	0.02	-	1.66	-	0.83	-	11.66	-	0.93%	0.00%
	Qvr	0%	9.35	-	17.01	-	5.14	-	130.14	-	10.43%	0.00%
	Qvrl	0%	-	-	-	-	-	-	0.00	-	0.00%	0.00%
	Qvt	0%	0.25	-	32.46	-	23.14	-	135.09	-	10.83%	0.00%
	Qw	0%	-	-	0.06	-	-	-	8.56	-	0.69%	0.00%
F	M	0%	-	-	-	-	-	-	1.31	-	0.11%	0.00%

Table B2-4. Miller Creek subbasin characteristics - 1994 base condition (STIA basins).

Land Use			Sub-basin Areas (acres)									
			SDS Basins									
		% of total	SDN-4X		MC-6B		MC-7B		Total		Percent of Total	
Land Use	Soil Type	basin equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
	Qu	0%	-	-	-	-	-	-	0.77	-	0.06%	0.00%
	Qvr	0%	1.16	-	7.81	-	-	-	75.83	-	6.08%	0.00%
	Qvrl	0%	-	-	-	-	-	-	9.76	-	0.78%	0.00%
	Qvt	0%	-	-	-	-	-	-	20.34	-	1.63%	0.00%
	Qw	0%	-	-	-	-	-	-	5.45	-	0.44%	0.00%
	Wetland	0%	-		4.55		1.92		51.73	-	4.15%	0.00%
	Lake		-		-		-		8.06		0.65%	0.00%
	Mcrk-df		-		-		-		20.24		1.62%	0.00%
	Other		-		-		-		0.04		0.00%	0.00%
Basin total:			12.73	0.00	100.27	3.14	46.54	2.12	1020.36	226.97	81.80%	18.20%
PERLND areas:												
(16)	Till-Forest		-		-		-		31.42		2.52%	
(26)	Till-Grass		1.57		34.94		36.16		351.08		28.15%	
(34)	Outwash-Forest		1.16		7.81		-		76.60		6.14%	
(44)	Outwash-Grass		10.01		52.91		8.46		491.81		39.43%	
(54)	Wetland		-		4.61		1.92		69.46		5.57%	
	subtotal:		12.73		100.27		46.54		1020.36		81.80%	
IMPLND areas:												
	EIA			0.00		3.14		2.12		226.97		18.20%
Basin total:			12.73		103.41		48.66		1247.33		100.00%	
Percent Impervious:				0.0%		3.0%		4.4%				

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Table B2-5. Miller Creek subbasin characteristics - 1994 base condition (non-STIA basins).

Land Use			Sub-basin Areas (acres)															
		% of total basin equal to EIA	Non-STIA Basins of M-1 to M-24															
			M-1		M-2		M-3		M-4		M-4A		M-11		M-12		M-13	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare	M	85%	-	-	0.49	2.77	-	-	0.00	0.01	0.37	2.11	0.24	1.33	-	-	-	-
Ground	Qb	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asphalt	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	0.76	4.31	0.85	4.82	1.58	8.96	0.56	3.18	0.99	5.61	11.64	65.96	1.21	6.86	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.67	3.77	1.21	6.88	-	-
	Qvt	85%	3.62	20.53	1.99	11.26	0.10	0.56	0.12	0.71	0.54	3.03	9.34	52.91	5.32	30.15	1.09	6.20
	Qw	85%	-	-	-	-	-	-	-	-	0.07	0.37	-	-	0.25	1.42	-	-
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	0.01	0.04	-	-	-	-
Rock	Qvr	85%	0.05	0.26	-	-	0.02	0.13	-	-	-	-	0.59	3.36	0.11	0.62	-	-
Concrete	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	0.07	0.39	-	-	-	-	-	-	0.05	0.26	0.26	1.48	0.14	0.80	-	-
Develop	M	85%	-	-	0.22	1.27	-	-	-	-	0.08	0.47	0.11	0.61	-	-	-	-
High	Qb	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	0.43	2.46	0.06	0.34	0.59	3.33	0.23	1.31	0.10	0.57	7.59	42.99	0.50	2.81	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.12	0.70	0.18	1.03	-	-
	Qvt	85%	0.87	4.95	0.47	2.68	0.24	1.38	0.08	0.45	1.70	9.64	5.96	33.78	2.64	14.97	0.87	4.95
	Qw	85%	0.00	0.02	-	-	-	-	-	-	0.00	0.02	-	-	0.27	1.52	-	-
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop	M	10%	-	-	0.43	0.05	-	-	0.87	0.10	1.89	0.21	0.67	0.07	-	-	-	-
Medium	Qb	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	10%	25.02	2.78	23.96	2.66	30.84	3.43	43.41	4.82	11.93	1.33	34.17	3.80	29.76	3.31	-	-
	Qvrl	10%	-	-	-	-	-	-	-	-	-	-	1.07	0.12	4.03	0.45	-	-
	Qvt	10%	153.51	17.06	113.34	12.59	51.26	5.70	37.01	4.11	19.59	2.18	161.00	17.89	65.20	7.24	122.70	13.63
	Qvu	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	10%	0.42	0.05	-	-	0.04	0.00	-	-	0.35	0.04	-	-	0.05	0.01	-	-
	Qyal	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop.	M	4%	-	-	-	-	-	-	1.01	0.04	1.81	0.08	0.45	0.02	-	-	-	-
Low	Qb	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	10.82	0.45	13.18	0.55	42.19	1.76	44.72	1.86	49.05	2.04	10.49	0.44	21.25	0.89	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	0.15	0.01	3.02	0.13	-	-
	Qvt	4%	66.93	2.79	77.05	3.21	49.44	2.06	43.74	1.82	27.82	1.16	36.85	1.54	18.11	0.75	69.05	2.88
	Qvu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	1.98	0.08	-	-	-	-	-	-	0.82	0.03	-	-	0.07	0.00	-	-
	Qyal	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table B2-5. Miller Creek subbasin characteristics - 1994 base condition (non-STIA basins).

Land Use			Sub-basin Areas (acres)															
		% of total basin	Non-STIA Basins of M-1 to M-24															
			M-1		M-2		M-3		M-4		M-4A		M-11		M-12		M-13	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Grass	M	0%	-	-	0.62	-	-	-	0.01	-	2.76	-	-	-	-	-	-	-
	Qb	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	0.95	-	0.65	-	27.67	-	3.14	-	16.01	-	1.17	-	2.16	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.62	-	-	-
	Qvt	0%	7.36	-	5.44	-	7.34	-	3.11	-	5.04	-	1.04	-	0.71	-	3.96	-
	Qw	0%	0.39	-	-	-	-	-	-	-	1.28	-	-	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forest	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.07	-	0.46	-	16.02	-	3.75	-	22.06	-	1.32	-	5.64	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.08	-	-	-
	Qvt	0%	3.41	-	5.56	-	8.26	-	2.95	-	8.66	-	0.89	-	0.31	-	0.79	-
	Qw	0%	1.08	-	-	-	-	-	-	-	0.66	-	-	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland		-		-		-		-		9.32		-		-		-	
	Lake		4.59		-		-		-		2.13		-		0.65		41.70	
	Other		-		-		-		-		-		-		-		-	
Basin total:			280.75	56.14	244.78	42.22	235.59	27.30	184.72	18.43	173.62	29.14	285.78	230.80	162.84	79.83	198.47	27.66
PERLND areas:																		
perlnd 16 Till-forest			3.41		5.56		8.26		2.95		8.66		0.89		0.39		0.79	
perlnd 26 Till-grass			232.36		200.05		108.38		85.95		61.64		217.92		101.18		197.68	
perlnd 34 Outwash-forest			3.07		0.46		16.02		3.75		22.06		1.32		5.64		-	
perlnd 44 Outwash-grass			38.03		38.71		102.89		92.06		78.09		65.65		54.98		-	
perlnd 54 Wetland			3.87		-		0.04		-		12.50		-		0.64		-	
subtotal:			280.75		244.78		235.59		184.72		182.95		285.78		162.84		198.47	
IMPLND areas:																		
EIA				56.14		42.22		27.30		18.43		29.14		230.80		79.83		27.66
Basin total:			336.89		286.99		262.89		203.14		212.09		516.59		242.67		226.12	
Percent impervious:				16.7%		14.7%		10.4%		9.1%		13.7%		44.7%		32.9%		12.2%

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Table B2-5. Miller Creek subbasin characteristics - 1994 base condition (non-STIA basins).

Land Use			Sub-basin Areas (acres)													
		% of total basin equal to	Non-STIA Basins of M-1 to M-24													
			M-14		M-15		M-17		M-23		M-24		Total		Percent of Total	
Land Use	Soil Type	EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare	M	85%	-	-	-	-	-	-	-	-	1.19	6.75	2.29	12.98	0.07%	0.38%
Ground	Qb	85%	-	-	-	-	0.06	0.31	-	-	-	-	0.06	0.31	0.00%	0.01%
Asphalt	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvr	85%	0.02	0.13	0.99	5.61	0.24	1.39	1.12	6.34	2.54	14.41	22.52	127.59	0.66%	3.76%
	Qvrl	85%	-	-	0.42	2.38	-	-	0.17	0.96	-	-	2.47	13.99	0.07%	0.41%
	Qvt	85%	0.81	4.60	0.03	0.19	-	-	3.61	20.44	3.69	20.88	30.26	171.45	0.89%	5.05%
	Qw	85%	-	-	-	-	0.01	0.04	-	-	-	-	0.32	1.83	0.01%	0.05%
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	0.01	0.04	0.00%	0.00%
Rock	Qvr	85%	-	-	-	-	0.19	1.05	0.16	0.93	0.53	3.02	1.65	9.37	0.05%	0.28%
Concrete	Qvrl	85%	-	-	0.05	0.26	-	-	-	-	-	-	0.05	0.26	0.00%	0.01%
	Qvt	85%	0.12	0.66	-	-	-	-	0.16	0.91	0.07	0.39	0.86	4.89	0.03%	0.14%
Develop	M	85%	-	-	-	-	-	-	-	-	0.17	0.97	0.59	3.32	0.02%	0.10%
High	Qb	85%	-	-	-	-	0.03	0.16	-	-	-	-	0.03	0.16	0.00%	0.00%
Intensity	Qpf	85%	-	-	0.03	0.15	-	-	-	-	-	-	0.03	0.15	0.00%	0.00%
	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvr	85%	0.02	0.13	0.14	0.77	0.56	3.15	0.33	1.88	1.45	8.20	11.99	67.96	0.35%	2.00%
	Qvrl	85%	-	-	0.12	0.66	-	-	0.22	1.27	-	-	0.64	3.65	0.02%	0.11%
	Qvt	85%	0.35	1.97	0.07	0.39	-	-	1.38	7.83	1.33	7.54	15.98	90.53	0.47%	2.67%
	Qw	85%	-	-	-	-	-	-	-	-	-	-	0.28	1.56	0.01%	0.05%
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
Develop	M	10%	-	-	-	-	-	-	-	-	2.47	0.27	6.33	0.70	0.19%	0.02%
Medium	Qb	10%	-	-	-	-	0.17	0.02	-	-	-	-	0.17	0.02	0.01%	0.00%
Intensity	Qpf	10%	0.16	0.02	1.37	0.15	2.75	0.31	-	-	-	-	4.28	0.48	0.13%	0.01%
	Qvi	10%	-	-	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvr	10%	13.61	1.51	20.11	2.23	5.84	0.65	28.90	3.21	40.50	4.50	308.06	34.23	9.08%	1.01%
	Qvrl	10%	-	-	3.38	0.38	-	-	2.78	0.31	-	-	11.26	1.25	0.33%	0.04%
	Qvt	10%	82.83	9.20	27.53	3.06	1.20	0.13	111.89	12.43	103.71	11.52	1050.76	116.75	30.96%	3.44%
	Qvu	10%	-	-	-	-	0.07	0.01	-	-	-	-	0.07	0.01	0.00%	0.00%
	Qw	10%	-	-	-	-	0.38	0.04	-	-	-	-	1.24	0.14	0.04%	0.00%
	Qyal	10%	-	-	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
Develop.	M	4%	-	-	-	-	-	-	-	-	0.19	0.01	3.46	0.14	0.10%	0.00%
Low	Qb	4%	-	-	-	-	0.05	0.00	-	-	-	-	0.05	0.00	0.00%	0.00%
Intensity	Qpf	4%	2.21	0.09	3.36	0.14	8.61	0.36	-	-	-	-	14.18	0.59	0.42%	0.02%
	Qu	4%	-	-	1.42	0.06	-	-	-	-	-	-	1.42	0.06	0.04%	0.00%
	Qvi	4%	-	-	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvr	4%	23.03	0.96	55.70	2.32	51.91	2.16	14.46	0.60	17.88	0.74	354.68	14.78	10.45%	0.44%
	Qvrl	4%	-	-	7.20	0.30	-	-	2.73	0.11	-	-	13.10	0.55	0.39%	0.02%
	Qvt	4%	33.29	1.39	9.84	0.41	14.64	0.61	29.04	1.21	18.29	0.76	494.07	20.59	14.56%	0.61%
	Qvu	4%	-	-	-	-	0.40	0.02	-	-	-	-	0.40	0.02	0.01%	0.00%
	Qw	4%	-	-	-	-	0.98	0.04	-	-	-	-	3.84	0.16	0.11%	0.00%
	Qyal	4%	-	-	-	-	0.82	0.03	-	-	-	-	0.82	0.03	0.02%	0.00%

Table B2-5. Miller Creek subbasin characteristics - 1994 base condition (non-STIA basins).

Land Use			Sub-basin Areas (acres)													
		% of total	Non-STIA Basins of M-1 to M-24													
		basin	M-14		M-15		M-17		M-23		M-24		Total		Percent of Total	
Land	Soil	equal to		Effective		Effective		Effective		Effective		Effective		Effective		Effective
Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
Grass	M	0%	-	-	-	-	-	-	-	-	0.89	-	4.29	-	0.13%	0.00%
	Qb	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qpf	0%	0.20	-	0.45	-	0.99	-	-	-	-	-	1.63	-	0.05%	0.00%
	Qvr	0%	2.66	-	2.97	-	9.39	-	0.87	-	6.39	-	74.01	-	2.18%	0.00%
	Qvrl	0%	-	-	0.23	-	-	-	0.79	-	-	-	1.64	-	0.05%	0.00%
	Qvt	0%	1.28	-	0.70	-	0.47	-	3.37	-	3.43	-	43.23	-	1.27%	0.00%
	Qw	0%	-	-	-	-	0.55	-	-	-	-	-	2.22	-	0.07%	0.00%
	Qyal	0%	-	-	-	-	0.04	-	-	-	-	-	0.04	-	0.00%	0.00%
Forest	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qpf	0%	2.48	-	-	-	1.83	-	-	-	-	-	4.31	-	0.13%	0.00%
	Qu	0%	-	-	3.20	-	-	-	-	-	-	-	3.20	-	0.09%	0.00%
	Qvl	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvr	0%	10.98	-	46.89	-	29.25	-	2.25	-	2.02	-	143.73	-	4.23%	0.00%
	Qvrl	0%	-	-	0.41	-	-	-	1.03	-	-	-	1.52	-	0.04%	0.00%
	Qvt	0%	0.24	-	6.18	-	0.90	-	2.06	-	-	-	40.22	-	1.18%	0.00%
	Qw	0%	-	-	-	-	0.27	-	-	-	-	-	2.01	-	0.06%	0.00%
	Qyal	0%	-	-	-	-	3.73	-	-	-	-	-	3.73	-	0.11%	0.00%
	Wetland		-		-		-		-		-		9.32		0.27%	
	Lake		-		-		0.24		0.94		0.33		50.58		1.49%	
	Other		-		-		-		-		-		-		0.00%	
Basin total:			174.29	20.66	192.75	19.47	136.33	10.49	207.33	58.44	206.74	79.98	2693.31	700.55	79.36%	20.64%
PERLND areas:																
perlnd 16 Till-forest			0.24		6.59		0.90		3.09		-		41.74		1.23%	
perlnd 26 Till-grass			118.67		49.55		16.31		156.15		135.43		1681.27		49.54%	
perlnd 34 Outwash-forest			13.46		50.09		34.82		2.25		2.02		154.97		4.57%	
perlnd 44 Outwash-grass			41.91		86.52		82.11		45.84		69.29		796.09		23.46%	
perlnd 54 Wetland			-		-		2.19		-		-		19.24		0.57%	
subtotal:			174.29		192.75		136.33		207.33		206.74		2693.31		79.36%	
IMPLND areas:																
EIA				20.66		19.47		10.49		58.44		79.98		700.55		20.64%
Basin total:			194.94		212.22		146.82		265.77		286.72		3393.86		100.00%	
Percent impervious:				10.6%		9.2%		7.1%		22.0%		27.9%				

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Table B2-6. Walker Creek subbasin characteristics - 1994 base condition (STIA basins).

Land Use			Sub-basin Areas (acres)											
		% of total basin	M-20		MC-8		MC-9		MC-8B		Total		Percent of Total	
Land Use	Soil Type	equal to EIA	Pervious	Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	1.39	-	0.69	-	2.09	-	0.89%	0.00%
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvt	0%	-	-	-	-	-	-	0.63	-	0.63	-	0.27%	0.00%
	Qw	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	TIA	100%	-	-	-	-	-	0.31	-	0.28	-	0.59		
COMM	Qvr	85%	7.04	39.91	-	-	-	-	-	-	7.04	39.91	3.01%	17.08%
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
TRANS	M	0%	1.74	-	-	-	1.76	-	-	-	3.50	-	1.50%	0.00%
	Qvr	0%	10.76	-	1.19	-	0.33	-	-	-	12.28	-	5.26%	0.00%
	Qvrl	0%	0.95	-	-	-	-	-	-	-	0.95	-	0.41%	0.00%
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qw	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	TIA	100%	-	11.38	-	0.01	-	0.01	-	-	-	11.39		
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
HD	Qvr	15%	3.66	0.65	5.02	0.89	-	-	2.90	0.51	11.58	2.04	4.96%	0.87%
	Qvrl	15%	0.16	0.03	-	-	-	-	-	-	0.16	0.03	0.07%	0.01%
	Qvt	15%	-	-	5.08	0.90	-	-	5.19	0.92	10.27	1.81	4.39%	0.78%
	Qw	15%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
LD	M	4%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qu	4%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvr	4%	20.81	0.87	-	-	-	-	-	-	20.81	0.87	8.91%	0.37%
	Qvrl	4%	0.00	0.00	-	-	-	-	-	-	0.00	0.00	0.00%	0.00%
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qw	4%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
OG	M	0%	-	-	-	-	6.17	-	1.53	-	7.70	-	3.30%	0.00%
	Qvr	0%	11.16	-	14.70	-	3.60	-	12.56	-	42.02	-	17.98%	0.00%
	Qvrl	0%	9.37	-	-	-	-	-	-	-	9.37	-	4.01%	0.00%
	Qvt	0%	0.31	-	0.11	-	-	-	11.16	-	11.58	-	4.96%	0.00%
	Qw	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
F	M	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qu	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qw	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%

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Table B2-6. Walker Creek subbasin characteristics - 1994 base condition (STIA basins).

Land Use			Sub-basin Areas (acres)											
		% of total basin equal to	M-20		MC-8		MC-9		MC-8B		Total		Percent of Total	
Land Use	Soil Type	EIA	Pervious	Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
–	Wetland	0%	33.43		2.91		0.08		0.61		37.04	-	15.85%	0.00%
	Lake		-		-		-		-		-		0.00%	0.00%
	Mcrk-df		-		-		-		-		-		0.00%	0.00%
	Other		-		-		-		-		-		0.00%	0.00%
Basin total:			99.40	52.83	29.02	1.79	13.34	0.32	35.27	1.71	177.03	56.65	75.76%	24.24%
PERLND areas:														
(16)	Till-Forest		-		-		-		-		-		0.00%	
(26)	Till-Grass		12.53		5.19		9.33		19.21		46.25		19.79%	
(34)	Outwash-Forest		-		-		-		-		-		0.00%	
(44)	Outwash-Grass		53.43		20.92		3.93		15.45		93.74		40.11%	
(54)	Wetland		33.43		2.91		0.08		0.61		37.04		15.85%	
	subtotal:		99.40		29.02		13.34		35.27		177.03		75.76%	
IMPLND areas:														
	EIA			52.83		1.79		0.32		1.71		56.65		24.24%
Basin total:			152.23		30.81		13.66		36.98		233.68		100.00%	
Percent impervious:				34.7%		5.8%		2.3%		4.6%				

Table B2-7. Walker Creeks subbasin characteristics - 1994 base condition (non-STIA basins).

Land Use			Sub-basin Areas (acres)											
		% of total basin equal to EIA	Non-STIA Basins of M-1 to M-24											
			M-18		M-19		M-21		M-22		Total		Percent of Total	
Land Use	Soil Type		Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
Ground	Qb	85%	-	-	-	-	-	-	0.20	1.11	0.20	1.11	0.03%	0.16%
Asphalt	Qvl	85%	-	-	-	-	-	-	0.00	0.01	0.00	0.01	0.00%	0.00%
	Qvr	85%	-	-	2.12	12.02	2.55	14.45	-	-	4.67	26.47	0.69%	3.89%
	Qvrl	85%	-	-	0.03	0.14	-	-	-	-	0.03	0.14	0.00%	0.02%
	Qvt	85%	-	-	0.08	0.46	0.66	3.76	-	-	0.74	4.22	0.11%	0.62%
	Qw	85%	-	-	-	-	-	-	0.06	0.32	0.06	0.32	0.01%	0.05%
	Qyal	85%	-	-	-	-	-	-	0.02	0.13	0.02	0.13	0.00%	0.02%
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
Rock	Qvr	85%	-	-	0.02	0.10	0.09	0.52	-	-	0.11	0.62	0.02%	0.09%
Concrete	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvt	85%	-	-	-	-	0.03	0.15	-	-	0.03	0.15	0.00%	0.02%
Develop	M	85%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
High	Qb	85%	-	-	-	-	-	-	0.04	0.25	0.04	0.25	0.01%	0.04%
Intensity	Qpf	85%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvl	85%	-	-	-	-	-	-	0.02	0.11	0.02	0.11	0.00%	0.02%
	Qvr	85%	0.01	0.05	0.41	2.31	0.92	5.20	-	-	1.34	7.57	0.20%	1.11%
	Qvrl	85%	-	-	0.11	0.60	-	-	-	-	0.11	0.60	0.02%	0.09%
	Qvt	85%	-	-	0.27	1.52	1.15	6.51	-	-	1.42	8.03	0.21%	1.18%
	Qw	85%	-	-	-	-	-	-	0.02	0.13	0.02	0.13	0.00%	0.02%
	Qyal	85%	-	-	-	-	-	-	0.12	0.66	0.12	0.66	0.02%	0.10%
Develop	M	10%	-	-	0.71	0.08	-	-	-	-	0.71	0.08	0.10%	0.01%
Medium	Qb	10%	-	-	-	-	-	-	0.14	0.02	0.14	0.02	0.02%	0.00%
Intensity	Qpf	10%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvl	10%	-	-	-	-	1.47	0.16	4.17	0.46	5.65	0.63	0.83%	0.09%
	Qvr	10%	6.70	0.74	45.89	5.10	52.06	5.78	0.07	0.01	104.71	11.63	15.40%	1.71%
	Qvrl	10%	-	-	21.79	2.42	-	-	-	-	21.79	2.42	3.20%	0.36%
	Qvt	10%	2.21	0.25	16.06	1.78	75.17	8.35	-	-	93.43	10.38	13.74%	1.53%
	Qvu	10%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qw	10%	-	-	-	-	-	-	0.81	0.09	0.81	0.09	0.12%	0.01%
	Qyal	10%	-	-	-	-	0.02	0.00	1.31	0.15	1.33	0.15	0.20%	0.02%
Develop.	M	4%	-	-	1.23	0.05	-	-	-	-	1.23	0.05	0.18%	0.01%
Low	Qb	4%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
Intensity	Qpf	4%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qu	4%	-	-	0.10	0.00	-	-	-	-	0.10	0.00	0.01%	0.00%
	Qvi	4%	-	-	-	-	2.87	0.12	6.50	0.27	9.37	0.39	1.38%	0.06%
	Qvr	4%	41.48	1.73	44.89	1.87	57.86	2.41	0.71	0.03	144.93	6.04	21.31%	0.89%
	Qvrl	4%	-	-	37.05	1.54	-	-	-	-	37.05	1.54	5.45%	0.23%
	Qvt	4%	12.79	0.53	12.72	0.53	52.24	2.18	-	-	77.75	3.24	11.43%	0.48%
	Qvu	4%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qw	4%	-	-	-	-	-	-	0.42	0.02	0.42	0.02	0.06%	0.00%
	Qyal	4%	-	-	-	-	0.36	0.02	4.61	0.19	4.98	0.21	0.73%	0.03%

Table B2-7. Walker Creeks subbasin characteristics - 1994 base condition (non-STIA basins).

Land Use			Sub-basin Areas (acres)											
		% of total basin	Non-STIA Basins of M-1 to M-24											
			M-18		M-19		M-21		M-22		Total		Percent of Total	
	Soil	equal to		Effective		Effective		Effective		Effective		Effective		Effective
Land Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
Grass	M	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qb	0%	-	-	-	-	-	-	0.01	-	0.01	-	0.00%	0.00%
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qvr	0%	1.03	-	2.13	-	5.18	-	0.08	-	8.43	-	1.24%	0.00%
	Qvrl	0%	-	-	1.70	-	-	-	-	-	1.70	-	0.25%	0.00%
	Qvt	0%	1.08	-	0.34	-	3.66	-	-	-	5.08	-	0.75%	0.00%
	Qw	0%	-	-	-	-	-	-	1.83	-	1.83	-	0.27%	0.00%
	Qyal	0%	-	-	-	-	-	-	1.49	-	1.49	-	0.22%	0.00%
Forest	M	0%	-	-	0.32	-	-	-	-	-	0.32	-	0.05%	0.00%
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	0.00%	0.00%
	Qu	0%	-	-	0.24	-	-	-	-	-	0.24	-	0.04%	0.00%
	Qvi	0%	-	-	-	-	-	-	0.64	-	0.64	-	0.09%	0.00%
	Qvr	0%	20.95	-	8.15	-	5.96	-	1.32	-	36.37	-	5.35%	0.00%
	Qvrl	0%	-	-	12.09	-	-	-	-	-	12.09	-	1.78%	0.00%
	Qvt	0%	0.76	-	0.30	-	7.61	-	-	-	8.67	-	1.27%	0.00%
	Qw	0%	-	-	-	-	-	-	0.07	-	0.07	-	0.01%	0.00%
	Qyal	0%	-	-	-	-	0.13	-	2.35	-	2.47	-	0.36%	0.00%
	Wetland		-		-		-		-		-		0.00%	
	Lake		-		0.25		-		0.47		0.72		0.11%	
	Other		-		-		-		-		-		0.00%	
Basin total:			87.00	3.30	208.72	30.53	269.99	49.63	27.01	3.95	592.72	87.41	87.15%	12.85%
PERLND areas:														
perlnd 16	Till-forest		0.76		12.72		7.61		-		21.08		3.10%	
perlnd 26	Till-grass		16.08		92.07		132.91		-		241.06		35.44%	
perlnd 34	Outwash-forest		20.95		8.39		6.09		4.30		39.72		5.84%	
perlnd 44	Outwash-grass		49.22		95.55		123.39		19.49		287.65		42.29%	
perlnd 54	Wetland		-		-		-		3.21		3.21		0.47%	
	subtotal:		87.00		208.72		269.99		27.01		592.72		87.15%	
IMPLND areas:														
	EIA			3.30		30.53		49.63		3.95		87.41		12.85%
Basin total:			90.30		239.25		319.62		30.96		680.13		100.00%	
Percent impervious:				3.7%		12.8%		15.5%		12.8%				

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3. MILLER CREEK

3.1 WATERSHED BOUNDARIES

Separate field investigations by Dave Harms and Ron Simmons of Parametrix identified areas where subbasin boundaries required modification. The boundary for subbasin M11 was moved to the north to include a portion of M24 and additional area previously considered to be out of the Miller Creek basin. A new subbasin (M23) was created to include area previously outside of the drainage basin to the west. City of Burien drainage basin mapping supports creation of subbasin M23 for this model. Subbasin M23 discharges through the Hermes depression. Another new subbasin (M24) was created, primarily as a result of subdividing M2, to separate two conveyance systems. M4 was subdivided into subbasins M4 and M4A. M4A consists primarily of airport buyout areas, where the team estimated the percent effective impervious area from aerial photography to be approximately 7 percent.

3.2 GROUNDWATER ROUTING

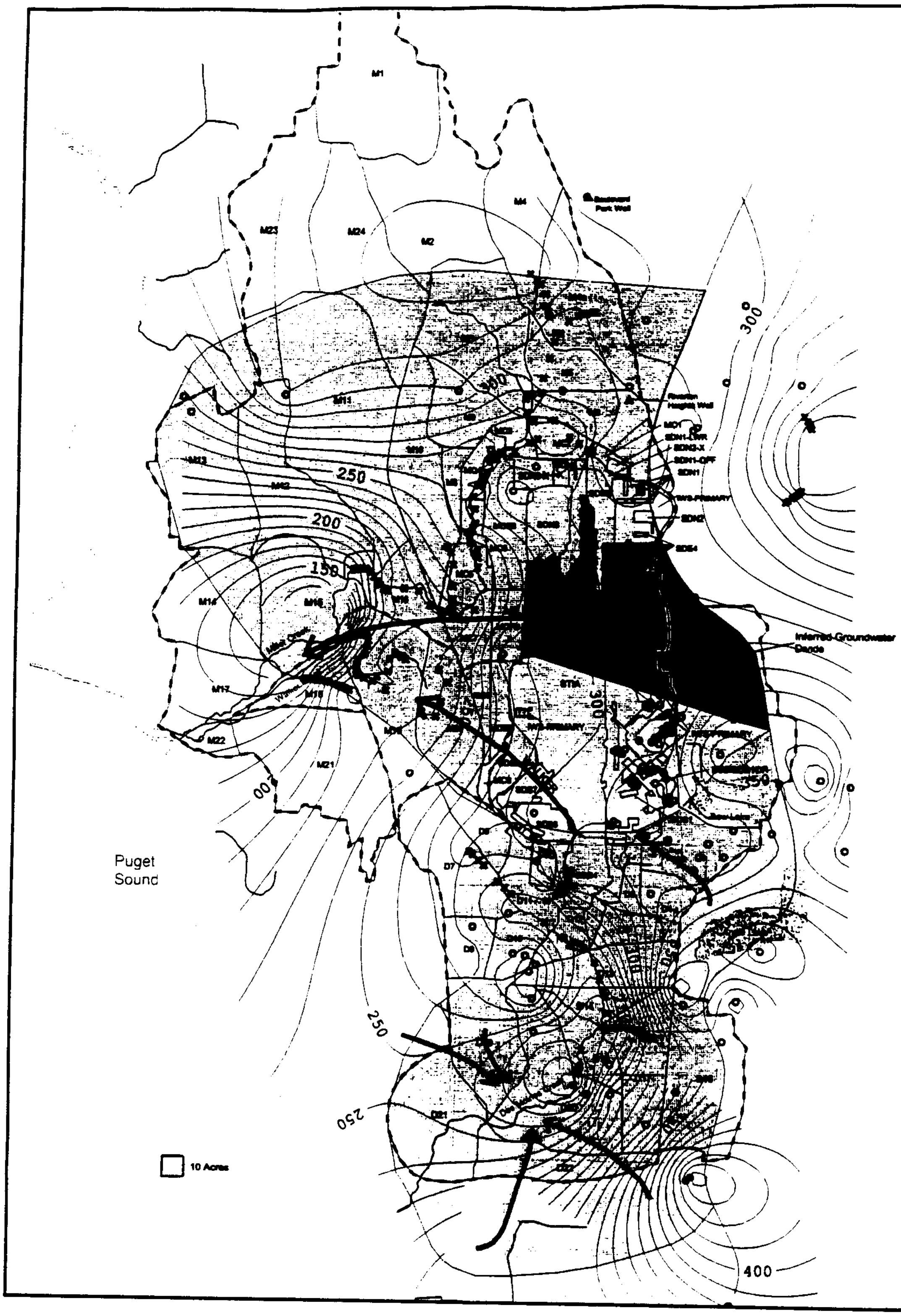
Groundwater plays a key role in properly calibrating the Miller Creek watershed. Using the standard assumption that all groundwater generated within the Miller Creek watershed surface water boundaries drains to Miller Creek upstream of the gage site, simulated streamflows at the mouth of Miller Creek are nearly double that of observed streamflows. This result indicated that the Miller Creek watershed contributes to recharging a deeper underlying aquifer. The exact relationship between this deep aquifer and Miller Creek is unknown. However, a groundwater contour map (Figure B2-2) was prepared as part of a groundwater study performed by S.S. Papadopulos and Associates, Inc. using nearly 700 well logs. This map was used by the team as the basis for the groundwater routing in the calibration of the Miller Creek watershed. Figures B2-3a and B2-3b show detailed routing schematics, which include the routing of all surface water, interflow, and groundwater.

3.3 FTABLES

All the stage-storage-discharge relationships from the previous model were reviewed. As a result, FTABLEs 1, 4, 10, 11, 12, 13, 14, 15, 16, 17, 34, 35, 50, 53, and 54 were modified.

In addition to the above changes, four new FTABLES were added to the model:

1. Subbasin M3 detention facility. RCHRES number 33.
2. Vacca Farm. RCHRES number 135.
3. Hermes depression. RCHRES number 23.
4. Downstream of Hermes depression. RCHRES number 24.



- Existing (1994) Drainage Subbasins
- STIA Area (see note)
- Watershed Boundary
- Subwatershed Boundaries
- Rivers
- Roads
- Water Bodies
- Noncontiguous Miller Creek groundwater area
- Noncontiguous Walker Creek groundwater area
- Contiguous Miller/Walker groundwater area
- Noncontiguous Des Moines Creek groundwater area
- Contiguous Des Moines Creek groundwater area
- Ground water elevation contour (10 ft. interval) for shallow (C1) aquifer
- Data Point (e.g. monitoring well)
- Wells
- Locations where ground water elevation intersects stream channel
- General ground water flow direction

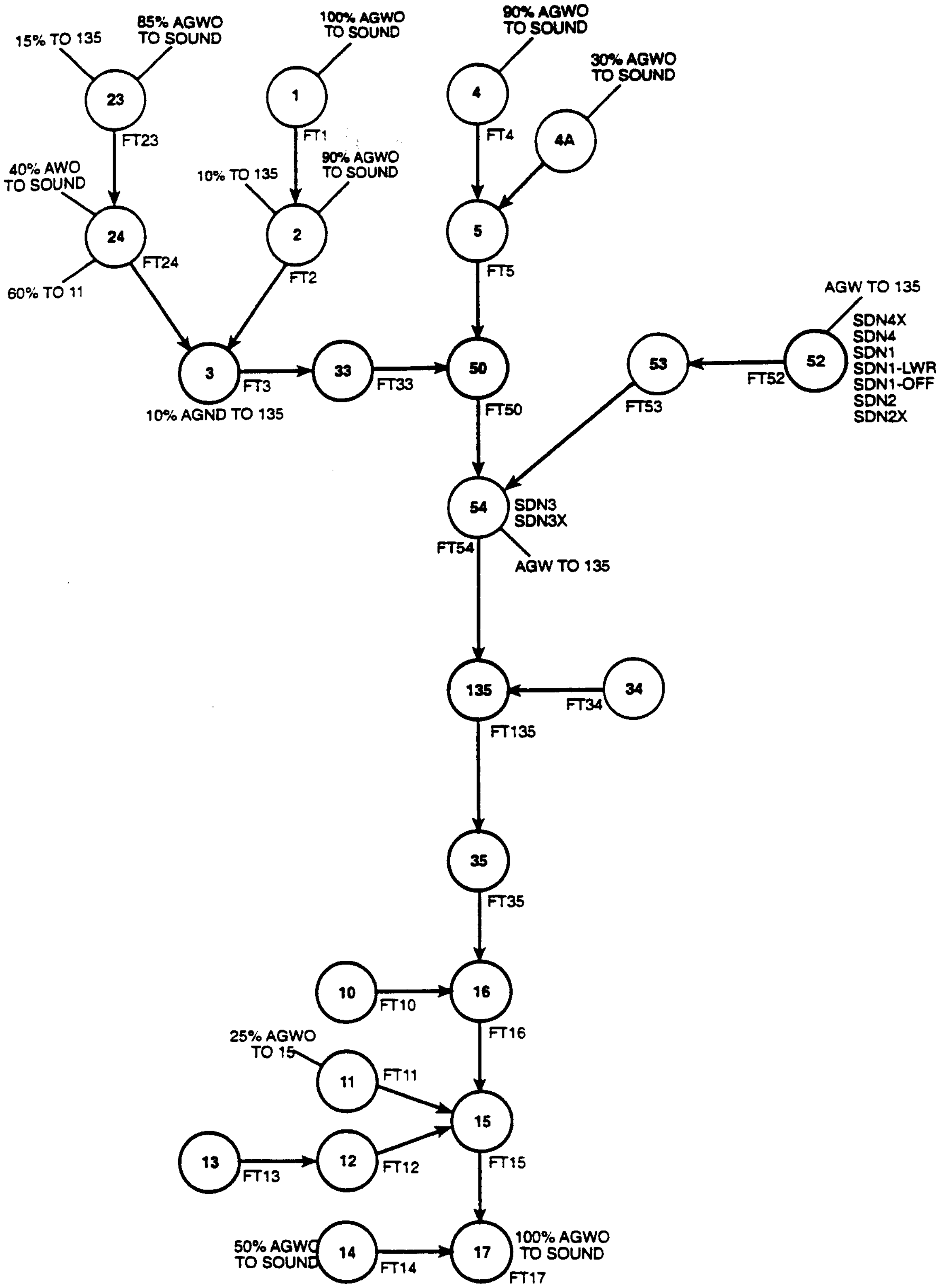
N

1000 0 1000 2000 Feet

1:36,000

July 2001
556-2912-001 (28)

Figure B2-2 Groundwater Flow Direction and Boundaries



Parametrix, Inc. Port of Seattle/556-2912-001(028) 8/00 (K)

Figure B2-3a
HSPF Model Schematic
Miller Creek

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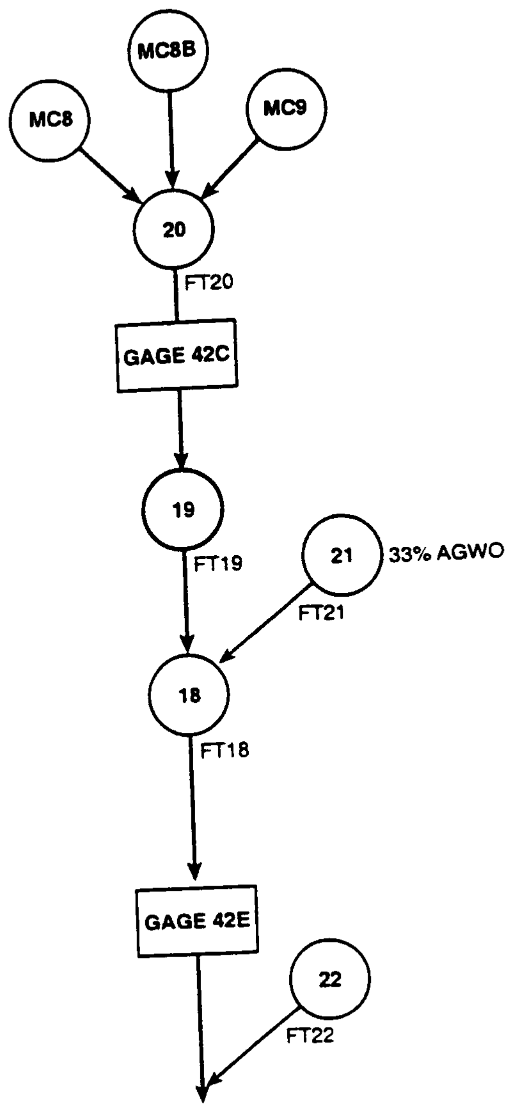

July 2001
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Figure B2-3b
HSPF Model Schematic
Walker Creek

3.4 ROUTING

The following changes were made to the Miller Creek model to reflect updated information about the watershed drainage characteristics:

- MC9 was routed to Lora Lake.
- MC4 & MC6 were routed downstream to Reach 35.
- MC6B was routed to Reach 35.
- MC7B was routed to Reach 35.
- M8 was routed to Reach 35.
- M6 was routed directly to Lake Reba.
- M9 was routed directly to Lora Lake.
- Reaches 51 and 52 were combined to form Reach 52, with FTABLE 52.
- MC3 was routed to Reach 54.
- M3 detention storage was modified based on field visit.
- Reach 50 was routed directly to reach 54 (MCDF).
- A new reach was added upstream of Reach 50.

3.5 LAKES

Arbor, Tub, and Lora Lakes are all underlain by outwash soils. Field inspection indicated that these lakes can drop several feet below the outlets during the summer dry period. This cannot be accomplished by evaporation alone. As a result, a small amount of seepage (0.11 cfs) from each of the lakes was modeled.

3.6 HERMES POND

Hermes Pond is a natural depression that has been modified to serve as a stormwater detention facility. All of subbasin 23 drains to this depression and there is no natural outlet. As a result, two pumps have been installed in an attempt to keep the depression from flooding. The maximum capacity of the outlet pipe is 0.5 cfs. Using this set of assumptions, the simulated elevation of the depression is much higher than the observed maximum flood stage. As with the lakes, Hermes depression is underlain by outwash soils. Using seepage in the range of 0.05 to 0.4 cfs resulted in a corresponding maximum flood stage near that which has been observed.

3.7 CALIBRATION PERLND PARAMETERS

Seven PERLND parameters were adjusted in the following manner:

- The LZSN value for all soils was doubled from 4.5 to 9.0 for till soils and from 5.0 to 10.0 for outwash soils. This was done to increase the ability of the soil to store moisture. The basis for this change is related to the thick layers of permeable soil overlaying the till layer for much of the till soils.
- INFILT was multiplied by four for all till soils in an effort to infiltrate more runoff.
- INFEXP was set to 2.0 for all soils.
- DEEPFR was set to 0.33 for all soil types. This represents the loss of groundwater from the Miller Creek watershed to a deeper aquifer.
- UZSN was doubled for all soils. This increases evaporation from the soil surface and decreases summer and fall peaks. This adjustment improved the overall simulation performance during these time frames.
- INTFW was set to nine for till soils. This reduces the amount of surface runoff, again reducing peak flows.
- IRC has been set to 0.7 for all till soils.

4. MILLER CREEK CALIBRATION RESULTS

4.1 MILLER CREEK STREAMFLOW AT THE MOUTH

Calibration was performed for water-years 1993 through 1996. Total simulated runoff volume for the calibration period was within 0.75 inch of the total observed volume (Table B2-8). Simulated runoff volumes for water-years 1994 and 1996 are within 0.60 inch of observed runoff volumes. Simulated runoff volumes for water-years 1993 and 1995 are within 2.45 inches of observed runoff volumes. However, the streamflow gage was down for 4 months during water-year 1995. Examination of the recorded data after a gage malfunction in December and January of water-year 1995 indicates possible disruption in the reliability of the recorded data for the months of January through May. The gage again malfunctioned starting in June of 1995 and lasting until the middle of October 1995. These chronic problems during water-year 1995 call into question the overall reliability of the gaged streamflow data for this water-year. Figures B2-4 through B2-7 show the annual simulated and observed streamflow for water-years 1993 through 1996 at the mouth of Miller Creek.

4.2 MILLER CREEK STREAMFLOW DOWNSTREAM OF THE REGIONAL DETENTION FACILITY.

Calibration was performed for water-years 1993 through 1996. Total simulated runoff volume for the calibration period is within 0.9 inch of the total observed volume. Simulated runoff volumes for three of the four water-years are higher than observed runoff volumes. The largest over-simulation error is 0.56 inch, which occurs in water-year 1993. All other water-years are within 0.44 inch of observed volumes. Figures B2-8 through B2-11 show the annual simulated and observed streamflow for water-years 1993 through 1996 downstream of the Miller Creek Regional Detention Facility (RDF).

4.3 PEAK FLOW EVENTS

Five peak flow events have been examined during the calibration process and are listed below:

- January 20, 1993 through January 31, 1993
- March 16, 1993 through March 31, 1993
- February 16, 1994 through March 15, 1994
- November 21, 1995 through December 21, 1995
- January 1, 1996 through January 31, 1996

Calibration plots from these events are listed in Figures B2-12 through B2-21.

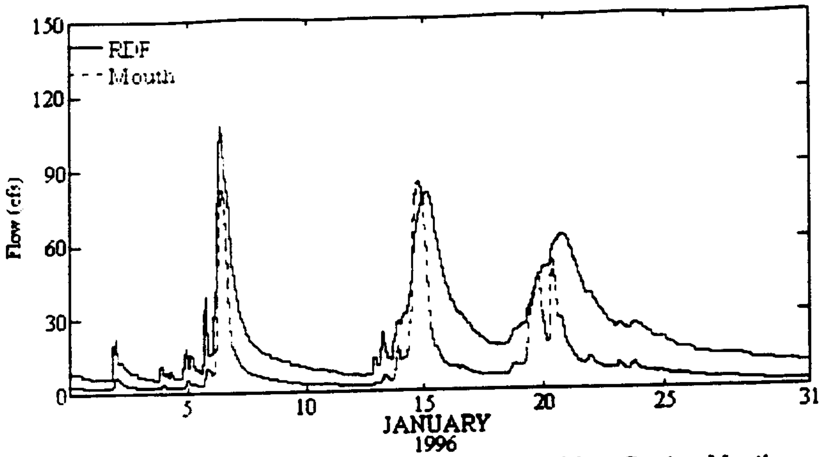
No events from water-year 1995 were used as a result of the documented malfunctions of the stream gage during this time period. Although the February 1996 flood event is the largest of the calibration period, it was not used because of the manipulation of the outlet gate from the RDF during this event.

Simulated streamflows at both the mouth of Miller Creek and downstream of the RDF generally match the timing, shape, and magnitude of the observed streamflows. Some events such as the January 1993 event match very well, while others such as the January 1996 event do not. However, close examination of the January 1996 event shows some potential errors in the observed data. Figure B2-22 shows the observed streamflow for Miller Creek at both the downstream end of the RDF and at the mouth. This figure clearly indicates that observed streamflows at the RDF are higher than at the mouth. This is obviously not possible, so as a result, the team concluded that some error in the observed data is likely. A comparison of observed flows at the RDF and at the mouth reveals that peak flows at the mouth are generally three or four times higher than peak flows at the RDF. If the ratio drops to below two, then the observed streamflow can be called into question.

Table B2-8. Miller Creek runoff volumes: calibration period water-years 1993 through 1996.

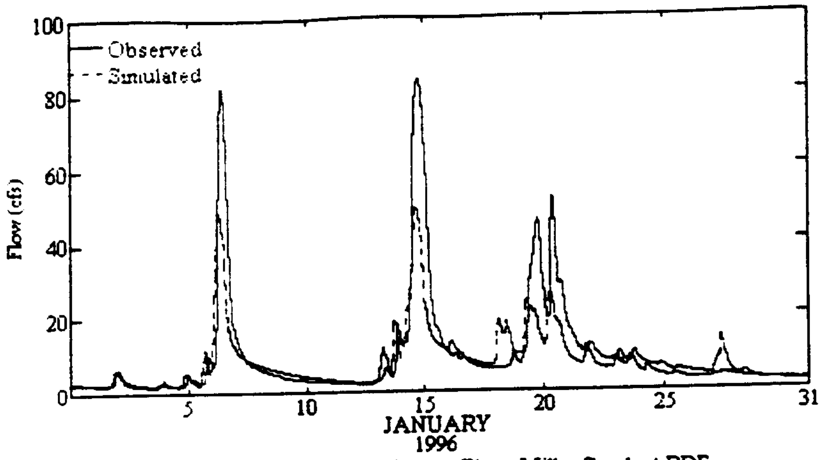
Water-Year	Observed Streamflow Volumes Regional Detention Facility (inches)	Observed Streamflow Volumes Mouth (inches)	Simulated Streamflow Volumes Regional Detention Facility (inches)	Simulated Streamflow Volumes Mouth (inches)	Simulated Minus Observed Regional Detention Facility (inches)	Simulated Minus Observed Mouth (inches)
1993	5.41	8.53	5.97	10.53	0.56	2.00
1994	3.66	7.79	3.43	7.22	-0.23	-0.57
1995	6.60	12.02	6.85	9.68	0.25	-2.34
1996	13.64	20.94	14.25	21.65	0.61	0.71
Total	29.31	49.28	30.50	49.08	1.19	-0.20

AR 047138



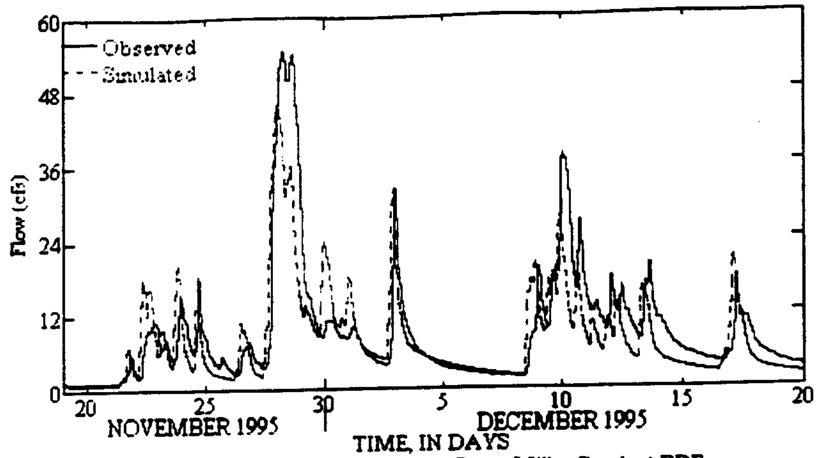
Observed Stream Flow: Miller Creek at RDF and Miller Creek at Mouth

Figure B2-22



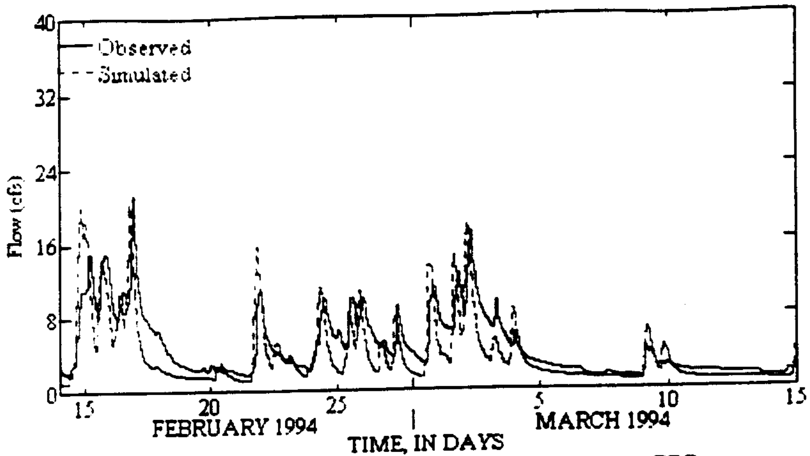
Observed vs Simulated Stream Flow: Miller Creek at RDF

Figure B2-21



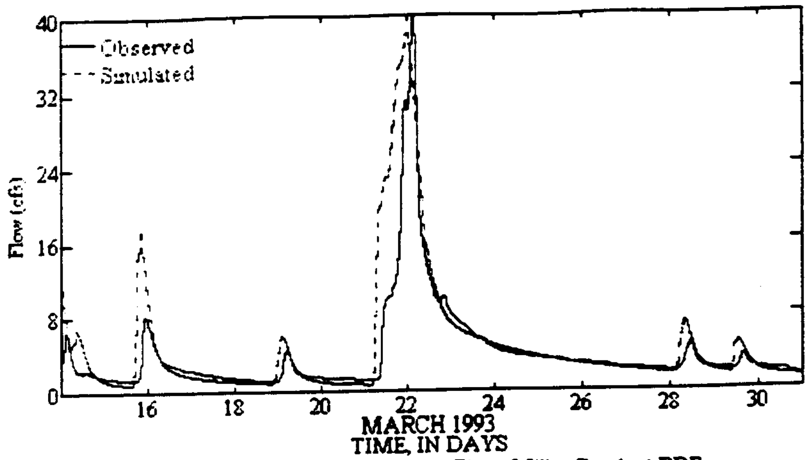
Observed vs Simulated Stream Flow: Miller Creek at RDF

Figure B2-20



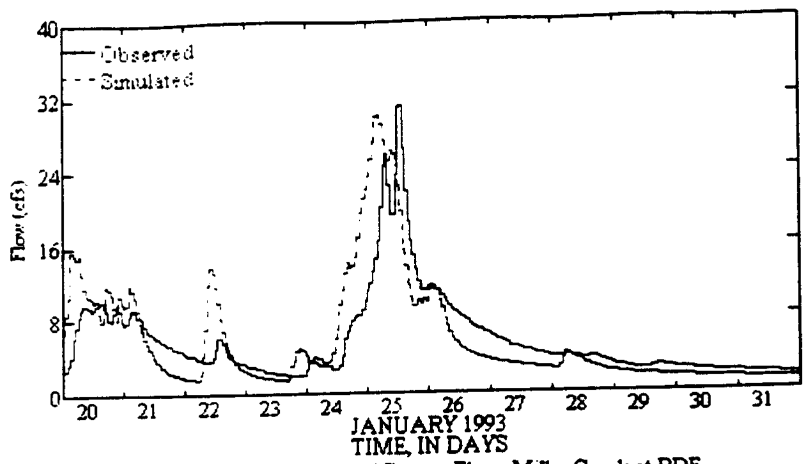
Observed vs Simulated Stream Flow: Miller Creek at RDF

Figure B2-19



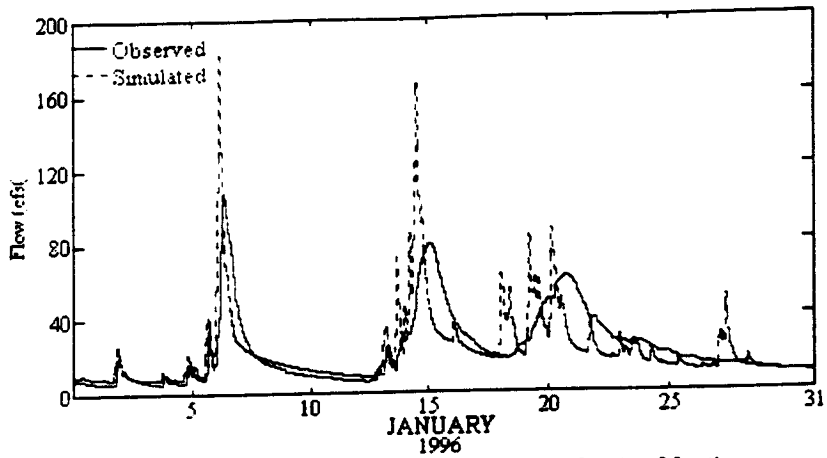
Observed vs Simulated Stream Flow: Miller Creek at RDF

Figure B2-18



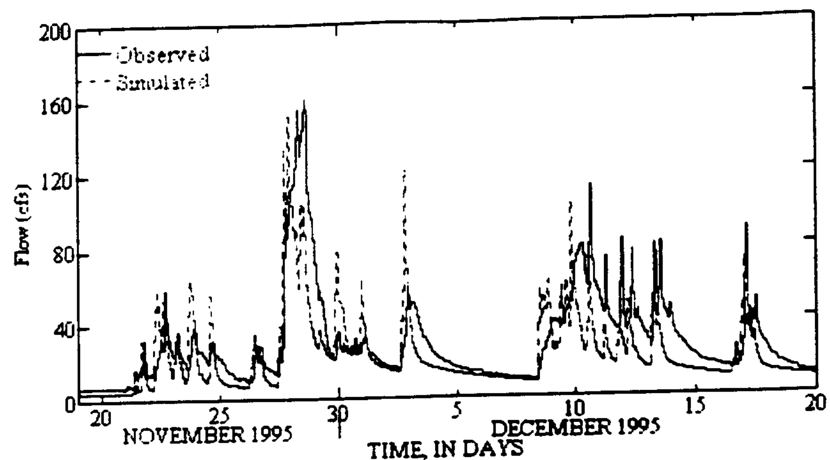
Observed vs Simulated Stream Flow: Miller Creek at RDF

Figure B2-17



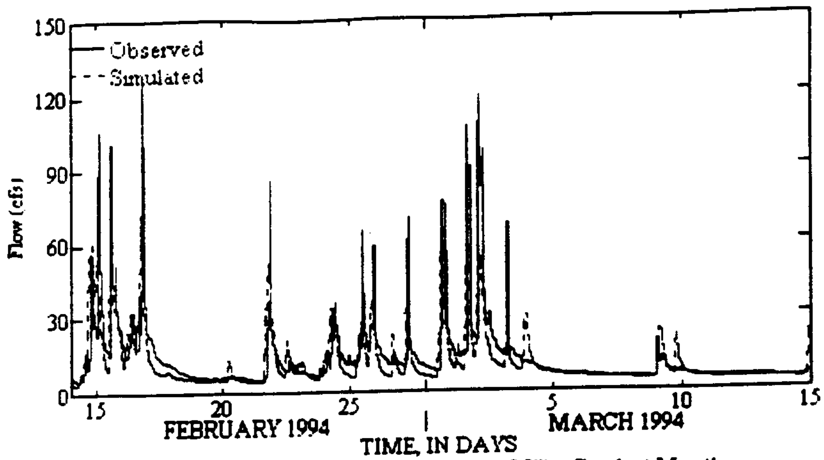
Observed vs Simulated Stream Flow: Miller Creek at Mouth

Figure B2-16



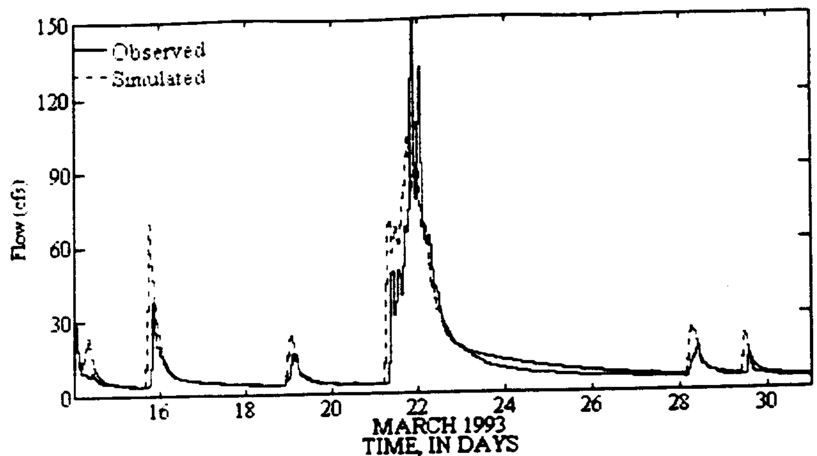
Observed vs Simulated Stream Flow: Miller Creek at Mouth

Figure B2-15



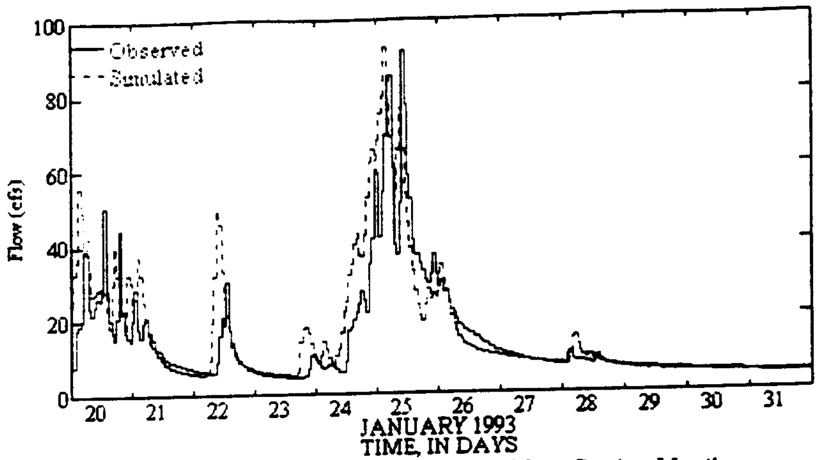
Observed vs Simulated Stream Flow: Miller Creek at Mouth

Figure B2-14



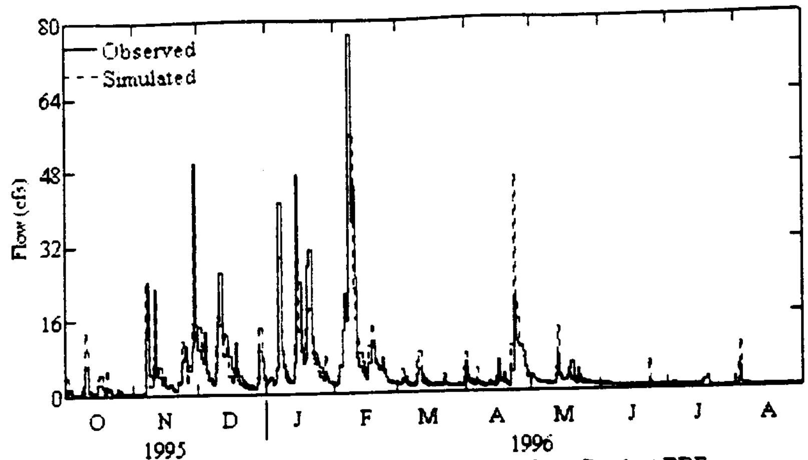
Observed vs Simulated Stream Flow: Miller Creek at Mouth

Figure B2-13



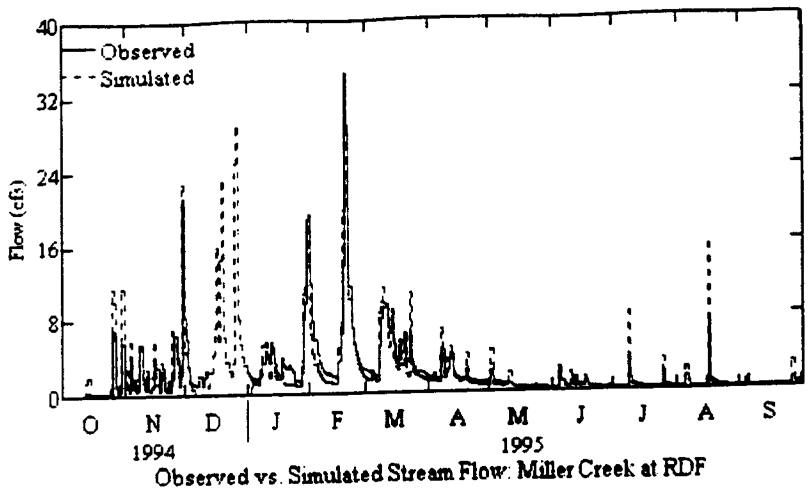
Observed vs Simulated Stream Flow: Miller Creek at Mouth

Figure B2-12



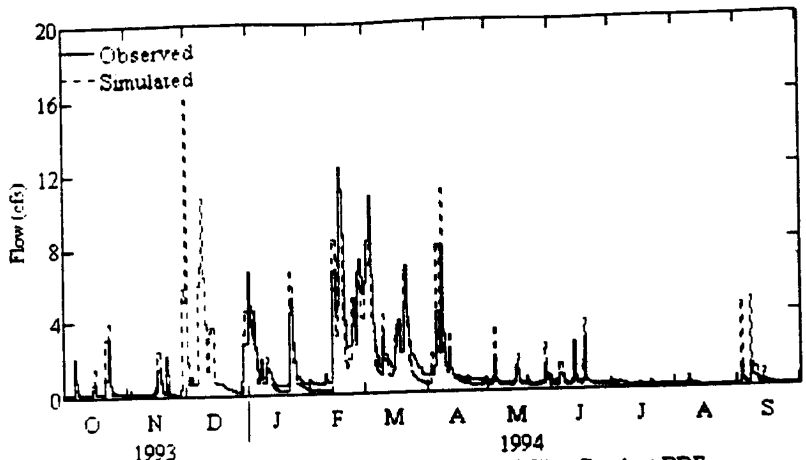
Observed vs. Simulated Stream Flow: Miller Creek at RDF

Figure B2-11



Observed
Simulated
Flow (cfs)
40
32
24
16
8
0
O
N
D
J
F
M
A
M
J
J
A
S
1994
1995
Observed vs. Simulated Stream Flow: Miller Creek at RDF

Figure B2-10



Observed vs. Simulated Stream Flow: Miller Creek at RDF

Figure B2-9

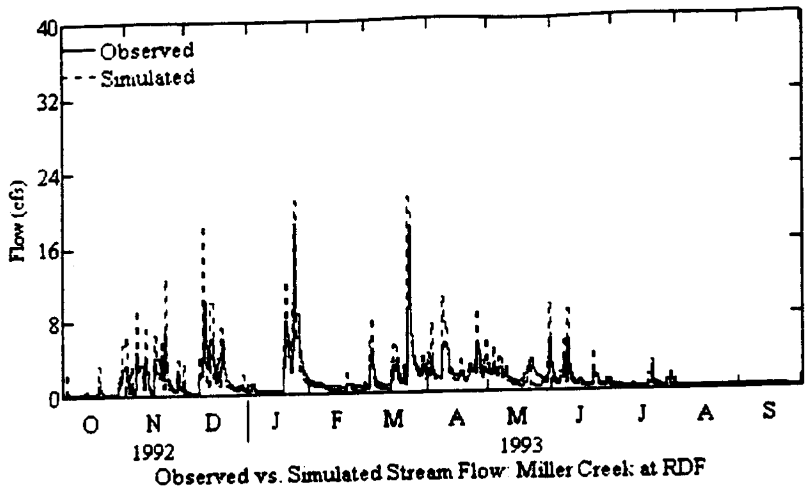
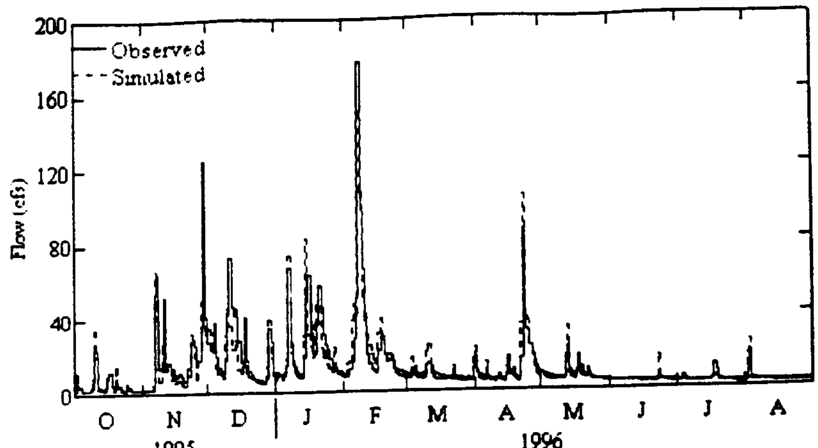
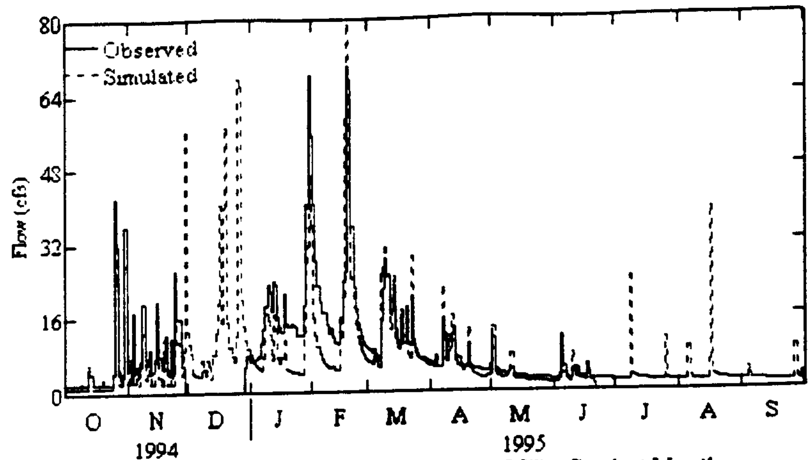

Observed
Simulated
Flow (cfs)
40
32
24
16
8
0
O
N
D
J
F
M
A
M
J
J
A
S
1992
1993
Observed vs. Simulated Stream Flow: Miller Creek at RDF

Figure B2-8



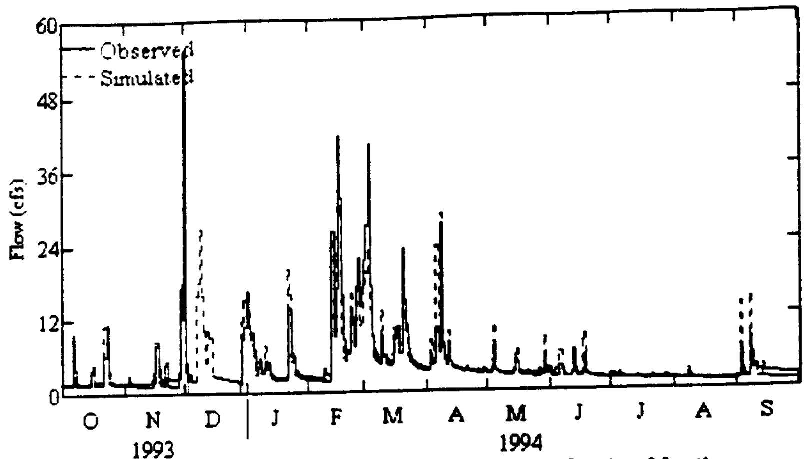
Observed vs. Simulated Stream Flow: Miller Creek at Mouth

Figure B2-7



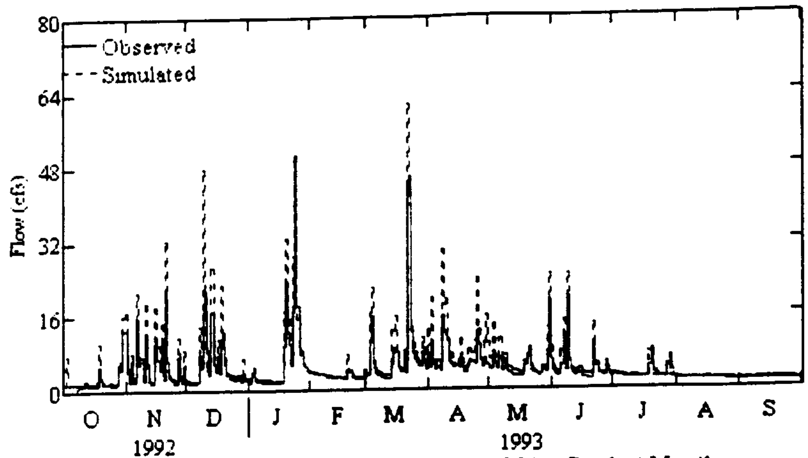
Observed vs. Simulated Stream Flow: Miller Creek at Mouth

Figure B2-6



Observed vs. Simulated Stream Flow: Miller Creek at Mouth

Figure B2-5



Observed vs Simulated Stream Flow: Miller Creek at Mouth

Figure B2-4

5. WALKER CREEK

5.1 WATERSHED BOUNDARIES

The Walker Creek watershed boundary has been verified and will be used without any alterations. However, based on topographical mapping, one-third of the groundwater from subbasin M21 has been routed upstream of the Walker Creek gage (Figure B2-23).

5.2 GROUNDWATER ROUTING

As with the Miller Creek watershed, groundwater plays a key role in properly calibrating the Walker Creek watershed. Using the standard assumption that all groundwater generated within the Walker Creek surface water boundaries drains to Walker Creek upstream of the gage site, simulated streamflows at the mouth of Walker Creek are approximately only half that of observed streamflows. This clearly indicates that Walker Creek is receiving groundwater from outside the surface water boundaries. Groundwater mapping (see Figure B2-2) indicates that approximately 630 acres of the Des Moines Creek watershed contribute groundwater to the Walker Creek watershed. As a result, 630 acres of till-grass soil has been added to the Walker Creek model. This PERLND uses an INFILT of 0.12, while the rest of the parameters correspond to regional values. Only the groundwater from this PERLND contributes to the Walker Creek watershed.

5.3 WALKER CREEK WETLAND

The Walker Creek wetland controls all of the runoff from subbasins MC-8, MC-8B, MC-9, and 20. There is a semi-blocked culvert that carries flows under Des Moines Way. Exact flow capacity of the culvert is unknown; however, using streamflow gage 42c, a rough approximation of the capacity is that of a 36-inch culvert.

5.4 FTABLES

All the stage-storage-discharge relationships from the previous model were reviewed. As a result, FTABLEs 18, 19, and 20 were modified.

FTABLE 20 represents a large wetland at the headwaters of Walker Creek. The stage-storage-discharge relationship for this wetland is based on previous modeling efforts and is believed to be accurate.

5.5 CALIBRATION PERLND PARAMETERS

Four PERLND parameters were adjusted in an effort to obtain an acceptable calibration:

- INFEXP was set to 2.0 for all soils.
- AGWRC was set to 0.996.

- INTFW was set to two for till soils. This moves most of the surface runoff away from interflow.
- IRC was set to 0.15 for all soils. This allows the interflow to respond rapidly, causing higher peak flows.

5.6 WALKER CREEK CALIBRATION RESULTS

Calibration was performed for water-years 1993 through 1996. Total simulated runoff volume at the mouth of Walker Creek for the calibration period is within 3.28 inches of the total observed volume (Table B2-9). Simulated runoff volumes for water-years 1994, 1995, and 1996 are within 0.7 inch of observed runoff volumes. The simulated runoff volume for water-year 1993 is below the observed runoff volume by 2.86 inches, which represents most of the volume deficiency. However, the streamflow gage installed in September 1992 malfunctioned at different times during water-years 1993 and 1994. This led the team to question the accuracy of the observed data for water-year 1993. Figures B2-24 through B2-27 show the annual simulated and observed streamflow for water-years 1993 through 1996 at the mouth of Walker Creek. Total simulated runoff volume at the upper gage of Walker Creek for the calibration period is within 1.36 inches of the total observed volume (Table B2-9). Figures B2-28 through B2-31 show the annual simulated and observed streamflow for water-years 1993 through 1996 at the upper Walker Creek gage.

5.7 PEAK FLOW EVENTS

Five peak flow events have been examined during the calibration process and are listed below:

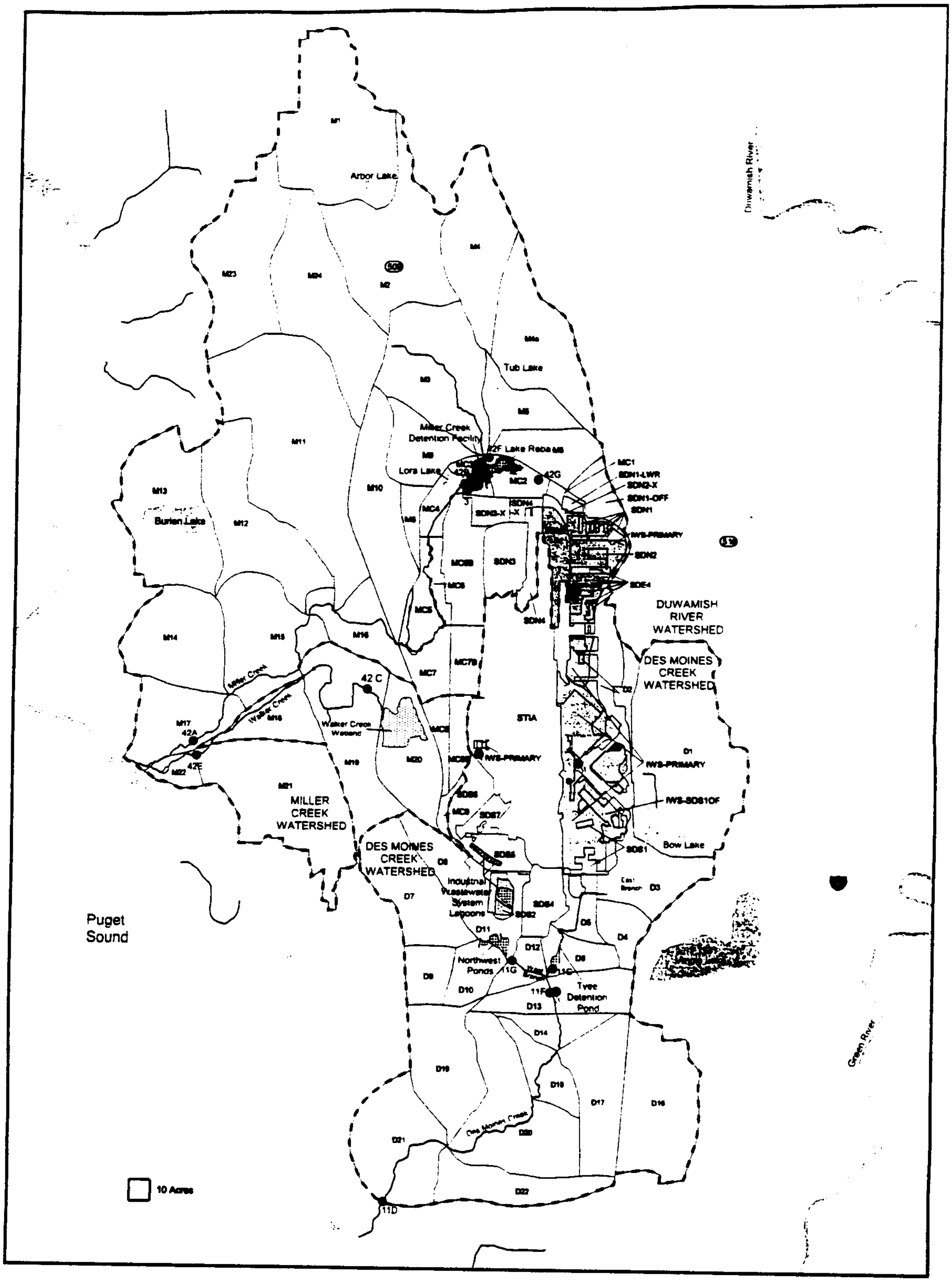
- February 5, 1996 through February 10, 1996
- February 13, 1995 through February 28, 1995
- December 13, 1994 through December 31, 1994
- April 2, 1996 through April 30, 1996
- November 2, 1995 through November 30, 1995

Calibration plots from these events are listed in Figures B2-32 through B2-41.

No events from water-year 1993 were used as a result of the documented malfunctions of the stream gage during this time period.

Simulated streamflows at the mouth of Walker Creek generally match the timing and shape of the observed streamflows. However, the peak flows for water-years 1993 and 1994 are generally too low at both the upper gage and at the mouth. Peak streamflows for water-years 1995 and 1996 are much closer to observed flows for both gage locations.

In addition to the recorded streamflow data at the upper Walker Creek gage 42c, hand-measured data points were recorded for this same location. These data points were compared to the simulated streamflow data and the recorded streamflow data for each of the days that data exists (Table B2-10). Since hand-recorded streamflow data can occur at any time during the day, it should not be expected that these data points should match exactly. A comparison of the daily average flow and the daily maximum flow against the hand-measured streamflow shows that for summer low flow conditions the numbers are nearly identical, but for winter peak flow events the numbers vary greatly. Overall, the hand-measured streamflows, the recorded or (gaged) streamflows, and the simulated streamflows exhibit a fairly good match, indicating that the model has replicated general streamflow characteristics.



July 2001
556-2912-001 (28)

Roads

Existing (1994) Drainage Subbasins

STIA Area (see note)

Constructed Water Features

IWS Drainage Area

Subwatershed Boundary

Watershed Boundary

Rivers

Water Bodies

Detention Facilities (existing)

N

1000 0 1000 2000 Feet

1:36,000

Figure B2-23
Walker Creek
Subbasin Boundary

AR 047161

Table B2-9. Walker Creek runoff volumes: calibration period water-years 1993 through 1996.

Walker Creek at mouth runoff volumes: calibration period water-years 1993 through 1996.

Water-Year	Observed Mouth (inches)	Simulated Mouth (inches)	Simulated minus Observed Mouth (inches)
1993	15.64	12.78	-2.86
1994	11.41	10.7	-0.71
1995	17.54	17.59	0.05
1996	24.04	24.28	0.24
Total	**68.63**	**65.35**	**-3.28**

Walker Creek upper gage runoff volumes: calibration period water-years 1993 through 1996.

Water-Year	Observed Mouth (inches)	Simulated Mouth (inches)	Simulated minus Observed Mouth (inches)
1993	9.64	8.16	-1.48
1994	8.38	6.75	-1.63
1995	9.01	9.43	0.42
1996	11.09	12.42	1.33
Total	**38.12**	**36.76**	**-1.36**

Table B2-10. Spot field-measured flows for Walker Creek gage 42c (upper Walker Creek gage).

Field Measured Data		Observed Gage 42C		Simulated Data	
Date	Flow (cfs)	Daily Average (cfs)	Hourly Max For Day (cfs)	Daily Average (cfs)	Hourly Max For Day (cfs)
09/06/90	0.93	N/A	N/A	N/A	N/A
10/07/90	0.94	1.04	1.14	0.70	0.71
11/06/90	1.23	1.27	1.30	0.86	0.86
11/09/90	19.15	11.94	23.00	9.32	17.76
02/05/91	2.69	3.93	10.80	2.99	5.15
03/26/91	1.47	1.49	1.60	2.21	2.25
04/04/92	24.71	22.35	26.00	16.26	21.21
05/17/91	1.36	1.30	1.40	1.55	1.62
09/05/91	1.32	1.34	1.40	0.95	0.96
10/14/91	1.37	1.40	1.40	0.77	0.77
11/14/91	1.57	1.55	1.60	0.8	0.81
11/19/91	6.74	3.78	7.10	2.61	3.83
12/05/91	11.51	5.89	11.00	4.71	7.15
01/29/92	10.76	6.77	14.00	4.51	8.61
01/30/92	4.25	5.71	9.50	4.93	7.23
03/19/92	1.46	1.55	1.60	1.76	1.79
04/16/92	2.39	2.09	4.90	3.37	10.65
05/22/92	1.38	1.20	1.20	1.2	1.21
08/05/92	1.14	1.30	1.30	0.81	0.81
09/10/92	1.31	1.24	1.40	0.73	0.73
11/17/92	1.04	1.92	3.00	1.44	3.28
02/10/93	1.21	1.29	1.30	1.44	1.47
03/16/93	1.25	1.97	5.10	2.37	6.88
04/16/93	1.25	1.62	1.70	1.88	2.49
09/16/93	0.76	0.90	0.90	0.74	0.74
10/26/93	0.97	1.20	1.20	0.7	0.70
11/30/93	1.52	1.96	2.92	1.84	7.48
01/19/94	0.98	1.30	1.30	1.06	1.07
02/14/94	1.82	3.11	4.48	1.59	2.39
04/21/94	1.35	0.93	0.93	1.5	1.56
07/18/94	0.68	1.00	1.00	0.79	0.79
08/25/94	0.88	0.82	0.82	0.67	0.68
09/22/94	0.84	0.87	0.89	0.65	0.66
10/20/94	0.94	0.88	0.89	0.63	0.66

Table B2-10. Spot field-measured flows for Walker Creek gage 42c (upper Walker Creek gage) (continued).

Field Measured Data		Observed Gage 42C		Simulated Data	
Date	Flow (cfs)	Daily Average (cfs)	Hourly Max For Day (cfs)	Daily Average (cfs)	Hourly Max For Day (cfs)
01/11/95	2.36	2.41	3.00	2.61	3.40
02/09/95	1.34	1.43	1.60	2	2.03
05/25/95	1.32	1.30	1.30	1.16	1.17
07/10/95	1.43	1.36	2.40	1.04	1.19
08/08/95	1.16	1.16	1.25	0.86	0.86
09/13/95	0.81	0.72	0.72	0.79	0.79
10/20/95	3.17	1.50	3.03	1.77	4.21
01/05/96	1.21	1.22	1.30	2.68	3.58
04/10/96	1.21	1.23	1.30	1.86	1.88

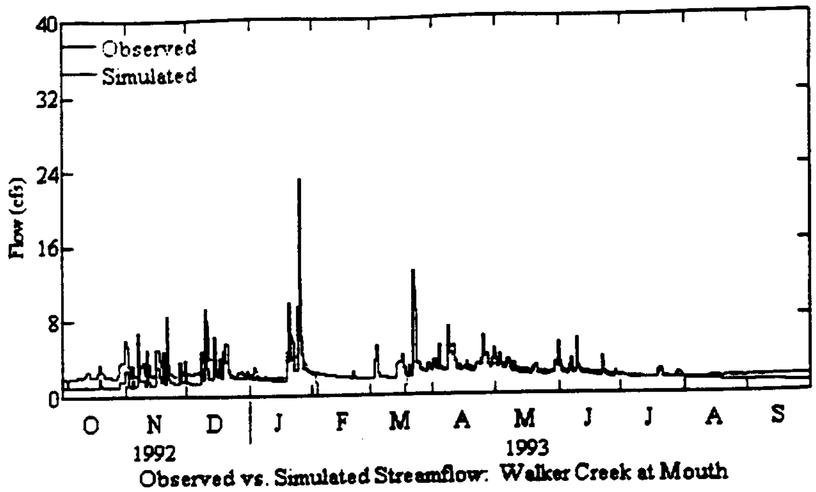
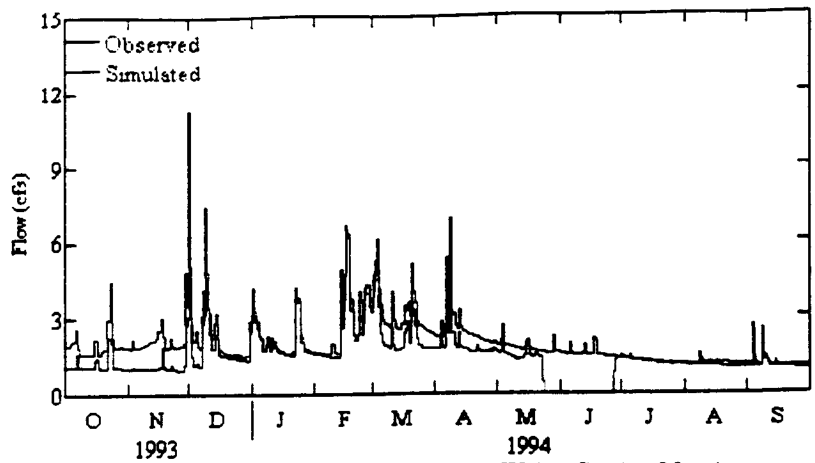
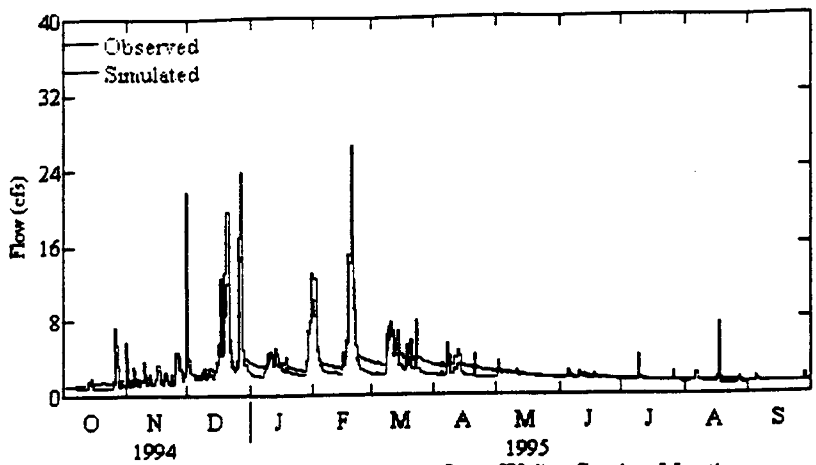

Observed
Simulated
40
32
24
16
8
0
Flow (cfs)
O
N
D
J
F
M
A
M
J
J
A
S
1992
1993
Observed vs. Simulated Streamflow: Walker Creek at Mouth

Figure B2-24



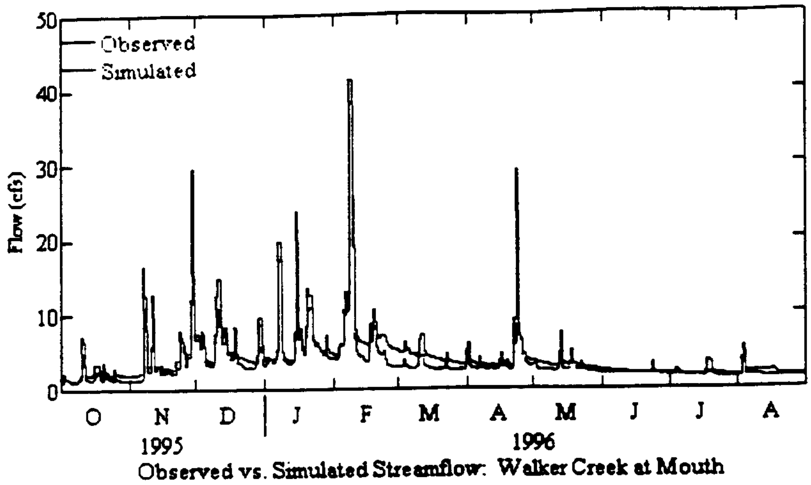
Observed vs. Simulated Streamflow: Walker Creek at Mouth

Figure B2-25



Observed vs. Simulated Streamflow: Walker Creek at Mouth

Figure B2-26



Observed vs. Simulated Streamflow: Walker Creek at Mouth

Figure B2-27

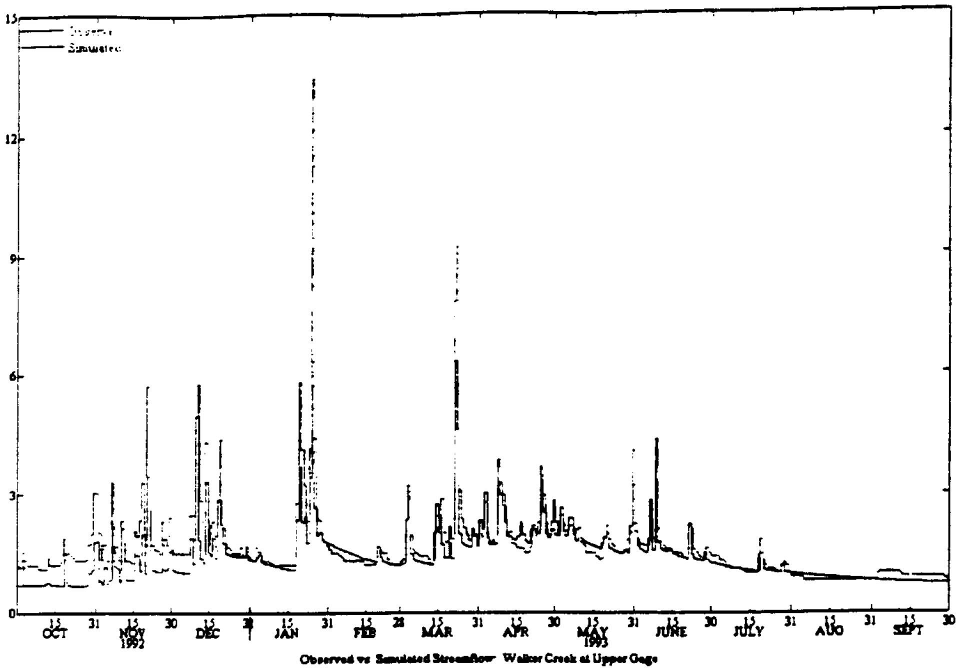

Observed
Simulated
Flow (cfs)
15
12
9
6
3
0
15 OCT
31
15 NOV 1992
30
15 DEC
31
15 JAN
31
15 FEB
28
15 MAR
31
15 APR
30
15 MAY 1993
31
15 JUNE
30
15 JULY
31
15 AUG
31
15 SEPT
30
Observed vs Simulated Streamflow Walker Creek at Upper Gage

Figure B2-28

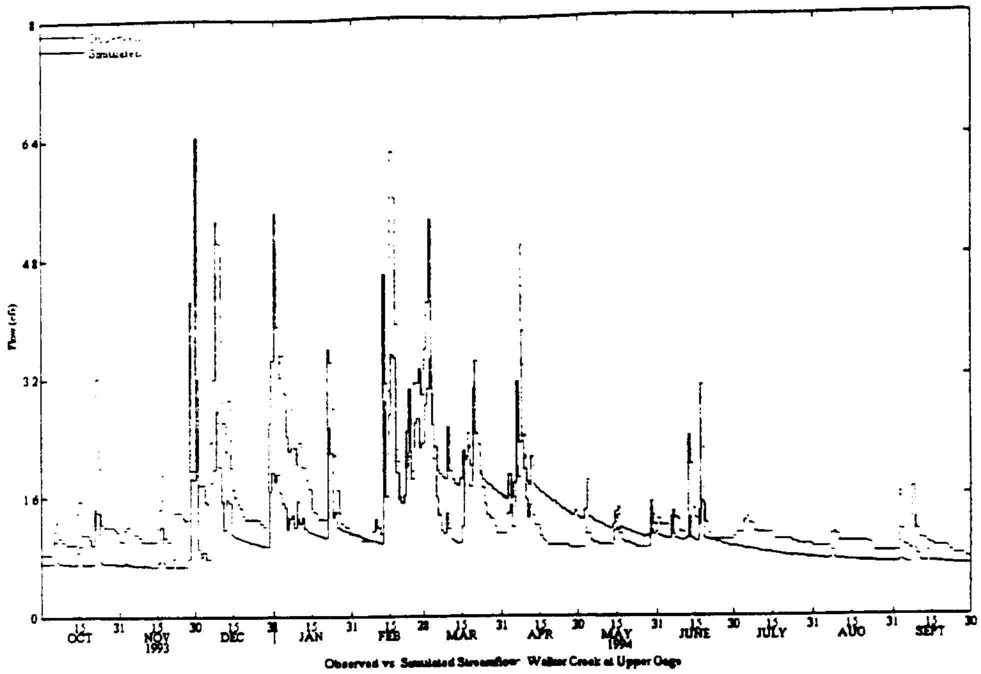

Observed
Simulated
64
48
32
16
0
Flow (cfs)
15
31
30
28
OCT
NOV
1993
DEC
JAN
FEB
MAR
APR
MAY
1994
JUNE
JULY
AUG
SEPT
Observed vs Simulated Streamflow Walker Creek at Upper Gage

Figure B2-29

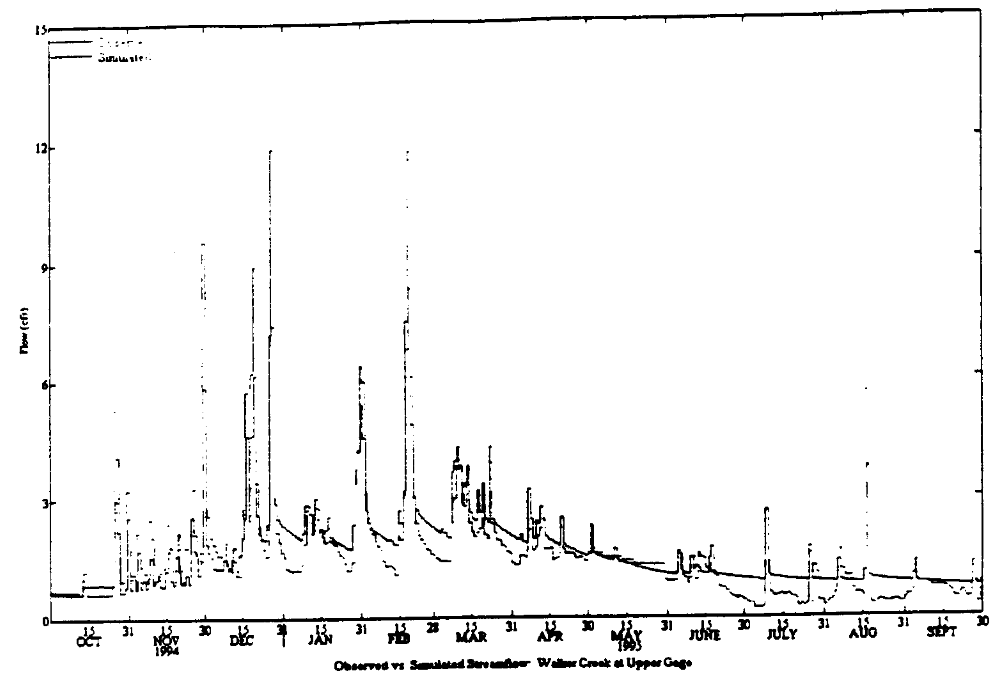
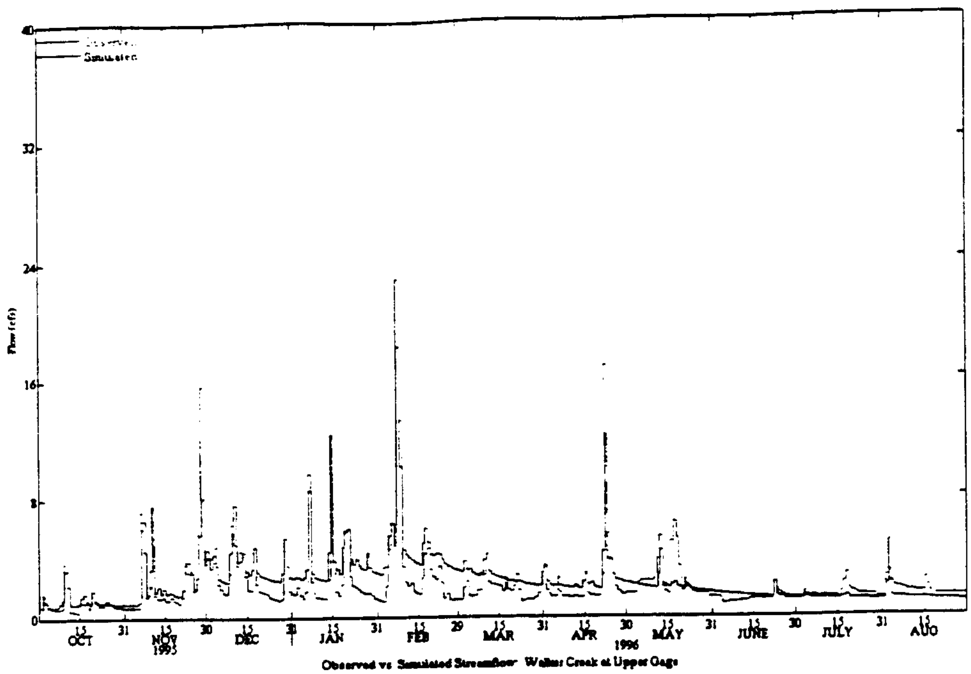
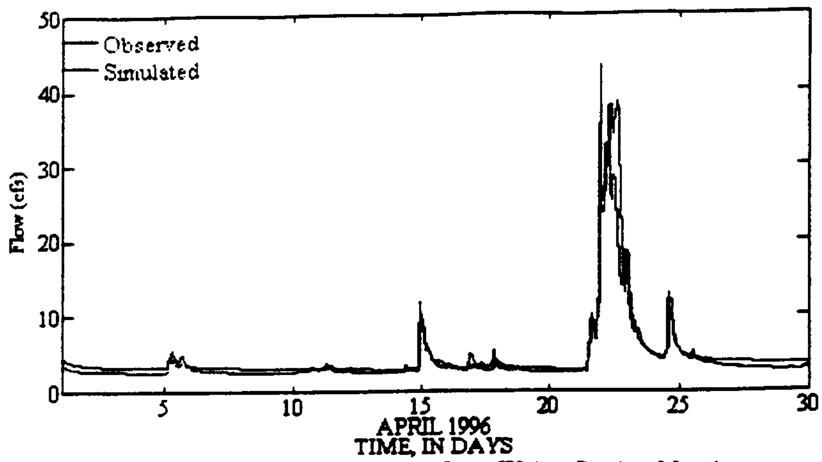

Flow (cfs)
15
12
9
6
3
0
15 OCT
31
15 NOV 1994
30
15 DEC
31
15 JAN
31
15 FEB
28
15 MAR
31
15 APR
30
15 MAY 1995
31
15 JUNE
30
15 JULY
31
15 AUG
31
15 SEPT
30
Observed vs Simulated Streamflow Walker Creek at Upper Gage

Figure B2-30



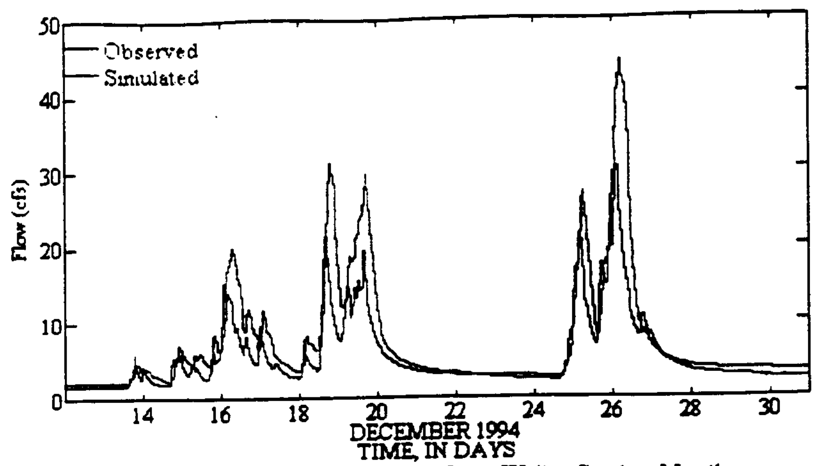
Simulated
Flow (cfs)
40
32
24
16
8
0
15
31
30
29
OCT
NOV
1995
DEC
JAN
FEB
MAR
APR
1996
MAY
JUNE
JULY
AUG
Observed vs Simulated Streamflow Walker Creek at Upper Gage

Figure B2-31



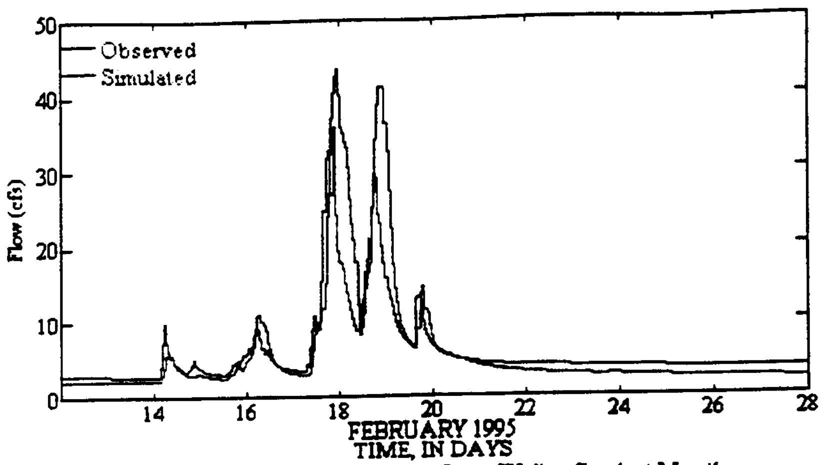
Observed vs. Simulated Streamflow: Walker Creek at Mouth

Figure B2-32



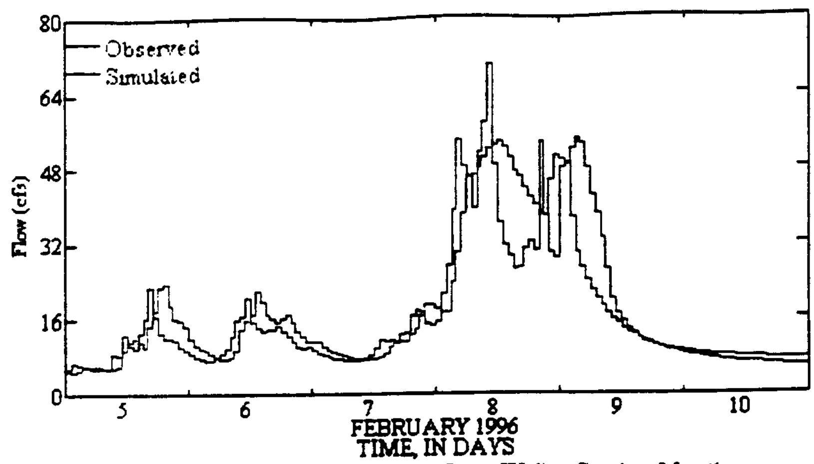
Observed vs. Simulated Streamflow: Walker Creek at Mouth

Figure B2-33



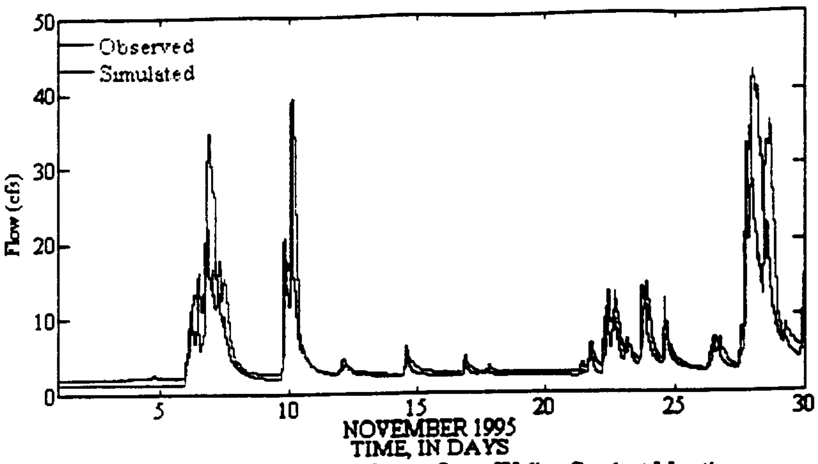
Observed vs. Simulated Streamflow: Walker Creek at Mouth

Figure B2-34



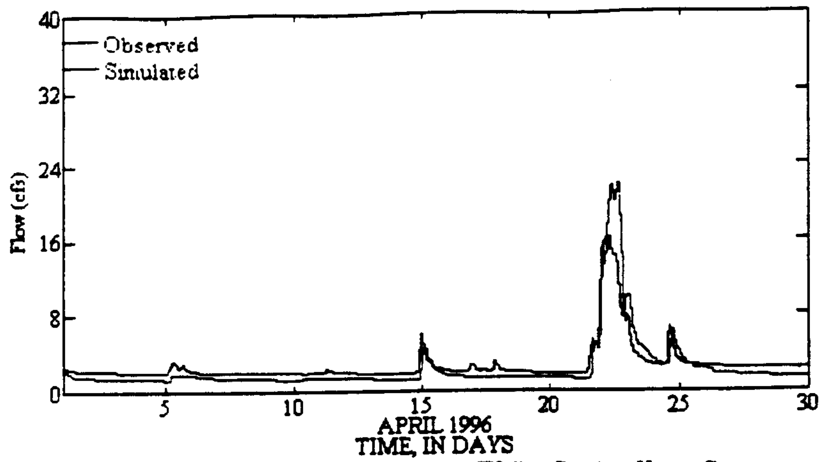
Observed vs. Simulated Streamflow: Walker Creek at Mouth

Figure B2-35



Observed vs. Simulated Streamflow: Walker Creek at Mouth

Figure B2-36



Observed vs. Simulated Streamflow: Walker Creek at Upper Gage

Figure B2-37

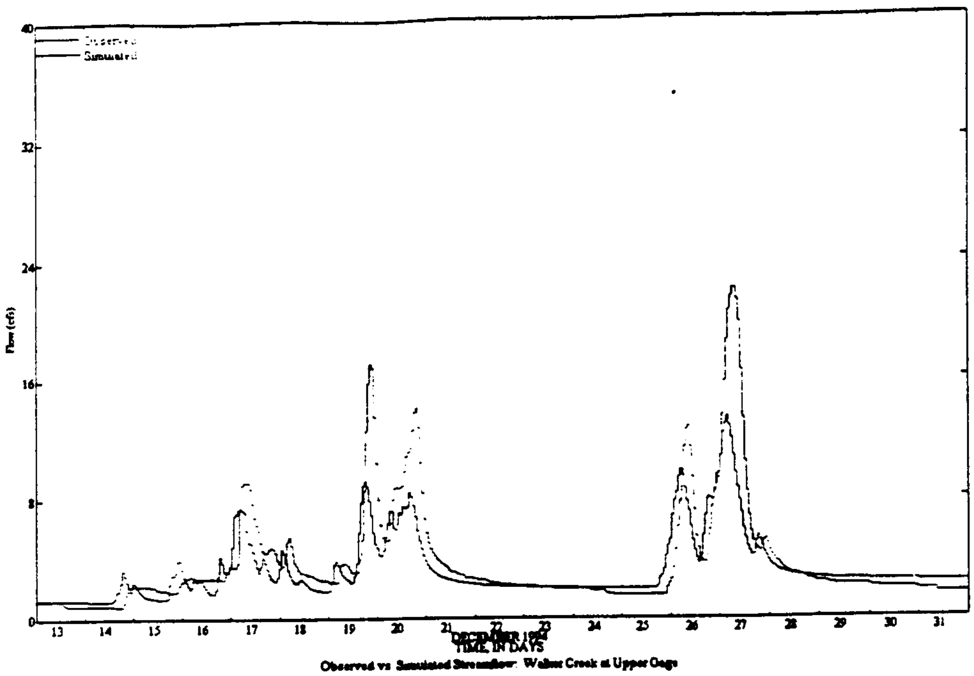
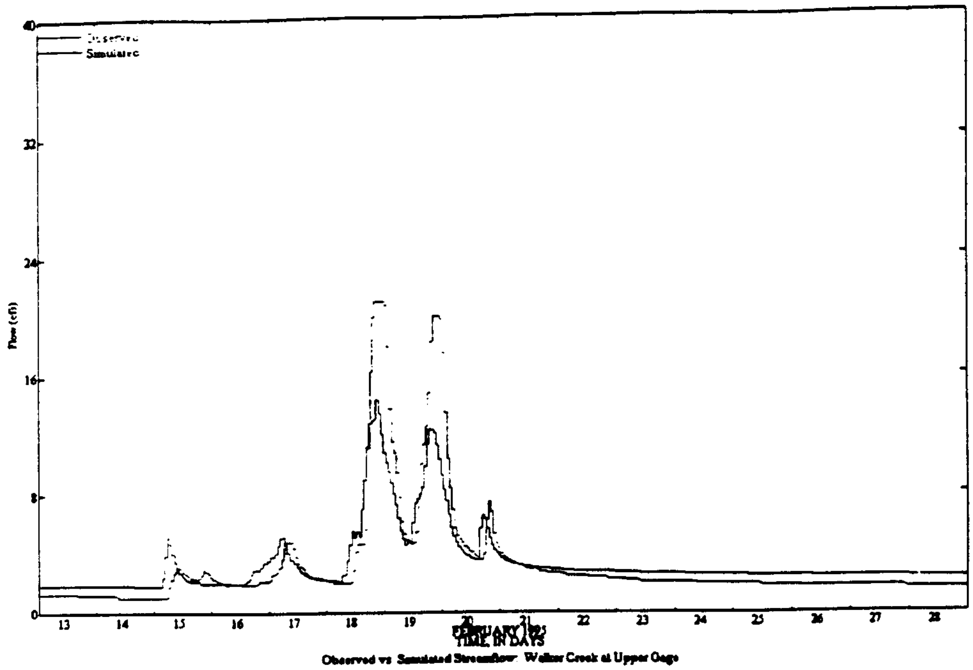
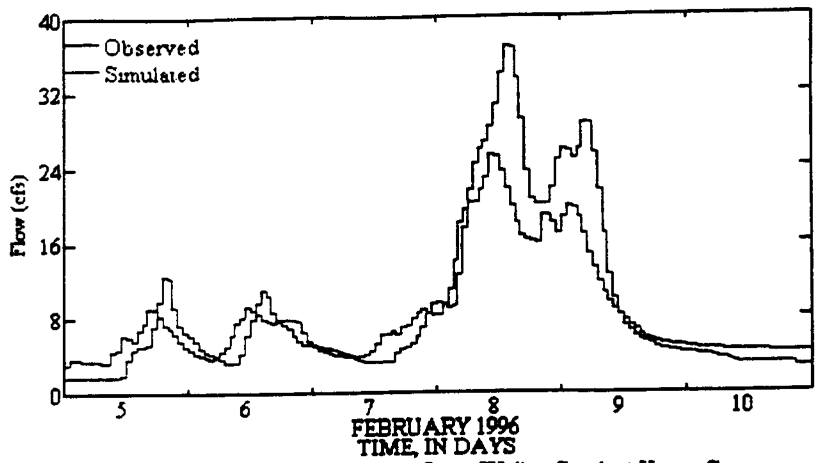

Observed
Simulated
Flow (cfs)
0
8
16
24
32
40
13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
DECEMBER
TIME, IN DAYS
Observed vs Simulated Streamflow: Walker Creek at Upper Gage

Figure B2-38



Observed
Simulated
40
32
24
16
8
0
Flow (cfs)
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
TIME, IN DAYS
Observed vs Simulated Streamflow: Walker Creek at Upper Gage

Figure B2-39



Observed vs. Simulated Streamflow: Walker Creek at Upper Gage

Figure B2-40

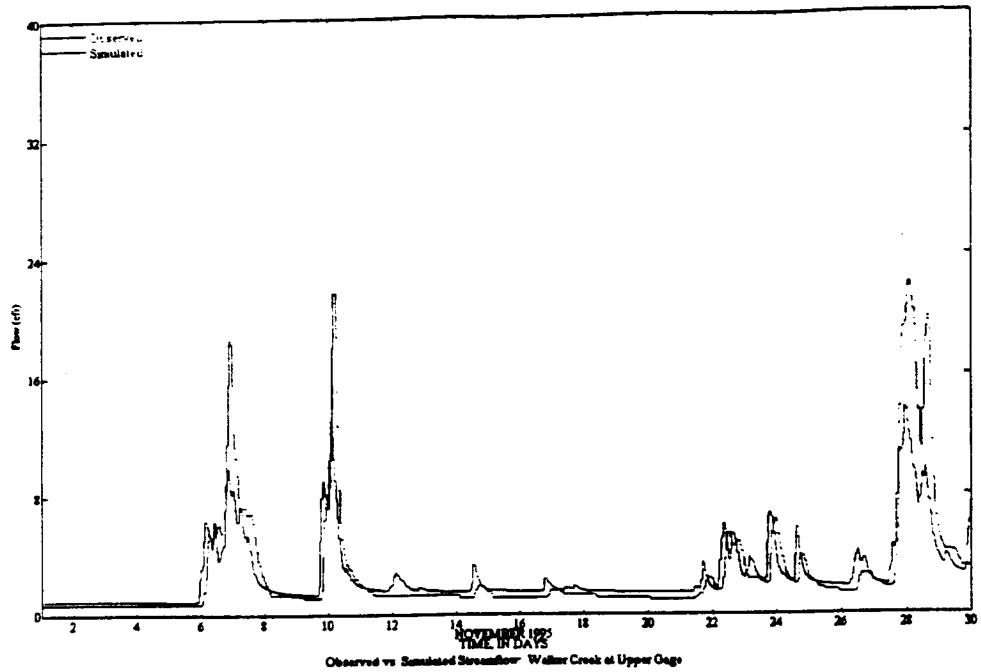

Observed
Simulated
Flow (cfs)
NOVEMBER 1995
TIME, IN DAYS
Observed vs Simulated Streamflow Walker Creek at Upper Gage

Figure B2-41

6. SUMMARY

This computer calibration effort resulted in calibrated models for both the Miller and Walker Creek watersheds. The final calibrations include all of the best available data. Each stage-storage-discharge relationship was derived from field data or topographical mapping. The land use data were updated based on the King County land use coverage. The watershed boundaries were altered to include an additional 300 or so acres to the northwest as a result of field investigations.

Simulated streamflow volumes over the calibration period are within 10 percent of recorded volumes. There was some difficulty matching the magnitude of recorded streamflow peaks. A total of 65 calibration runs were performed for Miller Creek and 21 calibration runs were performed for Walker Creek in an effort to match the magnitude of the recorded streamflow peaks. The best possible match for the given data has been achieved. Investigation of the recorded streamflow data at both gage sites for Miller Creek and both gage sites at Walker Creek demonstrates some possible errors as a result of gage malfunctions and shifting control situations. The team believes these errors may contribute to the inability for simulated streamflows to match observed streamflows.

Most importantly, both calibration HSPF models behave in a consistent manner, which will enable them to be used to study the impacts of differing land use conditions that are proposed for both these watersheds.

MILLER CREEK HSPF CALIBRATION
MODEL INPUT FILE

```
RUN
GLOBAL
  ***  FILE: mill65.inp REVISED Aug 2000  Joe Brascher(atc)
  *** for parameterix
  ***  SEATAC AIRPORT HSPF BASIN MODEL OF MILLER CREEK
  ***  - POST-MILLER CK DETENTION FACIITY 10/92-6/93
  *** m23 AND M24 new area west of m2.  Flows to rdf
  MILLER CREEK BASIN HSPF MODEL
  START        1989 01  1  0  0  END    1996  8 30 24  0
  RUN INTERP OUTPUT LEVEL    3
  RESUME     0 RUN     1
END GLOBAL

FILES
<type>  <fun>***<------------fname------------------------------------------->
MESSU      24   D:\PARA\SEATAC\MILLER\MILL.MES
WDM        25   D:\PARA\SEATAC\MILLER\MILL.WDM
           61   D:\PARA\SEATAC\MILLER\PER.L61
           62   D:\PARA\SEATAC\MILLER\RCH.L62
END FILES

OPN SEQUENCE
    INGRP              INDELT 01:00
      PERLND     14
      PERLND     16
      PERLND     18
      PERLND     24
      PERLND     26
      PERLND     28
      PERLND     34
      PERLND     44
      PERLND     54
      IMPLND     14
      RCHRES      1
      RCHRES     23
      RCHRES     24
      RCHRES      2
      RCHRES      3
      RCHRES     33
      RCHRES      4
      RCHRES      5
      RCHRES     50
      RCHRES     52
      RCHRES     53
      RCHRES     54
      RCHRES     34
      RCHRES    135
      RCHRES     35
      RCHRES     10
      RCHRES     16
      RCHRES     11
      RCHRES     13
      RCHRES     12
      RCHRES     15
      RCHRES     14
      RCHRES     17
    END INGRP
```

```
END OPN SEQUENCE                                                                          ***

COPY
  TIMESERIES                                                                              ***
  Copy-opn                                                                                ***
    # -  #  NPT  NMN
    1    5        1
  END TIMESERIES
END COPY

PERLND
  GEN-INFO                                                                                ***
    <PLS >       Name              NBLKS   Unit-systems   Printer                          ***
    # -  #                                User  t-series Engl Metr                          ***
                                                  in  out                                   ***
   14        TFF- TILL FOR FLT       1     1     1    1   61    0
   16        TFM- TILL FOR MOD       1     1     1    1   61    0
   18        TFS- TILL FOR STP       1     1     1    1   61    0
   24        TGF- TILL GR FLT        1     1     1    1   61    0
   26        TGM- TILL GR MOD        1     1     1    1   61    0
   28        TGS- TILL GR STP        1     1     1    1   61    0
   34        OF - OUTWASH FOR        1     1     1    1   61    0
   44        OG - OUTWASH GR         1     1     1    1   61    0
 ***PERLND FOR NEW AIRPORT FILL; NONE IN CALIBRATION
   45        AIRPORT FILL            1     1     1    1   61    0
   54        SA - WETLANDS           1     1     1    1   61    0
   64        RES- GROUNDWATER        1     1     1    1   61    0
  END GEN-INFO
  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC                    ***
   14  200    0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    <PLS > ******************** Print-flags ************************ PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
   14  200    0    0    5    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  PWAT-PARM1
    <PLS > ***************** Flags ********************
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                                    ***
   14         0    0    0    0    0    0    0    0    0
   16         0    0    0    0    0    0    0    0    0
   18         0    0    0    0    0    0    0    0    0
   24         0    0    0    0    0    0    0    0    0
   26         0    0    0    0    0    0    0    0    0
   28         0    0    0    0    0    0    0    0    0
   34         0    0    0    0    0    0    0    0    0
   44         0    0    0    0    0    0    0    0    0
   45         0    0    0    0    0    0    0    0    0
   54         0    0    0    0    0    0    0    0    0
   64         0    0    0    0    0    0    0    0    0
  END PWAT-PARM1
  PWAT-PARM2
    <PLS > ***
    # -  # ***FOREST       LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   14                    9.0000    0.3200    400.00    0.0500    0.5000    0.9960
```

```
  16              9.0000    0.3200    400.00    0.1000    0.5000    0.9960
  18              9.0000    0.3200    200.00    0.2000    0.5000    0.9960
  24              9.0000    0.1200    400.00    0.0500    0.5000    0.9960
  26              9.0000    0.1200    400.00    0.1000    0.5000    0.9960
  28              9.0000    0.1200    200.00    0.2000    0.5000    0.9960
  34             10.0000    2.0000    400.00    0.0500    0.3000    0.9960
  44             10.0000    0.8000    400.00    0.0500    0.3000    0.9960
  45              7.5000    0.0200    300.00    0.0700    0.0000    0.9000
  54              8.0000    2.0000    100.00    0.0010    0.5000    0.9960
END PWAT-PARM2
PWAT-PARM3
  <PLS >***
  # -  #*** PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  14                          2.0000    2.0000      0.33      0.00       0.0
  16                          2.0000    2.0000      0.33      0.00       0.0
  18                          2.0000    2.0000      0.33      0.00       0.0
  24                          2.0000    2.0000      0.33      0.00        0.
  26                          2.0000    2.0000      0.33        0.        0.
  28                          2.0000    2.0000      0.33        0.        0.
  34                          2.0000    2.0000      0.33      0.00       0.0
  44                          2.0000    2.0000      0.33        0.        0.
  54                          10.000    2.0000      0.33        0.       0.7
END PWAT-PARM3
PWAT-PARM4
  <PLS >                                                        ***
  # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP***
  14        0.2000    1.5000    0.3500     9.000    0.7000    0.7000
  16        0.2000    0.7500    0.3500     9.000    0.7000    0.7000
  18        0.2000    0.4500    0.3500     9.000    0.3000    0.7000
  24        0.1000    0.7500    0.2500     9.000    0.7000    0.2500
  26        0.1000    0.3750    0.2500     9.000    0.7000    0.2500
  28        0.1000    0.2250    0.2500     9.000    0.3000    0.2500
  34        0.2000    0.7500    0.3500     0.000    0.7000    0.7000
  44        0.1000    0.7500    0.2500     0.000    0.7000    0.2500
  54        0.1000    2.2500    0.5000     1.000    0.7000    0.8000
END PWAT-PARM4
PWAT-STATE1
  <PLS >  PWATER state variables***
  # -  #***   CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  14         0.078        0.    0.2500      0.10     2.000     2.000     0.000
  16         0.078        0.    0.2500      0.10     2.000     2.000     0.000
  18         0.078        0.    0.2500      0.10     2.000     2.000     0.000
  24         0.051        0.    0.2500      0.10     2.000     2.000     0.000
  26         0.051        0.    0.2500      0.10     2.000     2.000     0.000
  28         0.051        0.    0.2500      0.10     2.000     2.000     0.000
  34         0.078        0.    0.2500      0.10     2.000     2.000     0.000
  44         0.051        0.    0.2500      0.10     2.000     2.000     0.000
  45         0.051        0.    0.2500      0.10     2.000     2.000     0.000
  54         0.051        0.    0.2500      0.10     2.000     2.000     0.000
  64         0.051        0.    0.2500      0.10     2.000     2.000     0.000
END PWAT-STATE1
END PERLND
IMPLND
  GEN-INFO
    <ILS >       Name             Unit-systems   Printer                      ***
    # -  #                      User  t-series Engl Metr                      ***
                                        in  out                               ***
```

```
   14       IMPERVIOUS               1    1    1   60    0
  END GEN-INFO
  ACTIVITY
    <ILS > ************* Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
   14        0    0    1    0    0    0
  END ACTIVITY
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
   14        0    0    6    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1                                                          ***
    <ILS >          Flags            ***                                ***
    # -  # CSNO RTOP  VRS  VNN RTLI    ***
   14        0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2                                                          ***
    <ILS >                                                              ***
    # -  #       LSUR     SLSUR      NSUR     RETSC
   14          100.00    0.0100    0.1000    0.1000
  END IWAT-PARM2
  IWAT-PARM3                                                          ***
    <ILS >                                                              ***
    # -  #     PETMAX    PETMIN
   14
  END IWAT-PARM3
  IWAT-STATE1                                                         ***
    <ILS >  IWATER state variables                                      ***
    # -  #       RETS       SURS
   14       1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND
                                                                      ***
EXT SOURCES
                                                                      ***
*** NOTE: The only RCHRES that precip and PET are applied to are lakes.
                                                                      ***
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
*** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
WDM      2 PREC      ENGLZERO  1.00        PERLND  14 200 EXTNL  PREC
WDM      2 PREC      ENGLZERO  1.00        IMPLND  14     EXTNL  PREC
WDM   1010 EVAP      ENGLZERO  0.8         PERLND  14  18 EXTNL  PETINP
WDM   1010 EVAP      ENGLZERO  0.8         PERLND  24  28 EXTNL  PETINP
WDM   1010 EVAP      ENGLZERO  0.8         PERLND  34  54 EXTNL  PETINP
WDM   1010 EVAP      ENGLZERO  0.8         PERLND  64     EXTNL  PETINP
WDM   1010 EVAP      ENGLZERO  0.8         IMPLND  14     EXTNL  PETINP
*** PRECIP/EVAP TO LAKES
WDM      2 PREC      ENGLZERO              RCHRES   1     EXTNL  PREC
WDM   1010 EVAP      ENGLZERO    0.8       RCHRES   1     EXTNL  POTEV
WDM      2 PREC      ENGLZERO              RCHRES   4     EXTNL  PREC
WDM   1010 EVAP      ENGLZERO    0.8       RCHRES   4     EXTNL  POTEV
WDM   1010 EVAP      ENGLZERO    0.8       RCHRES   1     EXTNL  POTEV
WDM      2 PREC      ENGLZERO              RCHRES   1     EXTNL  PREC
WDM   1010 EVAP      ENGLZERO    0.8       RCHRES   4     EXTNL  POTEV
WDM      2 PREC      ENGLZERO              RCHRES   4     EXTNL  PREC
```

```
WDM       2 PREC      ENGLZERO              RCHRES  11      EXTNL  PREC
WDM    1010 EVAP      ENGLZERO    0.8       RCHRES  11      EXTNL  POTEV
WDM       2 PREC      ENGLZERO              RCHRES  13      EXTNL  PREC
WDM    1010 EVAP      ENGLZERO    0.8       RCHRES  13      EXTNL  POTEV
WDM       2 PREC      ENGLZERO              RCHRES  23      EXTNL  PREC
WDM    1010 EVAP      ENGLZERO    0.8       RCHRES  23      EXTNL  POTEV
WDM       2 PREC      ENGLZERO              RCHRES  34      EXTNL  PREC
WDM    1010 EVAP      ENGLZERO    0.8       RCHRES  34      EXTNL  POTEV
WDM       2 PREC      ENGLZERO              RCHRES  53      EXTNL  PREC
WDM    1010 EVAP      ENGLZERO    0.8       RCHRES  53      EXTNL  POTEV
WDM       2 PREC      ENGLZERO              RCHRES  54      EXTNL  PREC
WDM    1010 EVAP      ENGLZERO    0.8       RCHRES  54      EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
*** UPPER MILLER CREEK GROUNDWATER PUMPING
COPY *** 1 OUTPUT MEAN   1    12.1         WDM     18 FLOW     ENGL      REPL
*** GAUGE POINTS (17=MOUTH, 54=MILLER RDF, 50=SR 518, 18=WALKER CK)
RCHRES  17 HYDR   RO                       WDM     33 FLOW     ENGL      REPL
RCHRES  54 HYDR   RO                       WDM     34 FLOW     ENGL      REPL
RCHRES  50 HYDR   RO        ***            WDM     35 FLOW     ENGL      REPL
RCHRES  18 HYDR   RO        ***            WDM     36 FLOW     ENGL      REPL
*** MISC (20=WALKER WETLAND, 55=SR509, 56=1ST AVE, 1=ARBOR LAKE)
RCHRES  23 HYDR   STAGE  ***               WDM     91 STAG     ENGL      REPL
RCHRES  20 HYDR   RO     ***               WDM     37 FLOW     ENGL      REPL
RCHRES  55 HYDR   RO     ***               WDM     38 FLOW     ENGL      REPL
RCHRES  62 HYDR   RO     ***               WDM     39 FLOW     ENGL      REPL
RCHRES   1 HYDR   RO     ***               WDM     80 FLOW     ENGL      REPL
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
 ***MOUTH
RCHRES  54 HYDR   RO     1 1 0.000419      WDM     60 SIMQ     ENGL      REPL
RCHRES  17 HYDR   RO     1 1 0.000213      WDM     70 SIMQ     ENGL      REPL
END EXT TARGETS
                                                                             ***

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK     ***
<Name>   #                  <-factor->     <Name>   #   Tbl#     ***
  *** SUB-CATCHMENT 1 all agwo goes to sound
PERLND  16                        3.41     RCHRES   1      6
PERLND  26                      232.36     RCHRES   1      6
PERLND  34                        3.07     RCHRES   1      6
PERLND  44                       38.03     RCHRES   1      6
PERLND  54                        3.87     RCHRES   1      6
IMPLND  14                       56.14     RCHRES   1      2
 *** SUB-CATCHMENT 2 10% of area GW goes to vaca 90% goes to sound
PERLND  16                        5.56     RCHRES   2      6
PERLND  26                      200.05     RCHRES   2      6
PERLND  34                        0.46     RCHRES   2      6
PERLND  44                       38.71     RCHRES   2      6
PERLND  16                        0.56     RCHRES 135      7
PERLND  26                       20.01     RCHRES 135      7
PERLND  34                        0.05     RCHRES 135      7
PERLND  44                        3.87     RCHRES 135      7
```

```
IMPLND  14                        42.22     RCHRES   2        2
 *** SUB-CATCHMENT 23 New subbasin 15 % OF GW GOES TO VACCA 85% TO SOUND
PERLND  16                         3.09     RCHRES  23        6
PERLND  26                       156.15     RCHRES  23        6
PERLND  34                         2.25     RCHRES  23        6
PERLND  44                        45.84     RCHRES  23        6
PERLND  16                         0.46     RCHRES 135        7
PERLND  26                        23.42     RCHRES 135        7
PERLND  34                         0.34     RCHRES 135        7
PERLND  44                         6.88     RCHRES 135        7
IMPLND  14                        58.44     RCHRES  23        2
 *** SUB-CATCHMENT 24 New subbasin 60 % OF GW GOES TO 11 40% TO SOUND
PERLND  26                       135.43     RCHRES  24        6
PERLND  34                         2.02     RCHRES  24        6
PERLND  44                        69.29     RCHRES  24        6
PERLND  26                        81.26     RCHRES  11        7
PERLND  34                         1.21     RCHRES  11        7
PERLND  44                        41.57     RCHRES  11        7
IMPLND  14                        79.98     RCHRES  24        2
  *** SUB-CATCHMENT 3 agwo goes to vaca(135)
PERLND  16                         8.26     RCHRES   3        6
PERLND  26                       108.38     RCHRES   3        6
PERLND  34                        16.02     RCHRES   3        6
PERLND  44                       102.89     RCHRES   3        6
PERLND  54                         0.04     RCHRES   3        6
PERLND  16                         8.26     RCHRES 135        7
PERLND  26                       108.38     RCHRES 135        7
PERLND  34                        16.02     RCHRES 135        7
PERLND  44                       102.89     RCHRES 135        7
PERLND  54                         0.04     RCHRES 135        7
IMPLND  14                        27.30     RCHRES   3        2
  *** SUB-CATCHMENT 4 10% of agwo goes to rchres 90% goes to sound
PERLND  16                         2.95     RCHRES   4        6
PERLND  26                        85.95     RCHRES   4        6
PERLND  34                         3.75     RCHRES   4        6
PERLND  44                        92.06     RCHRES   4        6
PERLND  16                         0.30     RCHRES   4        7
PERLND  26                         8.60     RCHRES   4        7
PERLND  34                         0.38     RCHRES   4        7
PERLND  44                         9.21     RCHRES   4        7
IMPLND  14                        18.43     RCHRES   4        2
  *** SUB-CATCHMENT 4a 70% of agwo goes to rchres 30% goes to sound
PERLND  16                         8.66     RCHRES   4        6
PERLND  26                        61.64     RCHRES   4        6
PERLND  34                        22.06     RCHRES   4        6
PERLND  44                        78.09     RCHRES   4        6
PERLND  54                        12.50     RCHRES   4        6
PERLND  16                         6.06     RCHRES   4        7
PERLND  26                        43.15     RCHRES   4        7
PERLND  34                        15.44     RCHRES   4        7
PERLND  44                        54.66     RCHRES   4        7
PERLND  54                         8.75     RCHRES   4        7
IMPLND  14                        29.14     RCHRES   4        2
  *** SUB-CATCHMENT 5
PERLND  26                        10.29     RCHRES   5        1
PERLND  44                        50.04     RCHRES   5        1
PERLND  54                        10.74     RCHRES   5        1
```

```
IMPLND  14                           16.31     RCHRES   5        2
  *** SUB-CATCHMENT 6
PERLND  16                           10.66     RCHRES  53        1
PERLND  26                           41.08     RCHRES  53        1
PERLND  34                           21.75     RCHRES  53        1
PERLND  44                           13.39     RCHRES  53        1
PERLND  54                            0.82     RCHRES  53        1
IMPLND  14                            7.14     RCHRES  53        2
  *** SUB-CATCHMENT 8
PERLND  44                           22.21     RCHRES  35        1
IMPLND  14                            6.60     RCHRES  35        2
  *** SUB-CATCHMENT 9
PERLND  16                            4.94     RCHRES  34        1
PERLND  26                           14.32     RCHRES  34        1
PERLND  34                            0.05     RCHRES  34        1
PERLND  44                           56.70     RCHRES  34        1
PERLND  54                            0.01     RCHRES  34        1
IMPLND  14                           22.46     RCHRES  34        2
  *** SUB-CATCHMENT 10
PERLND  16                            4.15     RCHRES  10        1
PERLND  26                           31.94     RCHRES  10        1
PERLND  44                           95.23     RCHRES  10        1
IMPLND  14                           71.97     RCHRES  10        2
  *** SUB-CATCHMENT 11 25% OF AGWO GOES TO 15
PERLND  16                            0.89     RCHRES  11        6
PERLND  26                          217.92     RCHRES  11        6
PERLND  34                            1.32     RCHRES  11        6
PERLND  44                           65.65     RCHRES  11        6
PERLND  16                            0.67     RCHRES  11        7
PERLND  26                          163.44     RCHRES  11        7
PERLND  34                            0.99     RCHRES  11        7
PERLND  44                           49.24     RCHRES  11        7
PERLND  16                            0.22     RCHRES  15        7
PERLND  26                           54.48     RCHRES  15        7
PERLND  34                            0.33     RCHRES  15        7
PERLND  44                           16.41     RCHRES  15        7
IMPLND  14                          230.80     RCHRES  11        2
  *** SUB-CATCHMENT 12
PERLND  16                            0.39     RCHRES  12        1
PERLND  26                          101.18     RCHRES  12        1
PERLND  34                            5.64     RCHRES  12        1
PERLND  44                           54.98     RCHRES  12        1
PERLND  54                            0.64     RCHRES  12        1
IMPLND  14                           79.83     RCHRES  12        2
  *** SUB-CATCHMENT 13
PERLND  16                            0.79     RCHRES  13        1
PERLND  26                          197.68     RCHRES  13        1
IMPLND  14                           27.66     RCHRES  13        2
  *** SUB-CATCHMENT 14 50% OF AGWO GOES TO SOUND
PERLND  16                            0.24     RCHRES  14        6
PERLND  26                          118.67     RCHRES  14        6
PERLND  34                           13.46     RCHRES  14        6
PERLND  44                           41.91     RCHRES  14        6
PERLND  16                            0.12     RCHRES  14        7
PERLND  26                           59.34     RCHRES  14        7
PERLND  34                            6.73     RCHRES  14        7
PERLND  44                           20.95     RCHRES  14        7
```

IMPLND 14	20.66	RCHRES	14	2
*** SUB-CATCHMENT 15				
PERLND 16	6.59	RCHRES	15	1
PERLND 26	49.55	RCHRES	15	1
PERLND 34	50.09	RCHRES	15	1
PERLND 44	86.52	RCHRES	15	1
IMPLND 14	19.47	RCHRES	15	2
*** SUB-CATCHMENT 16				
PERLND 16	10.93	RCHRES	16	1
PERLND 26	30.30	RCHRES	16	1
PERLND 34	20.03	RCHRES	16	1
PERLND 44	31.42	RCHRES	16	1
IMPLND 14	15.54	RCHRES	16	2
*** SUB-CATCHMENT 17 AGWO GOES TO SOUND				
PERLND 16	0.90	RCHRES	17	6
PERLND 26	16.31	RCHRES	17	6
PERLND 34	34.82	RCHRES	17	6
PERLND 44	82.11	RCHRES	17	6
PERLND 54	2.19	RCHRES	17	6
IMPLND 14	10.49	RCHRES	17	2
*** SUB-CATCHMENT MC-1				
PERLND 26	0.17	RCHRES	52	1
PERLND 44	8.21	RCHRES	52	1
PERLND 54	0.27	RCHRES	52	1
IMPLND 14	0.09	RCHRES	52	2
*** SUB-CATCHMENT MC-2				
PERLND 16	0.08	RCHRES	53	1
PERLND 26	0.64	RCHRES	53	1
PERLND 34	6.72	RCHRES	53	1
PERLND 44	10.43	RCHRES	53	1
PERLND 54	15.25	RCHRES	53	1
IMPLND 14	0.27	RCHRES	53	2
*** SUB-CATCHMENT MC-3				
PERLND 34	5.44	RCHRES	54	1
PERLND 44	5.03	RCHRES	54	1
PERLND 54	2.28	RCHRES	54	1
IMPLND 14	0.11	RCHRES	54	2
*** SUB-CATCHMENT MC-4				
PERLND 44	17.32	RCHRES	135	1
PERLND 54	14.41	RCHRES	135	1
IMPLND 14	1.77	RCHRES	135	2
*** SUB-CATCHMENT MC-5				
PERLND 26	13.49	RCHRES	35	1
PERLND 44	31.06	RCHRES	35	1
PERLND 54	5.95	RCHRES	35	1
IMPLND 14	2.50	RCHRES	35	2
*** SUB-CATCHMENT MC-6				
PERLND 44	17.75	RCHRES	35	1
PERLND 54	6.54	RCHRES	35	1
IMPLND 14	0.95	RCHRES	35	2
*** SUB-CATCHMENT MC-6B				
PERLND 26	34.94	RCHRES	35	1
PERLND 34	7.81	RCHRES	35	1
PERLND 44	52.91	RCHRES	35	1
PERLND 54	4.61	RCHRES	35	1
IMPLND 14	3.14	RCHRES	35	2
*** SUB-CATCHMENT MC-7				

```
PERLND  26                    12.66   RCHRES  16    1
PERLND  44                    33.53   RCHRES  16    1
PERLND  54                     4.16   RCHRES  16    1
IMPLND  14                     3.88   RCHRES  16    2
  *** SUB-CATCHMENT MC-7B
PERLND  26                    36.16   RCHRES  16    1
PERLND  44                     8.46   RCHRES  16    1
PERLND  54                     1.92   RCHRES  16    1
IMPLND  14                     2.12   RCHRES  16    2
***all sdn basin agwo goes to 35
  *** SUB-CATCHMENT SDN-1
PERLND  26                     3.23   RCHRES  52    6
PERLND  44                     2.11   RCHRES  52    6
PERLND  54                     0.20   RCHRES  52    6
PERLND  26                     3.23   RCHRES 135    7
PERLND  44                     2.11   RCHRES 135    7
PERLND  54                     0.20   RCHRES 135    7
IMPLND  14                     8.29   RCHRES  52    2

  *** SUB-CATCHMENT SDN-1-LWR
PERLND  44                     4.97   RCHRES  52    6
PERLND  54                     0.07   RCHRES  52    6
PERLND  44                     4.97   RCHRES 135    7
PERLND  54                     0.07   RCHRES 135    7
IMPLND  14                     0.38   RCHRES  52    2

  *** SUB-CATCHMENT SDN-1-OFF
PERLND  26                    29.12   RCHRES  52    6
PERLND  44                     3.62   RCHRES  52    6
PERLND  54                     1.67   RCHRES  52    6
PERLND  26                    29.12   RCHRES 135    7
PERLND  44                     3.62   RCHRES 135    7
PERLND  54                     1.67   RCHRES 135    7
IMPLND  14                    11.50   RCHRES  52    2

  *** SUB-CATCHMENT SDN-2
PERLND  26                    10.41   RCHRES  52    6
PERLND  44                     3.04   RCHRES  52    6
PERLND  26                    10.41   RCHRES 135    7
PERLND  44                     3.04   RCHRES 135    7
IMPLND  14                    33.22   RCHRES  52    2

  *** SUB-CATCHMENT SDN-2X
PERLND  26                     1.37   RCHRES  52    6
PERLND  44                     5.84   RCHRES  52    6
PERLND  26                     1.37   RCHRES 135    7
PERLND  44                     5.84   RCHRES 135    7
IMPLND  14                     0.28   RCHRES  52    2

  *** SUB-CATCHMENT SDN-3
PERLND  26                    49.79   RCHRES  54    6
PERLND  26                    49.79   RCHRES 135    7
IMPLND  14                    15.82   RCHRES  54    2

  *** SUB-CATCHMENT SDN-3X
PERLND  16                     0.65   RCHRES  54    6
PERLND  26                     5.17   RCHRES  54    6
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PERLND  34                        13.64    RCHRES  54        6
PERLND  44                         5.34    RCHRES  54        6
PERLND  54                         0.57    RCHRES  54        6
PERLND  16                         0.65    RCHRES 135        7
PERLND  26                         5.17    RCHRES 135        7
PERLND  34                        13.64    RCHRES 135        7
PERLND  44                         5.34    RCHRES 135        7
PERLND  54                         0.57    RCHRES 135        7

  *** SUB-CATCHMENT SDN-4
PERLND  26                        24.43    RCHRES  52        6
PERLND  44                         3.19    RCHRES  52        6
PERLND  26                        24.43    RCHRES 135        7
PERLND  44                         3.19    RCHRES 135        7
IMPLND  14                         2.61    RCHRES  52        2

  *** SUB-CATCHMENT SDN-4X
PERLND  26                         1.57    RCHRES  52        6
PERLND  34                         1.16    RCHRES  52        6
PERLND  44                        10.01    RCHRES  52        6
PERLND  26                         1.57    RCHRES 135        7
PERLND  34                         1.16    RCHRES 135        7
PERLND  44                        10.01    RCHRES 135        7

***ROUTING FOR MILLER CREEK
*** M1 TO M2 TO M3 TO STORAGE 50.  M4 TO M5 TO STORAGE 50
RCHRES   1                                 RCHRES   2        4
RCHRES  23                                 RCHRES  24        4
RCHRES  24                                 RCHRES   3        3
RCHRES   2                                 RCHRES   3        3
RCHRES   3                                 RCHRES  33        3
RCHRES  33                                 RCHRES  50        3
RCHRES   4                                 RCHRES   5        4
RCHRES   5                                 RCHRES  50        3
*** NEW STREAM REACH 52 TO LAKE REBA 53 TO RDF 54
RCHRES  52                                 RCHRES  53        3
RCHRES  53                                 RCHRES  54        3
RCHRES  50                                 RCHRES  54        3
*** RDF 54 TO 35
RCHRES  54                                 RCHRES 135        3
RCHRES  34                                 RCHRES 135        4
RCHRES  34                                 RCHRES 135        5
RCHRES 135                                 RCHRES  35        3
RCHRES  10                                 RCHRES  16        3
RCHRES  35                                 RCHRES  16        3
RCHRES  11                                 RCHRES  15        3
RCHRES  13                                 RCHRES  12        4
RCHRES  13                                 RCHRES  12        5
RCHRES  12                                 RCHRES  15        3
RCHRES  16                                 RCHRES  15        3
RCHRES  14                                 RCHRES  17        3
RCHRES  15                                 RCHRES  17        3
END SCHEMATIC

NETWORK
                                                                       ***
***        <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>        <-MEMBER->
```

```
<NAME>    # <NAME>    TEM STRG<-FACTOR->STRG <NAME>    #    # <-GRP> <NAME> # # ***
                                                                                ***

END NETWORK                                                                     ***

RCHRES
  GEN-INFO                                                                      ***
    RCHRES         Name          Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG               ***
                                              in   out
    1      Arbor Lake  M 1           2     1    1    1   62    0    0
    2      Arbor Ck -03710 M 2       1     1    1    1   62    0    0
    3      Arbor Ck    M 3           1     1    1    1   62    0    0
    4      Tub Lake    M 4           2     1    1    1   62    0    0
    5      Miller Ck SR518 M5        1     1    1    1   62    0    0
   10      Trib (0371G)    M 10      1     1    1    1   62    0    0
   11      M11 Ambaum Detention      1     1    1    1   62    0    0
   12      Trib(0354)  M 12          1     1    1    1   62    0    0
   13      Burien Lake M 13          2     1    1    1   62    0    0
   14      Trib (0353) M 14          1     1    1    1   62    0    0
   15      M/S U/S OF 17             1     1    1    1   62    0    0
   16      U/S OF 15 M/S             1     1    1    1   62    0    0
   17      GAGE                      1     1    1    1   62    0    0
   23      BASIN M23                 2     1    1    1   62    0    0
   24      BASIN M24                 1     1    1    1   62    0    0
   33      detention m3              1     1    1    1   62    0    0
   34      LORA LAKE                 2     1    1    1   62    0    0
   35      D/S OF VACA FARM          1     1    1    1   62    0    0
   38      MC basins                 1     1    1    1   62    0    0
   50      sr 518                    1     1    1    1   62    0    0
   52      U/S OF LAKE REBA          1     1    1    1   62    0    0
   53      Reba outflow              1     1    1    1   62    0    0
   54      Miller RDF outflow        1     1    1    1   62    0    0
  135      VACA FARMS                1     1    1    1   62    0    0
  END GEN-INFO
  ACTIVITY
    RCHRES *************** Active Sections *****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG                     ***
    1  999    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    RCHRES *************** Printout Flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
    1  999    5    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                         ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible   exit *** possible   exit     possible  exit
             *  *  *  *    *  *  *  *  *        *  *  *  *  *        ***
    1        0  1  0  0    4  5  0  0  0        0  0  0  0  0      2  2  2  2  2
    2        0  0  0  0    4  0  0  0  0        0  0  0  0  0      2  2  2  2  2
    3        0  0  0  0    4  0  0  0  0        0  0  0  0  0      2  2  2  2  2
    4        0  1  0  0    4  5  0  0  0        0  0  0  0  0      2  2  2  2  2
    5    12  0  0  0  0    4  0  0  0  0        0  0  0  0  0      2  2  2  2  2
   13        0  1  0  0    4  5  0  0  0        0  0  0  0  0      2  2  2  2  2
   14    22  0  0  0  0    4  0  0  0  0        0  0  0  0  0      2  2  2  2  2
   23        0  1  0  0    4  5  0  0  0        0  0  0  0  0      2  2  2  2  2
```

```
   24    33   0   0   0   0    4   0   0   0   0        0   0   0   0   0       2   2   2   2   2
   34         0   1   0   0    4   5   0   0   0        0   0   0   0   0       2   2   2   2   2
   35   999   0   0   0   0    4   0   0   0   0        0   0   0   0   0       2   2   2   2   2
END HYDR-PARM1
HYDR-PARM2                                                                                     ***
  RCHRES                                                                                       ***
  # -  #     FTABNO        LEN      DELTH     STCOR        KS       DB50                      ***
<------><--------><--------><--------><--------><--------><-------->
  1               1   0.010                                  0.3
  2               2   0.776                                  0.3
  3               3   0.980                                  0.3
  4               4   0.010                                  0.3
  5               5   0.380                                  0.3
 10              10   0.380                                  0.3
 11              11   0.010                                  0.3
 12              12   1.000                                  0.3
 13              13   0.015                                  0.3
 14              14   0.450                                  0.3
 15              15   0.735                                  0.3
 16              16   0.587                                  0.3
 17              17   0.379                                  0.3
 23              23   0.379            300.0                 0.3
 24              24   0.379                                  0.3
 33              33   0.200                                  0.3
 34              34   0.852                                  0.3
 35              35   0.663                                  0.3
 38              38   0.010                                  0.3
 50              50   0.010                                  0.3
 52              52   0.010                                  0.3
 53              53   0.010                                  0.3
 54              54   0.010                                  0.3
135             135   0.350                                  0.3
END HYDR-PARM2
HYDR-INIT
  RCHRES  Initial conditions for each HYDR section                                       ***
  # -  # ***   VOL     Initial  value  of COLIND    Initial  value  of OUTDGT
         *** ac-ft     for each possible exit       for each possible exit
<------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  1     2.0              4.0  5.0
  2     0.0              4.0
  3     0.0              4.0  5.0
  4     2.0              4.0
  5     0.0              4.0
 10     0.0              4.0
 11     0.0              4.0
 12     0.0              4.0
 13     10.0             4.0  5.0
 14     0.0              4.0
 15     0.0              4.0
 16     0.0              4.0
 17     0.0              4.0
 23     6.0              4.0  5.0
 24     0.0              4.0
 33     0.0              4.0
 34     9.0              4.0  5.0
 35     0.1              4.0
 38     0.1              4.0
```

```
   50      0.0                 4.0
   52      0.0                 4.0
   53      0.1                 4.0
   54      2.25                4.0
  135      0.00                4.0
  END HYDR-INIT
END RCHRES

FTABLES
***UPPER BASIN
***===========

  FTABLE      1
 ROWS COLS ***
   11    5
     DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.00        3.00     0.00        0.00    0.00
     2.50        3.00     7.50        0.00    0.11
     3.00        3.00     9.00        1.80    0.11
     3.50        3.30     10.58       5.00    0.11
     4.00        3.60     12.30       10.90   0.11
     4.50        3.90     14.18       17.50   0.11
     5.00        4.10     16.18       26.20   0.11
     5.50        4.30     18.28       32.50   0.11
     6.00        4.50     20.48       35.90   0.11
     7.00        5.00     25.23       38.10   0.11
     8.00        5.50     30.48       46.40   0.11
  END FTABLE  1

  FTABLE      2
 ROWS COLS ***
    9    4
     DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.000     0.0000     0.0000      0.00
     0.100     0.2571     0.0129      0.16
     0.500     0.3873     0.1417      6.53
     1.000     0.5501     0.3761     25.95
     1.500     0.7128     0.6918     59.86
     2.000     0.8756     1.0889    110.67
     3.000     1.2011     2.1273    272.24
     3.500     1.3639     2.7685    387.38
     4.000     1.5266     3.4912    528.19
  END FTABLE  2

  FTABLE      3
 ROWS COLS ***
   12    4
     DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.000     0.0000     0.0000      0.00
     0.100     0.9669     0.0483      0.13
     0.500     1.0637     0.4545      4.92
     1.000     1.1846     1.0165     17.12
     1.500     1.3055     1.6390     34.92
     2.000     1.4264     2.3220     57.95
     2.500     1.5473     3.0654     86.14
     3.000     1.6682     3.8693    119.53
     3.500     1.7891     4.7336    158.24
```

```
    4.000    1.9100    5.6584    202.41
    4.500    2.0294    6.6310    251.52
    5.000    2.1488    7.6624    306.28
 END FTABLE  3

 FTABLE      4
ROWS COLS ***
   7    5
    DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.00    3.00     0.00      0.00      0.00
     2.50    4.50     9.38      0.00      0.11
     3.00    6.00     12.00     6.00      0.11
     4.00    10.00    20.00     13.00     0.11
     5.00    15.00    32.50     20.00     0.11
     6.00    20.00    50.00     26.00     0.11
     7.00    25.00    72.50     168.00    0.11
 END FTABLE  4

 FTABLE      5
ROWS COLS ***
  10    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000    0.0000    0.0000      0.00
    0.100    0.1010    0.0051      0.03
    0.500    0.1754    0.0603      1.46
    1.000    0.2684    0.1713      6.16
    1.500    0.3614    0.3288     14.89
    2.000    0.4544    0.5327     28.48
    2.500    0.5474    0.7832     47.70
    3.000    0.6404    1.0801     73.29
    3.500    0.7334    1.4236    105.94
    4.000    0.8264    1.8136    146.33
 END FTABLE  5

 FTABLE     10
ROWS COLS ***
   9    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000    0.0000    0.0000      0.00
    0.100    0.1010    0.0051      0.06
    0.500    0.1660    0.0585      2.27
    1.000    0.2472    0.1618      9.32
    1.500    0.3285    0.3057     22.08
    2.000    0.4097    0.4902     41.66
    2.500    0.4909    0.7154     69.09
    3.000    0.5722    0.9811    105.37
    4.000    0.6887    1.6116    209.70
 END FTABLE 10

 POST AMBAUM DETENTION ***
 FTABLE     11
ROWS COLS ***
  11    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000    0.0000    0.0000      0.00
    1.000    0.1000    0.2300      3.90
    2.000    0.2000    0.6000      6.30
```

```
   3.000     0.3000     0.9700      8.10
   4.000     0.4000     1.3400     11.10
   5.000     0.5000     1.8200     16.00
   6.000     0.6000     2.2700     19.10
   7.000     0.7000     2.8300     21.60
   8.000     0.8000     3.3700     30.80
   9.000     0.9000     4.0000     38.10
  10.000     1.0000     4.6500     74.10
  10.500     1.1000     5.2000    133.00
  11.000     1.1500     5.3000    500.00
 END FTABLE 11

 FTABLE      12
ROWS COLS ***
   6    4
   DEPTH       AREA     VOLUME    OUTFLOW    ***
   0.000     0.0000     0.0000      0.00
   0.100     0.6327     0.0316      0.15
   0.500     0.7960     0.3174      5.87
   1.000     1.0002     0.7664     21.53
   1.500     1.2043     1.3176     46.43
   2.000     1.4085     1.9708     81.20
   3.000     1.8168     3.5834    183.79
   4.000     2.2251     5.6044    336.22
   5.000     2.6335     8.0337    545.30
   6.000     3.0418    10.8713    817.51
 END FTABLE 12

 FTABLE      13
ROWS COLS ***
   7    5
   DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
   0.000     40.000     0.0000      0.00      0.00
   1.000     41.400     40.000      0.00      0.11
   1.500     42.000     60.000     10.00      0.11
   2.000     42.700     80.000     16.00      0.11
   2.500     43.300     100.00     20.00      0.11
   3.000     44.000     120.00     28.00      0.11
   5.000     45.000     210.00     45.00      0.11
 END FTABLE 13

 FTABLE      14
ROWS COLS ***
   6    4
   DEPTH       AREA     VOLUME    OUTFLOW    ***
   0.000     0.0000     0.0000      0.00
   0.100     0.3361     0.0168      0.24
   0.500     0.3809     0.1602      9.04
   1.000     0.4370     0.3647     31.61
   1.500     0.4930     0.5972     65.00
   2.000     0.5491     0.8577    108.85
   2.500     0.6051     1.1462    163.33
   3.000     0.6612     1.4628    228.78
 END FTABLE 14

 FTABLE      15
ROWS COLS ***
```

```
   4    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
      0.00       0.10       0.00       0.00
      1.00       1.00       0.55      91.00
      2.00       1.10       1.60     268.00
      3.00       1.20       2.75     493.00
 END FTABLE 15

 FTABLE     16
ROWS COLS ***
   4    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
      0.00       0.10       0.00       0.00
      1.00       1.00       0.55      74.00
      2.00       1.10       1.60     219.00
      3.00       1.20       2.75     403.00
 END FTABLE 16

 FTABLE     17
ROWS COLS ***
   5    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
      0.00       0.10       0.00       0.00
      1.00       1.00       0.55      59.00
      2.00       1.10       1.60     173.00
      3.00       1.20       2.75     318.00
      4.00       1.30       4.00     484.00
 END FTABLE 17

 FTABLE     23
ROWS COLS ***  HERMES
   9    5
     DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW   ***
      0.00       0.00       0.00       0.00    0.00           0.00
      5.00       0.50       1.91       0.00    0.00         305.00
     11.00       0.79       5.79       0.00    0.00         311.00
     15.00       1.13       9.64       0.50    0.01         315.00
     19.00       1.72      15.34       0.50    0.05         319.00
     29.00       2.86      38.25       0.50    0.10         329.00
     39.00       4.40      74.55       0.50    0.20         339.00
     50.00       6.22     132.98       0.50    0.30         350.00
     60.00      10.00    1212.98       0.50    0.40         360.00
 END FTABLE 23

 FTABLE     24
ROWS COLS ***
   9    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.000     0.0000     0.0000       0.00
     0.100     0.2571     0.0129       0.16
     0.500     0.3873     0.1417       6.53
     1.000     0.5501     0.3761      25.95
     1.500     0.7128     0.6918      59.86
     2.000     0.8756     1.0889     110.67
     3.000     1.2011     2.1273     272.24
     3.500     1.3639     2.7685     387.38
     4.000     1.5266     3.4912     528.19
```

```
END FTABLE 24

FTABLE     33
ROWS COLS ***
  11    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.00       1.00      0.00      0.00
     0.50       1.20      0.55      2.00
     1.00       1.40      1.20      6.00
     1.50       1.60      1.95      9.00
     2.00       1.80      2.80     13.00
     2.50       2.00      3.75     16.50
     3.00       2.20      4.80     20.00
     3.50       2.40      5.95     23.00
     4.00       2.60      7.20     26.00
     5.00       2.80      9.90    104.00
     6.00       3.00     12.80    246.00
END FTABLE 33

FTABLE     34
ROWS COLS *** REVISED 11/19/97 BASED ON HEC-RAS MODEL
   6    5
    DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.00       3.00      0.00      0.00      0.00
     3.00       3.05      9.08      0.00      0.11
     4.00       3.10     12.15      0.00      0.11
     5.00       3.15     15.28      0.00      0.11
     6.00       3.20     18.45      72.0      0.11
     7.00       3.25     21.68     225.0      0.11
END FTABLE 34

FTABLE     35
ROWS COLS *** REVISED 11/19/97 BASED ON HECRAS MODEL
   5    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.00       0.10      0.00      0.00
     1.00       1.10      0.60     38.00
     2.00       1.20      1.75    108.00
     3.00       1.30      3.00    194.00
     4.00       1.40      4.35    290.00
END FTABLE 35

FTABLE     38
ROWS COLS ***
   7    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000     0.0000    0.0000      0.00
    1.000     0.4000    0.4000      2.00
    1.500     0.5000    1.0000      4.00
    2.000     0.9000    1.3000     11.00
    2.500     1.3000    1.6000     15.00
    3.000     1.6000    2.0000     18.00
    3.500     1.9000    2.5000     20.80
END FTABLE 38

FTABLE     45
ROWS COLS ***
```

```
NORTH EMPLOYEE PARKING LOT VAULT (AS-BUILT)***
  12     4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000     0.2200     0.0000       0.00
    2.000     0.2200     0.4500       1.20
    4.000     0.2200     0.9000       1.70
    6.000     0.2200     1.3400       2.10
    8.000     0.2200     1.7900       2.40
   10.000     0.2200     2.2400       2.70
   12.240     0.2200     2.7400       3.00
   14.000     0.2200     3.1400       6.90
   15.440     0.2200     3.4600       8.30
   16.000     0.2200     3.5800      10.30
   18.000     0.2200     4.0300      13.60
   20.000     0.2200     4.4800      30.79
 END FTABLE 45

 FTABLE      50
ROWS COLS ***
  10     4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.00       1.00       0.00       0.00
     0.50       1.10       0.53       5.00
     1.00       1.20       1.10      15.00
     1.50       1.30       1.73      25.00
     2.00       1.40       2.40      35.00
     2.50       1.50       3.13      52.00
     3.00       1.60       3.90      70.00
     3.50       1.70       4.73      87.00
     4.00       1.80       5.60     105.00
     6.00       1.90       9.30     165.00
 END FTABLE 50

 FTABLE      52
ROWS COLS ***
   6     4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000     0.0000     0.0000       0.00
    0.100     0.3680     0.0184       0.25
    0.500     0.3717     0.1664       9.39
    1.000     0.3763     0.3534      31.06
    2.000     0.3819     0.7325      94.37
    3.000     0.3874     1.1171     174.33
 END FTABLE 52

 FTABLE      53
OLD LAKE REBA                                 ***
MAX DEPTH = 4.9 FEET                          ***
30" CMP, 40 CFS DISCHARGE AT MAX DEPTH        ***
ROWS COLS ***
   7     4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000     2.4000     0.0000       0.00
    1.000     2.5800     2.5000      18.00
    2.000     2.9400     5.3000      26.00
    3.000     3.4100     8.4000      31.00
    4.000     3.8800     12.100      36.00
```

```
    4.900    4.3000     15.800      40.00
    6.000    4.3000     15.810     500.00
 END FTABLE 53

 FTABLE     54
EXISTING MILLER CREEK DETENTION FACILITY*** REVISED STORAGE/Q DATA
GATE SETTING: 2.0 FEET***
ROWS COLS ***
  12    4
    DEPTH        AREA     VOLUME    OUTFLOW    ***
    0.000        0.00       0.00       0.00
    1.300        0.01       0.01      10.00
    2.000        0.01       0.02      20.00
    2.900        0.70       0.40      30.00
    4.000        1.50       1.50      40.00
    5.400        3.50       4.90      50.00
    7.000        8.60      13.30      60.00
    8.800       15.60      34.80      70.00
   10.000       19.90      57.30      76.00
   10.500       21.50      68.00      92.00
   11.000       23.10      78.80     179.00
   11.500       24.70      88.60     303.00
 END FTABLE 54

 PRE AMBAUM DETENTION ***
 FTABLE    111
ROWS COLS ***
  12    4
    DEPTH        AREA     VOLUME    OUTFLOW    ***
    0.000      0.0000     0.0000       0.00
    0.500      0.2160     0.0750       5.30
    1.000      0.2730     0.1990      21.10
    1.500      0.2890     0.3410      43.90
    2.000      0.2900     0.4830      68.80
    2.500      0.2910     0.6070      89.10
    3.000      0.2950     0.6820      90.00
    3.500      0.3000     2.1000     100.00
    4.000      0.3050     2.5000     105.00
    4.500      0.3100     3.0000     110.00
    5.000      0.3200     3.5000     120.00
    5.500      0.3300     4.0000     130.00
 END FTABLE111

 FTABLE    135
ROWS COLS *** VACA FARM
   6    4
    DEPTH        AREA     VOLUME    OUTFLOW    ***
     0.00      0.10      0.00      0.00
     1.00      0.10      0.10      4.00
     2.00      0.11      0.21      8.00
     2.50      1.00      0.48     13.00
     3.50      6.50      4.23     86.00
     4.50     13.00     13.98    235.00
 END FTABLE135
```

***

```
END FTABLES


MASS-LINK
<Volume>    <-Grp> <-Member-><--Mult-->      <Target>       <-Grp> <-Member->***
<Name>             <Name> # #<-factor->      <Name>                <Name> # #***
  MASS-LINK        1
  conversion from acre-inches to acre-ft (1/12)              ***
PERLND      PWATER PERO        0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    1

  MASS-LINK        2
IMPLND      IWATER SURO        0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
RCHRES      ROFLOW                           RCHRES         INFLOW
  END MASS-LINK    3

  MASS-LINK        4
RCHRES      OFLOW  OVOL   1                  RCHRES         INFLOW IVOL
  END MASS-LINK    4

  MASS-LINK        5
RCHRES      OFLOW  OVOL   2                  RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
PERLND      PWATER SURO        0.0833333     RCHRES         INFLOW IVOL
PERLND      PWATER IFWO        0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    6

  MASS-LINK        7
PERLND      PWATER AGWO        0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
PERLND      PWATER PERO        0.0833333     COPY           INPUT  MEAN
  END MASS-LINK    8
  MASS-LINK        12
PERLND      PWATER AGWO        0.0833333     COPY           INPUT  MEAN
  END MASS-LINK    12

  MASS-LINK        9
IMPLND      IWATER SURO        0.0833333     COPY           INPUT  MEAN
  END MASS-LINK    9

  MASS-LINK        10
COPY        OUTPUT MEAN                      RCHRES         INFLOW IVOL
  END MASS-LINK    10

END MASS-LINK
END RUN
```

WALKER CREEK HSPF CALIBRATION
MODEL INPUT FILE

This page included for guidance only.
(Not to be included in document.)

```
RUN
GLOBAL
  ***  FILE: WALKER21.inp REVISED March 2001  Joe Brascher ATC
  ***  SEATAC AIRPORT HSPF BASIN MODEL OF WALKER CREEK (Calibration)
  ***  DEVELOPED BY PARAMETRIX (JRD) 2000 BASED ON 1999 SMP MODEL (KWR)
  WALKER CREEK BASIN HSPF MODEL
  START       1989 01  1  0  0  END    1996  8 30 24  0
  RUN INTERP OUTPUT LEVEL    3
  RESUME      0 RUN      1
END GLOBAL

FILES
<type>  <fun>***<------------fname------------------------------------------->
MESSU      24   D:\PARA\SEATAC\MILLER\WALKER.MES
WDM        25   D:\PARA\SEATAC\MILLER\MILL.WDM
           61   D:\PARA\SEATAC\MILLER\wPER.L61
           62   D:\PARA\SEATAC\MILLER\wRCH.L62
END FILES

OPN SEQUENCE
    INGRP              INDELT 01:00
      PERLND      14
      PERLND      16
      PERLND      18
      PERLND      24
      PERLND      26
      PERLND      28
      PERLND      34
      PERLND      44
      PERLND      45
      PERLND      54
      PERLND      64
      PERLND      65
      IMPLND      14
      RCHRES      20
      RCHRES      19
      RCHRES      18
    END INGRP
END OPN SEQUENCE
                                                                          ***
COPY
  TIMESERIES
  Copy-opn                                                                ***
    # -  #  NPT  NMN                                                      ***
    1    5        1
  END TIMESERIES
END COPY

PERLND
  GEN-INFO
    <PLS >       Name          NBLKS   Unit-systems   Printer             ***
    # -  #                           User  t-series Engl Metr             ***
                                             in  out                      ***
   14       TFF- TILL FOR FLT      1     1    1    1   61    0
   16       TFM- TILL FOR MOD      1     1    1    1   61    0
   18       TFS- TILL FOR STP      1     1    1    1   61    0
   24       TGF- TILL GR FLT       1     1    1    1   61    0
```

```
  26      TGM- TILL GR MOD       1    1    1    1   61    0
  28      TGS- TILL GR STP       1    1    1    1   61    0
  34      OF - OUTWASH FOR       1    1    1    1   61    0
  44      OG - OUTWASH GR        1    1    1    1   61    0
***PERLND FOR NEW AIRPORT FILL; NONE IN CALIBRATION
  45      AIRPORT FILL           1    1    1    1   61    0
  54      SA - WETLANDS          1    1    1    1   61    0
  64      TGM DES MOINES         1    1    1    1   61    0
  65      OG  DES MOINES         1    1    1    1   61    0
END GEN-INFO
ACTIVITY
  <PLS > ************* Active Sections *****************************
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC         ***
  14  200    0    0    1    0    0    0    0    0    0    0    0    0
END ACTIVITY
PRINT-INFO
  <PLS > ********************* Print-flags ************************ PIVL  PYR
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
  14  200    0    0    5    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO
PWAT-PARM1
  <PLS > ***************** Flags *******************
  # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                          ***
  14        0    0    0    0    0    0    0    0    0
  16        0    0    0    0    0    0    0    0    0
  18        0    0    0    0    0    0    0    0    0
  24        0    0    0    0    0    0    0    0    0
  26        0    0    0    0    0    0    0    0    0
  28        0    0    0    0    0    0    0    0    0
  34        0    0    0    0    0    0    0    0    0
  44        0    0    0    0    0    0    0    0    0
  45        0    0    0    0    0    0    0    0    0
  54        0    0    0    0    0    0    0    0    0
  64        0    0    0    0    0    0    0    0    0
END PWAT-PARM1
PWAT-PARM2
  <PLS > ***
  # -  # ***FOREST        LZSN     INFILT       LSUR      SLSUR      KVARY      AGWRC
  14                    4.5000     0.0800     400.00     0.0500     0.5000     0.9960
  16                    4.5000     0.0800     400.00     0.1000     0.5000     0.9960
  18                    4.5000     0.0800     200.00     0.2000     0.5000     0.9960
  24                    4.5000     0.0300     400.00     0.0500     0.5000     0.9960
  26                    4.5000     0.0300     400.00     0.1000     0.5000     0.9960
  28                    4.5000     0.0300     200.00     0.2000     0.5000     0.9960
  34                    5.0000     2.0000     400.00     0.0500     0.3000     0.9960
  44                    5.0000     0.8000     400.00     0.0500     0.3000     0.9960
  45                    7.5000     0.0200     300.00     0.0700     0.0000     0.9960
  54                    4.0000     2.0000     100.00     0.0010     0.5000     0.9960
  64                    4.5000     0.1200     400.00     0.1000     0.5000     0.9990
  65                    5.0000     0.8000     400.00     0.0500     0.5000     0.9960
END PWAT-PARM2
PWAT-PARM3
  <PLS >***
  # -  #*** PETMAX      PETMIN     INFEXP     INFILD     DEEPFR     BASETP     AGWETP
  14                               2.0000     2.0000       0.00       0.00        0.0
  16                               2.0000     2.0000       0.00       0.00        0.0
  18                               2.0000     2.0000       0.00       0.00        0.0
```

```
   24                         2.0000    2.0000      0.00      0.00        0.
   26                         2.0000    2.0000      0.00        0.        0.
   28                         2.0000    2.0000      0.00        0.        0.
   34                         2.0000    2.0000      0.00      0.00       0.0
   44                         2.0000    2.0000      0.00        0.        0.
   45                         2.0000    2.0000      0.00        0.        0.
   54                         10.000    2.0000      0.00        0.       0.7
   64                         2.0000    2.0000      0.00        0.       0.0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >                                                      ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC    LZETP***
   14         0.2000    1.0000    0.3500     2.000    0.1500    0.7000
   16         0.2000    0.5000    0.3500     2.000    0.1500    0.7000
   18         0.2000    0.3000    0.3500     2.000    0.1500    0.7000
   24         0.1000    0.5000    0.2500     2.000    0.1500    0.2500
   26         0.1000    0.2500    0.2500     2.000    0.1500    0.2500
   28         0.1000    0.1500    0.2500     2.000    0.1500    0.2500
   34         0.2000    0.5000    0.3500     0.000    0.5000    0.7000
   44         0.1000    0.5000    0.2500     0.000    0.5000    0.2500
   45         0.1000    0.2800    0.2500     0.000    0.5000    0.2500
   54         0.1000    3.0000    0.5000     1.000    0.7000    0.8000
   64         0.1000    0.2500    0.2500     3.000    0.5000    0.2500
   65         0.1000    0.5000    0.2500     0.000    0.5000    0.2500
  END PWAT-PARM4
  PWAT-STATE1
    <PLS >  PWATER state variables***
    # -  #***   CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   14          0.078        0.    0.2500      0.10     2.500      2.00     0.000
   16          0.078        0.    0.2500      0.10     2.500      2.00     0.000
   18          0.078        0.    0.2500      0.10     2.500      2.00     0.000
   24          0.051        0.    0.2500      0.10     2.500      2.00     0.000
   26          0.051        0.    0.2500      0.10     2.500      2.00     0.000
   28          0.051        0.    0.2500      0.10     2.500      2.00     0.000
   34          0.078        0.    0.2500      0.10     0.000      2.00     0.000
   44          0.051        0.    0.2500      0.10     0.000      2.00     0.000
   45          0.051        0.    0.2500      0.10     0.000      2.00     0.000
   54          0.051        0.    0.2500      0.10     2.000      2.00     0.000
   64          0.051        0.    0.2500      0.10     2.000     20.00     0.000
   65          0.051        0.    0.2500      0.10     0.000     20.00     0.000
  END PWAT-STATE1
END PERLND
IMPLND
  GEN-INFO
    <ILS >      Name             Unit-systems   Printer                     ***
    # -  #                     User  t-series Engl Metr                     ***
                                       in  out                              ***
   14       IMPERVIOUS            1    1    1   60    0
  END GEN-INFO
  ACTIVITY
    <ILS > ************* Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL  ***
   14         0    0    1    0    0    0
  END ACTIVITY
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
```

```
  14          0    0    6    0    0    0    1    9
 END PRINT-INFO
 IWAT-PARM1                                                             ***
   <ILS >           Flags            ***                                ***
   # -  # CSNO RTOP  VRS  VNN RTLI   ***
  14          0    0    0    0    0
 END IWAT-PARM1
 IWAT-PARM2                                                             ***
   <ILS >                                                               ***
   # -  #      LSUR     SLSUR      NSUR     RETSC
  14         100.00    0.0100    0.1000    0.1000
 END IWAT-PARM2
 IWAT-PARM3                                                             ***
   <ILS >                                                               ***
   # -  #    PETMAX    PETMIN
  14
 END IWAT-PARM3
 IWAT-STATE1                                                            ***
   <ILS >  IWATER state variables                                       ***
   # -  #      RETS      SURS
  14      1.0000E-3 1.0000E-3
 END IWAT-STATE1
END IMPLND
                                                                        ***
EXT SOURCES
                                                                        ***
*** NOTE: The only RCHRES that precip and PET are applied to are lakes.
                                                                        ***
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
*** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
WDM      2 PREC     ENGLZERO  1.00         PERLND  14 200 EXTNL  PREC
WDM      2 PREC     ENGLZERO  1.00         IMPLND  14     EXTNL  PREC
WDM   1010 EVAP     ENGLZERO  0.8          PERLND  14  65 EXTNL  PETINP
WDM   1010 EVAP     ENGLZERO  0.8          IMPLND  14     EXTNL  PETINP
*** PRECIP/EVAP TO LAKES
WDM      2 PREC     ENGLZERO               RCHRES  20     EXTNL  PREC
WDM   1010 EVAP     ENGLZERO    0.8        RCHRES  20     EXTNL  POTEV

END EXT SOURCES
                                                                        ***
EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
*** GAUGE POINTS (17=MOUTH, 54=MILLER RDF, 50=SR 518, 18=WALKER CK)
RCHRES  18 HYDR   RO                       WDM     36 FLOW     ENGL      REPL
*** MISC (20=WALKER WETLAND, 55=SR509, 56=1ST AVE)
RCHRES  20 HYDR   RO                       WDM     37 FLOW     ENGL      REPL
RCHRES  20 HYDR   STAGE  1 1     ***       WDM   1037 STAG     ENGL      REPL
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
***WALKER NR MTH
RCHRES  18 HYDR   RO     1 1 0.000764      WDM     50 SIMQ     ENGL      REPL
RCHRES  20 HYDR   RO     1 1 0.006520      WDM   1051 SIMQ     ENGL      REPL
END EXT TARGETS
                                                                        ***
SCHEMATIC
```

```
<-Source->                    <--Area-->   <-Target->  MBLK    ***
<Name>   #                    <-factor->   <Name>   #  Tbl#    ***

***WALKER CREEK
  *** SUB-CATCHMENT  MC 8
PERLND  26                       5.19      RCHRES  20     1
PERLND  44                      20.92      RCHRES  20     1
PERLND  54                       2.91      RCHRES  20     1
IMPLND  14                       1.79      RCHRES  20     2
  *** SUB-CATCHMENT  MC 8B
PERLND  26                      19.21      RCHRES  20     1
PERLND  44                      15.45      RCHRES  20     1
PERLND  54                       0.61      RCHRES  20     1
IMPLND  14                       1.71      RCHRES  20     2
  *** SUB-CATCHMENT  MC 9
PERLND  26                       9.33      RCHRES  20     1
PERLND  44                       3.93      RCHRES  20     1
PERLND  54                       0.08      RCHRES  20     1
IMPLND  14                       0.32      RCHRES  20     2
  *** SUB-CATCHMENT 18
PERLND  16                       0.76      RCHRES  18     1
PERLND  26                      16.08      RCHRES  18     1
PERLND  34                      20.95      RCHRES  18     1
PERLND  44                      49.22      RCHRES  18     1
IMPLND  14                       3.30      RCHRES  18     2
  *** SUB-CATCHMENT 19
PERLND  16                      12.72      RCHRES  19     1
PERLND  26                      92.07      RCHRES  19     1
PERLND  34                       8.39      RCHRES  19     1
PERLND  44                      95.55      RCHRES  19     1
IMPLND  14                      30.53      RCHRES  19     2
  *** SUB-CATCHMENT 20
PERLND  26                      12.53      RCHRES  20     1
PERLND  44                      53.43      RCHRES  20     1
PERLND  54                      33.43      RCHRES  20     1
IMPLND  14                      52.83      RCHRES  20     2
*** DOWN STREAM OF WALKER CREEK GAGE
  *** SUB-CATCHMENT 21 33% OF GW GOES TO GAGE REST GOES TO SOUND
PERLND  16                       2.54      RCHRES  18     7
PERLND  26                      44.30      RCHRES  18     7
PERLND  34                       2.03      RCHRES  18     7
PERLND  44                      41.13      RCHRES  18     7
  *** SUB-CATCHMENT 22
PERLND  34                       4.30      RCHRES  22     1
PERLND  44                      19.49      RCHRES  22     1
PERLND  54                       3.21      RCHRES  22     1
IMPLND  14                       3.95      RCHRES  22     2

***GROUNDWATER FROM OUTSIDE OF WALKER CREEK

PERLND  64                     630.00      RCHRES  20     7
PERLND  65               ***   130.00      RCHRES  20     7


***STREAM ROUTING
RCHRES  20                                 RCHRES  19     3
RCHRES  19                                 RCHRES  18     3
```

```
END SCHEMATIC

NETWORK                                                                                  ***

***          <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>          <-MEMBER->
<NAME>    # <NAME>    TEM STRG<-FACTOR->STRG <NAME>    #    # <-GRP> <NAME> # # ***
                                                                                         ***

END NETWORK                                                                              ***

RCHRES
  GEN-INFO                                                                               ***
    RCHRES         Name          Nexits   Unit Systems   Printer                         ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG                        ***
                                           in   out                                      ***
   18     Trib (0371A) M 18        1     1    1    1    62    0    0
   19     Trib (0371A) M 19        1     1    1    1    62    0    0
   20     Trib   M 20              1     1    1    1    62    0    1
   21     Trib (0371H) M 21        1     1    1    1    62    0    0
   22     Trib (0371A) M 22        1     1    1    1    62    0    0

  END GEN-INFO
  ACTIVITY
    RCHRES *************** Active Sections *****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG                             ***
    1   63    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    RCHRES *************** Printout Flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
    1   63    5    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible   exit *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1   99   0  1  0  0    4  0  0  0  0       0  0  0  0  0      2  2  2  2  2
  END HYDR-PARM1
  HYDR-PARM2
    RCHRES                                                                               ***
    # -  #     FTABNO       LEN     DELTH     STCOR        KS      DB50                  ***
  <------><--------><--------><--------><--------><--------><-------->                   ***
   18             18   0.800                               0.3
   19             19   0.568                               0.3
   20             20   0.379                               0.3
   21             21   0.450                               0.3
   22             22   0.300                               0.3
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
   18      0.1             4.0
   19      0.1             4.0
```


AR 047211

```
    20      10.0               4.0
    21      0.1                4.0
    22      0.1                4.0
  END HYDR-INIT
END RCHRES

FTABLES

  FTABLE     18
 ROWS COLS ***
   3    4
     DEPTH       AREA     VOLUME    OUTFLOW    ***
      0.00       1.30       0.00       0.00
      1.00       1.30       1.30     166.00
      2.00       1.40       2.65     490.00
  END FTABLE 18

  FTABLE     19
 ROWS COLS ***
   3    4
     DEPTH       AREA     VOLUME    OUTFLOW    ***
      0.00       1.10       0.00       0.00
      1.00       1.10       1.10      65.00
      2.00       1.20       2.25     223.00
  END FTABLE 19

  FTABLE     20
*** WALKER CREEK WETLAND
 ROWS COLS ***
  10    4
     DEPTH       AREA     VOLUME    OUTFLOW   OUTFLOW ***
      0.00       0.00       0.00       0.00
      1.00       2.50       1.25       7.04
      2.00       5.00       5.00      17.84
      3.00      12.00      13.50      32.17
      4.00      19.00      29.00      45.13
      5.00      22.00      49.50      54.95
      6.00      23.00      72.00      61.62
      6.10      23.00      74.30      62.15
      7.00      23.50      95.25      67.00
      7.24      24.10     101.10     100.00
  END FTABLE 20

  FTABLE     21
 ROWS COLS ***
   8    4
     DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.000     0.0000     0.0000       0.00
     0.100     0.2259     0.0113       0.11
     0.500     0.2707     0.1106       4.27
     1.000     0.3268     0.2600      15.13
     1.500     0.3828     0.4374      31.67
     2.000     0.4389     0.6428      54.02
     2.500     0.4949     0.8763      82.52
     3.000     0.5510     1.1377     117.55
  END FTABLE 21
```

```
  FTABLE     22
 ROWS COLS ***
   9    4
     DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.000     0.0000     0.0000       0.00
     0.100     0.3680     0.0184       0.25
     0.500     0.3717     0.1664       9.39
     1.000     0.3763     0.3534      31.06
     2.000     0.3819     0.7325      94.37
     3.000     0.3874     1.1171     174.33
     4.000     0.3930     1.5073     265.38
     5.000     0.3985     1.9030     364.68
     6.000     0.4040     2.3043     470.60
  END FTABLE 22
END FTABLES
MASS-LINK
<Volume>    <-Grp> <-Member-><--Mult-->     <Target>        <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                 <Name> # #***
  MASS-LINK        1
  conversion from acre-inches to acre-ft (1/12)             ***
PERLND      PWATER PERO        0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK    1

  MASS-LINK        2
IMPLND      IWATER SURO        0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
RCHRES      ROFLOW                           RCHRES          INFLOW
  END MASS-LINK    3

  MASS-LINK        4
RCHRES      OFLOW  OVOL   1                  RCHRES          INFLOW IVOL
  END MASS-LINK    4

  MASS-LINK        5
RCHRES      OFLOW  OVOL   2                  RCHRES          INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
PERLND      PWATER SURO        0.0833333     RCHRES          INFLOW IVOL
PERLND      PWATER IFWO        0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK    6

  MASS-LINK        7
PERLND      PWATER AGWO        0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
PERLND      PWATER PERO        0.0833333     COPY            INPUT  MEAN
  END MASS-LINK    8
  MASS-LINK       12
PERLND      PWATER AGWO        0.0833333     COPY            INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK        9
IMPLND      IWATER SURO        0.0833333     COPY            INPUT  MEAN
```

```
  END MASS-LINK     9

  MASS-LINK        10
COPY       OUTPUT MEAN                    RCHRES          INFLOW IVOL
  END MASS-LINK    10

END MASS-LINK
END RUN
```

PREFACE

Comprehensive Stormwater Management Plan
Seattle-Tacoma International Airport
Master Plan Update Improvements

July 2001

This document contains replacement pages developed in response to comments received from the Washington State Department of Ecology (Ecology) on Volumes 1 through 4 of the December 2000 Comprehensive Stormwater Management Plan (SMP) for the Seattle-Tacoma International Airport Master Plan Update Improvements. A facilitated process was used to document specific revisions required by Ecology to the December 2000 SMP. Each SMP volume contains an itemized list of replacement pages, and the replacement pages are identified by a July 2001 footer.

SMP VOLUME 4
JULY 2001 REPLACEMENT PAGES

Preface (before pg. *i*)
List of Volume 4 Replacement Pages
APPENDIX D (*Entire Appendix replaced*):
- List of Pond Plan and Profiles;
- Exhibits C131; C132; C133; C133.1; C134; C134.1; C134.2; C134.3; C135; C135.1; C136; C136.1; C136.2; C137; C138; C139; C140: C141; C145; C146; C147; C148; C149; C150; C151; and D-2
- October 27, 2000 Vault Structural Feasibility Memo (1 pg.)
- April 23, 2001 Supplemental Vault Structural Feasibility Memo (3 pgs.)
- April 21, 2001 Geotechnical Assessment of Constructing Vaults in Fill (2 pgs.)
- April 26, 2001 Feasibility of Vault Maintenance Memo (3 pgs.)

APPENDIX F
- Pg. 1 of December 14, 2000 Infiltration Memo
- May 23, 2001 Infiltration Feasibility Memo for Pond F (10 pgs.)

APPENDIX G:
- Section 3.2 (pg. G-5)
- Table G-2 (pg. G-6)

APPENDIX H:
- Table H-6 (pg. H-10)

APPENDIX Q:
- Exhibits C113, C114; C116; C118; C127; C128; C129; and C130

APPENDIX R:
- R-4 Pond B Drawing (Sheet C40)

APPENDIX Y:
- *Entire Appendix replaced* (17 pgs.)

Note: Listed page totals do not include "guidance" pages (the guidance pages do not need to be inserted as replacement pages).

COMPREHENSIVE STORMWATER MANAGEMENT PLAN

VOLUME 4

APPENDICES C THROUGH Z

SEATTLE-TACOMA INTERNATIONAL AIRPORT MASTER PLAN UPDATE IMPROVEMENTS

FOR AGENCY REVIEW

Prepared for

PORT OF SEATTLE
Seattle-Tacoma International Airport
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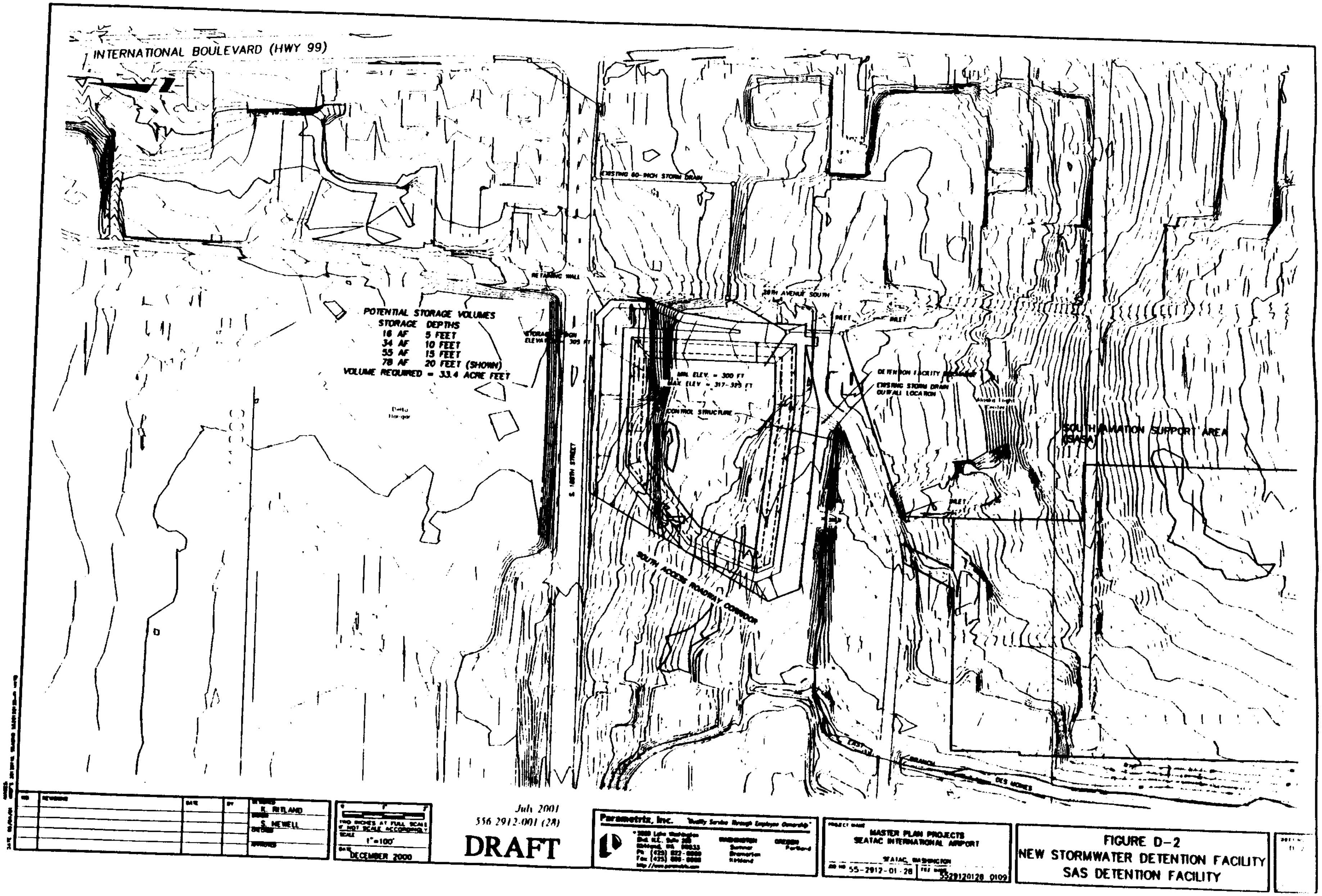
Seattle, Washington 98168-0727

Prepared by

PARAMETRIX, INC.
5808 Lake Washington Blvd. N.E., Suite 200
Kirkland, Washington 98033-7350

December 2000
556-2912-001 (28)

VOLUME 4


INTERNATIONAL BOULEVARD (HWY 99)
EXISTING 60-INCH STORM DRAIN
RETAINING WALL
28TH AVENUE SOUTH
INLET
POTENTIAL STORAGE VOLUMES
STORAGE DEPTHS
16 AF 5 FEET
34 AF 10 FEET
55 AF 15 FEET
78 AF 20 FEET (SHOWN)
VOLUME REQUIRED = 33.4 ACRE FEET
S. 188TH STREET
MIN. ELEV. = 300 FT
MAX ELEV. = 317-319 FT
CONTROL STRUCTURE
SOUTH ACCESS ROADWAY CORRIDOR
EXISTING STORM DRAIN
OUTFALL LOCATION
SOUTH AVIATION SUPPORT AREA
(SASA)
DES MOINES
R. RITLAND
S. NEWELL
1"=100'
DECEMBER 2000
July 2001
556 2912-001 (28)
DRAFT
Parametrix, Inc.
MASTER PLAN PROJECTS
SEATAC INTERNATIONAL AIRPORT
SEATAC, WASHINGTON
55-2912-01-28
5529120128 0109
FIGURE D-2
NEW STORMWATER DETENTION FACILITY
SAS DETENTION FACILITY

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Memorandum

To Michael Cheyne, Program Manager Date 10/27/00

From Tom Cossette, P.E.

Subject Port of Seattle – Stormwater Master Plan (SMP)
Stormwater Detention Vaults – Structural Feasibility

The storage of storm water runoff as part of a comprehensive drainage system is critical to the viability of the proposed Master Plan Improvements at Sea-Tac. As structural engineers who have had experience with large water storage tanks and buried structures, HNTB structural engineering group was asked to assess the feasibility of constructing a number of large buried stormwater detention vaults necessary to meet the requirements of these improvements. The capacity of the vaults currently proposed range from 4.3 to 98.1 acre-feet.

For the purposes of feasibility analysis, geotechnical and soil data was assumed to be similar to that investigated elsewhere on the airport site for buried vault facilities. Based on currently available information and professional knowledge of structural considerations for above and below grade facilities, HNTB offers the following comments:

> There are contractors in this country that have built numerous buried water storage facilities under a variety of site-specific conditions. One such contractor, Preload Inc., Garden City, N.Y, has constructed thousands of prestressed concrete water tanks in the one to ten million gallon range, and advertises sizes to 40 million gallons (approx.123 acre-feet) and beyond. As evidenced by numerous above and below grade potable water storage tanks and industrial chemical storage tanks around the country, steel containment vessels have also been designed and constructed to meet similar applications. It was concluded that the sizes of the proposed vaults are apparently well within what contractors can build with proven construction means and methods.

> There are existing stormwater detention vaults on site, between S. 188th Way and Runway 34L, with a total capacity of 6.2 acre-feet. They are below grade caste-in-place reinforced concrete box structures, approximately 40 ft. wide x 20 ft. tall x 300 ft. long, with a single interior wall that divides the vault longitudinally into two 20 ft. wide cells. For purposes of evaluating structural feasibility, a simple analysis of replicating the existing structures to obtain the necessary volumes was evaluated. The analysis concluded that similar construction could be used for the proposed 98.1 acre-feet capacity vault. The resulting configuration could be a box structure approximately 260 ft. wide x 26 ft. tall x 680 ft. long, consisting of thirteen 20 ft. wide cells. Furthermore, while the ultimate size of the vault might be constrained by land use features or topography, it is not constrained (horizontally) by structural limitations.

> The invert depths and heights of soil cover on the proposed vaults are not excessive and the proposed locations of vaults do not require the capability to support large aircraft loads. No significant structural issues have been identified due to soil cover and surface loadings on the proposed vaults.

Based on structural considerations, stormwater detention vaults of the magnitude shown in the SMP are feasible and well within the engineering and constructability standards and practices used in industry for similar facilities.

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Supplemental Memorandum

To: Michael Cheyne, Program Manager

Date: April 23, 2001

From: Tom Cossette/Alan Black

Subject: Port of Seattle – Stormwater Master Plan (SMP)
Stormwater Detention Vaults – Structural Feasibility

HNTB structural engineering group was asked to provide additional assessment for the feasibility of two non-standard vault design conditions that are shown in the Stormwater Master Plan Document: above ground detention/retention vaults and vaults within embankment areas.

Above Ground Vaults

There are three above ground vaults currently proposed in the Stormwater Master Plan Document.

Vault	Volume	Description of Condition
SDS3	12.9 Ac.Ft.	220' diameter x 18' deep portion above grade varies from 0' on one side to 10' on the opposite side
SDS7	21.4 Ac.Ft.	300' x 135' x 22' deep almost entirely above grade
SDN3	25.6 Ac.Ft.	300' x 187' x 25' deep. Mostly buried but the top 15 feet of one corner would be above grade

Based on currently available information and professional knowledge of structural considerations for these above grade facilities, HNTB offers the following comments:

SDS3 - Circular concrete tanks (vaults) are one of the most common types of water storage structures – whether above ground, partially buried, or fully buried. Preload Inc., Natgun Corp., and Crom Corp. are three examples of contractors who construct these tanks in various diameters and heights and in storage volume capacities that range from 0.6 to 120 Ac.Ft. Design and construction of circular concrete tanks is addressed by publications from the American Concrete Institute (ACI) and the Portland Cement Association (PCA).

SDS7 – This vault could be constructed as rectangular, but further investigation found that two circular vaults would be more cost effective to provide the required storage volume at this location. The two vaults can be hydraulically connected via large diameter pipe(s), either through the walls or through the floor. Penetrations through such structural elements can be accommodated by localized addition of steel reinforcing bars and/or member thickening. See SDS3 for discussion regarding circular tanks.

SDN3 – SeaTac has a an existing buried reinforced concrete stormwater detention vault on site, between S. 188th Way and Runway 34L, that is smaller but similar to this proposed vault. Design and construction of partially buried and buried rectangular concrete water storage vaults has a history and a future. A few comparable facilities elsewhere in the United States are described below.

HNTB is completing conceptual design for Lansing's Art and Education Center that is adjacent to a 30.6 Ac.Ft. partially buried water storage vault that was built in 1938. The water company owner is expecting that the vault will serve their needs for another 50 to 60 years.

A 20.7 Ac.Ft. buried reinforced concrete stormwater storage vault was constructed ten years ago as part of a new hold apron at Chicago's Midway Airport.

The Norumbega Reservoir, a 350 Ac.Ft. buried water storage vault, is currently being constructed by the Massachussetts Water Resources Authority.

One corner of this vault would be above grade. The differential earth and hydrostatic pressures generated by the sloping fill can be accommodated in the vault design. This generally takes the form of localized additions of steel reinforcing bars and/or member thickening.

Vaults within Embankment Areas

There are two vaults currently proposed to be within the airfield embankment.

Vault	Volume	Description of Condition
SDW1A	13.8 Ac.Ft.	200' x 100' x 30' deep below grade – set as close to edge of embankment as possible to minimize area for aircraft loading design
SDN3A	10.2 Ac.Ft.	Two 120' x 120' x 23' deep below grade vaults connected by a 48-in diameter equalizer pipe– set near the edge of embankment (or retaining wall) as possible to minimize area for aircraft loading design.

Based on currently available information and professional knowledge of structural considerations for these above grade facilities, HNTB offers the following comments:

SDW1A – Structural investigations of a particular conceptual layout for a rectangular vault was made for two contrasting siting conditions. The investigations included 2-dimensional frame analyses to arrive at preliminary foundation, wall, and top slab sizes. The assumed values for the geotechnical soil parameters (soil unit weight, lateral earth pressure, bearing capacity) used to complete the analyses are within a likely range for the soil units to be expected for this project, as presented in the Preliminary Geotchnical Assessment that accompanies this memo.

The first siting condition for which the concept layout was investigated was for the top of the vault to be flush with the 3rd runway apron and subject to direct aircraft loading (taxi weight of a 757-200). The second siting condition was for the vault located within the embankment slope such that 40 feet of the top surface would be exposed along the west edge. The dominant loading for this condition results from the approximately 38 feet deep triangular wedge of fill on top of the vault along east side and the accompanying highly differential lateral earth forces.

As a result of these specific structural investigations, HNTB engineers conclude that buried and partially buried rectangular vaults, of comparable order-of-magnitude size, are certainly feasible as a stormwater storage facility choice for this project.

SDN3A – These proposed vaults are of comparable size, and may be sited similar, to SDW1A for which specific structural investigations and affirmative feasibility conclusions were made, as discussed above.

PRELIMINARY GEOTECHNICAL ASSESSMENT OF CONSTRUCTING STORM WATER DETENTION VAULTS C_1, C_2 AND G_1, IN EMBANKMENT FILL

Hart Crowser evaluated stability of proposed stormwater vaults C_1, C_2 and G1, located as shown in the December 2000 Comprehensive Stormwater Management Plan, and including alternate locations on the top and bottom of the west facing embankment slope adjacent to Runway Stations 206+44 and near the toe of the embankment slope adjacent to Station 202+47.

1. Slope stability does not present a "critical flaw" for any of the proposed vault locations that we evaluated. Current feasibility level analyses were accomplished for both the 475- and 975-year seismic events. Ranges in factors of safety, with and without subgrade improvements, are slightly affected by vault location, but requirements for subgrade improvement (to provide slope stability) are more or less the same with and without vaults.

2. Embankment fill constructed to date has typically been compacted to minimum percentages of maximum, modified Proctor density of 90 to 92 percent, depending primarily on type of fill material. Actual densities achieved typically vary, but exceed specified minimums. Hart Crowser typically recommends that fill placed to support structures be compacted to at least 95 percent of maximum, modified Proctor density. Although some additional construction effort will be required, Third Runway construction experience to date indicates this can be accomplished within the area needed to support vaults.

3. Allowable bearing pressures for structures in the fill are anticipated to be around 4 kips per square foot and may be higher. This value is in addition to the weight of the fill itself, for embedded structures. Preliminary analyses indicated only nominal setback or embedment for foundations would be required relative to the sloping embankment surface to obtain the recommended allowable bearing. Additional setback or embedment may be appropriate to prevent any potential sloughing from exposing the footing.

4. Total and differential settlement of fill supporting the vaults will vary depending on location, size and sequence of construction. Potential differential settlement of pipes connected to the vault(s) and extending across fill zones compacted to different minimum densities may need to be addressed by settlement monitoring and construction

of piping after completion of primary fill settlement. Hart Crowser does not anticipate this will present any significant construction difficulty.

5. Nominal unit weight of the fill for conceptual design purposes is around 140 pounds per cubic foot (pcf). Lateral earth pressures acting on the vaults under static conditions are anticipated to be around 60 pcf (expressed as an equivalent fluid density) assuming backfill against non-yielding walls. Seismic surcharge on the embedded structures will be comparable to basement structures of comparable size, constructed per UBC.

6. Shallow piping (inlet or outlet) extending down the embankment face can be designed and constructed with conventional procedures, such as seepage collars. Published guidance used for outlet control structures on earth dams provides a good basis for design of the vaults and connecting piping for the Third Runway embankment.

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Memorandum

To	Michael Cheyne, Program Manager	Date	April 26, 2001
From	Alan Black		
Subject	Port of Seattle – Stormwater Master Plan (SMP) Stormwater Detention Vaults –Feasibility of Maintenance		

The HNTB engineering group was asked to address January 2001 King County comments, Group 5 checklist item 2 requesting additional information on the maintenance feasibility of above ground and deeper than standard detention vaults that are shown in the Stormwater Master Plan.

King County standard detention vaults are described in the King County Surface Water Design Manual as facilities having the following characteristics:

- Maximum depth finished grade to the vault invert shall be 20 feet.
- Access ports located within 50 feet of any point in the vault with round solid locking lids, 3-foot square, locking diamond plate covers.
- Facilities with >1250 square feet (SF) shall include 5' x 10' removable panel
- Meet OSHA confined space requirements including ladders with hand holds provided at inlet and outlet pipe locations and clearly marked entrances to confined space areas.
- Internal walls shall be provided with openings sufficient for maintenance access and sized and situated for access to maintenance "v" in the vault floor.
- Ventilation pipes (12-inch diameter minimum) provided at all four corners to allow for artificial ventilation prior to entry of maintenance personnel.

Stormwater Master Plan Detention Vault Facilities

Vault Name	Exhibit	Depth*	Floor Area	Configuration
SDW2 Reserve Stormwater Release Vault	C131	16 ft	3600 SF	Below ground
SDS4	C139	20 ft	38,015 SF	Flush with ground at access road.
SDS7	C140	25 ft	47,250 SF	Above ground
SDS3	C141	41 ft	192,500 SF	Below ground
SDN3	C145	27 ft	56,100 SF	Mostly below ground
SDN2/SDN4	C146	23 ft	34,375 SF	Flush with ground at access road.
M6 (NEPL)	C147	28 ft	33,000 SF	Below ground
SDN1	C148	24 ft	21,905 SF	Mostly below ground
SDN6 (CARGO)	C149	18 ft	15,395 SF	Flush with ground
SDN3 (2 Vaults)	C150	25 ft	14,400 SF	Below ground
SDW1A	C151	38 ft	20,000 SF	Below ground

* An allowance of 2 feet has been used for the top slab thickness to estimate depth where defined by the top of structure. Maximum potential access depth is shown; actual depths vary.

Based on currently available information and discussion with Port of Seattle maintenance staff, HNTB offers the following comments:

There is one facility, SDS7 Basin Vault (sheet C140 in appendix D) shown as an above ground facility. The SDS7 Basin Vault would have a top elevation at approximately 325. The adjacent land varies between elevation 312 and 300. Two maintenance options are available: external stair, ladder, or access ramp roadway. The stair or ladder options would provide person access for regular inspections but a crane would be required to lift pump units or other equipment for less frequent cleaning operations. The lift height of 15 feet would allow use of smaller cherry-picker cranes. An access ramp is also feasible for this location. The King County standard 15 percent maximum slope would result in an 87-foot long ramp grade along the tank wall. Site constraints would likely require that this ramp would be constructed as a 15-foot wide asphalt roadway on a mechanically stabilized earth wall and barrier type wall coping. The drawings illustrate the ramp option since it would require the largest facility footprint (to facilitate assessment of greatest likely impact), but selection of which option is used will be done during final design.

All others that protrude above ground do so in only a portion of the top area. These will be designed for direct HS20 loading to allow full vehicular access to any part of the top to allow maintenance using the same methods typical of an underground tank. Those facilities are accessed from the side that is buried.

Most facilities exceed the King County maximum depth of 20 feet between top of finished grade and the invert of the vault in at least a portion of the facility. Though the KCSWDM does not specifically note the reason for this guideline, the maximum depth is likely the result of limitations for existent King County maintenance equipment. Since these facilities would be Port maintained facilities, the King County standard are not considered as design constraints for these facilities. The following special provisions are anticipated to address the maintenance of these facilities.

- The Port of Seattle currently uses a vactor truck, truck mounted cranes and block and tackle on tripod for vault cleaning work. The Port has noted that they do not see the depth of these facilities as a concern, but has noted that they may require some new or modified equipment to accommodate the facilities as shown. HNTB conducted a web search and verified that vactor trucks are available in a wide range of configurations and capacities. The largest "heavy industrial vacuum (Guzzler/Vactor) truck available through United Pumping was noted to be "capable of removing [water] from remote or inaccessible locations as far away from the machine as 1000 feet or more through suction lines 8" in diameter and smaller." This is consistent with the Port's intent to test alternate suction line configurations to address the proposed conditions, but also gives HNTB confidence that there is a vactor truck available if the Port's existing truck proves to be inadequate. A local utility cleaning service that uses vactor trucks indicated that they have gone to 100-foot depths with their equipment but they noted that pumping time increases with depth. The Port has the option to replace the function of the vactor truck with new or existing portable pumps that could be selected to perform better. The existing truck mounted crane or block and tackle could be used to lower a pump into position. The designer will continue to work with the Port through final design to allow them adequate time to plan and acquire equipment as needed.
- Vault access ports will meet or exceed King County standards.

- The Port has noted that we should use the current maximum of 41 feet as the depth limit in the event that further design/model developments identify a need for larger facilities.
- OSHA requires that ladders greater than 25 feet in height include intermediate landing for personnel access safety. This tends to add undesirable inconvenience for lowering items though the access ports on space constrained facilities. The large size of these facilities would allow space for landings or internal stairways for personnel access separate from the 5' x 10' equipment access doors or panels.
- The County's suggested provisions for ventilation might be inadequate for the large facilities shown. A qualified engineer will work with the Port to ensure that ventilation is adequate to meet OSHA confined space requirements. Self-contained supplied air is readily available to maintenance worker if needed.
- Pretreatment on the airfield including 60-foot filter strips, catchbasins, and frequent inspection/removal of foreign objects (including trash) for the airport operation area will significantly reduce maintenance requirements relative to typical King County facilities.
- Internal walls with openings sufficient for maintenance and access to maintenance "v" in the vault floor and to outlet structure or sediment trap sumps. These details are not shown on the drawings but will be addressed as part of the final design.

The Port's experience in owning, operating, and maintaining the two large existing detention vault facilities gives HNTB confidence that maintenance of the proposed facilities will be feasible. Final design will include consideration of OSHA confined space requirements, and special Port needs to establish personnel and equipment access appropriate for each vault location.

APPENDIX E

BMP SIZING ESTIMATIONS PER UNIT PGIS AREA

APPENDIX E

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LIST OF TABLES

1. STORM FLOW AND VOLUME CALCULATIONS

Bioswale and filter strip size were based on the water quality design flow rate, specified as the 6-month, 24-hour design storm. Wetpool and treatment wetland pool size were based on the mean annual storm runoff volume.

Water Quality Design Flow for Bioswales and Filter Strips

The following parameters were used in the StormSHED Hydrologic Modeling Program (Engenious Systems 1997):

Area: 1 acre
Curve Number: 98
Time of Concentration: 4 minutes

To estimate the 6-month storm flow rate, 64 percent of the 2-year, 24-hour precipitation of 2.0 inches was used. From StormSHED (output attached on following page), the 6-month peak flow rate was 0.32 cfs.

Runoff Volume from Mean Annual Storm for Wetvaults

Wetvault volume was based on the mean annual storm runoff volume. The mean annual storm volume for a 1-acre imperious area was calculated using the simplified method described in the King County Manual (King County 1998). Because the area to be treated is 100 percent impervious, the runoff formula from the King County Manual was simplified to:

Runoff Volume (ft^3), $V_r = 0.9 * A_i * (R/12)$

where: A_i = impervious area (ft^2)
R = mean annual storm precipitation (inches)

The mean annual storm precipitation of 0.47 inch was obtained from the isopluvial map provided in the King County Manual. The mean annual runoff was calculated to be:

$V_r = 0.9 * (43{,}560) * (0.47/12) = 1{,}535\ ft^3$

Drainage Area: 1AC

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur	24.00 hrs			
	Area	CN	TC	
Pervious	0.0000 ac	98.00	0.00 hrs	
Impervious	1.0000 ac	98.00	0.07 hrs	
Total	1.0000 ac			

Supporting Data:

Impervious CN Data:

Impervious		98.00	1.0000 ac

Impervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Sheet	200.00 ft	1.00%	0.0100	3.26 min
Channel	Storm Drain	200.00 ft	1.00%	42.0000	0.79 min

1AC Event Summary:

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event
1AC	0.32	7.83	0.0887	1.00	SBUH/SCS	kc24hr	0.64"2y

2. BMP SIZE CALCULATIONS

BMP sizing was based on the 1998 King County Manual. Sizing requirements for the King County and Ecology manuals are approximately equivalent; however, the King County Manual's simpler sizing procedures were better suited for these generic calculations.

2.1 FILTER STRIP SIZING

Filter strips were sized for a 300-ft-wide by 145-ft-long (1-acre) section of runway. Although the typical maximum flow path across runways and taxiways is 140 ft across the pavement and shoulder of straightaway taxiways, the flow path may reach up to 300 feet across runway/taxiway intersections.

Note: For filter strips, as with bioswales, the *length* dimension is parallel to the direction of flow. Therefore, for filter strips, length is measured perpendicular to the runway, taxiway, or roadway centerline. Runway and taxiway length is measured parallel to the centerline.

The following assumptions were used for the filter strip sizing:

WQ design flow, $Q = 0.32$ cfs
Manning's roughness, $n = 0.35$ (per King County Manual)
Strip Width, $W = 145$ ft
Slope, $s = 0.02$[1]

The calculations are shown below:

$$\text{Flow depth, } d = \left[\frac{Q * n}{1.49 * W * s^{0.5}}\right]^{0.6} = \left[\frac{0.32 * 0.35}{1.49 * 145 * 0.02^{0.5}}\right]^{0.6} \approx 0.035 \text{ ft}$$

$$\text{Flow velocity, } V = \frac{Q}{A} = \frac{Q}{W * d} = \frac{0.32}{145 * 0.035} = 0.064 \text{ fps}$$

Per the King County Manual, the flow must have a minimum 9-minute (540-second) residence time.

Strip Length, $L = 540 * V = 540 * 0.064 = 34.5$ ft

$\Rightarrow$ Area = L * W = 145 * 34.5 ≈ 5,000 ft^2

2.2 BIOSWALE SIZING

The following assumptions were used for the bioswale sizing:

WQ design flow, $Q = 0.32$ cfs

---

[1] Nominal STIA design specifications call for a slope of 1.5 percent. This assumed slope results in a conservative size estimate.

Manning's roughness, $n = 0.2$ (per King County Manual)
Bottom width, $b = 6$ ft
Flow depth, $y = 2$ inches = 0.167 ft (regularly mowed)
H:V side slopes, $Z = 3$
Slope, $s = 0.02$

The calculations are shown below:

$$V = \frac{Q}{A} = \frac{Q}{by + Zy^2} = \frac{0.32}{(6 * 0.167) + (3 * 0.167^2)} = 0.30 \text{ fps}$$

Per the King County Manual, the flow must have a minimum 9-minute (540-second) residence time.

Swale Length, $L = 540 * V = 540 * 0.30 = 160$ ft

Swale Area $= L * W = 160 * 6 \approx 960$ ft^2

2.3 WETVAULT SIZING

The calculations for the wetvault sizing are shown below:

Basic wetpond size (per the King County Manual), therefore wetpool volume = 3 * (volume of mean annual 24-hour storm runoff)

Mean annual storm runoff volume = 1,535 ft^3

Wetpool volume = 3 * 1535 = 4,610 ft^3

2.4 SUMMARY

Unit sizes of BMPs per acre are shown in Table E-2.

Table E-2. BMP unit sizes per acre of PGIS.

BMP	Approximate required size per acre of PGIS
Filter Strip	5,000 ft^2
Bioswale[1]	960 ft^2
Wetvault	4,610 ft^3

1 Area given is for bottom of bioswale. Including side slopes, bioswale area at 1.0 ft depth would be 1915 ft^2. However, where the unit size (960 ft^2) was used to evaluate existing bioswales, the bottom width of the existing bioswales was used, consistent with the area calculation used to estimate 960 ft^2. Where this area figure is used to estimate future bioswale area, planners should be aware that an additional 6 ft of width is necessary (assuming Z = 3, 3 ft needed on each side of bottom).

3. REFERENCES

Ecology (Washington State Department of Ecology). 1992. Stormwater management manual for the Puget Sound basin, the technical manual. Washington Department of Ecology, Olympia, Washington.

Engenious Systems, Inc. 1997. WaterWorks hydrologic modeling program. Seattle, Washington.

King County Department of Natural Resources (King County DNR). 1998. King County surface water design manual. King County Department of Natural Resources, Water and Land Resources Division, Seattle, Washington.

APPENDIX F

FEASIBILITY OF STORMWATER INFILTRATION REPORT

Feasibility of Stormwater Infiltration
Third Runway Project
Sea-Tac International Airport
SeaTac, Washington

Prepared for
Port of Seattle

December 14, 2000
J-4978-06

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EXPLORATION LOGS

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FEASIBILITY OF STORMWATER INFILTRATION THIRD RUNWAY PROJECT, SEA-TAC INTERNATIONAL AIRPORT SEATAC, WASHINGTON

SUMMARY

Infiltration tests have been performed for selected sites on the west side of the proposed runway embankment to evaluate the feasibility of infiltration as part of the Stormwater Management Plan (SMP) for the Sea-Tac Third Runway project. The testing performed to date shows infiltration is feasible in two of the areas tested (Areas 1 and 3). Preliminary design infiltration rates have been developed from the field tests using methods stipulated by King County (1998) as listed in Table 1. Based on these results, potential infiltration capacities (in cubic feet per second [cfs]) at the individual sites have been developed for nominal 8-foot-wide infiltration trenches totaling 400 feet in length:

- Infiltration Area 1 can accommodate stormwater disposal at an average rate of 0.30 cfs; and
- Infiltration Area 3 can accommodate stormwater disposal at an average rate of 0.20 cfs.

Additional trenches may be located in these areas to increase infiltration capacity, depending on site logistics.

These data are suitable for conceptual infiltration facility design. The infiltration capacity of any site will depend on the detailed design and layout (i.e., area and elevation) of the infiltration facility, and the degree of variability in soil conditions beneath the facility. Additional infiltration tests and soil borings will be needed to meet all the requirements of the King County Surface Water Design Manual (1998) and should be completed once provisional footprints of the facilities are established.

This report summarizes design requirements for infiltration facilities, field data collection performed by Hart Crowser, and results of our work to date for Infiltration Areas 1 and 3.

INTRODUCTION

As a result of increased stormwater storage capacity requirements in the SMP, Hart Crowser was tasked to investigate potential sites for infiltration of detained stormwater on the west side of the proposed Third Runway project area (see Figure 1 for general location). Based on the location of detention ponds C, D, and G, three sites were identified as potential sites for infiltration of water discharged from detention ponds and/or vaults on the airfield. Additionally, the footprint of detention ponds C, D, and G were also considered for potential infiltration capacity. Locations of the detention ponds and Infiltration Areas 1, 2, and 3 are shown on Figures 2 and 3.

Infiltration testing was conducted along with the collection of soils and groundwater data that are needed to establish if infiltration can be implemented in each area in accordance with the requirements of the King County Surface Water Design Manual (KCSWDM - King County, 1998). The overall requirements for infiltration facilities are summarized in the following section.

INFILTRATION FACILITY REQUIREMENTS

The following summary outlines the General Requirements (Section 5.4.1 of the KCSWDM) for infiltration facilities (ponds, tanks, and trenches) associated with the natural site conditions. Additional requirements identified below under "Other Engineering Considerations" need to be addressed by the engineering design team.

Soils

- The basic requirement is a minimum of 3 feet of permeable soil below the bottom of the facility and at least 3 feet between the bottom of the facility and the maximum wet-season water table.
- A minimum of two test pits or soil borings per 10,000 ft^2 of infiltration area are required to characterize the site.
- Test pits or borings should extend at least 5 feet below the bottom of the infiltration facility, and at least one test hole should reach the water table.

Measured Infiltration Rates

- The measured infiltration rate should be determined using either the double-ring infiltrometer test (ASTM Method D 3385, 2000) or the EPA falling head percolation test procedure (EPA, 1980).
- Sufficient tests should be performed to determine a representative infiltration rate but at least three tests shall be performed for each proposed infiltration facility.

Design Infiltration Rate

- The design infiltration rate should be calculated by Equation 5-9 of the KCSWDM, using the correction factors listed in that Section 5.4.1.

Off-site Groundwater Impacts

- The impacts of infiltration should be considered for the potential to provide increased water to landslide areas, increased groundwater resources available, increased water levels in closed depressions, and higher groundwater levels.

Groundwater Protection

Groundwater protection requirements call for implementing one of the following actions when infiltrating water from pollution-generating surfaces:

- Provide water quality treatment prior to infiltration; or
- Demonstrate that the soil beneath the infiltration facility has properties which reduce the risk of groundwater contamination from typical stormwater runoff.

Other Engineering Considerations

- 100-Year Overflow Conveyance
- Spill Control Devices
- Pre-settling
- Protection from Upstream Erosion
- Construction Guidelines.

This report by Hart Crowser provides a preliminary assessment of the soils, infiltration rates, and hydrology of each site to establish the feasibility of infiltration. Engineering aspects and site logistics will be addressed by the design team as part of final design.

APPROACH

The type of infiltration test chosen at each location was dependent on the depth of the target soil strata or pond elevation. Generally, for tests less than 4 to 5 feet below ground surface, test pits were dug and the double-ring infiltrometer method was used. This method involved repeatedly measuring a small (< 1/4 inch) change in water level in both the inner and outer rings while consistently maintaining a head between 5.5 and 6 inches in both rings until a relatively constant rate was obtained. Pre-soaking the test area is not required; however, to limit the amount of inconsistent readings at the beginning of the test, a pre-soaking period of approximately one hour was employed.

For testing depths below 5 feet, the EPA method was used in an augered hole with a 6-inch-diameter temporary casing inserted to prevent caving of the borehole walls. This method involved repeatedly measuring the water level drop from an initial head (6 inches above the base of the hole) over a given period until a relatively constant rate was obtained. At the end time interval the water level was adjusted back to the original head level prior to starting the next measurement. A minimum of four hours or overnight pre-soaking of the test zone was performed.

The seasonal high groundwater level was estimated by measuring current groundwater levels in existing or recently installed monitoring wells at each site and comparing these with longer records from existing nearby wells in similar hydrogeologic settings. Additionally, soil profile characteristics such as low chroma mottling were also reviewed to assess the seasonal high groundwater levels.

RESULTS

We have completed infiltration tests and soil borings at one pond location and three potential infiltration areas:

- Pond G;
- Infiltration Area 1 (between Pond C and Pond G);
- Infiltration Area 2 (south of Pond G); and
- Infiltration Area 3 (northwest of Pond D).

Results of the double-ring infiltrometer tests are listed in Table 2; results of the EPA method falling head percolation tests are listed in Table 3.

Work on Pond D is still in progress. A third pond location (Pond C) was considered but the presence of groundwater seepage precluded further consideration of infiltration at Pond C. Infiltration in Pond G and Area 2 proved to be unfeasible due to low permeability soils and/or high groundwater levels. Logs of soil borings and test pits are included in Appendix A for Infiltration Areas 1 and 3.

In the following summaries, we include an estimate of the design infiltration rate for each area. This is currently based on the average values of the measured infiltration rates for each area, factored by our estimate of the appropriate correction factors, as stipulated by King County (1998). However, given the variability of the soils encountered to date, the mean value may not be appropriate for the entire facility at each location. Final design would take into account the results of additional facility-specific testing, the actual geometry of the proposed facilities, and additional design adjustments to provide an adequate "factor of safety."

Final measured infiltration values will be recommended for the design of the proposed facilities after completion of the additional borings and tests needed to fulfill KCSWDM requirements.

Infiltration Area 1

Investigative explorations show a consistent slightly silty fine to medium sand occurring across the site. The sand unit starts just below the surface and extends to depths of 8 feet (approximately 268 feet elevation) where deeper material increases in silt content.

The groundwater level measured in the new monitoring well HC00-B333, during November 2000, had an elevation of 268.5 feet. Table 4 lists the seasonal water level variations for two comparable wells east of Infiltration Area 1 with water level records that include last year's seasonal high. Based on the average seasonal fluctuation in these wells, and assuming currently observed water levels correspond to the seasonal low, the projected seasonal high water level for HC00-B333 is 273.1 feet (approximately 8 feet below ground surface).

The locations tested exhibited medium to high infiltration capacities ranging from 4.6 to 20.4 in./hr. Results are summarized in Table 1.

To illustrate the infiltration potential of this site, we have estimated the infiltration capacity of 400 lineal feet of 8-foot-wide infiltration trench(es). Using a design infiltration rate of 4.2 in./hr, such trenches in Area 1 may be expected to infiltrate 0.30 cfs of stormwater from SMP area SDW1A.

Infiltration Area 3

Three test pits revealed varying shallow soil composition. The northern two test pits (HC00-TP338 and HC00-TP339) encountered silty fine to medium sand at elevations between 297 and 308 feet. Test pit HC00-TP337 in the southern portion of the site revealed dry silt from the surface at approximate elevation 309 feet, to the bottom of the test pit (approximate elevation 301 feet). Although not determined at this time, the groundwater level in Infiltration Area 3 is expected to be at a depth of at least 10 feet, based on the absence of seepage into the test pits. Local water table mapping by AESI (2000) suggests that the groundwater elevation in the shallow regional aquifer is around 230 to 240 feet at this location.

Double-ring infiltrometer tests were conducted in test pits approximately 3 to 4 feet below the ground surface (i.e., approximately 302 to 309 feet elevation). Two were located in a silty sand deposit and provided moderate infiltration rates of 7.5 and 5.0 in./hr. The third test was performed in finer-grained silty soil and gave an infiltration rate of 0.94 in./hr.

Using an estimated design infiltration rate of 2.7 in./hr and assuming overall trench dimensions of 400 feet by 8 feet, Area 3 should infiltrate approximately 0.2 cfs of stormwater from SMP area SDW1B. Additional trenches may be an option in this area; however, the proximity of the adjacent slope (greater than 15%) may require regrading to create benches. The KCSWDM indicates that a geotechnical assessment of slope stability would likely be required for construction of an infiltration facility in Area 3.

CONCLUSIONS

The results of our soil borings and infiltration tests show that Areas 1 and 3 are suitable for infiltration of detained stormwater. The infiltration capacities quoted in this report are provisional; the appropriate design infiltration rate for each area depends on the chosen location, layout, depth, and length of infiltration trenches. The implementation of infiltration facilities will necessitate full consideration of relevant engineering requirements as outlined in the KCSWDM.

Sincerely,

HART CROWSER, INC.

ROBERT O. MIDDOUR
Project Hydrogeologist

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EXPIRES 12/13/01

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EPA, 1980. EPA Falling Head Percolation Test Procedure, Design Manual - Onsite Wastewater Treatment and Disposal Systems, EPA.

ASTM, 2000. Double Ring Infiltrometer Test, ASTM Method D 3385, Annual Book of ASTM Standards, Soil and Rock (1): D 420 - D 5799.

AESI, 1999. Seattle-Tacoma International Airport Ground Water Study, Associated Earth Sciences, Inc. and S. S. Papadopulos & Assoc.

Table 1 - Summary of Infiltration Testing Results; West Side of Third Runway Embankment

Location ID	Approximate Ground Surface Elevation in Feet (msl)	Measured Infiltration Rate in in./hr	Assumed Correction Factors $F_{testing}$	$F_{plugging}$	$F_{geometry}$	Design infiltration rate in in./hr	Estimated Infiltration Capacity in cfs using 200ft x 8ft trench(es) Number of Trenches 1 (200 linear ft)	2 (400 linear ft)	3 (600 linear ft)
Infiltration Area 1	(SDW1A)								
HC00-B327	276.1	20.40	0.3	0.9	1	5.51	0.20	0.41	0.61
HC00-B328	275.4	4.65	0.3	0.9	1	2.06	0.08	0.15	0.23
HC00-B329	280.8	18.45	0.3	0.9	1	4.98	0.18	0.37	0.55
Infiltration Area 2									
HC00-TP301	245.6	0.00	0.5	0.8	1	NA			
HC00-TP302	244.2	0.33	0.5	0.8	1	NA	NA	NA	NA
HC00-TP303	253.5	0.43	0.5	0.8	1	NA			
Infiltration Area 3	(SDW1B)								
HC00-TP307	309.2	0.94	0.5	0.9	1	0.42	0.02	0.03	0.05
HC00-TP308	304.9	5.00	0.5	0.9	1	2.25	0.08	0.17	0.25
HC00-TP309	311.7	7.50	0.5	0.9	1	3.38	0.13	0.25	0.38
Pond G									
HC00-B310A	264.9	0.24	0.3	0.8	0.25	NA	NA	NA	NA
HC00-B313A	260.2	1.68	0.3	0.8	0.25	NA			

Notes:

(1) Infiltration rates determined by double-ring infiltrometer (ASTM method D 3385) or a modified EPA falling head percolation test procedure (Design Manual - Onsite Wastewater Treatment and Disposal Systems, EPA, 1980)

(2) Correction Factors: per King County Surface Water Design Manual (1998)

$F_{testing}$ = 0.5 for ASTM method D3385 and 0.3 for EPA method

$F_{plugging}$ = 0.8 for fine sands and loamy sands, 0.9 for medium sands

$F_{geometry}$ = 0.25 to 1.0, values for the trenches all exceeded 1.0 and Pond G was < 0.25

Design infiltration rate = measure rate x $F_{testing}$ x $F_{plugging}$ x $F_{geometry}$

497806/3rd_infil_tests.xls Table 1

Table 2 - Double Ring Infiltrometer Tests

Test ID	Final Reading from Inner Ring in Inches	Time Increment in Minutes	Infiltration Rate in in./hr	Soil Descrpition
Infiltration Area 2				
HC00-TP301A *	0.11	191	0.03	SILT
HC00-TP302A	0.25	46	0.33	Gravelly, silty SAND
HC00-TP303A	0.28	39	0.43	Slightly gravelly SAND
Infiltration Area 3				
HC00-TP307A	0.25	16	0.94	SILT
HC00-TP308A	0.50	6	5.00	Slightly silty, fine to medium SAND
HC00-TP309A	0.50	4	7.50	Slightly silty, fine to medium SAND

* water seeping into test pit and pooling outside the rings

497806/3rd_infil_tests.xls Table 2

Table 3 - Falling Head Percolation Tests

Location ID	Test Number	Elapsed Time in min	Change in Head in feet	Percolation Rate in in./hr	Soil Type
Infiltration Area 1					
HC00-B327A	1	2	0.06	21.60	Slightly silty, fine to medium SAND
		5	0.15	21.60	
	2	2	0.06	21.60	
		5	0.14	20.16	
	3	2	0.06	21.60	
		5	0.14	20.16	
	4	2	0.05	18.00	
		5	0.14	20.16	
	5	2	0.05	18.00	
		5	0.14	20.16	
	6	2	0.06	21.60	
		5	0.14	20.16	
HC00-B328A	1	2	0.02	5.40	Slightly silty, fine to medium SAND
		5	0.05	7.20	
		10	0.10	7.20	
	2	2	0.02	7.20	
		5	0.06	8.64	
		10	0.11	7.92	
	3	2	0.02	7.20	
		5	0.05	7.20	
		10	0.11	7.92	
	4	2	0.03	10.80	
		5	0.06	8.64	
		10	0.11	7.92	

497806/3rd_infil_tests.xls Table 3

Table 3 - Falling Head Percolation Tests

Location ID	Test Number	Elapsed Time in min	Change in Head in feet	Percolation Rate in in./hr	Soil Type
Infiltration Area 1					
HC00-B329A	1	2	0.05	16.20	Slightly silty, fine to medium SAND
		5	0.10	14.40	
		10	0.20	14.40	
		15	0.29	13.92	
		20	0.37	13.32	
		25	0.45	12.96	
	2	2	0.05	18.00	
		5	0.12	17.28	
		10	0.23	16.56	
		15	0.33	15.84	
		20	0.44	15.84	
	3	2	0.05	18.00	
		5	0.12	17.28	
		10	0.26	18.72	
		15	0.37	17.76	
		20	0.49	17.64	
	4	2	0.06	21.60	
		5	0.14	20.16	
		10	0.26	18.72	
		15	0.39	18.72	
Pond G					
HC00-B310A	1	30	0.01	0.24	Slightly silty, fine to medium SAND
	2	30	0.01	0.24	
	3	30	0.01	0.24	
HC00-B313A	1	30	0.07	1.68	Silty, gravelly SAND
	2	30	0.06	1.44	
	3	30	0.07	1.68	
	4	30	0.07	1.68	

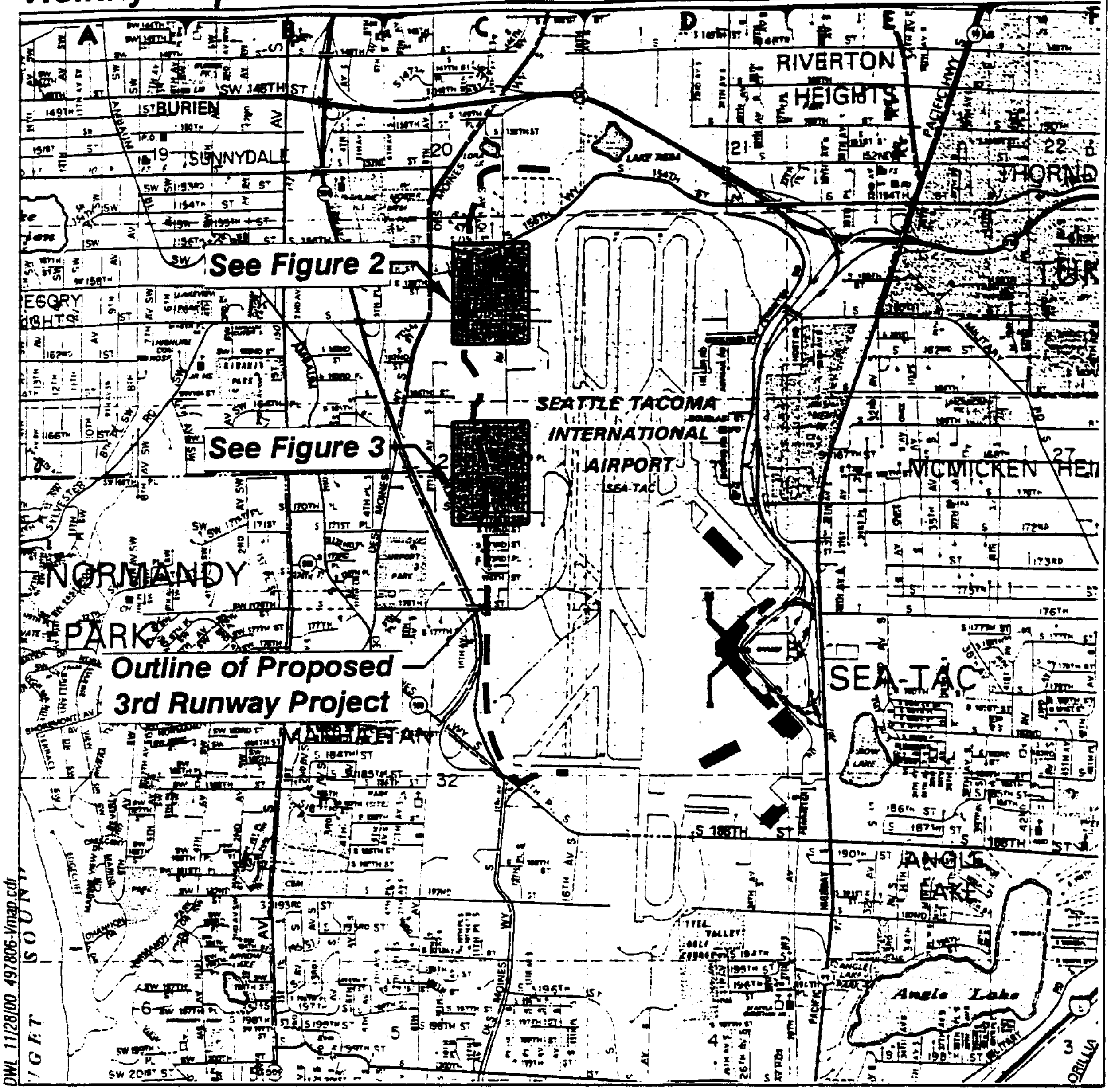
497806/3rd_infil_tests.xls Table 3

Table 4 - Estimation of Seasonal High Water Level in Infiltration Area 1

Monitoring Well ID	Ground Surface in Feet (msl)	Top of Casing in Feet (msl)	Seasonal Water Level Range: Minimum in Feet (msl)	Date	Maximum in Feet (msl)	Date	Period of Record	Range of Fluctuation in Feet
HC99-B64	292	294.2	284.9	Nov-00	288.2	Jan-00	12/99 to 10/00	3.3
HC99-B73	291.7	293.80	283.42	Oct-99	289.3	Mar-00	10/99 to 10/00	5.88
HC00-B333	281	283.5	268.5	Nov-00				

Projected Seasonal High Groundwater Level in HC00-B333 = **273.09** = 268.5 + (3.3+5.88)/2

Vicinity Map



0 2000 4000

Scale in Feet

N

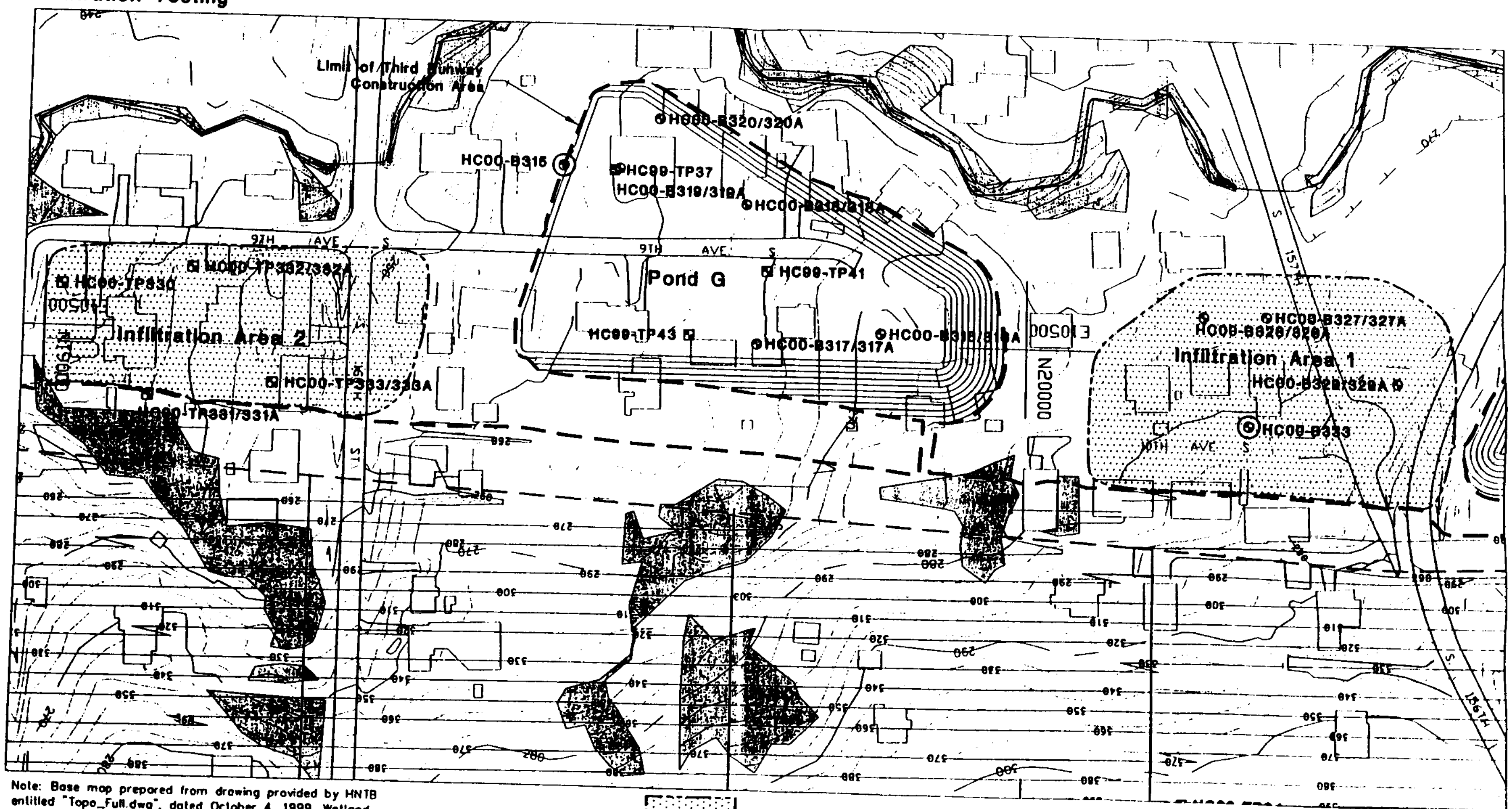
HARTCROWSER

J-4978-06 11/00

Figure 1

AR 047252

Site and Exploration Plan
Infiltration Testing



Note: Base map prepared from drawing provided by HNTB entitled "Topo_Full.dwg", dated October 4, 1999. Wetland delineation prepared from drawing provided by Parametrix entitled, "W_110800.dwg", dated November 8, 2000.

Infiltration Area

Exploration Location and Number

HC99-TP37 ⊠ Test Pit

HC00-B311/311A ⊗ Soil Boring

HC00-B315 ◉ Soil Boring Completed as Monitoring Well

N

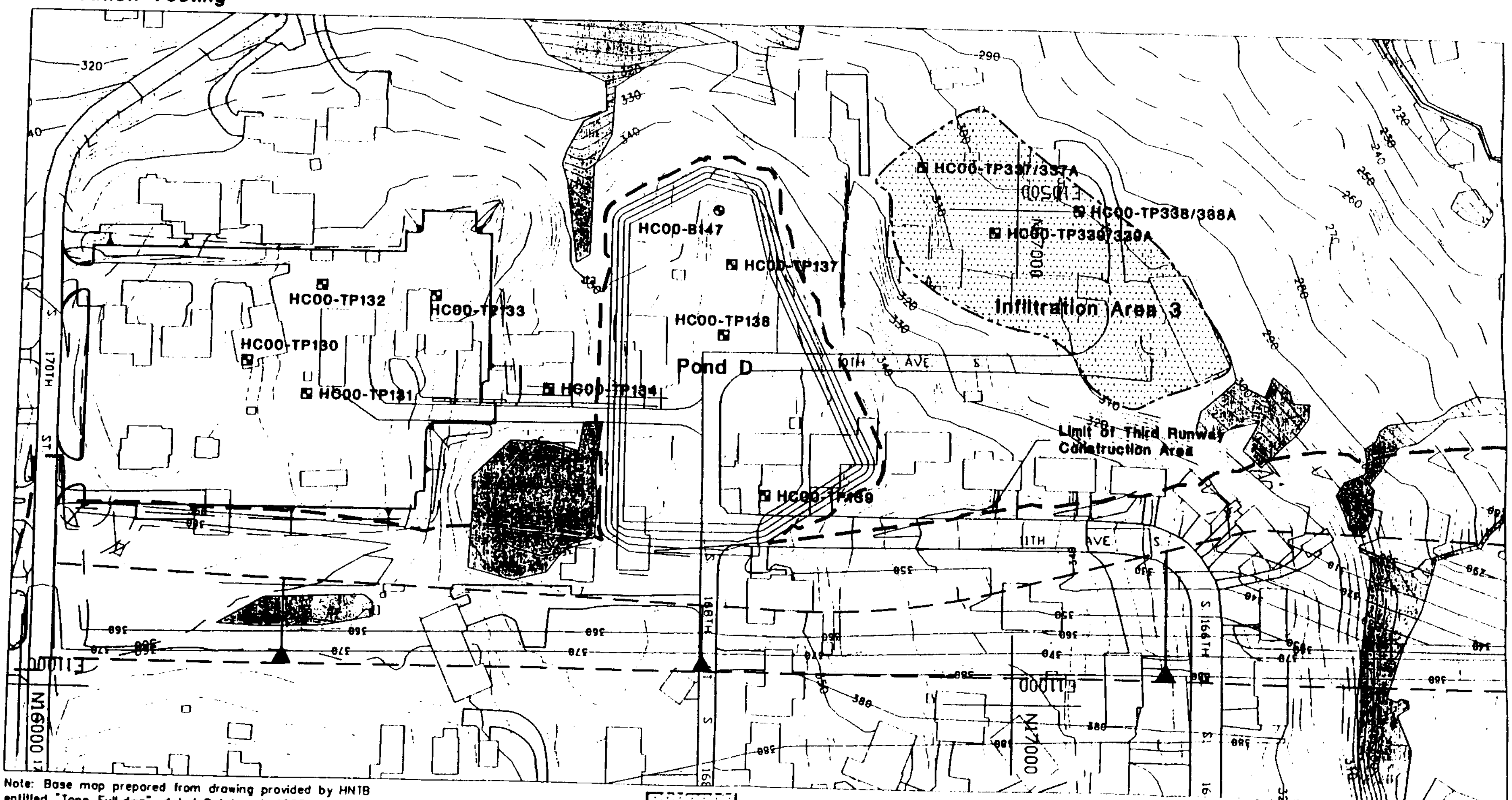
0 100 200
Scale in Feet

HARTCROWSER
J-4978-06 12/00
Figure 2

AR 047253

Site and Exploration Plan

Infiltration Testing



Note: Base map prepared from drawing provided by HNTB entitled "Topo_Full.dwg", dated October 4, 1999. Wetland delineation prepared from drawing provided by Parametrix entitled, "W_110800.dwg", dated November 8, 2000.

Infiltration Area

Exploration Location and Number

HC99-TP37 Test Pit

HC00-B311/311A Soil Boring

HARTCROWSER

J-4978-08 12/00

Figure 3

AR 047254

MEMORANDUM

DATE: May 23, 2001

TO: Jim Thomson, HNTB

FROM: Michael Kenrick and Robert Middour, Hart Crowser Inc.

RE: **Sea-Tac Third Runway Project**
Infiltration Feasibility at Pond F (Walker Creek Basin)
4978-06

CC: Tom Atkins, Parametrix

Summary

This memo describes field investigations performed by Hart Crower at the site of stormwater detention Pond F to determine the feasibility of stormwater infiltration. Three borings were drilled to the proposed depth of the pond; the material encountered was dense glacial till. The holes appeared dry, so water was added (as prescribed in the EPA percolation test method) to presoak the ground overnight. However, measurements made the following morning indicated more water had accumulated in the holes, showing saturated conditions in the till at this depth. The infiltration tests were abandoned because stormwater infiltration directly from Pond F is not feasible in these conditions.

Consideration also was given to the feasibility of shallow infiltration trenches constructed to the north of the pond. However, soil samples taken at a depth of 5 feet in each of the three borings revealed mottling indicative of shallow seasonal saturation, and weathered till overlying unweathered till was present within 5 to 8 feet of the surface. These conditions do not meet King County (1998) requirements for shallow infiltration facilities, so no further testing was performed.

Field Investigations

On April 25, 2001, investigative borings (designated HC01-B401, HC01-B402, and HC01-B403) were advanced east and northeast of the partially completed Pond F (see Figure 1). These three explorations revealed a surficial layer of silty, fine to medium sand approximately 5 feet thick overlying a dense to very dense, silty, gravelly, fine to coarse sand

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Tel 206.324.9530

(glacial till) that was consistent down to the end of the borings (approximately 25 to 30 feet below ground surface). Water-bearing zones were not observed during drilling.

Down-hole percolation tests (EPA Falling Head Percolation Test Procedure - EPA 1980) were set up in three borings to test the infiltration capacity of soils at the base elevation of the proposed Pond F. The infiltration testing apparatus was set up in accordance with the EPA procedure. Four gallons of clean water were added to presoak the soils at the base of each hole. After presoaking the boreholes overnight, measured water levels were higher than those from the previous day.

Subsequent water-level monitoring revealed stabilized water levels (Table 1) that indicate saturated conditions within the glacial till. Note that the measured water levels do not form a consistent water table as such, but appear to be dependent on the depth of the individual borehole. These observations are consistent with a steep downward hydraulic gradient within the thick layer of low-permeability glacial till in this area. This hydraulic gradient is in equilibrium with natural infiltration and is not a true perched groundwater condition. Regional groundwater levels in the shallow regional (Qva) aquifer are around 260 feet elevation, well below the static water levels measured in the Pond F boreholes (AESI, 1999).

Conclusions

Three factors negate the feasibility of stormwater infiltration at or in the vicinity of Pond F:

- The presence of thick glacial till at the base elevation of Pond F;
- Variably saturated conditions within the till; and
- Mottled appearance of shallow till soils beneath the surficial sand layer, suggesting seasonally high water levels.

Based on these findings, infiltration of stormwater at Pond F, either via the pond bottom or through shallow infiltration trenches located adjacent to the pond, is not feasible.

References

King County, 1998. King County Surface Water Design Manual, King County and Department of Natural Resources.

EPA, 1980. EPA Falling Head Percolation Test Procedure, Design Manual - Onsite Wastewater Treatment and Disposal Systems, EPA.

AESI, 1999. Seattle-Tacoma International Airport Ground Water Study, Associated Earth Sciences, Inc. and S. S. Papadopulos & Assoc.

Attachments:
Table 1 - Boreholes for Infiltration Feasibility at Pond F
Figure 1 - Site and Exploration Plan, Pond F
Appendix A - Exploration Logs

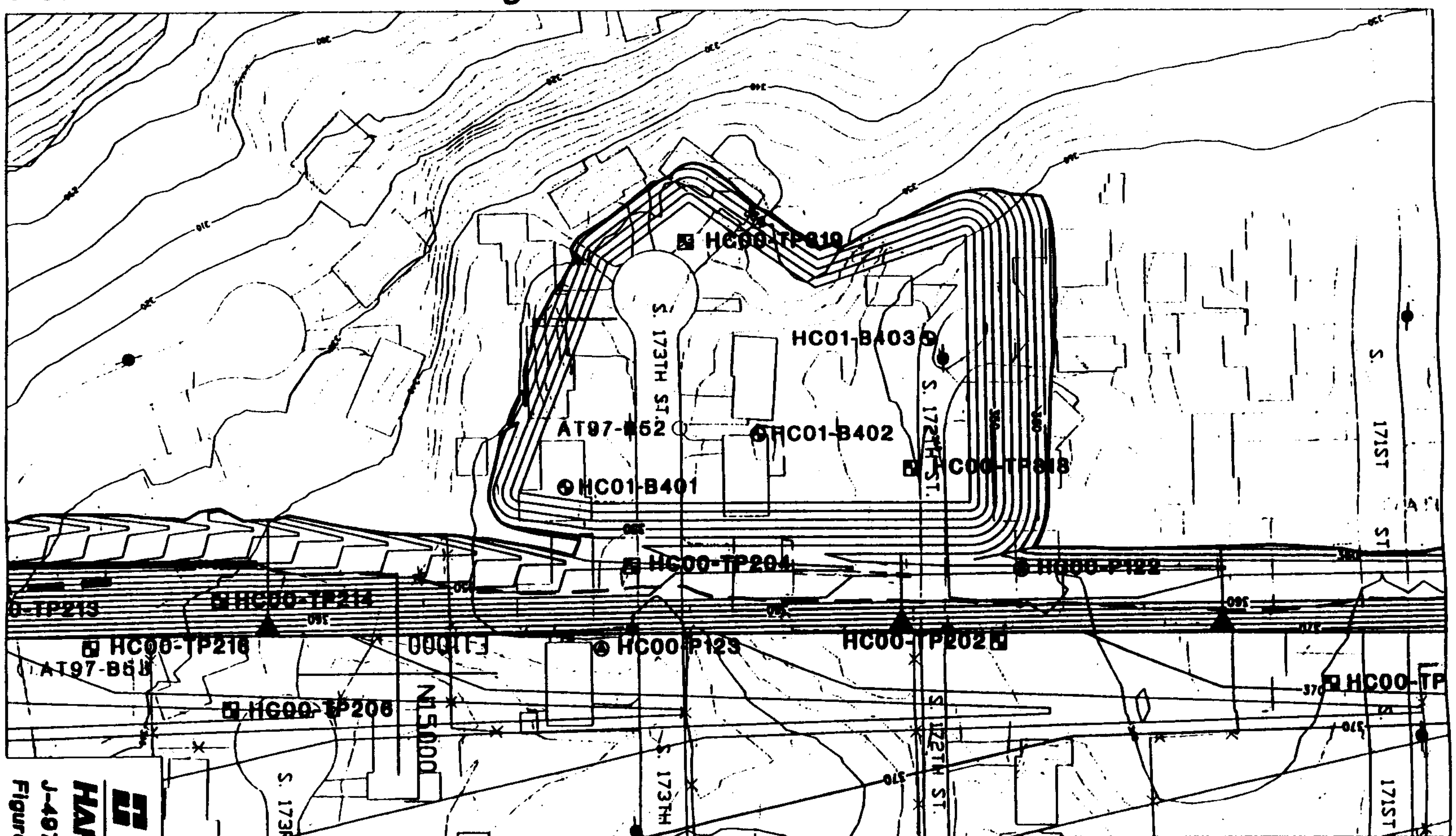
F:\Docs\Jobs\497806\PondFMemo.doc

Table 1– Boreholes for Infiltration Feasibility at Pond F

	GS Elevation in Feet	Borehole Depth in Feet	Borehole Bottom Elevation in Feet	Water Level Elevation in Feet
HC01-B401	349.6	19.8	329.8	331.4
HC01-B402	355.7	19.8	335.9	336.7
HC01-B403	361.7	24.8	336.9	340.6

RC 5/8/01 1=100 (xref)see drawing file/charlie

Pond F Infiltration Testing



HARTCROWSER
J-4978-06 5/01
Figure 1

July 2001
556-2912-001 (28)

Note: Base map prepared from drawing provided by HNTB entitled "X_TOPO0401.dwg", dated February 15, 2001. Wetlands delineations prepared from drawing provided by Parametrix entitled, "w_022201.dwg", dated February 22, 2001.

HC01-B403 ⊕ Approximate Boring Location and Designation

N

0 100 200

Scale in Feet

APPENDIX A
EXPLORATION LOGS

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual–manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance.
Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 – 4	Very soft	0 – 2	<0.125
Loose	4 – 10	Soft	2 – 4	0.125 – 0.25
Medium dense	10 – 30	Medium stiff	4 – 8	0.25 – 0.5
Dense	30 – 50	Stiff	8 – 15	0.5 – 1.0
Very dense	>50	Very stiff	15 – 30	1.0 – 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents

	Estimated Percentage
Not identified in description	0 – 5
Slightly (clayey, silty, etc.)	5 – 12
Clayey, silty, sandy, gravelly	12 – 30
Very (clayey, silty, etc.)	30 – 50

Legends

Sampling Test Symbols

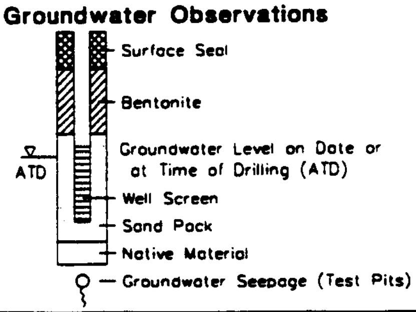
BORING SAMPLES

- ⊠ Split Spoon
- ⧅ Shelby Tube
- ▥ Cuttings
- ◫ Core Run
- * No Sample Recovery
- P Tube Pushed, Not Driven

TEST PIT SAMPLES

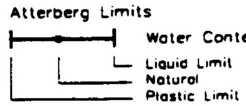
- ⊠ Grab (Jar)
- ⧄ Bag
- ⧅ Shelby Tube

Groundwater Observations



Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits



PID	Photoionization Detector Reading
CA	Chemical Analysis
DT	In Situ Density Test

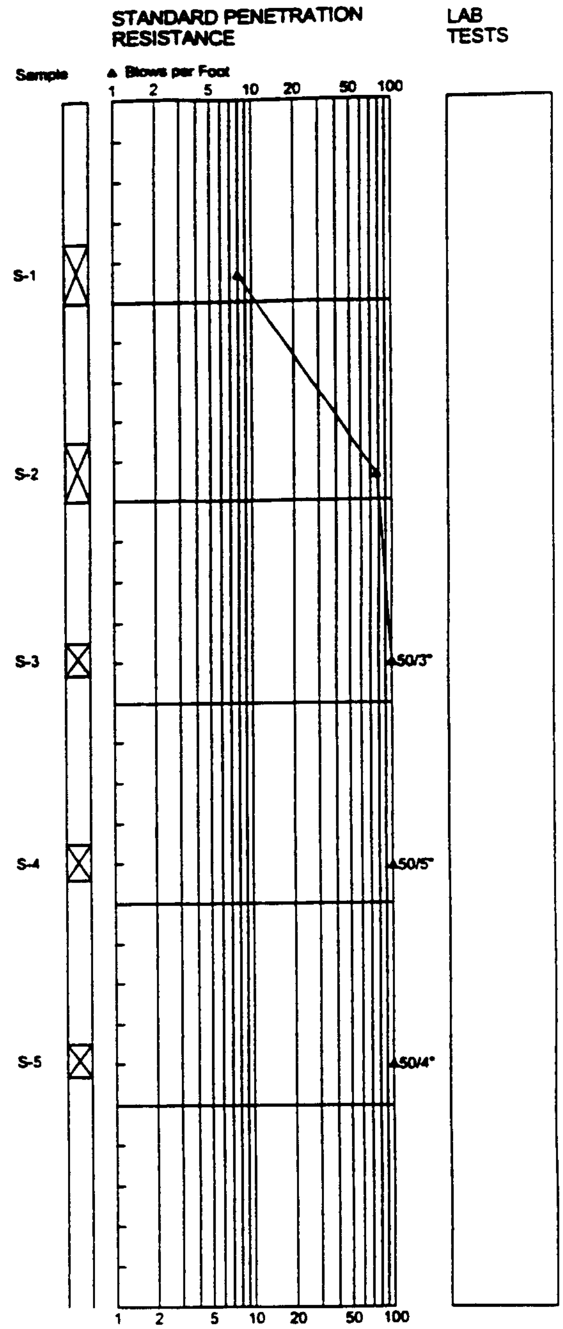
1=1 A-1 STANDARD

HARTCROWSER
J-4978-06 5/01
Figure A-1
July 2001
556-2912-001 (28)

Boring Log HC01-B401

Soil Descriptions
Approximate Ground Surface Elevation in Feet: 349.6

Soil Descriptions	Depth in Feet
Loose, moist to wet, gray and red-brown, mottled, gravelly, silty SAND. (WEATHERED TILL)	0
Very dense, moist, gray, gravelly, silty SAND with slightly silty zone near top. (TILL)	
Bottom of Boring at 24.3 Feet. Completed 04/25/01.	



BORING LOG 4978068.GPJ HC_CORP.GDT 5/23/01

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-4978-06 04/01
Figure A-2

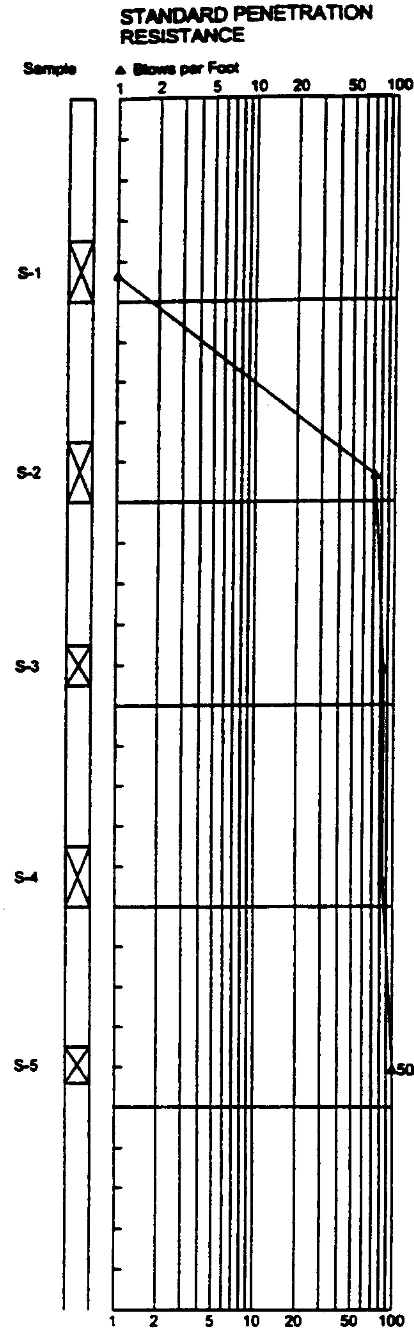
July 2001
556-2912-001 (28)

Boring Log HC01-B402

Soil Descriptions
Approximate Ground Surface Elevation in Feet: 355.7

Depth in Feet	Soil Descriptions
0	Fill with scattered concrete.
5	Very dense, moist, gray, gravelly, silty SAND. (TILL)
24.4	Bottom of Boring at 24.4 Feet. Completed 04/25/01.

Depth in Feet: 0, 5, 10, 15, 20, 25, 30



LAB TESTS

BORING LOG 4978068.GPJ HC_CORP.GDT 5/23/01

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-4978-06 **04/01**
Figure A-3

July 2001
556-2912-001 (28)

Boring Log HC01-B403

Soil Descriptions
Approximate Ground Surface Elevation in Feet: 361.7

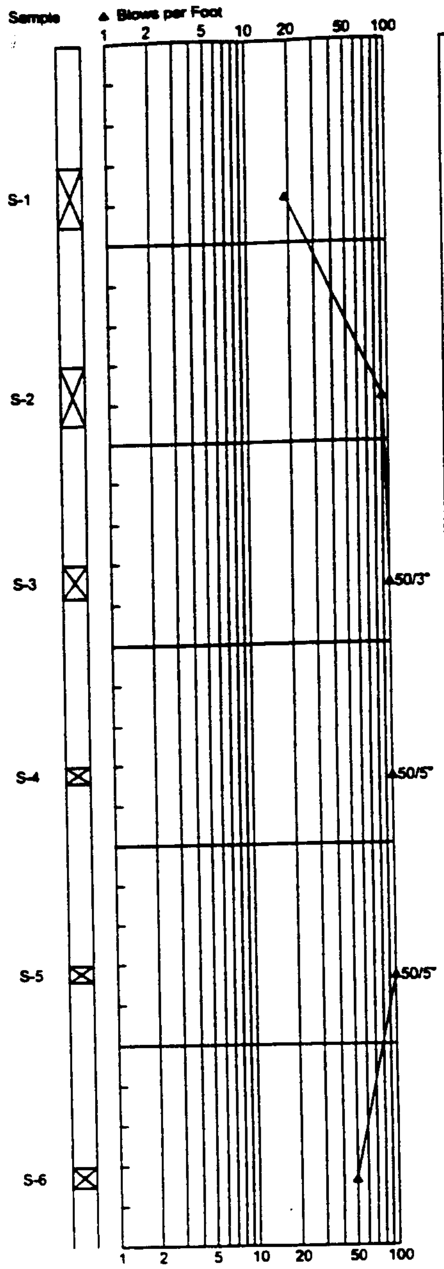
Depth in Feet

Soil Descriptions	Depth in Feet
Fill and gravelly roadbase.	0
Medium dense, moist, gray and brown mottled, slightly gravelly, silty SAND. (WEATHERED TILL)	5
Very dense, moist, gray, gravelly, silty SAND. (TILL)	10, 15, 20, 25
Bottom of Boring at 28.5 Feet. Completed 04/25/01.	30

BORING LOG 4978068.GPJ HC_CORP.GDT 5/23/01

STANDARD PENETRATION RESISTANCE

LAB TESTS



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-4978-06 04/01
Figure A-4

July 2001
556-2912-001 (28)

AR 047264

APPENDIX H

WATER QUALITY TREATMENT FACILITY SIZING CALCULATIONS FOR SASA, STEP, AND THIRD RUNWAY

APPENDIX H

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. WATER QUALITY DESIGN STORM PEAK FLOW CALCULATIONS FOR BIOSWALE AND FILTER STRIP SIZING

Bioswale and filter strip size was based on the water quality design flow rate, specified as the 6-month, 24-hour peak flow rate.

The Santa Barbara Urban Hydrograph (SBUH) method of the StormSHED hydrologic modeling program was used to estimate the 6-month storm flow rate, using 64 percent of the STIA 2-year, 24-hour precipitation of 2.0 inches. The StormSHED calculated flows for the SASA parking lot (17.76 acres), a 300-ft flowpath across a runway-taxiway intersection (assumed to be 145 ft long, for a total of 1.0 acre), and the North Cargo Area (4.30 acres) are provided in Table H-1. The StormSHED output files for these areas are provided in Tables H-2, H-3, and H-4.

Table H-1. Water quality design storm peak flows.

Area	6-month peak flow (64% of 2-yr) (cfs)
SASA Parking Lot	5.03
Taxiway	0.31
North Cargo Area	1.29

Drainage Area: SASA Parking

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number		
Peak Factor:	484.00		SCS Abs:	0.20		
Storm Dur	24.00 hrs					
	Area	CN	TC			
Pervious	0.0000 ac	0.00	0.00 hrs			
Impervious	17.7600 ac	98.00	0.13 hrs			
Total	17.7600 ac					
Supporting Data:						
Impervious CN Data:						
Imp Area		98.00	17.7600 ac			
Impervious TC Data:						
Flow type:	Description:		Length:	Slope:	Coeff:	Travel Time
Sheet	sheet		250.00 ft	1.00%	0.0110	4.44 min
Channel	pipes		800.00 ft	2.00%	42.0000	2.24 min

SASA Parking Event Summary:

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event
-------							
SASA Parking	5.03	8.00	1.5746	17.76	SBUH/SCS	kc24hr	0.64*2y

Drainage Area: RW/TW Intersection

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur	24.00 hrs			
	Area	CN	TC	
Pervious	0.0000 ac	78.00	0.00 hrs	
Impervious	1.0000 ac	98.00	0.08 hrs	
Total	1.0000 ac			

Supporting Data:

Impervious CN Data:

Impervious	98.00	1.0000 ac

Impervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Sheet	300.00 ft	1.50%	0.0100	5.06 min

RW/TW Intersection Event Summary:

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event
-------							
RW/TW Intersection	0.31	7.83	0.0887	1.00	SBUH/SCS	kc24hr	0.64*2y

Drainage Area: North Cargo

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number	
Peak Factor:	484.00		SCS Abs:	0.20	
Storm Dur	24.00 hrs				
	Area	CN	TC		
Pervious	0.0000 ac	78.00	0.00 hrs		
Impervious	4.3000 ac	98.00	0.09 hrs		
Total	4.3000 ac				

Supporting Data:

Impervious CN Data:

Impervious	98.00	4.3000 ac

Impervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Sheet	200.00 ft	2.00%	0.0100	3.26 min
Channel	Pipe	800.00 ft	2.00%	42.0000	2.24 min

North Cargo Event Summary:

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event
-------							
North Cargo	1.29	7.83	0.3812	4.30	SBUH/SCS	kc24hr	0.64*2y

2. MEAN ANNUAL STORM RUNOFF VOLUME CALCULATIONS FOR WETVAULT SIZING

Wetvault volume was based on the mean annual storm volume. The mean annual storm volume for the STEP service area and Air Cargo Road was calculated using the simplified method described in the King County Manual (King County, 1998). Because the area to be treated is 100 percent impervious, the runoff formula from the King County Manual was simplified to:

Runoff Volume (ft^3), $V_r = 0.9 * A_i * (R/12)$

where: A_i = impervious area (ft^2)
R = mean annual storm precipitation (inches)

The STEP service area and Air Cargo Road are approximately 9.05 acres (394,300 ft^2). The mean annual storm precipitation of 0.47 inch was obtained from the isopluvial map provided in the King County Manual. Therefore, the mean annual runoff was calculated to be:

$V_r = 0.9 * (394{,}300) * (0.47/12) = 13{,}900\ ft^3$.

3. TAXIWAY FILTER STRIP SIZE CALCULATIONS

Calculations were performed for a 300-ft flow path across a runway-taxiway intersection (assumed to be 145-ft long). 300 ft is approximately the longest flow path dimension among taxiways and runways, chosen for conservative BMP calculations.

Note: length measurements for runways and taxiways are perpendicular to length measurements for filter strips. For taxiways and runways, length is measured parallel to the direction of aircraft landing and takeoff; for filter strips, length is the dimension parallel to the direction of flow.

Assumptions:

WQ design flow, $Q = 0.31$ cfs (see Section 1 in this appendix)
Manning's roughness, $n = 0.35$ (per the King County Manual)
Strip width, $W = 145$ ft (assumed)
Longitudinal slope, $s = 0.02$[1]

Calculations:

Flow depth, $d = \left[\frac{Q * n}{1.49 * W * s^{0.5}}\right]^{0.6} = \left[\frac{0.31 * 0.35}{1.49 * 145 * 0.02^{0.5}}\right]^{0.6} \approx 0.034$ ft

Flow velocity, $V = \frac{Q}{W * d} = \frac{0.31}{145 * 0.034} \approx 0.063$ fps

Per the King County Manual, the strip must have a minimum 9-minute (540-second) residence time.

Strip Length, $L = 540 * V = 540 * 0.063 = 34$ ft

The plan view for a typical segment of filter strip drain is shown in Figure H-1, and the typical filter strip detail is shown in Figure H-2. As shown, the typical filter strip width will exceed the minimum required width in most locations, and the filter strips will meet the minimum required width in all locations.

[1] Nominal STIA design specifications call for a slope of 1.5 percent as shown on Figure H-2. This assumed slope results in a conservative size estimate.

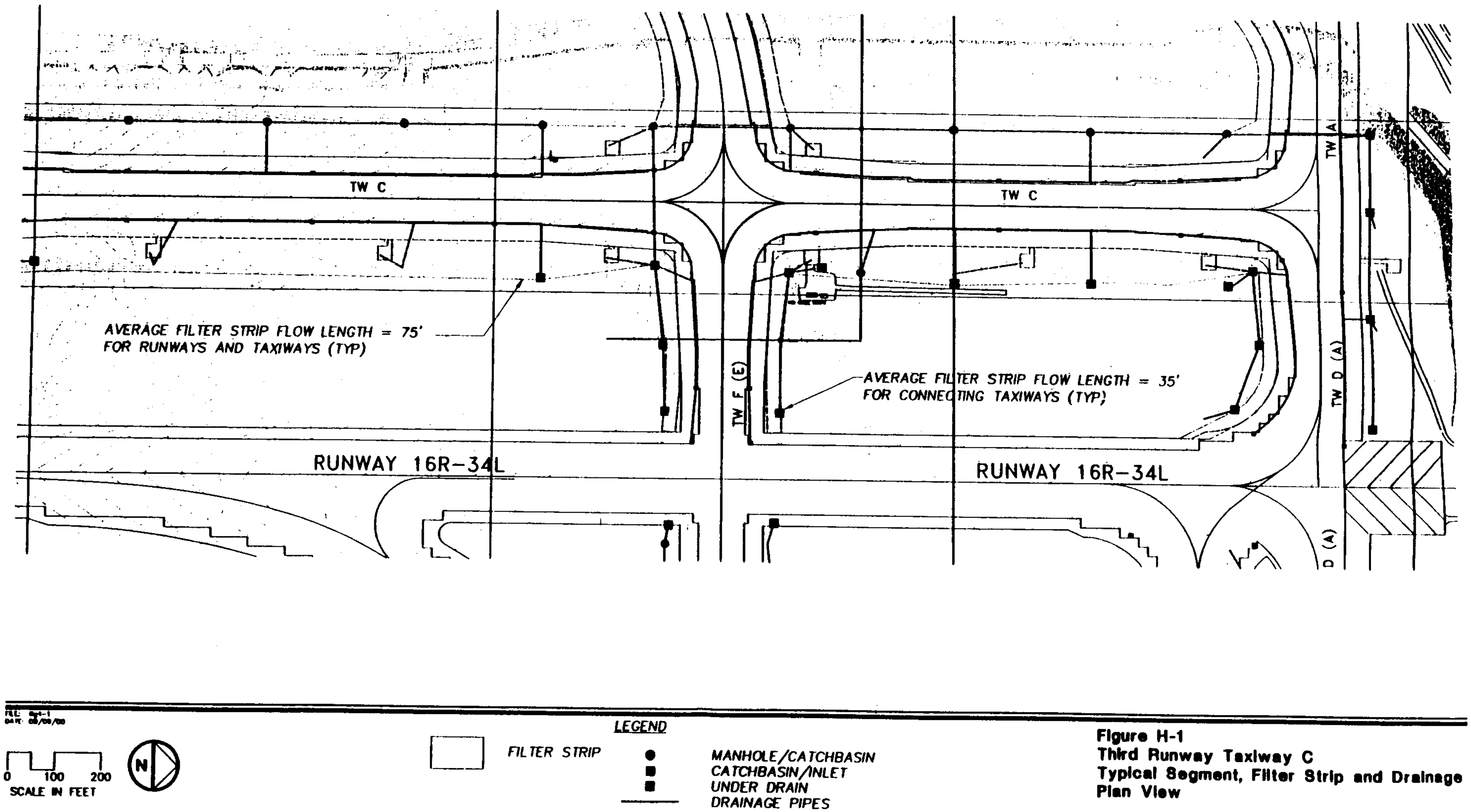
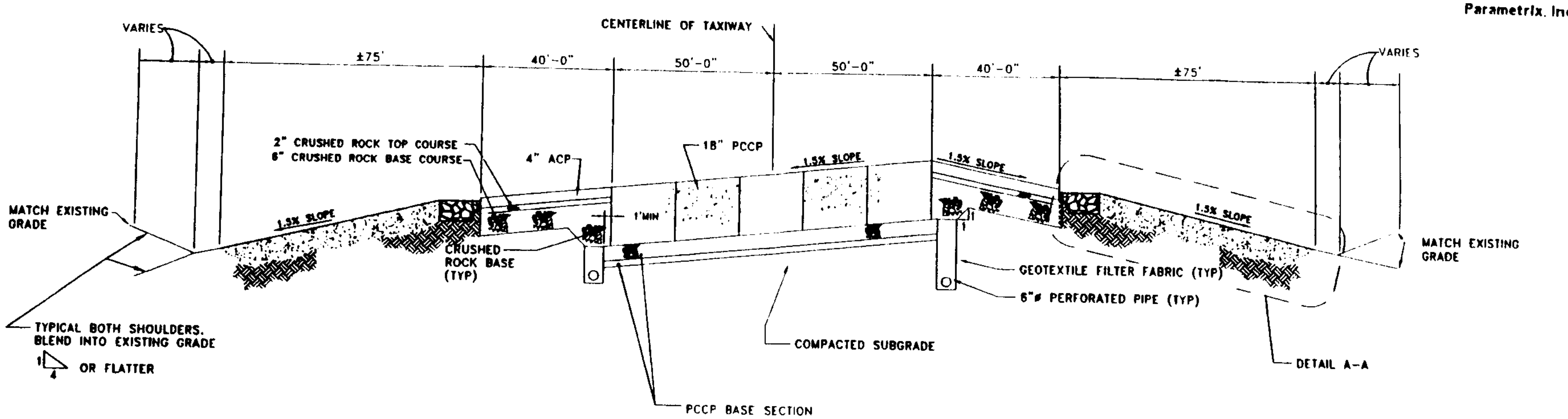
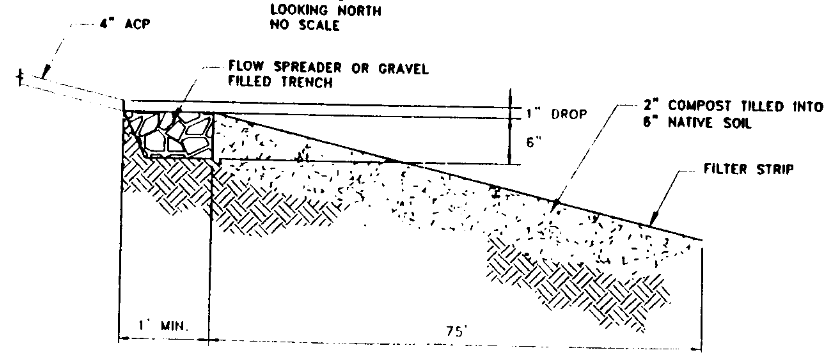


Figure H-1
Third Runway Taxiway C
Typical Segment, Filter Strip and Drainage
Plan View



TYPICAL SECTION

TAXIWAY C
LOOKING NORTH
NO SCALE



DETAIL A-A

NO SCALE

AR 047274

Figure H-2
Typical Filter Strip Detail
Third Runway Taxiway C

4. SASA BIOSWALE SIZE CALCULATIONS

The following assumptions were used for the SASA bioswale calculations:

Flow depth, $y = 2$ inches = 0.167 ft (per the King County Manual for regularly mowed swale)
H:V side slopes, $Z = 3$ (chosen value)
Manning's roughness, $n = 0.20$ (per the King County Manual)
Longitudinal slope, $s = 0.05$ (chosen value)

The SASA parking area was divided into four subareas (A through D). Bioswale sizes were calculated for each subarea. To calculate bioswale sizes, the total discharge of 5.03 cfs was divided among the subareas (weighted by area), as shown in Table H-5.

Table H-5. The SASA SDS subareas (conceptual).

Subarea	Area (acres)	% of SASA PGIS	Q (cfs)[a]
A	2.82	35%	1.76
B	3.06	38%	1.91
C	1.17	14%	0.70
D	1.02	13%	0.65
TOTAL	**8.07**	**100%**	**5.03**

[a] For this feasibility analysis, the total SASA water quality flow rate of 5.03 cfs was divided among the subareas (prorated by area). This is a conservative estimate of flows for each subarea–flows modeled individually for the subareas would be smaller.

An example calculation for Area B is shown below:

$$\text{Bottom width, } b = \frac{Q * n}{1.49 * y^{1.67} * s^{0.5}} = \frac{1.91 * 0.20}{1.49 * (0.167)^{1.67} * (0.05)^{0.5}} = 22.9 \text{ ft}$$

Bottom width cannot be greater than 10 ft. The swale was therefore divided into three flow channels, each taking one-third of the flow (= 0.64 cfs).

$$\text{Bottom width, } b = \frac{Q * n}{1.49 * y^{1.67} * s^{0.5}} = \frac{0.64 * 0.20}{1.49 * (0.167)^{1.67} * (0.05)^{0.5}} = 7.7 \text{ ft}$$

$$V = \frac{Q}{A} = \frac{Q}{by + Zy^2} = \frac{0.64}{(7.7 * 0.167) + (3 * 0.167^2)} = 0.47 \text{ ft/s}$$

The flow must have a minimum 9-minute (540-second) residence time.

Swale Length, $L = 540 * V = 540 * 0.47 \approx 254$ ft

The complete bioswale calculations for the four subareas are summarized in Table H-6. Subareas A and B required splitting the flow.

Table H-6. Bioswale sizing calculations for the SASA SDS (conceptual).

Subarea		Q	Z	n	y	s	b	V	L
A		1.76	3	0.20	0.17	0.05	21.1[a]		
	1.76 ÷ 3 =	0.59	3	0.20	0.17	0.05	7.0	0.47	253
B		1.91	3	0.20	0.17	0.05	22.9[a]		
	1.91 ÷ 3 =	0.64	3	0.20	0.17	0.05	7.7	0.47	254
C		0.70	3	0.20	0.17	0.05	8.4	0.47	256
D		0.65	3	0.20	0.17	0.05	7.8	0.47	254

[a] *b* must be less than 10 ft; therefore, divide flow into three equal-width swales.

The SASA parking lot conceptual bioswale layout is shown in Figure H-3, and the typical bioswale detail is shown in Figure H-4.

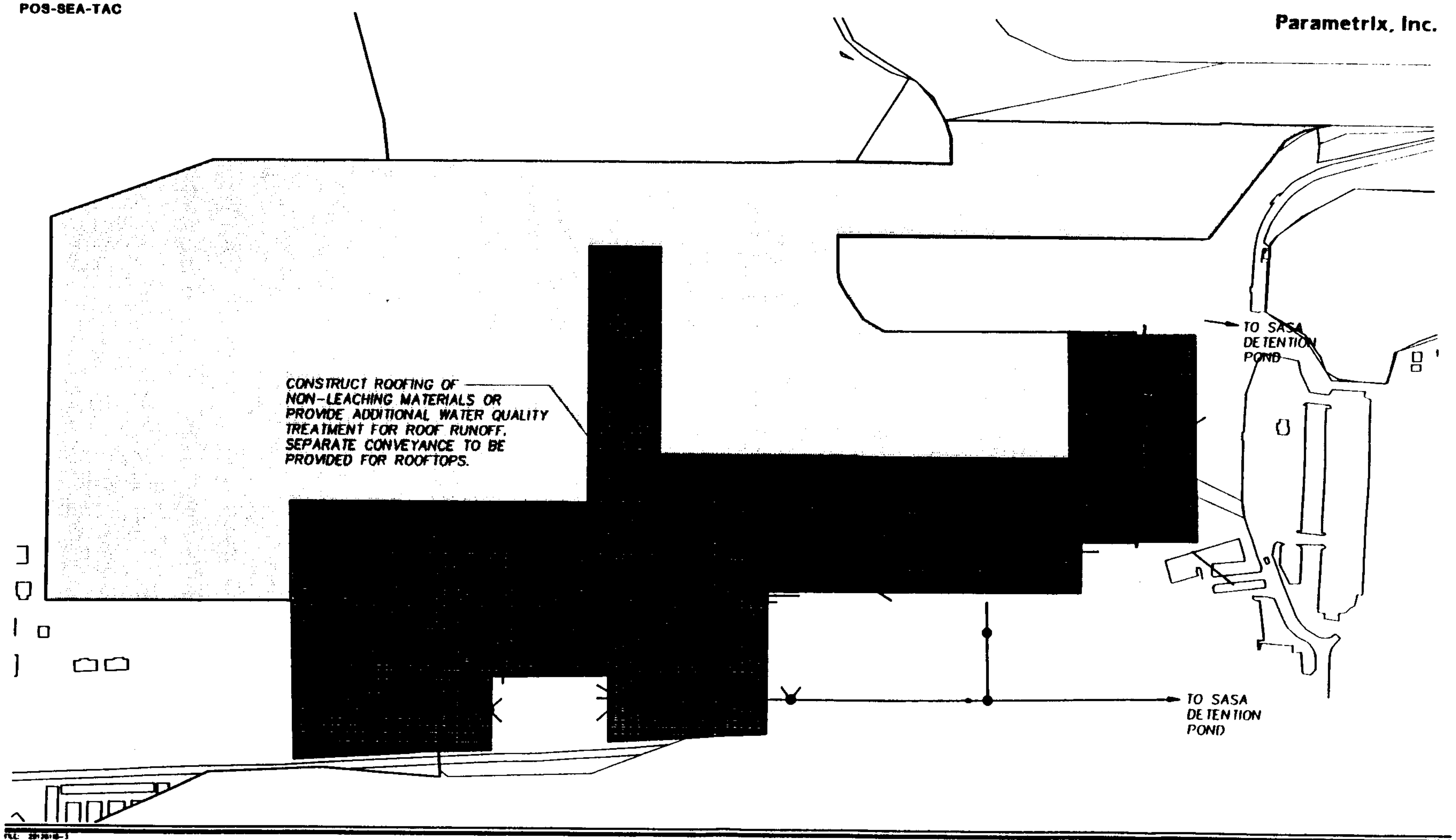
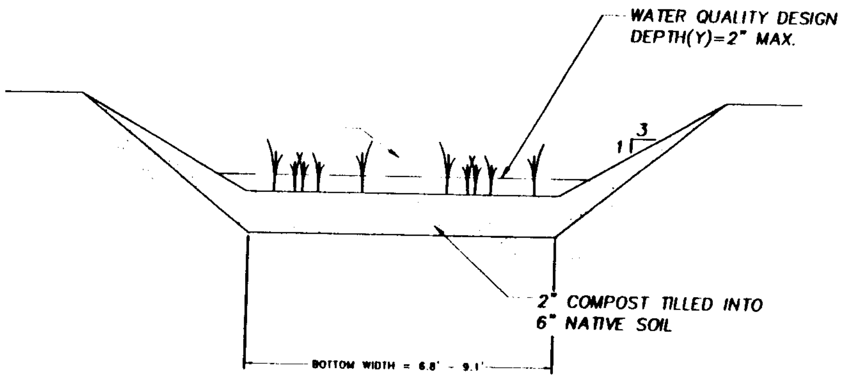


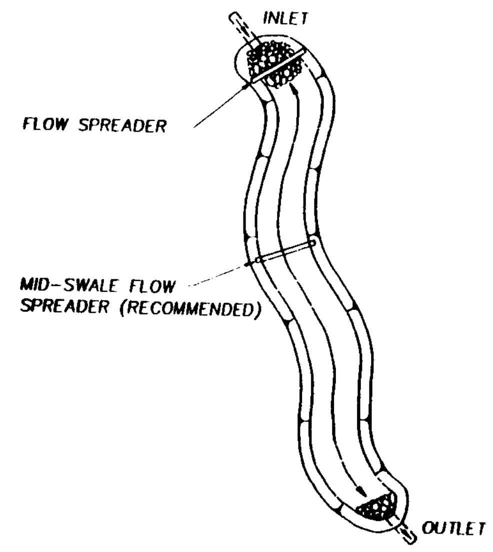
Figure H-3
SASA Parking Lot
Conceptual Bioswale Layout
(Based on Existing Topography)



TYPICAL SWALE

SECTION

NTS



NOTES:
LONGITUDINAL SLOPES 1-6%
PROVIDE UNDERDRAIN FOR SLOPES < 1.5%

BIOFILTRATION SWALE

PLAN

NTS

Figure H-4
Typical SASA Parking Lot
Bioswale Detail

AR 047278

5. NORTH CARGO AREA BIOSWALE CALCULATIONS

The following assumptions were used for the North Cargo Area bioswale calculations:

WQ design flow, Q = 1.29 cfs (see Section 1 in this appendix)

Flow depth, y = 2 inches = 0.167 ft (per the King County Manual for regularly mowed swale)

H:V side slopes, Z = 3 (chosen value)

Manning's roughness, n = 0.20 (per the King County Manual)

Longitudinal slope, s = 0.05 (chosen value)

The calculations are shown below:

$$\text{Bottom width, } b = \frac{Q * n}{1.49 * y^{1.67} * s^{0.5}} = \frac{1.29 * 0.20}{1.49 * (0.167)^{1.67} * (0.05)^{0.5}} = 15.4 \text{ ft}$$

The swale width of 15.4 ft is greater than the 10-ft minimum; therefore, the swale will be divided in the center to form two 7.7-ft wide swales. Each swale will treat half the flow (0.65 cfs each).

$$V = \frac{Q}{A} = \frac{Q}{by + Zy^2} = \frac{0.65}{(7.7 * 0.167) + (3 * 0.167^2)} = 0.47 \text{ ft/s}$$

The flow must have a minimum 9-minute (540-second) residence time.

Swale Length, $L = 540 * V = 540 * 0.47 = 254$ ft

The bioswale calculations are summarized in Table H-6.

Table H-6. Bioswale sizing calculations for the North Cargo Area (conceptual).

No. of Swales	Q (each swale)	Z	n	y	s	b	V	L
2	0.65	3	0.20	0.17	0.05	7.7	0.47	254

6. STEP WETVAULT SIZE CALCULATIONS

The following assumption was used for STEP Wetvault size calculations:

Basic Wetpond size (per the King County Manual), therefore:
Wetpool volume = 3 * [Volume of mean annual 24-hour storm runoff]

The calculation is shown below:

From Section 2 of this appendix, the mean annual storm runoff volume from STEP and Air Cargo Road = 13,900 ft^3.

Wetvault volume = 3 * 13,900 = 41,700 ft^3.

The dimension criteria are shown below:

- The wetvault shall be divided into two cells by a baffle;
- First cell shall have minimum sediment storage of at least 1 ft;
- Second cell shall be minimum 3 ft deep; and
- First cell shall be sized for 25 percent to 35 percent of wetvault volume.

A wetvault 350-ft-long by 10.5-ft-deep by 15-ft-wide would meet the above criteria. The first cell would be 87 ft long, the second cell would be 263 ft long. The 10.5-ft depth includes 2 ft of sediment storage provided in both cells of the vault.

The STEP drainage layout and wetvault location are shown in Figure H-5, and the wetvault details are shown in Figure H-6.

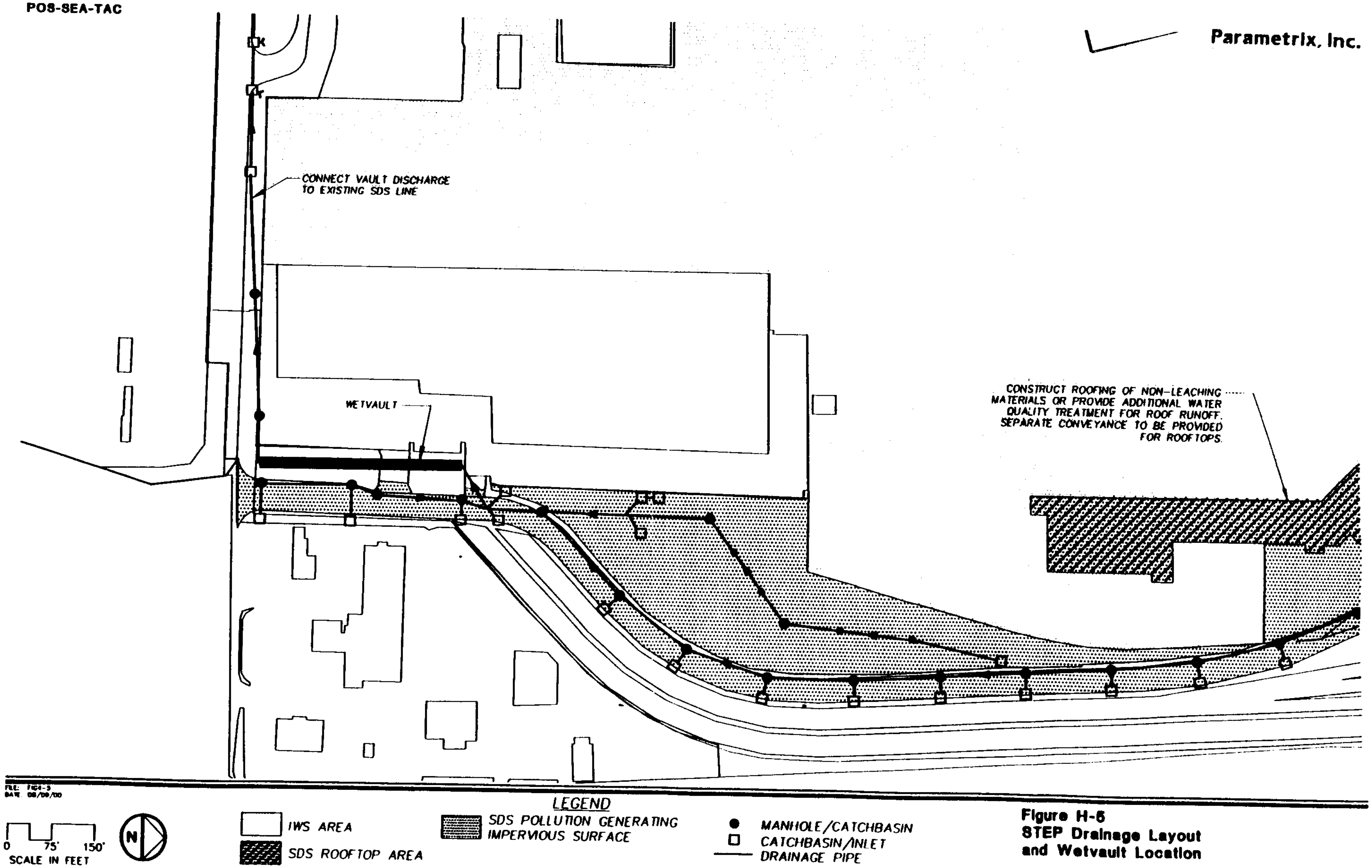


Figure H-5
STEP Drainage Layout and Wetvault Location

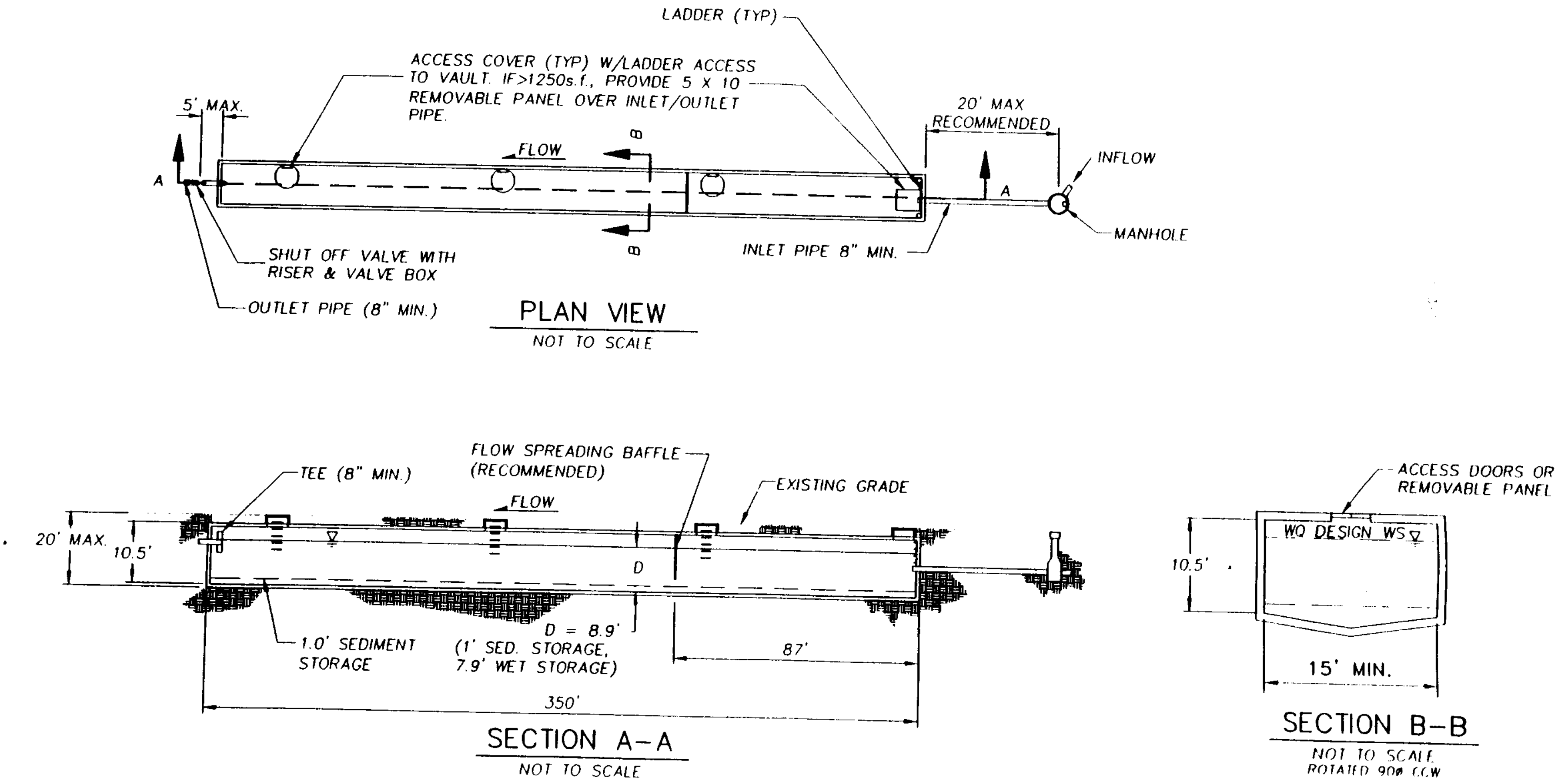


Figure H-6
STEP Wetvault Details

7. NORTH EMPLOYEE PARKING LOT BIOSWALE CALCULATIONS

For information on the North Employee Parking Lot bioswale calculations, see the attached excerpt from the technical information report prepared by David Evans and Associates, Inc.

Water Quantity Control

Detention facilities will be sized to limit peak rate runoff control to be at or below the existing 2, 10 and 100-year, 24-hour design storm event. Detention will be accomplished with an underground concrete detention vault located at the west end of the site. The outlet structure will consist of a flow restrictor/oil pollution control device with two orifices and a notch weir to control the 2, 10 and 100 year design storm events.

On-site water quantity calculations are contained in Appendix A.

Existing Flow (cfs)			Developed Flow (cfs)		
2 yr	10yr	100 yr	2 yr	10 yr	100 yr
2.99	8.14	15.84	19.00	28.84	41.07

Water Quality Control

On-site water quality control will be provided through the use of a grass-lined swale.

The water quality facility will be placed downstream of the detention facility which allows for the use of existing condition flow sizing for the biofiltration swale. Swale bottom width was determined using peak flow from a 2-year, 24-hour storm with existing conditions, 6.0% slope, 3:1 side slopes, Mannings "n" of 0.35 and a flow depth of 4 inches. The schematic layout for the water quantity and water quality facilities are shown in Figure 5.

On-site water quality calculations are contained in Appendix B.

CHANNEL DESIGN FORM

PROJECT: Port of Seattle - North Employee Parking Lot

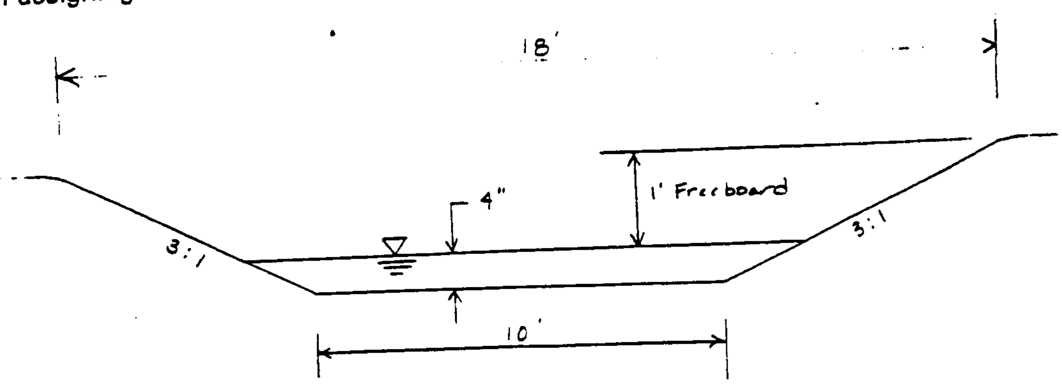
DESCRIPTION: Biofiltration Swale

BEGIN LOCATION:
END LOCATION:

LENGTH 200 LF

	Input		Output	
FREEBOARD DEPTH (FT)	f =	1	Velocity =	0.82
WATER DEPTH (FT)	y =	0.33	Flow, CFS =	2.96
SIDE SLOPE 1 = (1/H)	H1 =	3	Top Width =	17.98
SIDE SLOPE 2 = (1/H)	H2 =	3		
BOTTOM WIDTH IN FEET	b =	10		
MANNINGS VALUE	n =	0.2		
SLOPE OF CHANNEL FT/FT	s =	0.06		

The above indicates the design for biofiltration swale function for the 2-year event for existing conditions.
Per KCSWM, a swale slope of up to 6 % and Mannings "n" value of 0.20 shall be used when designing for swale function.



TYPICAL SECTION

AR 047285

CHANNEL DESIGN FORM

PROJECT: Port of Seattle - North Employee Parking Lot

DESCRIPTION: Biofiltration Swale

BEGIN LOCATION:
END LOCATION:

LENGTH 200 LF

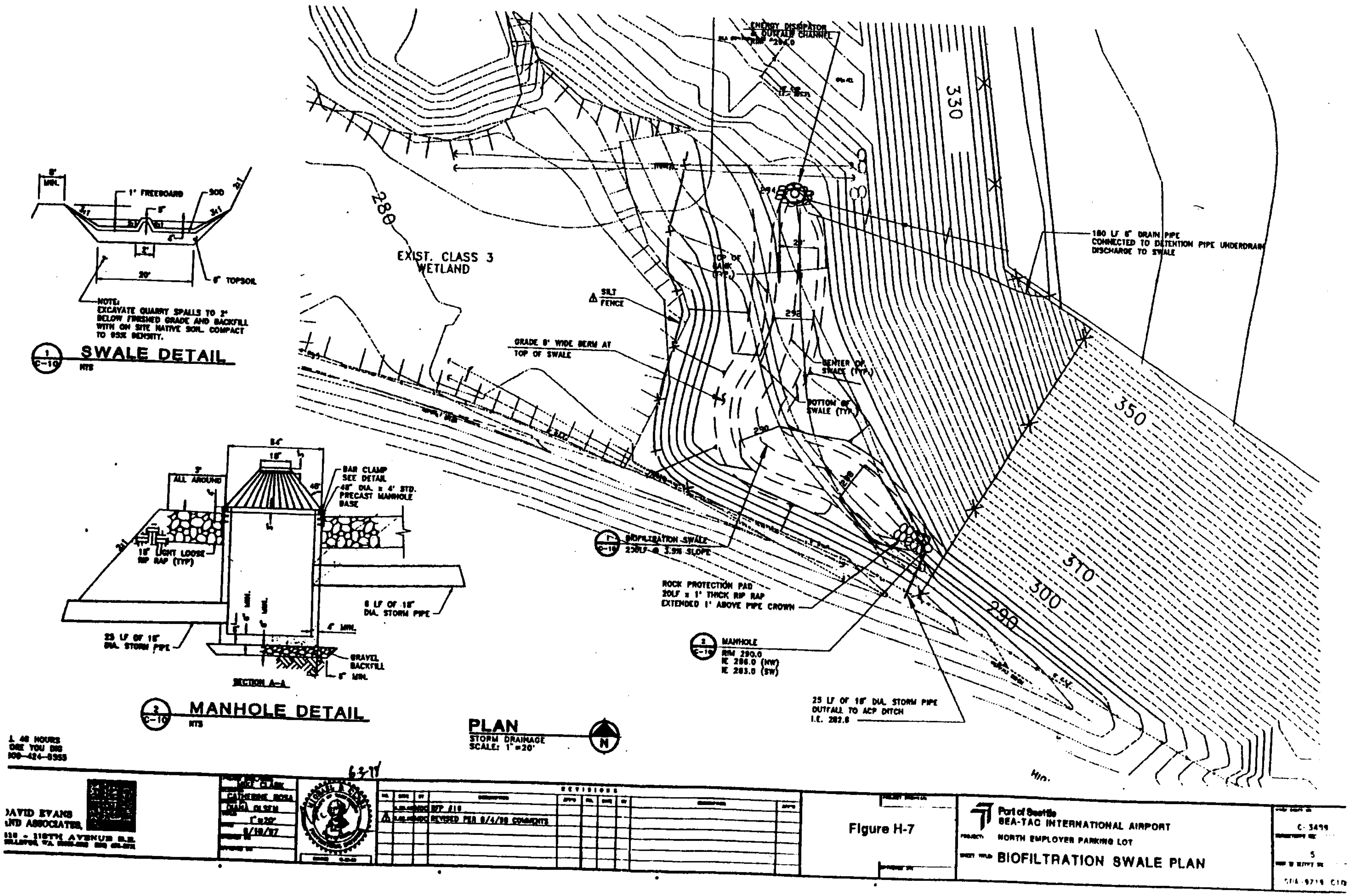
	Input		Output	
FREEBOARD DEPTH (FT)	f =	1	Velocity =	4.94
WATER DEPTH (FT)	y =	0.33	Flow, CFS =	17.93
SIDE SLOPE 1 = (1/H)	H1 =	3	Top Width =	17.98
SIDE SLOPE 2 = (1/H)	H2 =	3		
BOTTOM WIDTH IN FEET	b =	10		
MANNINGS VALUE	n =	0.033		
SLOPE OF CHANNEL FT/FT	s =	0.06		

The above indicates the swale conveyance and stability calculations.
The actual swale slope and Mannings "n" value are used.
The swale has the capacity to conveys the 100-year design flow of 15.84 cfs and maintain a freeboard of 1 foot with a velocity of less than 5 ft/sec.

SEE PREVIOUS SHEET FOR TYPICAL SECTION

TYPICAL SECTION

AR 047286


SWALE DETAIL
NTS
8" MIN.
1' FREEBOARD
SOD
6" TOPSOIL
20'
NOTE:
EXCAVATE QUARRY SPALLS TO 2' BELOW FINISHED GRADE AND BACKFILL WITH ON SITE NATIVE SOIL. COMPACT TO 95% DENSITY.
MANHOLE DETAIL
NTS
SECTION A-A
BAR CLAMP SEE DETAIL
48" DIA. x 4' STD. PRECAST MANHOLE BASE
ALL AROUND
18" LIGHT LOOSE RIP RAP (TYP)
8 LF OF 18" DIA. STORM PIPE
25 LF OF 18" DIA. STORM PIPE
GRAVEL BACKFILL
EXIST. CLASS 3 WETLAND
280
290
300
310
330
350
SILT FENCE
GRADE 8' WIDE BERM AT TOP OF SWALE
TOP OF BANK (TYP.)
CENTER OF SWALE (TYP.)
BOTTOM OF SWALE (TYP.)
ENERGY DISSIPATOR & OUTFALL CHANNEL
180 LF 8" DRAIN PIPE CONNECTED TO DETENTION PIPE UNDERDRAIN DISCHARGE TO SWALE
BIOFILTRATION SWALE 230LF @ 3.5% SLOPE
ROCK PROTECTION PAD 20LF x 1' THICK RIP RAP EXTENDED 1' ABOVE PIPE CROWN
MANHOLE RIM 290.0 IE 286.0 (NW) IE 283.0 (SW)
25 LF OF 18" DIA. STORM PIPE OUTFALL TO ACP DITCH I.E. 282.8
PLAN
STORM DRAINAGE SCALE: 1"=20'
N
DAVID EVANS AND ASSOCIATES, INC.
REVISED PER 8/4/98 COMMENTS
1"=20'
Figure H-7
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
NORTH EMPLOYER PARKING LOT
BIOFILTRATION SWALE PLAN
C-3499
5

8. SOUTH 154TH STREET/156TH WAY RELOCATION BIOSWALE CALCULATIONS AND STORMWATER DRAINAGE PLANS

For information on the South 154th Street/156th Way relocation bioswale calculations and stormwater drainage plans, see the attached excerpt from the technical information report prepared by Kato and Warren, Inc.

Surface Water Technical Information Report Appendix B Biofiltration Swale Calculations

for

Runways 16L/16R Safety Area Improvement Project South 154th Street/156th Way Relocation

Presented to:
Port of Seattle
Sea-Tac International Airport

Presented by:
Kato & Warren, Inc.

August 1998

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PHONE: ( )
By: KRS
Date: 7/21/98
Chkd:
Date:
Sheet: of
96-382
Job No.

BIOFILTRATION SWALE SIZING

DESIGN CRITERIA

draft 1997 King County Surface Water Design Manual (KCSWDM)
flow depth = 4 inches (unless otherwise noted to achieve $W_{min} = 2'$)
$Q_{WQ} = 60\% (Q_2)$ [15-minute time step]
$n = 0.20$ sizing for biofiltration
$n = 0.027$ 100-yr conveyance check
$V_{max} = 1$ ft/s @ Q_{WQ}
$V_{max} = 5$ ft/s @ Q_{100}

BIOSWALE #1 89+00 to 90+75
BIOSWALE #2 90+75 to 115+50
BIOSWALE #3 115+50 to 148+70
BIOSWALE #4 PERIM. ROAD 140+00 to E. END

2 & 100 yr. peak flow rates (Q_2 & Q_{100})
KCRTS
Rainfall region / scale factor : SeaTac 1.0
Time step 15-minute

Swale bottom width
sized using Manning's equation (FlowMaster software) rather than eqn's (6-1)-(6-4)

Swale Length
9-min residence time: $L = V(540)$ (eqn. 6-5)

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Date 7/21/98
Chkd
Date

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BIOSWALE #1 88+82 to 90+75

Impervious area:
11,549 S.F. → 0.27 AC
Pervious area:
13,060 − 11549 = 1511 S.F. → 0.04 AC

2 & 100-yr peak runoff (KCRTS)
Flow paths:
Impervious − 21.5' @ 2%
Pervious − 8' @ 2%

Q_2 = 0.19 cfs Q_{WQ} = 0.6 (Q_2) = 0.11 cfs
Q_{100} = 0.39 cfs

Swale geometry options:

SLOPE	WIDTH	DEPTH	VELOCITY	LENGTH	
1.5%	2'	0.18'	0.25 fps	135'	← selection
2%	2'	0.16'	0.27 fps	146'	
2.5%	2'	0.15'	0.30 fps	162'	

Swale design:
Bottom width = 2'
Bottom slope = 1.5%
Length = 135'

100-yr conveyance check
d_{100} = 0.35' ✓OK
V_{100} = 0.36 fps ✓OK

AR 047291

BIOSWALE #1

Flow Frequency Analysis
Time Series File:pos-bs1.tsf
Project Location:Sea-Tac

---Annual Flow Rate (CFS)	Peak Rank	Flow Rates--- Time of Peak
0.201	4	8/27/ 1 18:00
0.128	8	1/ 6/ 2 1:00
0.343	2	12/ 8/ 2 17:15
0.137	7	8/25/ 4 23:45
0.200	5	10/28/ 4 16:00
0.207	3	10/22/ 5 10:00
0.190	6	10/25/ 6 22:45
0.393	1	1/ 9/ 8 6:30
Computed Peaks		

-----Flow Frequency - - Peaks - - (CFS)	Rank	Analysis------- Return Period	Prob
0.393	1	100.00	0.990
0.343	2	25.00	0.960
0.207	3	10.00	0.900
0.201	4	5.00	0.800
0.200	5	3.00	0.667
0.190	6	2.00	0.500
0.137	7	1.30	0.231
0.128	8	1.10	0.091
0.377		50.00	0.980

Biofiltration Swale #1
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\fm\96382.fm2
Worksheet	Biofiltration sizing
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.015000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	2.00	ft
Discharge	0.11	ft³/s

Results		
Depth	0.18	ft
Flow Area	0.44	ft²
Wetted Perimeter	3.11	ft
Top Width	3.05	ft
Critical Depth	0.04	ft
Critical Slope	1.693355	ft/ft
Velocity	0.25	ft/s
Velocity Head	0.96e-3	ft
Specific Energy	0.18	ft
Froude Number	0.11	
Flow is subcritical.		

Biofiltration Swale #1
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\fm\96382.fm2
Worksheet	Biofiltration 100-year conveyance
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.015000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	2.00	ft
Discharge	0.39	ft³/s

Results		
Depth	0.35	ft
Flow Area	1.07	ft²
Wetted Perimeter	4.22	ft
Top Width	4.10	ft
Critical Depth	0.10	ft
Critical Slope	1.328946	ft/ft
Velocity	0.36	ft/s
Velocity Head	0.21e-2	ft
Specific Energy	0.35	ft
Froude Number	0.13	
Flow is subcritical.		

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BIOSWALE #2   90+75 to 115+50

Impervious area:
41' (115+50 - 90+75) = 101,475 S.F.
Widening @ W. end : 1017 S.F.
} 2.35 Ac

Pervious area:
16' (115+50 - 90+75) = 0.91 Ac (till grass)

2 & 100 yr. peak runoff (KCRTS)
Flow paths:
Impervious - 16' @ 2%
Pervious - 8' @ 2%

Q_2 = 1.67 cfs Q_{wq} = 0.6(Q_2) = 1.0 cfs
Q_{100} = 3.72 cfs

Swale geometry options:

SLOPE	WIDTH	VELOCITY	LENGTH	ELEVATIONAL DROP	
1%	8.2'	0.33 fps	178'	1.8'	← selection
1.5%	6.6'	0.40 fps	216'	3.2'	
2%	5.7'	0.45 fps	243'	4.9'	

Swale design
Bottom width = 9'
Bottom slope = 1%
Length = 180'

100-yr conveyance check
d_{100} = 0.67' √OK
V_{100} = 0.50 fps √OK

BIOSWALE #2

Flow Frequency Analysis
Time Series File:pos-bs2.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---

Flow Rate (CFS)	Rank	Time of Peak
1.76	5	8/27/ 1 18:00
1.20	8	1/ 6/ 2 1:00
3.24	2	12/ 8/ 2 17:15
1.22	7	8/25/ 4 23:45
2.00	3	11/17/ 4 5:00
1.82	4	10/22/ 5 10:00
1.67	6	10/25/ 6 22:45
3.72	1	1/ 9/ 8 6:30
Computed Peaks		

-----Flow Frequency Analysis-------

- - Peaks - - (CFS)	Rank	Return Period	Prob
3.72	1	100.00	0.990
3.24	2	25.00	0.960
2.00	3	10.00	0.900
1.82	4	5.00	0.800
1.76	5	3.00	0.667
1.67	6	2.00	0.500
1.22	7	1.30	0.231
1.20	8	1.10	0.091
3.56		50.00	0.980

Biofiltration Swale #2
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\fm\96382.fm2
Worksheet	Biofiltration sizing
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Bottom Width

Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.010000	ft/ft
Depth	0.33	ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Discharge	1.00	ft^3/s

Results		
Bottom Width	8.22	ft
Flow Area	3.04	ft^2
Wetted Perimeter	10.30	ft
Top Width	10.20	ft
Critical Depth	0.08	ft
Critical Slope	1.390935	ft/ft
Velocity	0.33	ft/s
Velocity Head	0.17e-2	ft
Specific Energy	0.33	ft
Froude Number	0.11	
Flow is subcritical.		

Biofiltration Swale #2
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\fm\96382.fm2
Worksheet	Biofiltration 100-year conveyance
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.010000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	9.00	ft
Discharge	3.72	ft^3/s

Results		
Depth	0.67	ft
Flow Area	7.39	ft^2
Wetted Perimeter	13.24	ft
Top Width	13.03	ft
Critical Depth	0.17	ft
Critical Slope	1.076273	ft/ft
Velocity	0.50	ft/s
Velocity Head	0.39e-2	ft
Specific Energy	0.67	ft
Froude Number	0.12	
Flow is subcritical.		

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BIOSWALE #3 115+50 to 148+70

Impervious area:
41' (148+70 − 115+50) = 136,120 S.F.
Widening @ E. end: 1011 SF.
Vehicle turn-outs/driveways: 450+4471 S.F = 4,921 S.F.
} 3.26 AC

Pervious area:
16' (145+00 − 115+50) = 47,200 S.F.
5' (148+70 − 145+00) = 1,850 S.F.
} 1.13 AC (till grass)

2 & 100 yr. peak runoff (KCRTS)
Flow paths
Impervious − 16' @ 2%
Pervious − 8' @ 2%

Q_2 = 2.34 cfs Q_{WQ} = 0.6 Q_2 = 1.40 cfs
Q_{100} = 5.21 cfs

swale geometry options:

SLOPE	WIDTH	VELOCITY	LENGTH
1.5%	9.5'	0.41 fps	221'
2.5%	7.2'	0.52 fps	281'
3.0%	6.6'	0.56 fps	300'
3.5%	6.1'	0.60 fps	324'

← selection (avg. swale slope) [for 3.0%]

Swale design:
Bottom width = 8'
Bottom slope = avg 3% (min 2.5%, max 3.5%)
Length = 300'

100yr conveyance check:
d_{100} = 0.86' ✓OK
V_{100} = 0.57 fps ✓OK

BIOSWALE #3

Flow Frequency Analysis
Time Series File:pos-bs3.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---		
Flow Rate (CFS)	Rank	Time of Peak
2.46	5	8/27/ 1 18:00
1.66	8	1/ 6/ 2 1:00
4.49	2	12/ 8/ 2 17:15
1.70	7	8/25/ 4 23:45
2.69	3	11/17/ 4 5:00
2.57	4	10/22/ 5 10:00
2.34	6	10/26/ 6 0:45
5.21	1	1/ 9/ 8 6:30
Computed Peaks		

-----Flow Frequency Analysis-------			
- - Peaks - - (CFS)	Rank	Return Period	Prob
5.21	1	100.00	0.990
4.49	2	25.00	0.960
2.69	3	10.00	0.900
2.57	4	5.00	0.800
2.46	5	3.00	0.667
2.34	6	2.00	0.500
1.70	7	1.30	0.231
1.66	8	1.10	0.091
4.97		50.00	0.980

Biofiltration Swale #3
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\fm\96382.fm2
Worksheet	Biofiltration sizing
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Bottom Width

Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.030000	ft/ft
Depth	0.33	ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Discharge	1.40	ft^3/s

Results		
Bottom Width	6.57	ft
Flow Area	2.49	ft^2
Wetted Perimeter	8.65	ft
Top Width	8.55	ft
Critical Depth	0.11	ft
Critical Slope	1.242869	ft/ft
Velocity	0.56	ft/s
Velocity Head	0.49e-2	ft
Specific Energy	0.33	ft
Froude Number	0.18	
Flow is subcritical.		

Biofiltration Swale #3
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\fm\96382.fm2
Worksheet	Biofiltration 100-year conveyance
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.010000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	8.00	ft
Discharge	5.21	ft^3/s

Results		
Depth	0.86	ft
Flow Area	9.10	ft^2
Wetted Perimeter	13.44	ft
Top Width	13.16	ft
Critical Depth	0.23	ft
Critical Slope	0.987059	ft/ft
Velocity	0.57	ft/s
Velocity Head	0.01	ft
Specific Energy	0.86	ft
Froude Number	0.12	
Flow is subcritical.		

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BIOSWALE #4 PERIM. RD. 140+00 to E. END

Impervious area:
20'(147+00 - 140+00) = 14,000 S.F. → 0.32 AC

Pervious area
[Basin E1] - [Area downstream of bioswale] - [impervious area]
[1.54 AC] - (25'×250') - [0.32 AC] = 1.08 AC (till grass)

2 & 100-yr peak runoff (KCRTS)
flow paths
Impervious - 20' @ 2%
Pervious - 130' @ 6%

Q_2 = 0.27 cfs Q_{wq} = 0.6 (Q_2) = 0.16 cfs
Q_{100} = 1.02 cfs

Swale geometry options:

SLOPE	WIDTH	DEPTH	VELOCITY	LENGTH	
4%	3'	0.13'	0.36 fps	194'	
4.5%	3'	0.13'	0.37 fps	200'	← selection
6%	3'	0.12'	0.41 fps	221'	

Swale design:
Bottom width = 3'
Bottom slope = 4.5%
*NOTE - Since the adjacent road slope is 6.5%, 1'-high check dams will be placed every 50' to reduce slope to 4.5%
Length = 200'
*NOTE - The design criteria for "continuous inflow bioswale" was not used because the majority of runoff enters at the end, and the road receives little travel.

100-yr conveyance check
d_{100} = 0.38' ✓OK
V_{100} = 0.69 fps ✓OK

BIOSWALE #4

Flow Frequency Analysis
Time Series File:pos-bs4.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---

Flow Rate (CFS)	Rank	Time of Peak
0.301	4	2/ 9/ 1 12:30
0.235	7	1/ 6/ 2 1:00
0.666	2	12/ 8/ 2 17:15
0.183	8	8/26/ 4 0:45
0.621	3	11/17/ 4 5:00
0.266	6	10/27/ 5 10:45
0.281	5	11/24/ 6 1:00
1.02	1	1/ 9/ 8 6:30

-----Flow Frequency Analysis-------

- - Peaks - - (CFS)	Rank	Return Period	Prob
1.02	1	100.00	0.990
0.666	2	25.00	0.960
0.621	3	10.00	0.900
0.301	4	5.00	0.800
0.281	5	3.00	0.667
0.266	6	2.00	0.500
0.235	7	1.30	0.231
0.183	8	1.10	0.091
0.899		50.00	0.980

Computed Peaks

Biofiltration Swale #4
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\-fm\96382.fm2
Worksheet	Biofiltration sizing
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.045000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	3.00	ft
Discharge	0.16	ft^3/s

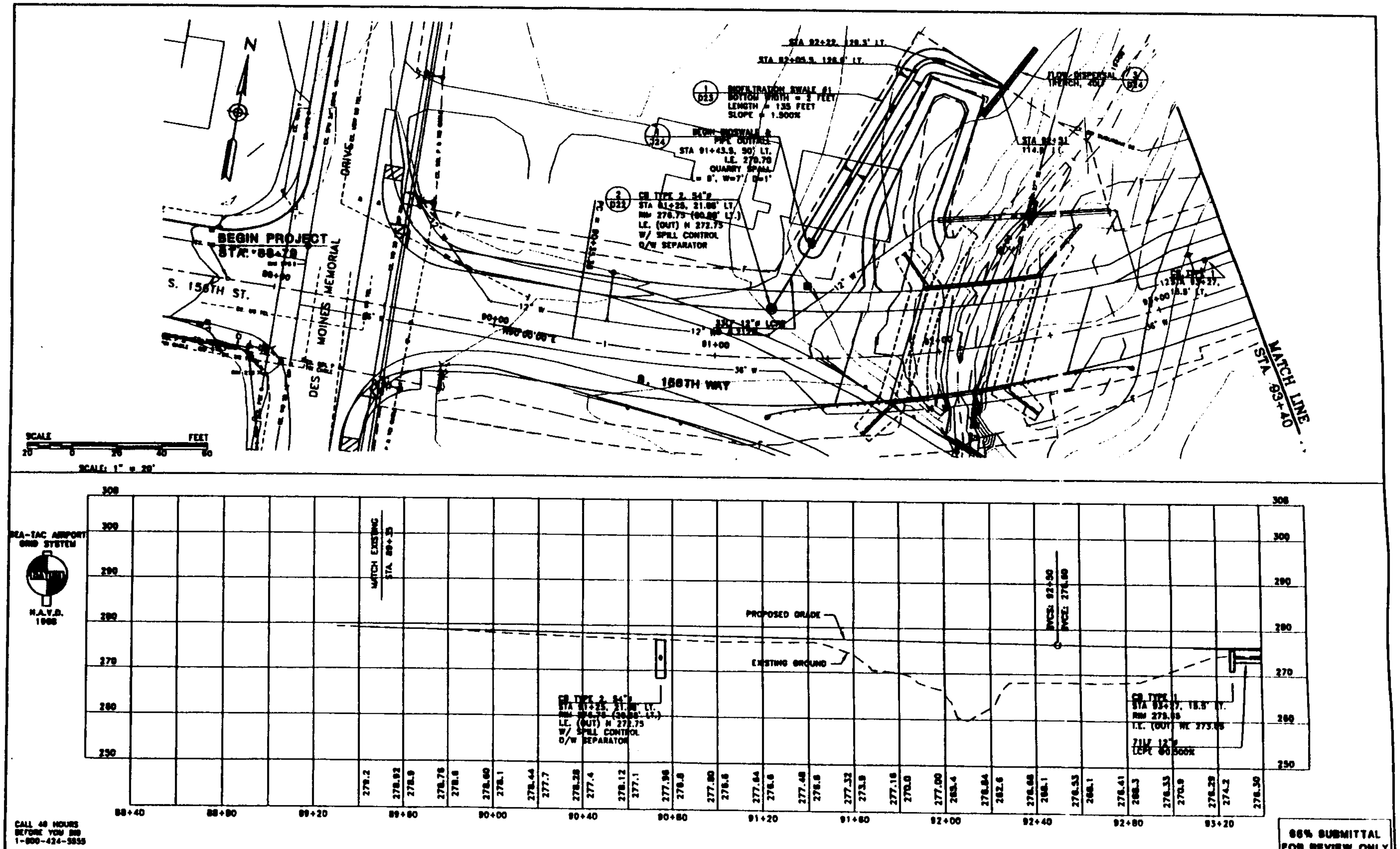
Results		
Depth	0.13	ft
Flow Area	0.43	ft^2
Wetted Perimeter	3.81	ft
Top Width	3.77	ft
Critical Depth	0.04	ft
Critical Slope	1.684690	ft/ft
Velocity	0.37	ft/s
Velocity Head	0.21e-2	ft
Specific Energy	0.13	ft
Froude Number	0.19	
Flow is subcritical.		

Biofiltration Swale #4
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\~fm\96382.fm2
Worksheet	Biofiltration 100-year conveyance
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.045000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	3.00	ft
Discharge	1.02	ft^3/s

Results		
Depth	0.37	ft
Flow Area	1.50	ft^2
Wetted Perimeter	5.32	ft
Top Width	5.20	ft
Critical Depth	0.15	ft
Critical Slope	1.171746	ft/ft
Velocity	0.68	ft/s
Velocity Head	0.01	ft
Specific Energy	0.37	ft
Froude Number	0.22	
Flow is subcritical.		



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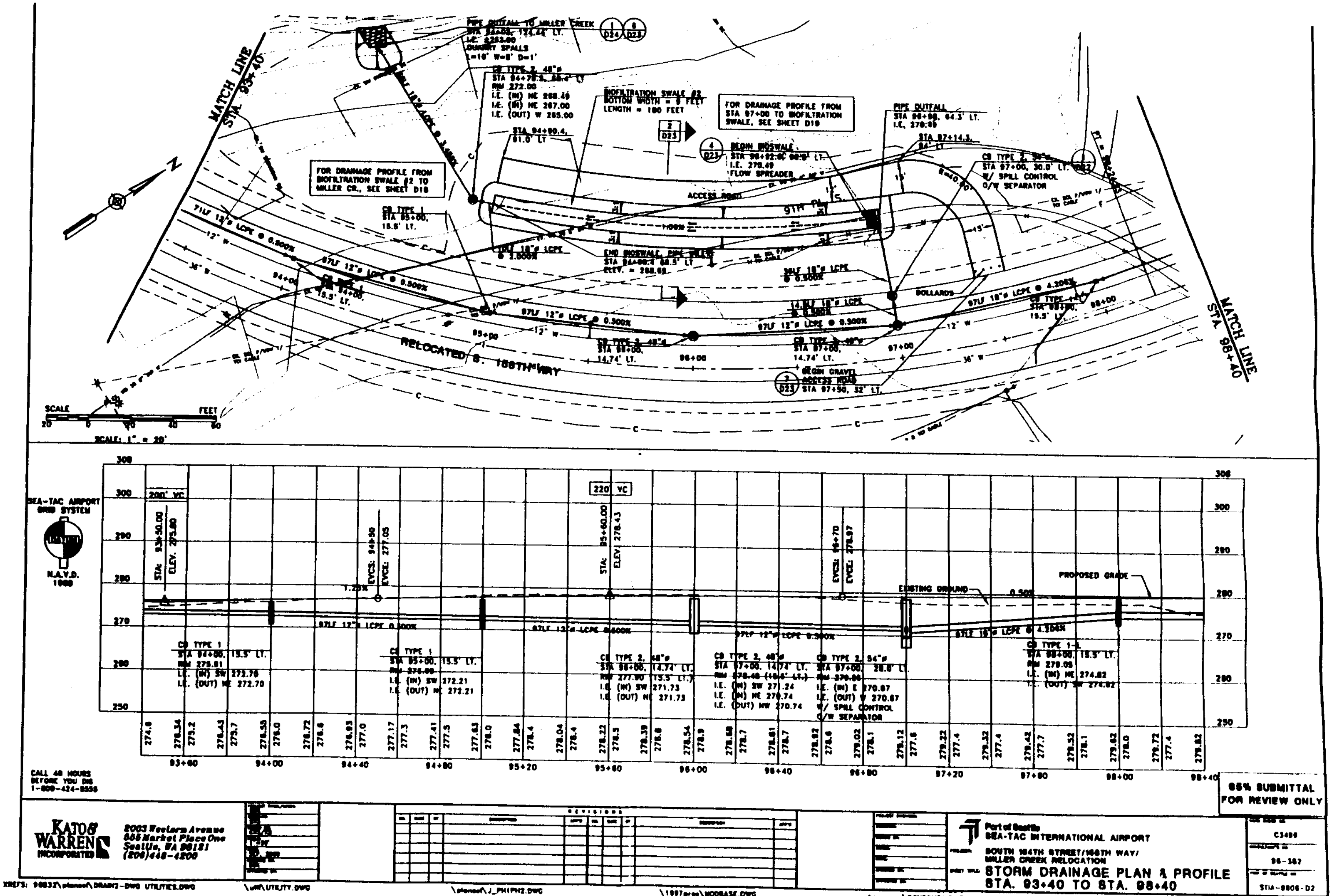
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
SOUTH 154TH STREET/156TH WAY/ MILLER CREEK RELOCATION

STORM DRAINAGE PLAN & PROFILE
STA. 88+79 TO STA. 93+40

C3496
98-387
STIA-9806-01

XREFS: 96382\PLANSET\DRAIN1.dwg \UTIL\UTILITY.DWG \PLANSET\J_PH1PH2.DWG \1997PRES\MODBASE.DWG \BASEMAP\CONTOUR1.DWG


MATCH LINE STA. 93+40
MATCH LINE STA. 98+40
PIPE OUTFALL TO MILLER CREEK
FOR DRAINAGE PROFILE FROM BIOFILTRATION SWALE #2 TO MILLER CR., SEE SHEET D18
FOR DRAINAGE PROFILE FROM STA 97+00 TO BIOFILTRATION SWALE, SEE SHEET D19
ACCESS ROAD
BOLLARDS
RELOCATED S. 188TH WAY
SCALE: 1" = 20'
SEA-TAC AIRPORT GRID SYSTEM
N.A.V.D. 1988
EXISTING GROUND
PROPOSED GRADE
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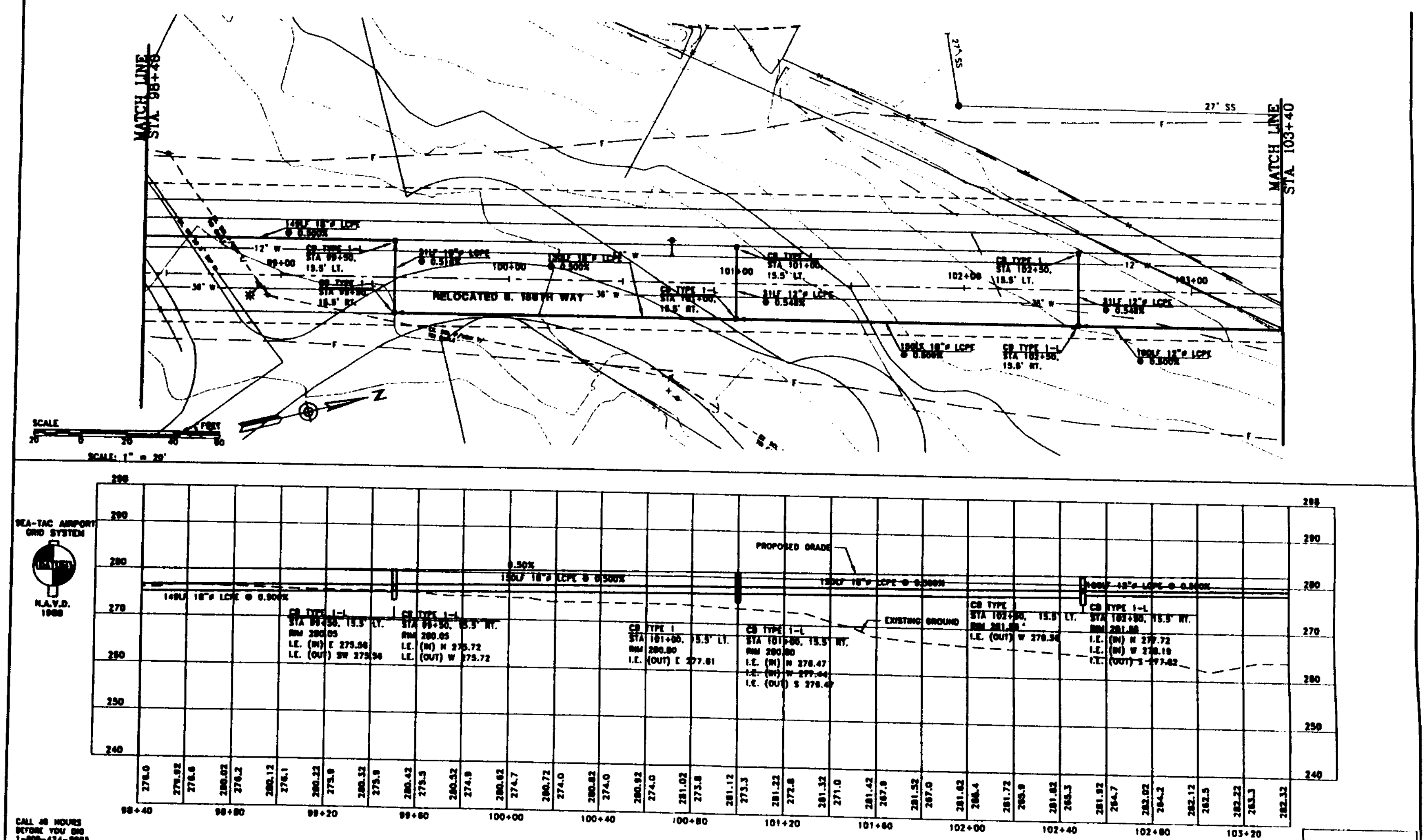
STORM DRAINAGE PLAN & PROFILE
STA. 93+40 TO STA. 98+40

H-9

AR 047308



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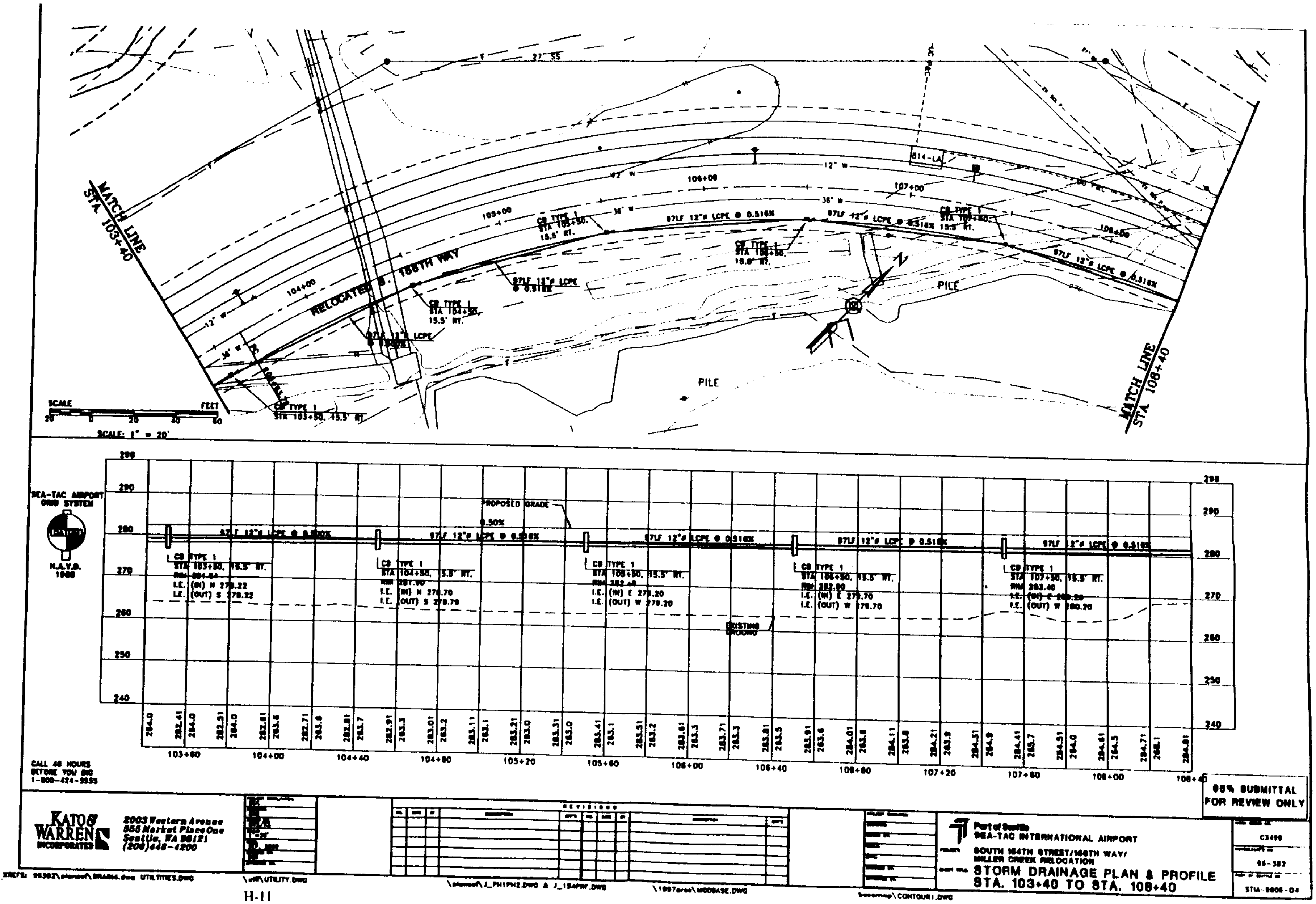
STORM DRAINAGE PLAN & PROFILE STA. 98+40 TO STA. 103+40

C3406
96-382
STIA-9806-D3

H-10

AR 047309


MATCH LINE STA. 103+40
MATCH LINE STA. 108+40
RELOCATED S. 156TH WAY
PILE
PILE
SCALE: 1" = 20'
SEA-TAC AIRPORT GRID SYSTEM
N.A.V.D. 1988
PROPOSED GRADE
0.50%
97LF 12"ø LCPE @ 0.516%
CB TYPE 1 STA 103+50, 15.5' RT.
CB TYPE 1 STA 104+50, 15.5' RT.
CB TYPE 1 STA 105+50, 15.5' RT.
CB TYPE 1 STA 106+50, 15.5' RT.
CB TYPE 1 STA 107+50, 15.5' RT.
EXISTING GROUND
103+60
104+00
104+40
104+80
105+20
105+60
106+00
106+40
106+80
107+20
107+60
108+00
108+40
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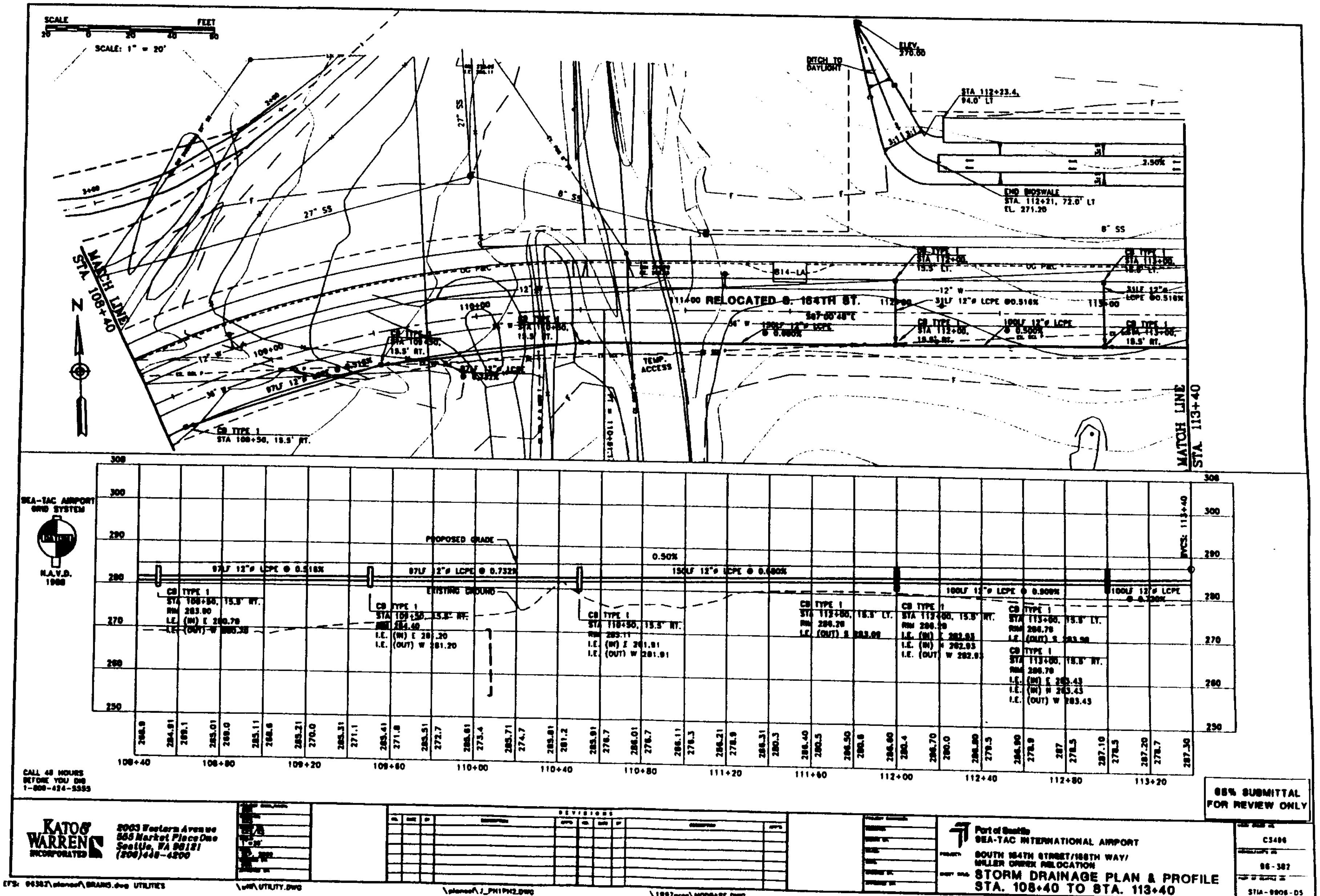
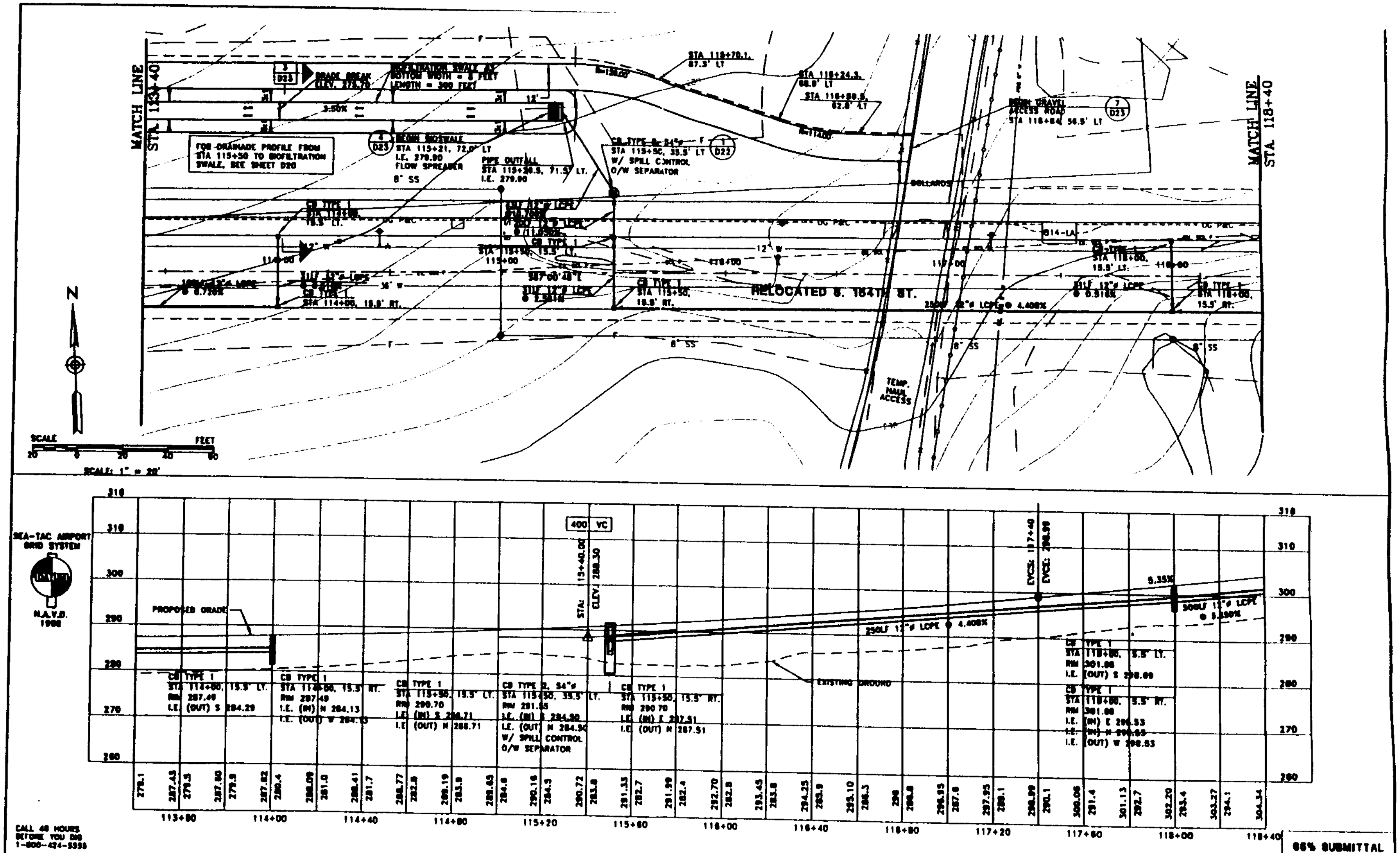
MILLER CREEK RELOCATION
STORM DRAINAGE PLAN & PROFILE
STA. 103+40 TO STA. 108+40
H-11



H-12

AR 047311



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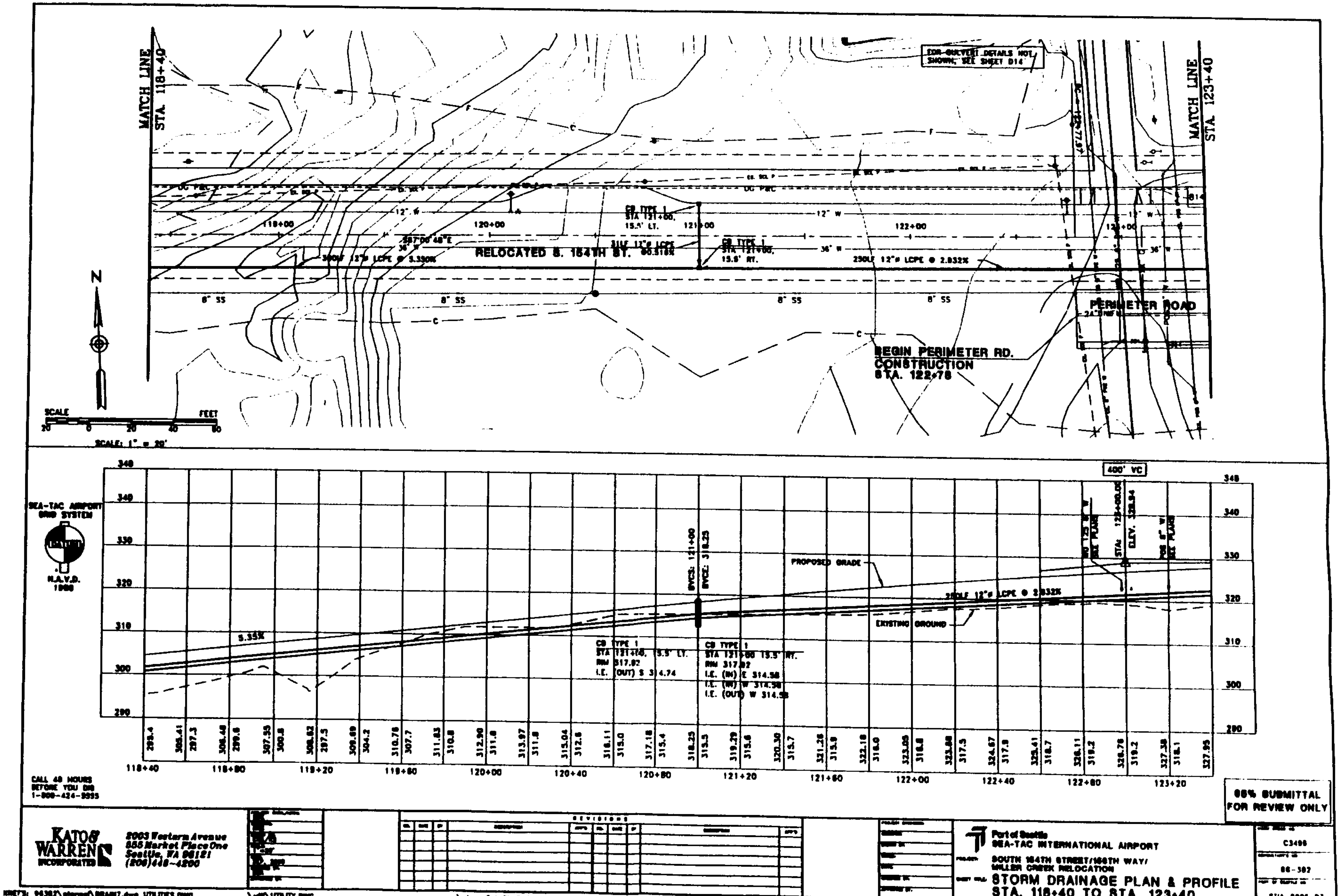
STORM DRAINAGE PLAN & PROFILE
STA. 113+40 TO STA. 118+40

65% SUBMITTAL FOR REVIEW ONLY

C3486
96-302
STIA-9806-D6

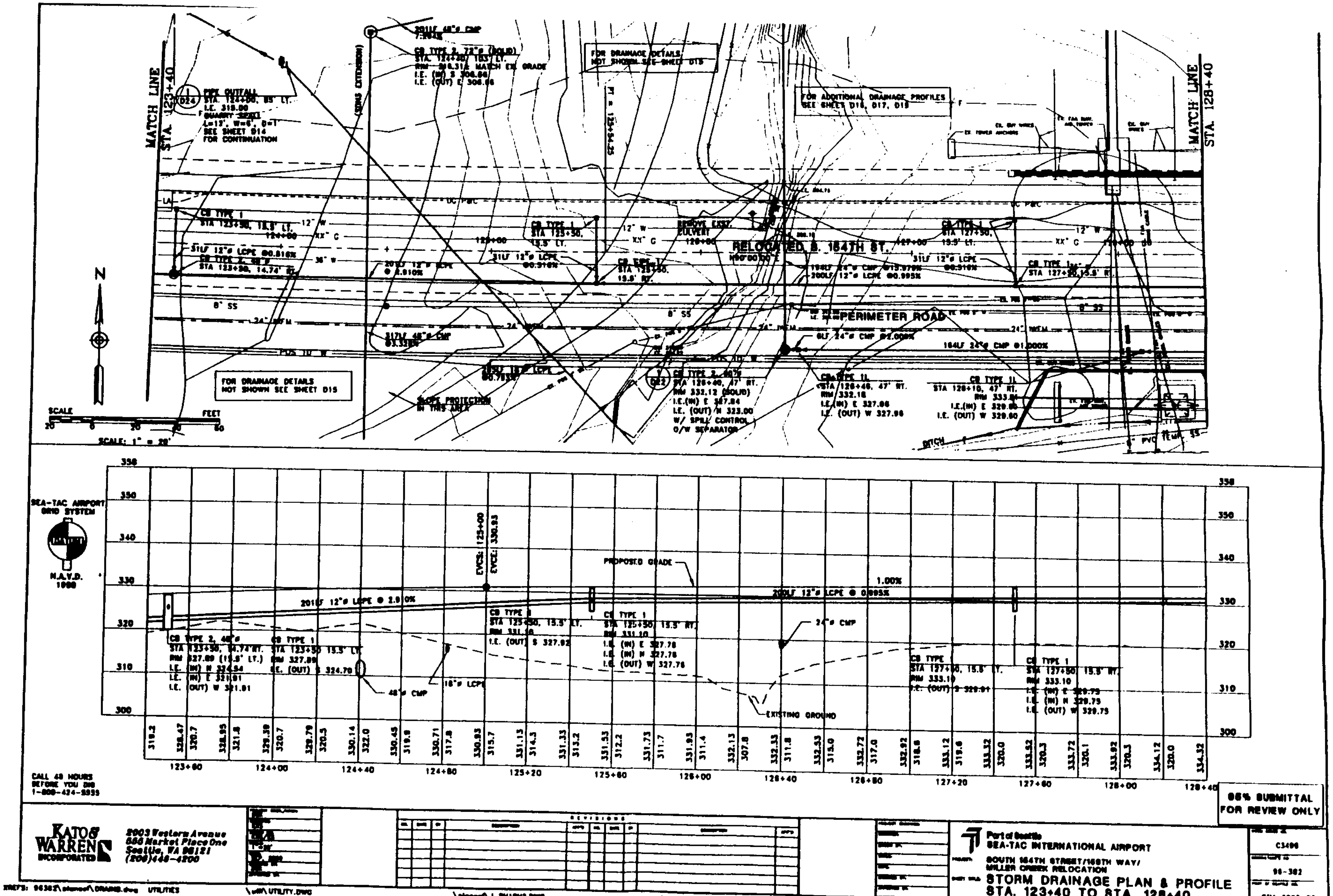
H-13

AR 047312



H-14

AR 047313


MATCH LINE STA. 123+40
MATCH LINE STA. 128+40
PIPE OUTFALL STA. 124+00, 85' LT. I.E. 318.00 QUARRY SPALL L=12', W=6', D=1' SEE SHEET D14 FOR CONTINUATION
CB TYPE 2, 72"ø (SOLID) STA. 124+30, 153' LT. RIM 306.31± MATCH EX. GRADE I.E. (IN) S 306.86 I.E. (OUT) E 306.86
FOR DRAINAGE DETAILS NOT SHOWN SEE SHEET D15
FOR ADDITIONAL DRAINAGE PROFILES SEE SHEETS D16, D17, D18
RELOCATED S. 164TH ST.
PERIMETER ROAD
SLOPE PROTECTION IN THIS AREA
CB TYPE 2, 60"ø STA 126+40, 47' RT. RIM 332.12 (SOLID) I.E.(IN) E 327.84 I.E. (OUT) N 323.00 W/ SPILL CONTROL O/W SEPARATOR
CB TYPE 1L STA 126+40, 47' RT. RIM 332.16 I.E.(IN) E 327.86 I.E. (OUT) W 327.96
CB TYPE 1L STA 128+10, 47' RT. RIM 333.84 I.E.(IN) E 329.80 I.E. (OUT) W 329.90
SCALE FEET 20 0 20 40 60 SCALE: 1" = 20'
SEA-TAC AIRPORT GRID SYSTEM
N.A.V.D. 1988
PROPOSED GRADE
EXISTING GROUND
201LF 12"ø LCPE @ 2.910%
200LF 12"ø LCPE @ 0.995%
48"ø CMP
18"ø LCPE
24"ø CMP
CALL 48 HOURS BEFORE YOU DIG 1-800-424-5555
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STORM DRAINAGE PLAN & PROFILE STA. 123+40 TO STA. 128+40
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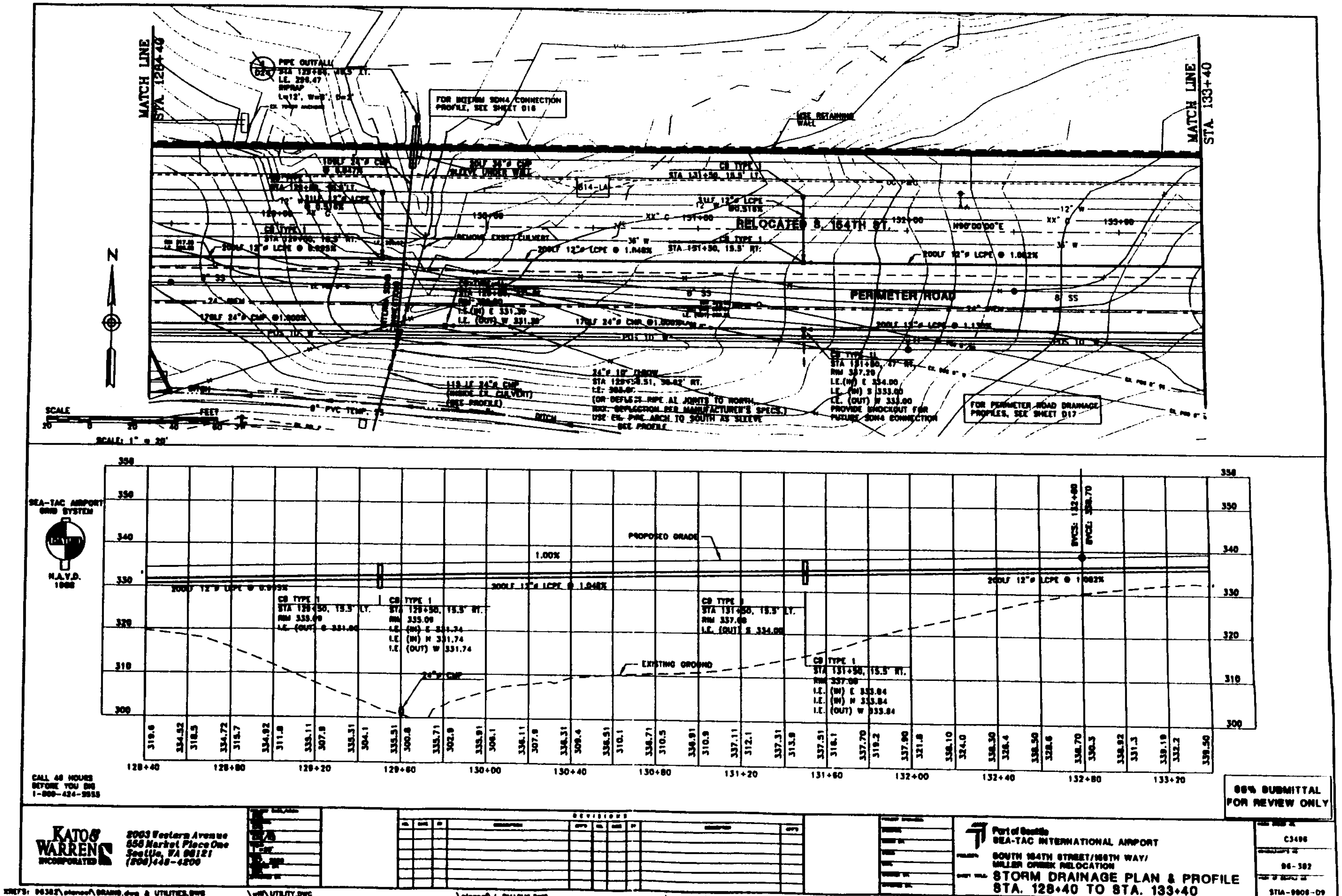
C3496
96-382
STM-8806-D8


MATCH LINE STA. 128+40
MATCH LINE STA. 133+40
RELOCATED S. 164TH ST.
PERIMETER ROAD
FOR PERIMETER ROAD DRAINAGE PROFILES, SEE SHEET D17
SCALE: 1" = 20'
SEA-TAC AIRPORT GRID SYSTEM
N.A.V.D. 1988
PROPOSED GRADE
EXISTING GROUND
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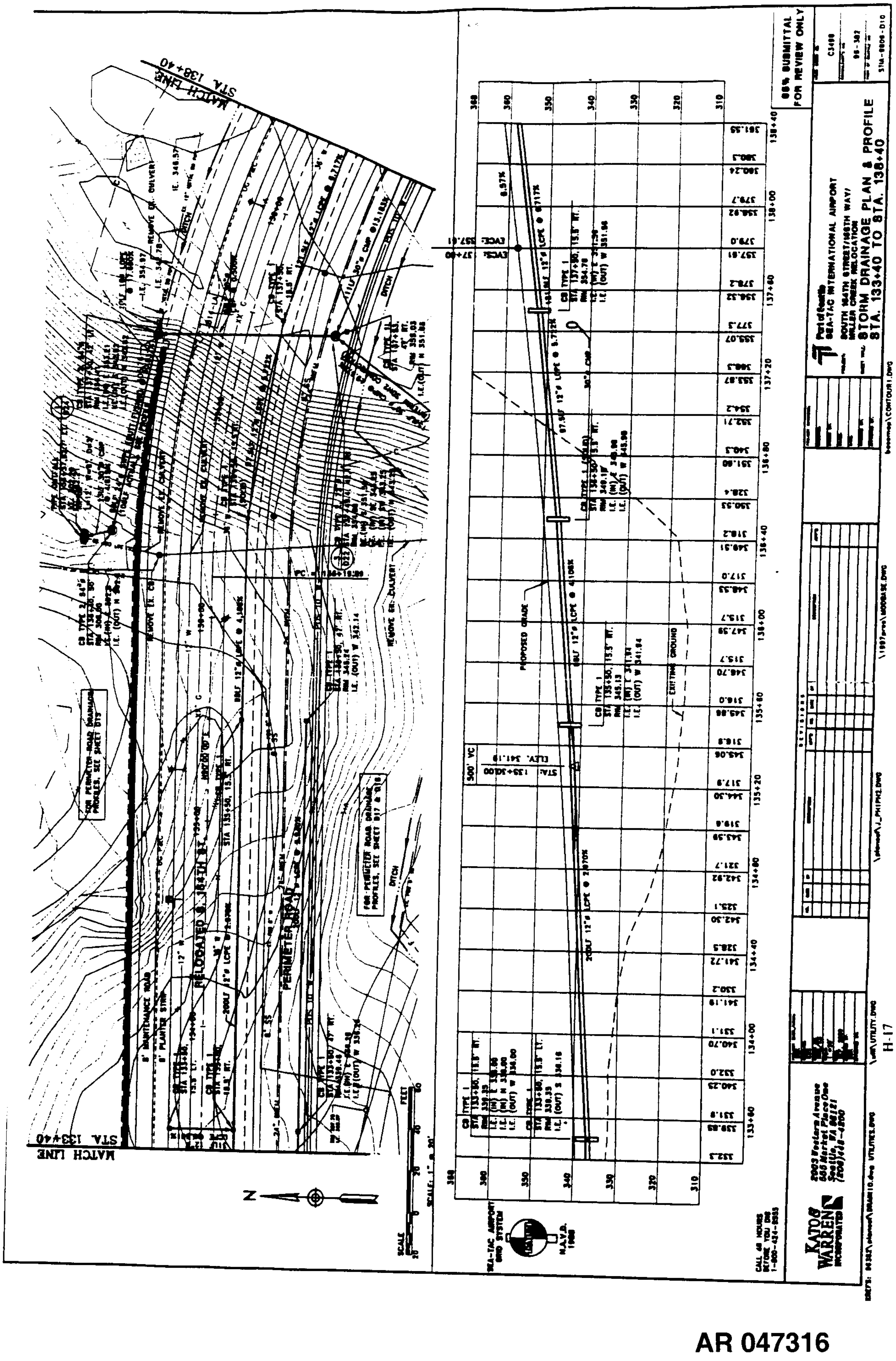
STA. 128+40 TO STA. 133+40
C3496
96-382
STIA-9608-D9

H-16



STORM DRAINAGE PLAN & PROFILE
STA. 133+40 TO STA. 138+40
SOUTH 154TH STREET/156TH WAY/
MILLER CREEK RELOCATION
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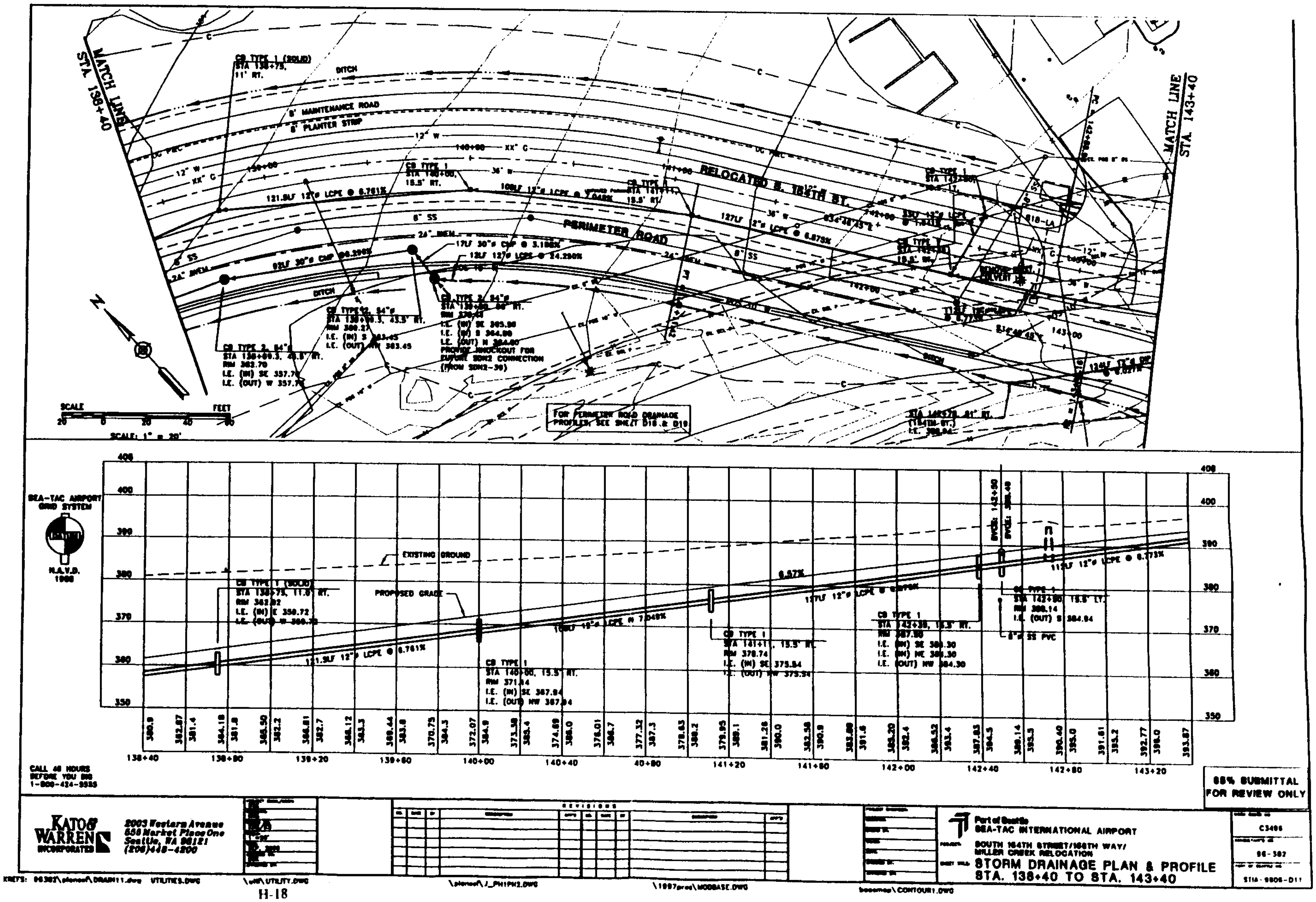
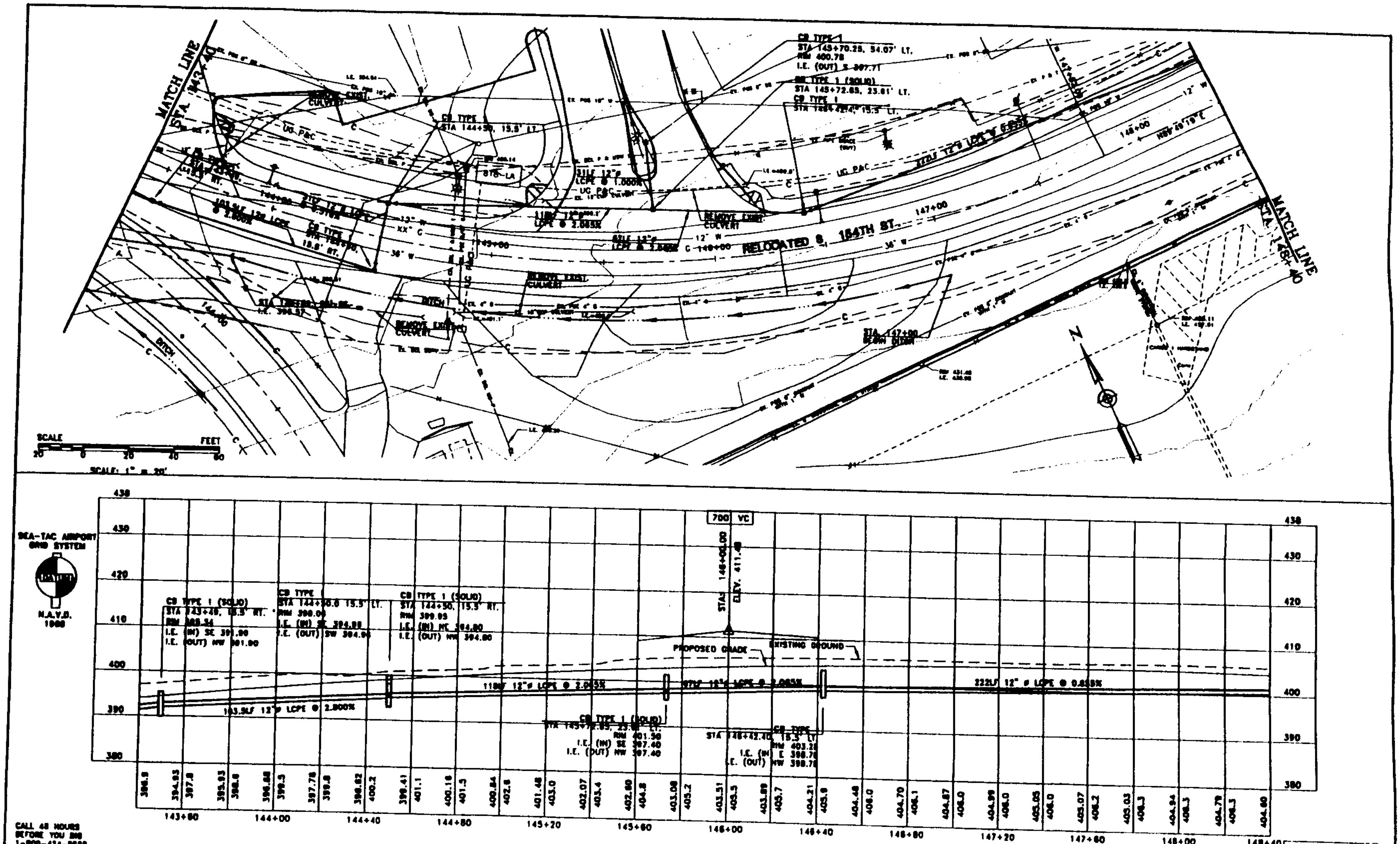
MATCH LINE STA. 138+40
MATCH LINE STA. 133+40
RELOCATED S. 154TH ST.
PERIMETER ROAD
PROPOSED GRADE
EXISTING GROUND
SEA-TAC AIRPORT GRID SYSTEM
N.A.V.D. 1988
CALL 48 HOURS BEFORE YOU DIG
H-17



H-18

AR 047317



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H-19

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STORM DRAINAGE PLAN & PROFILE STA. 143+40 TO STA. 146+40

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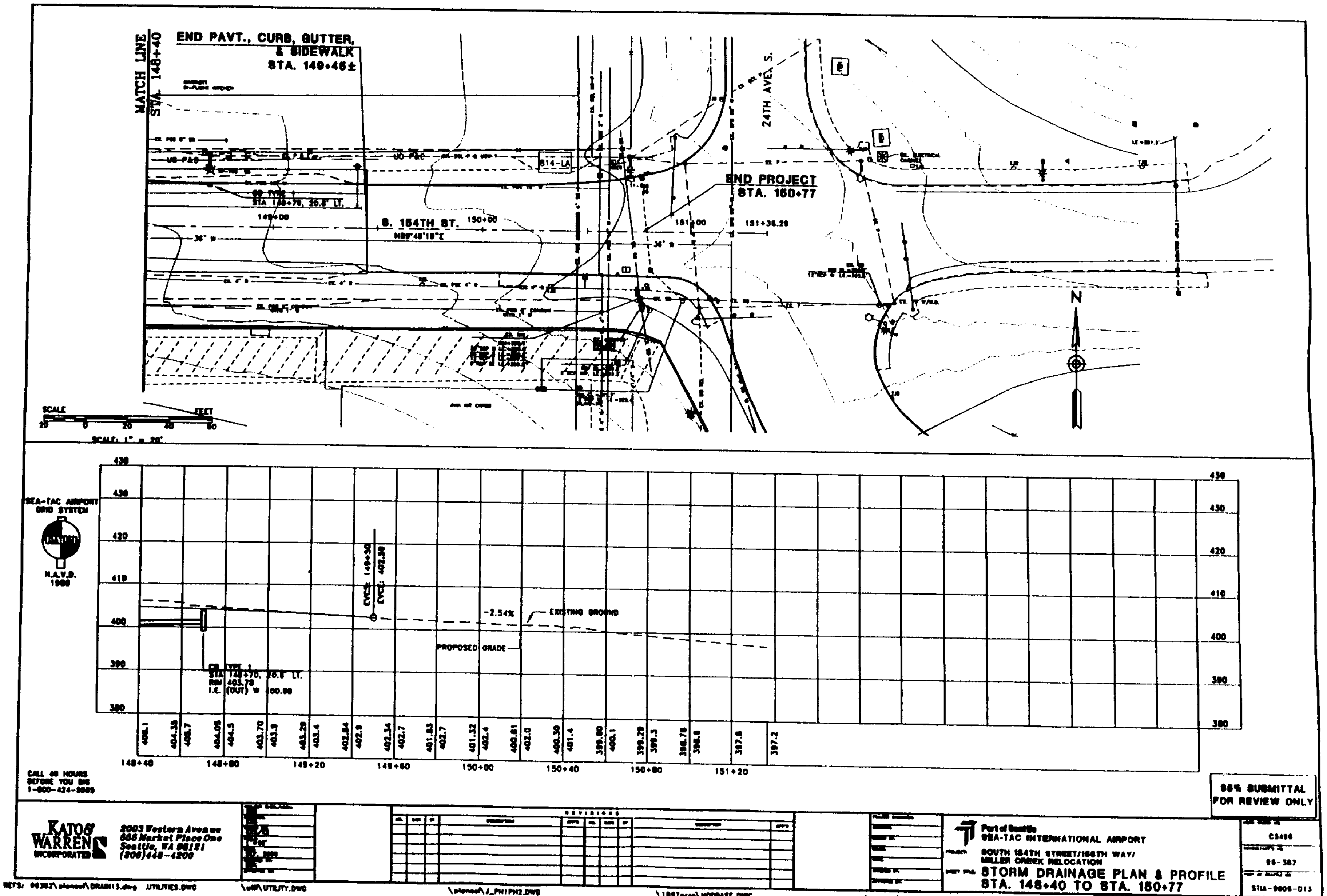
C3496

96-382

STIA-9806-D17

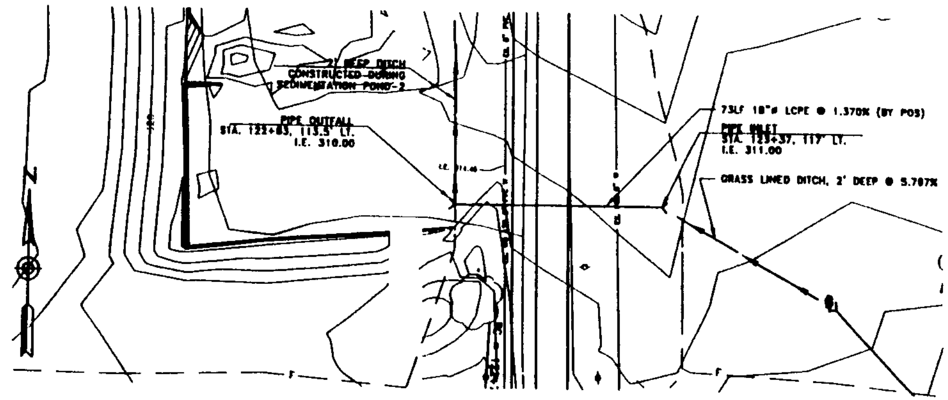
XREFS: 96382\planset\DRAIN12.dwg UTILITIES.DWG \util\UTILITY.DWG \planset\J_PH1PH2.DWG \1997pdsa\MODBASE.DWG basemap\CONTOUR1.DWG

AR 047318



H-20

AR 047319



PIPE OUTFALL @ STA 124+00, 86' LT.

SCALE: 1" = 20'

SEA-TAC AIRPORT GRID SYSTEM

N.A.V.D. 1988

STORM DRAINAGE NOTES:

1. ALL LABELED PIPE LENGTHS ARE MEASURED IN THE HORIZONTAL PLANE BETWEEN CENTERS OF STRUCTURES, ROUNDED TO THE NEAREST FOOT. LABELED PIPE SLOPES WERE COMPUTED USING THESE LENGTHS. ACTUAL PIPE LENGTHS AND SLOPES SHALL BE COMPUTED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
2. PIPES LABELED LCPE SHALL BE CORRUGATED POLYETHYLENE STORM SEWER PIPE.
3. PIPES LABELED CMP SHALL BE STEEL STORM SEWER PIPE.
4. PIPES LABELED DIP SHALL BE DUCTILE IRON STORM SEWER PIPE.
5. PIPES LABELED SWPE SHALL BE SOLID WALL POLYETHYLENE PIPE.
6. CATCH BASINS WITHIN THE RELOCATED S. 154TH WAY SHALL HAVE THROUGH-CURB INLETS WITH VANED GRATES, UNLESS OTHERWISE NOTED (SEE KCRS STD. DWGS. 2-016 & 2-017).
7. CATCH BASINS WITHIN THE AIRPORT PERIMETER ROAD SHALL HAVE STANDARD FRAMES AND VANED GRATES, UNLESS OTHERWISE NOTED.
8. STATION AND OFFSET CALLOUTS FOR AREA INLETS AND CATCH BASINS ARE FOR CENTER OF STRUCTURE, UNLESS OTHERWISE NOTED.

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STORM DRAINAGE PLAN & NOTES

C3496
96-382
STIA-9806 D14

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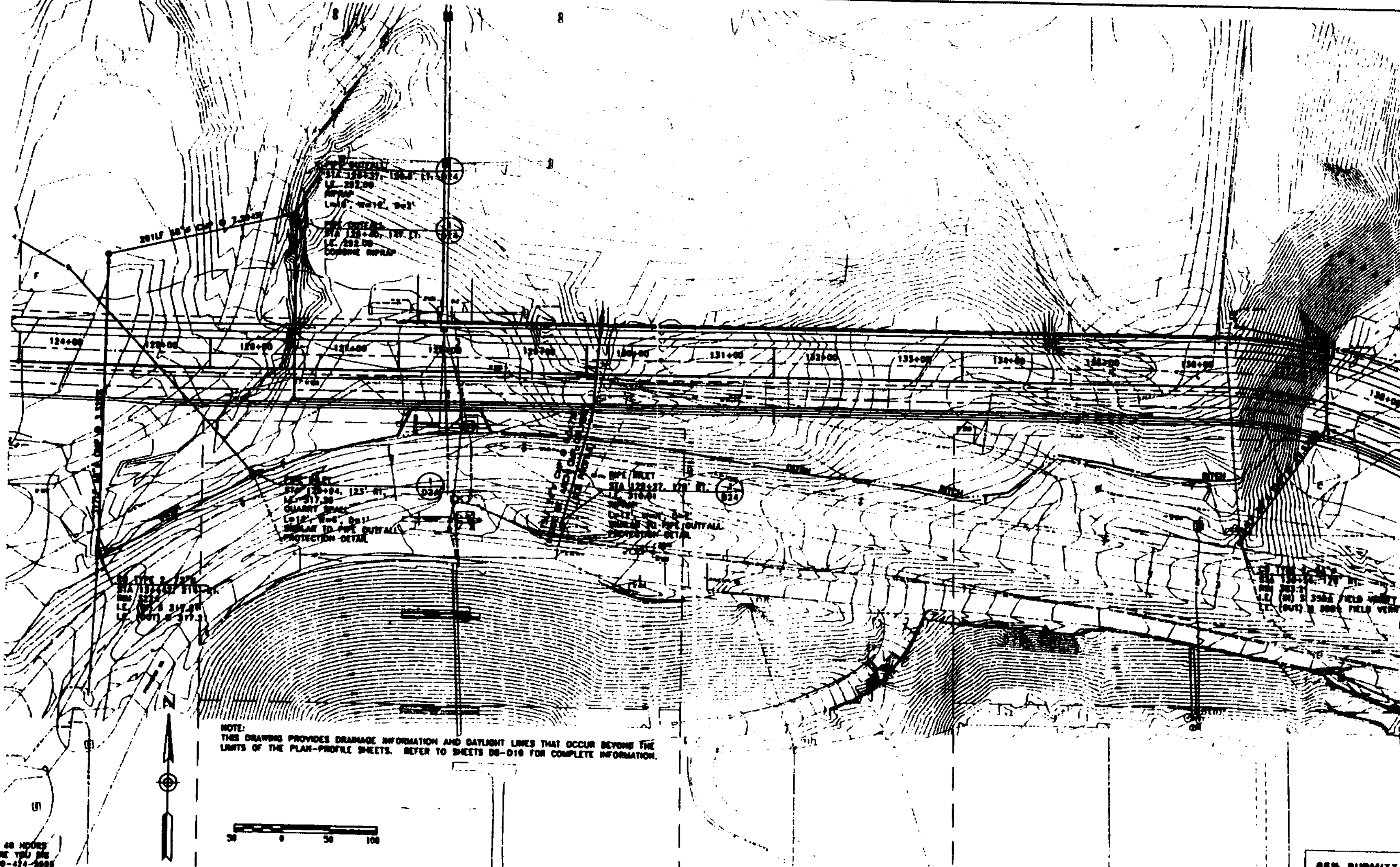

NOTE:
THIS DRAWING PROVIDES DRAINAGE INFORMATION AND DAYLIGHT LINES THAT OCCUR BEYOND THE LIMITS OF THE PLAN-PROFILE SHEETS. REFER TO SHEETS DS-D10 FOR COMPLETE INFORMATION.

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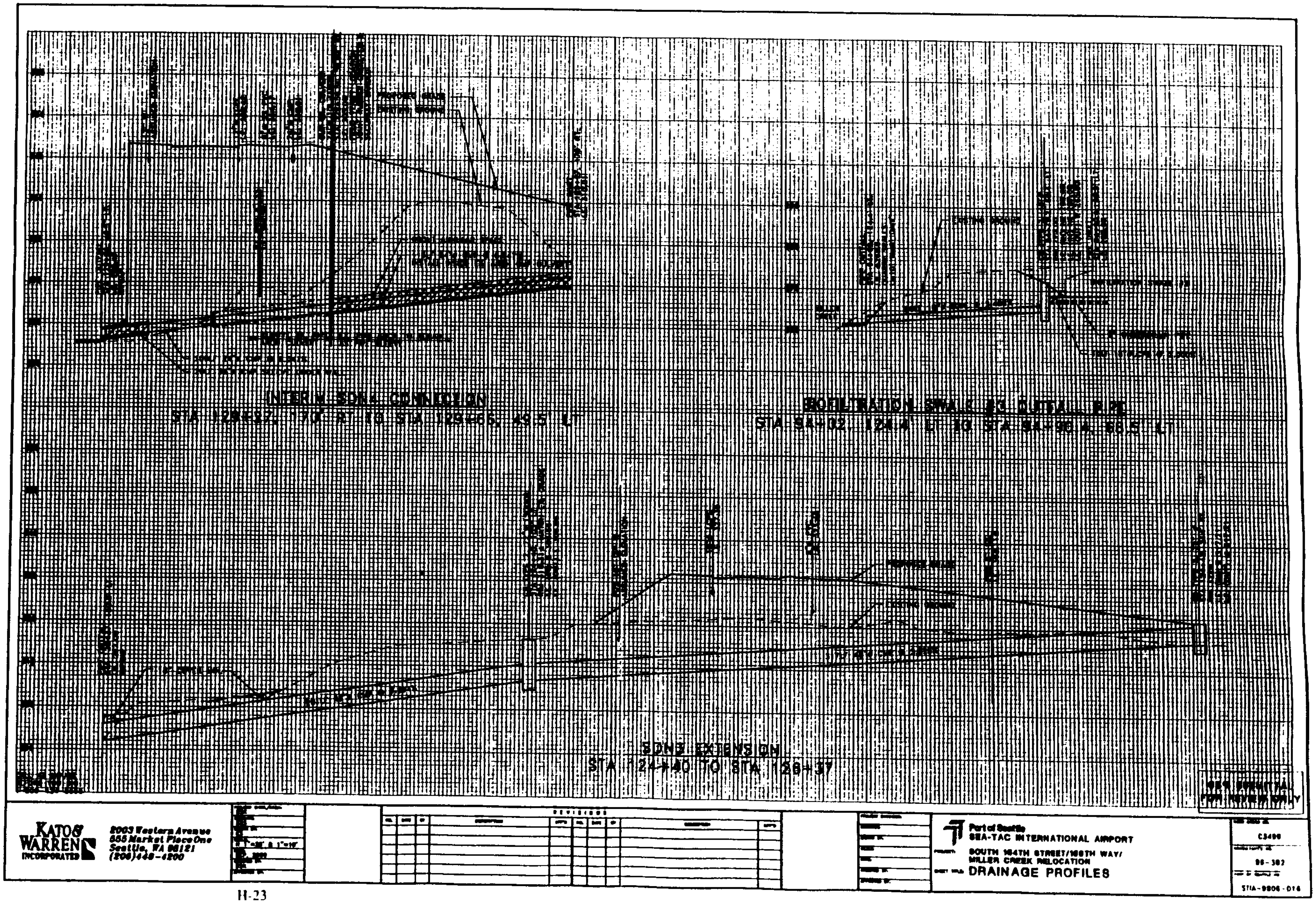
DRAINAGE PLAN
AREA "A"

C3498
96-382
STIA-9806-D15

H-22


INTERIM SDN4 CONNECTION
STA 129+37, 170' RT TO STA 129+66, 49.5' LT
BIOFILTRATION SWALE #3 OUTFALL PIPE
STA 94+02, 124.4' LT TO STA 94+90.4, 66.5' LT
SDN3 EXTENSION
STA 124+40 TO STA 126+37
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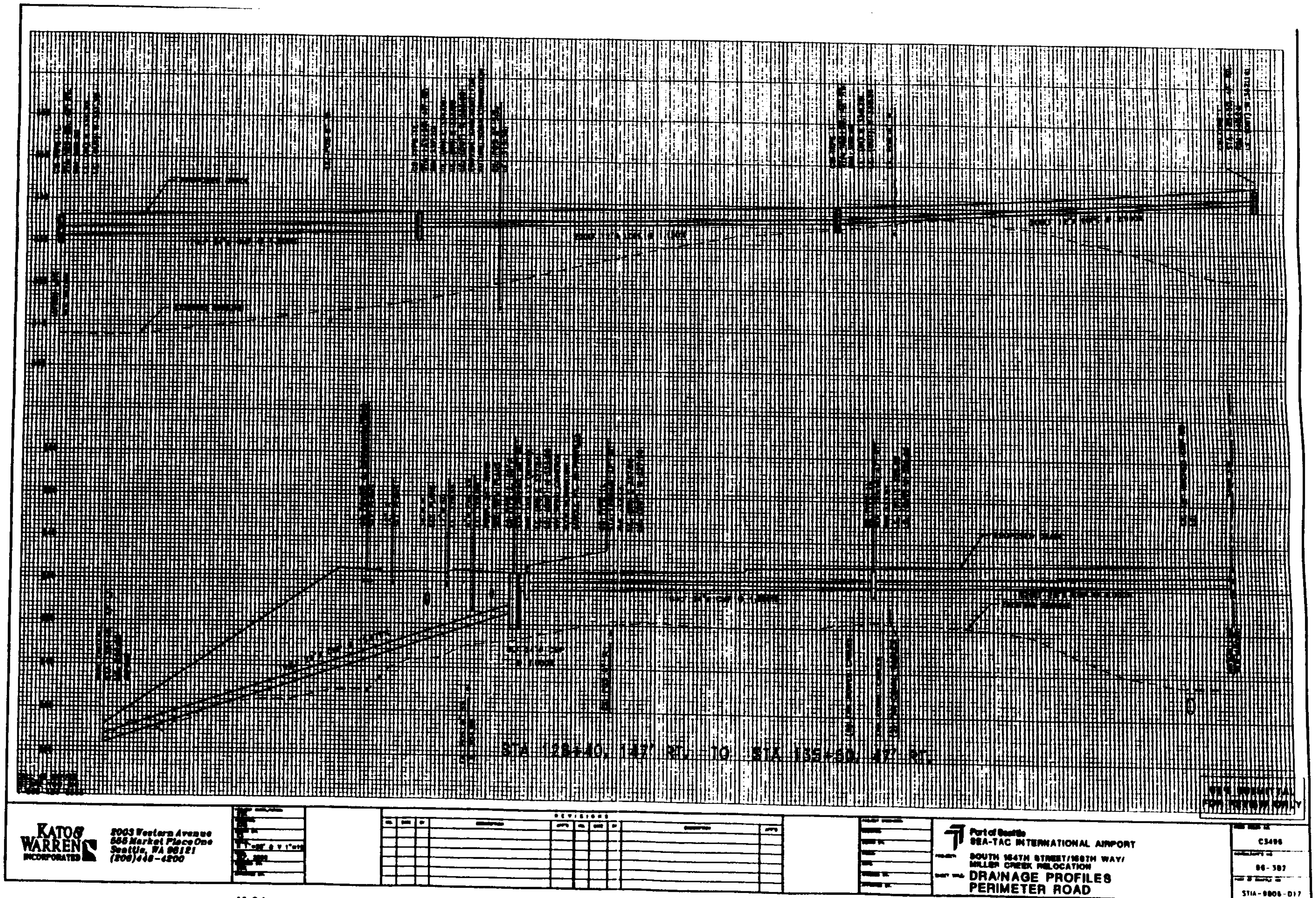
MILLER CREEK RELOCATION
DRAINAGE PROFILES



STA 128+40, 147' RT. TO STA 135+60, 47' RT.
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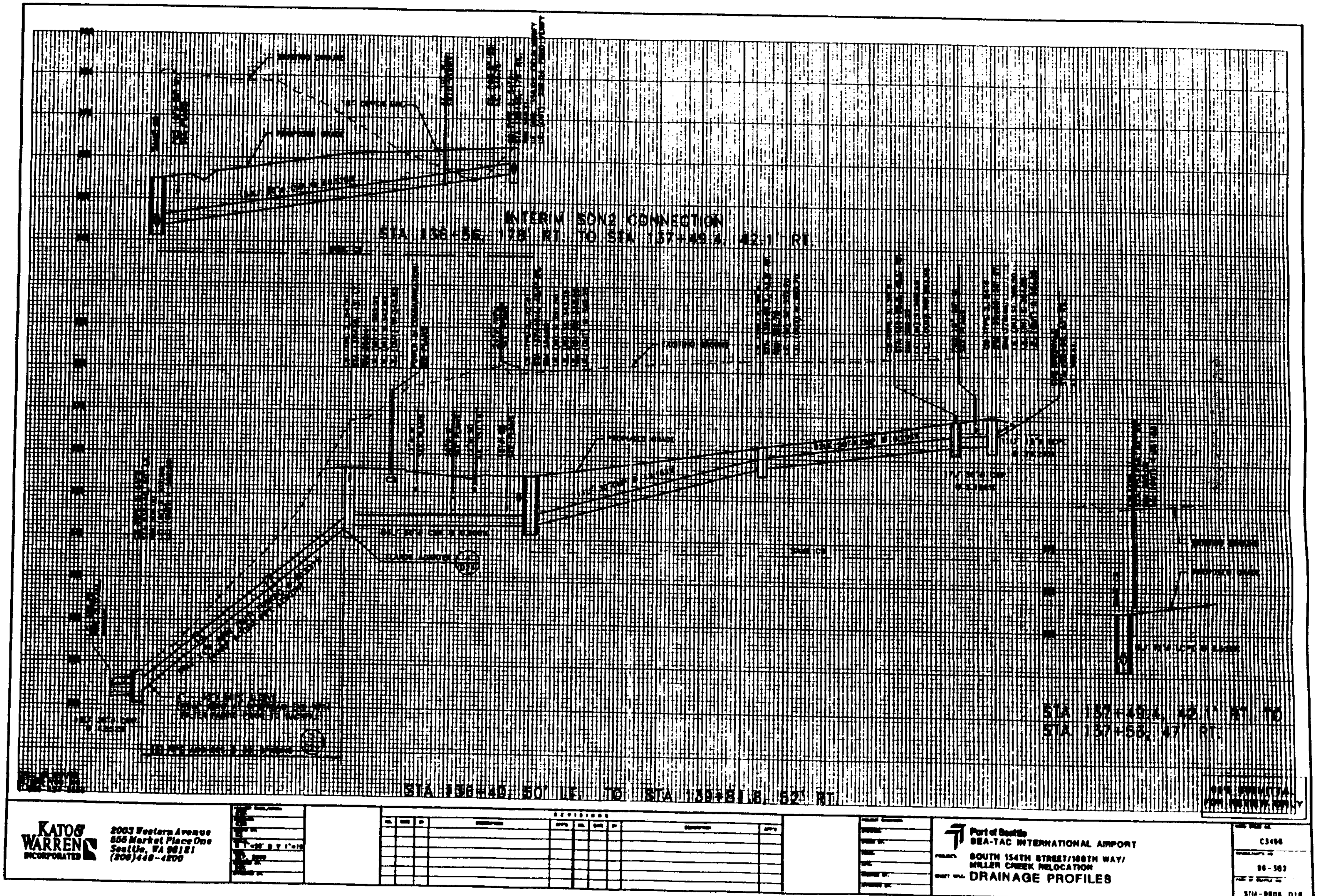
MILLER CREEK RELOCATION
DRAINAGE PROFILES
PERIMETER ROAD
C3496
86-387
STIA-9806-D17


INTERIM SDN2 CONNECTION
STA 156+56, 178' RT. TO STA 157+49.4, 42.1' RT.
STA 157+49.4, 42.1' RT. TO
STA 157+53, 47' RT.
STA 156+40, 50' LT. TO STA 155+81.8, 52' RT.
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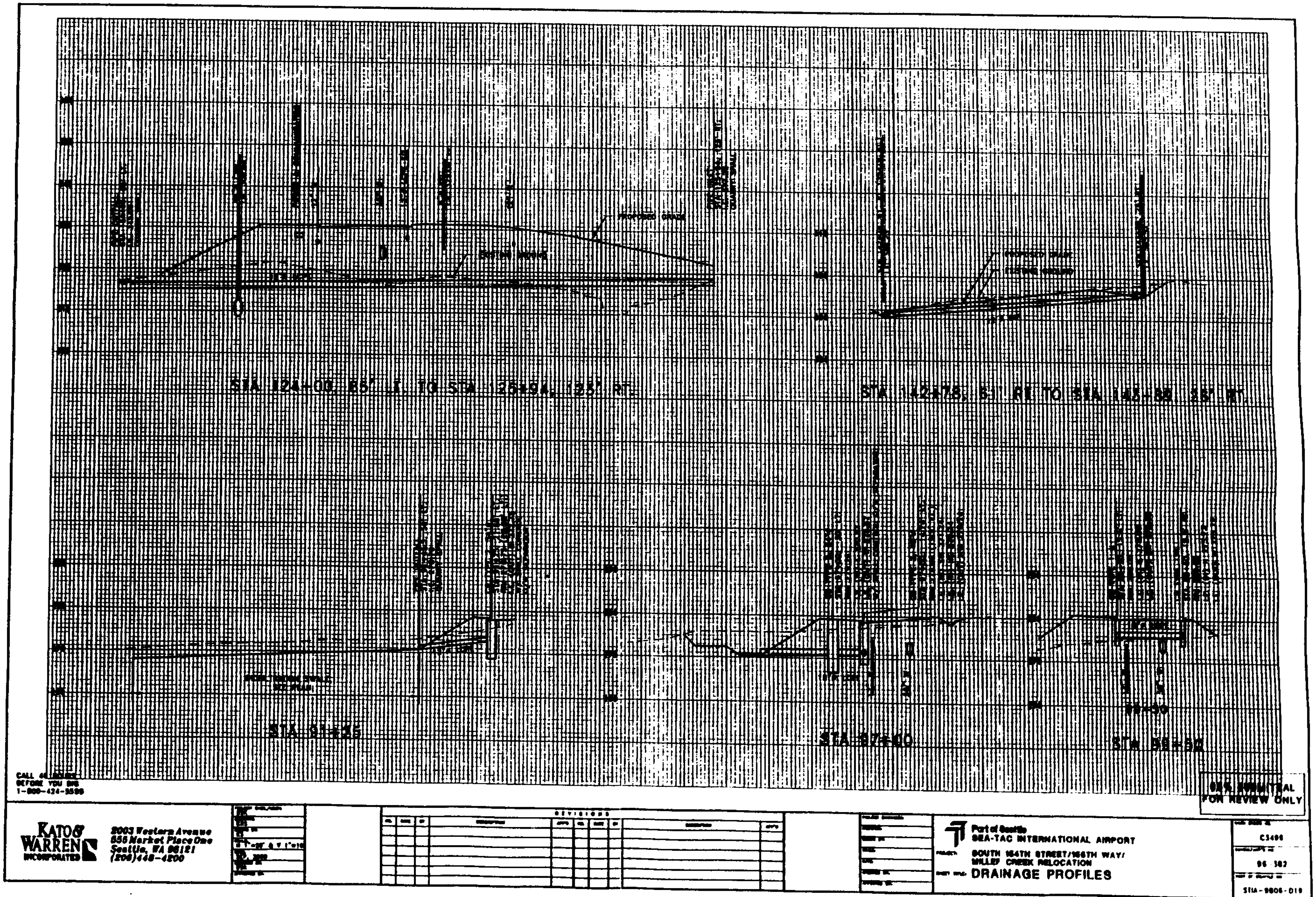
DRAINAGE PROFILES
C3496
96-382
STIA-9606 D18


STA 124+00, 85' LT TO STA 125+94, 125' RT
STA 142+78, 51' RT TO STA 145+88, 25' RT
STA 91+35
STA 97+40
STA 99+52
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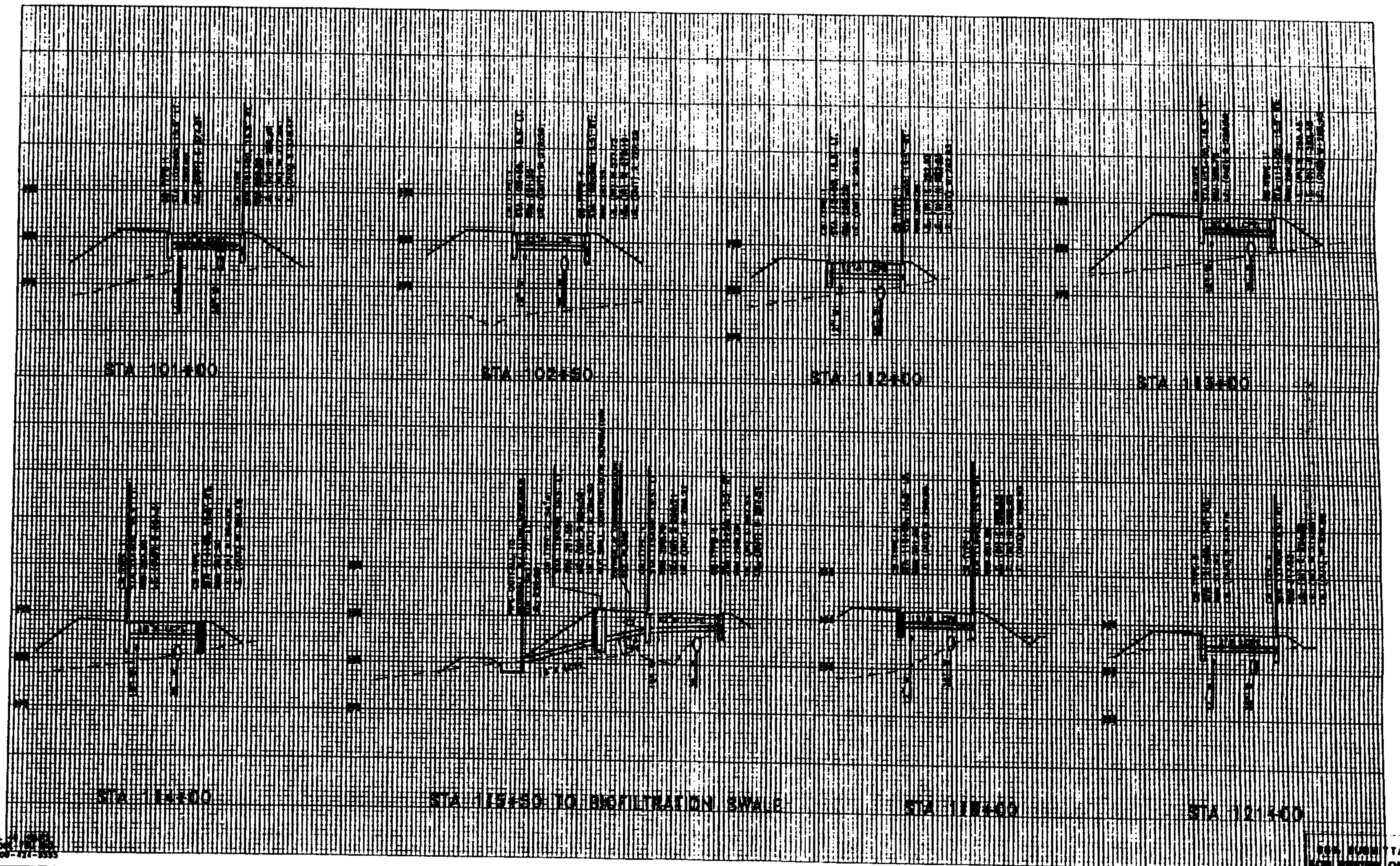
MILLER CREEK RELOCATION
DRAINAGE PROFILES
C3498
96 382
STIA-9806-D19
FOR REVIEW ONLY

AR 047325



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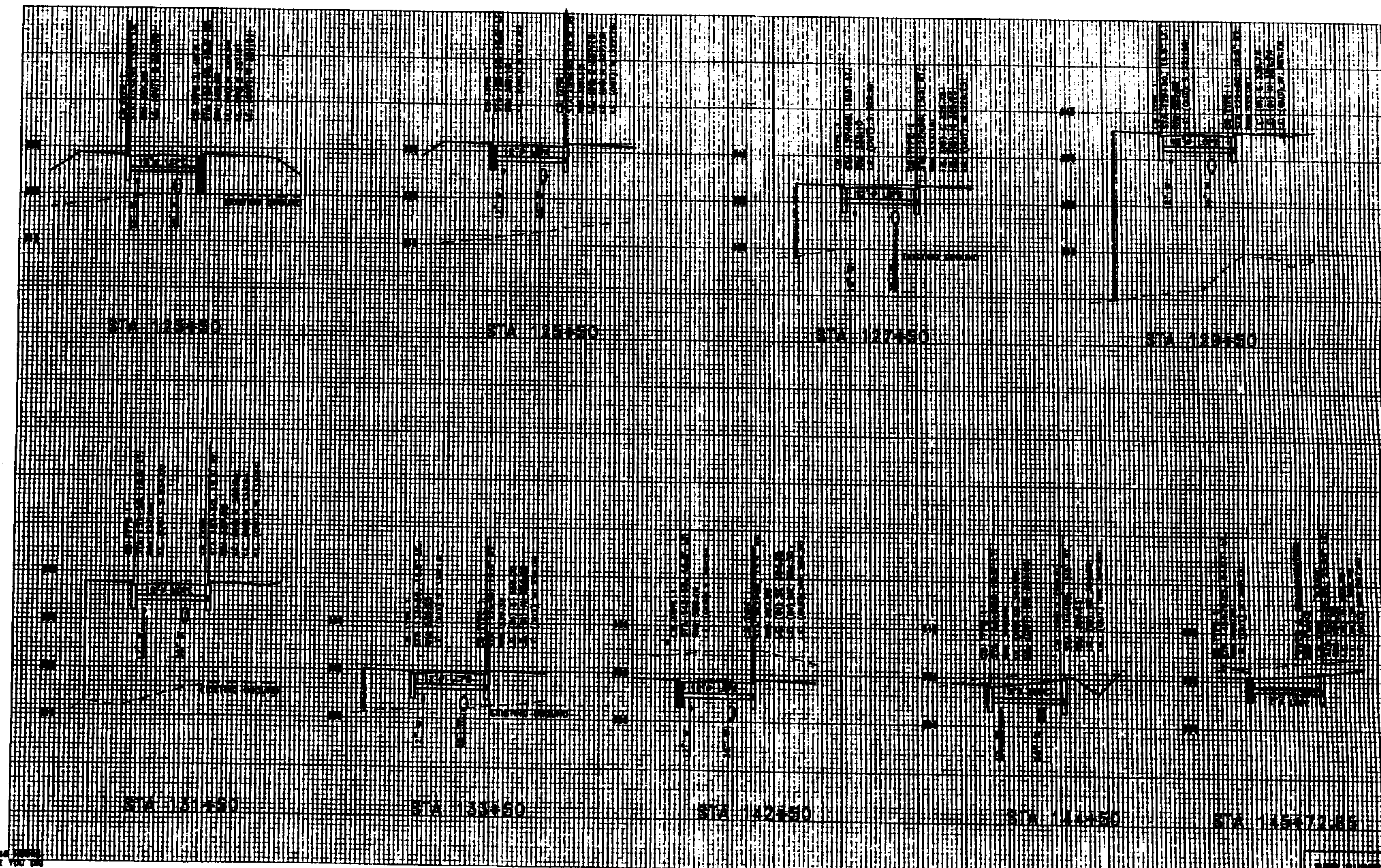
DRAINAGE PROFILES

C3496
96-382
STIA-9808-D70

XREFS:



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MILLER CREEK RELOCATION
DRAINAGE PROFILES

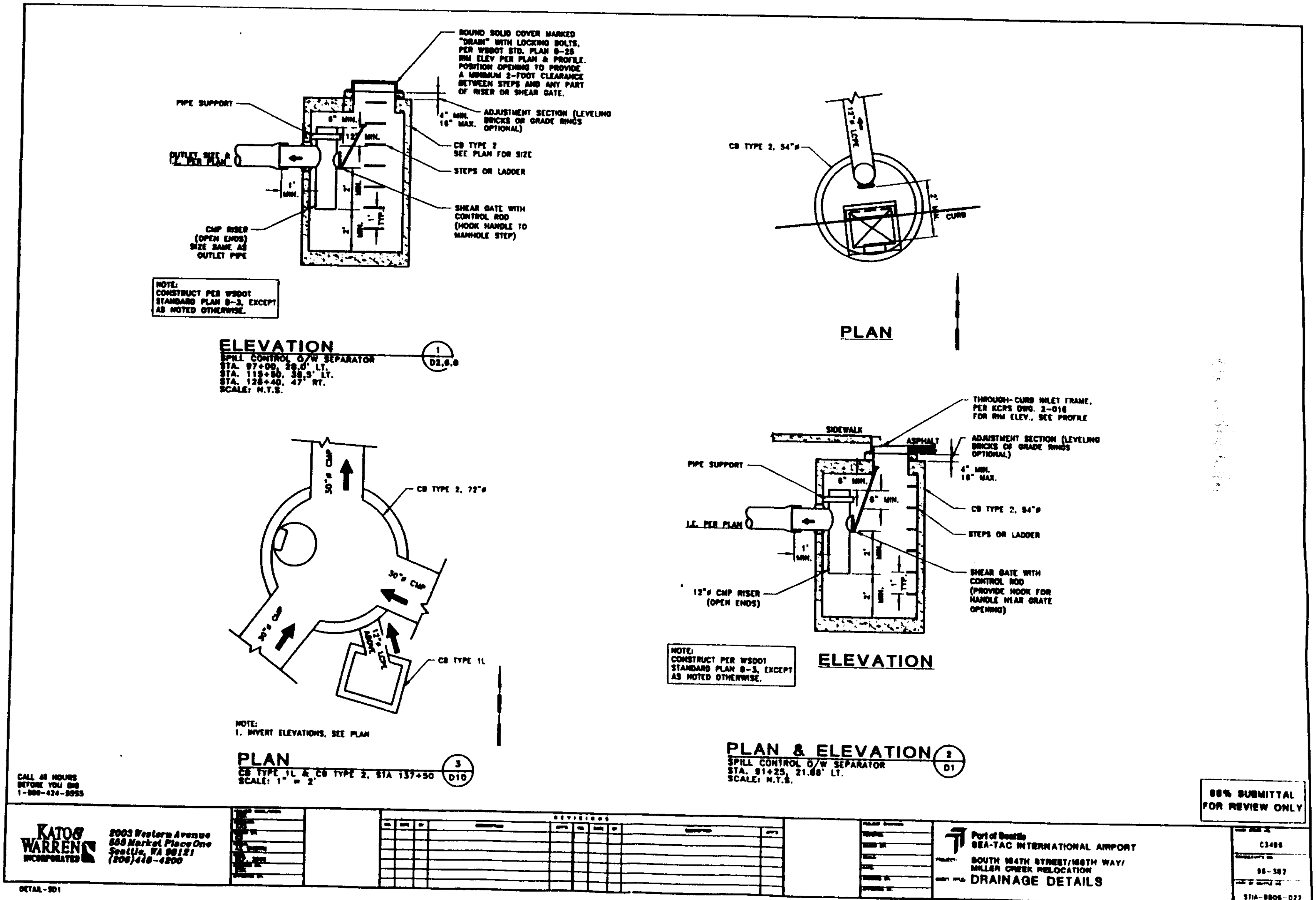
C3498

96-382

STIA-9806-D21

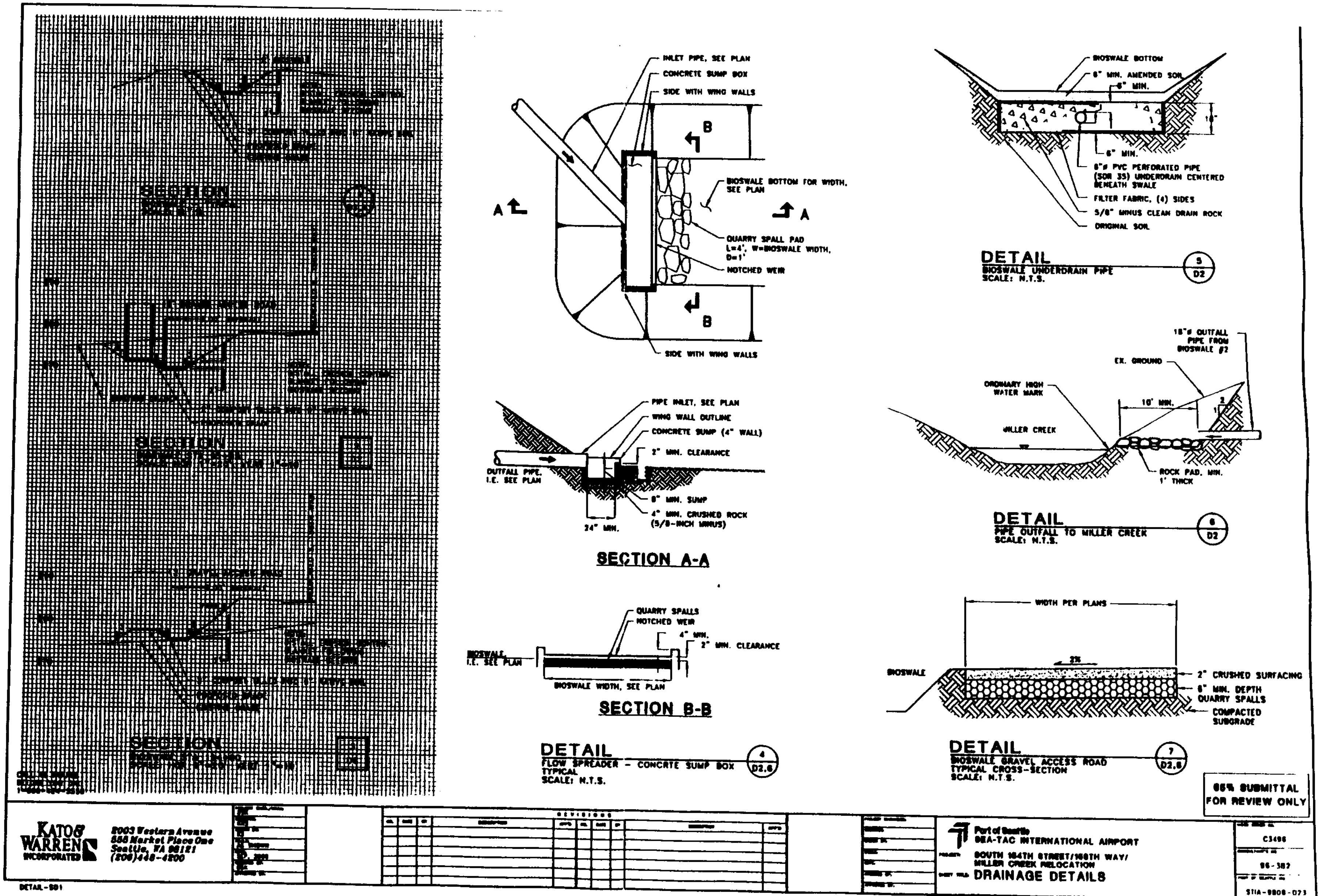
H-28

AR 047327

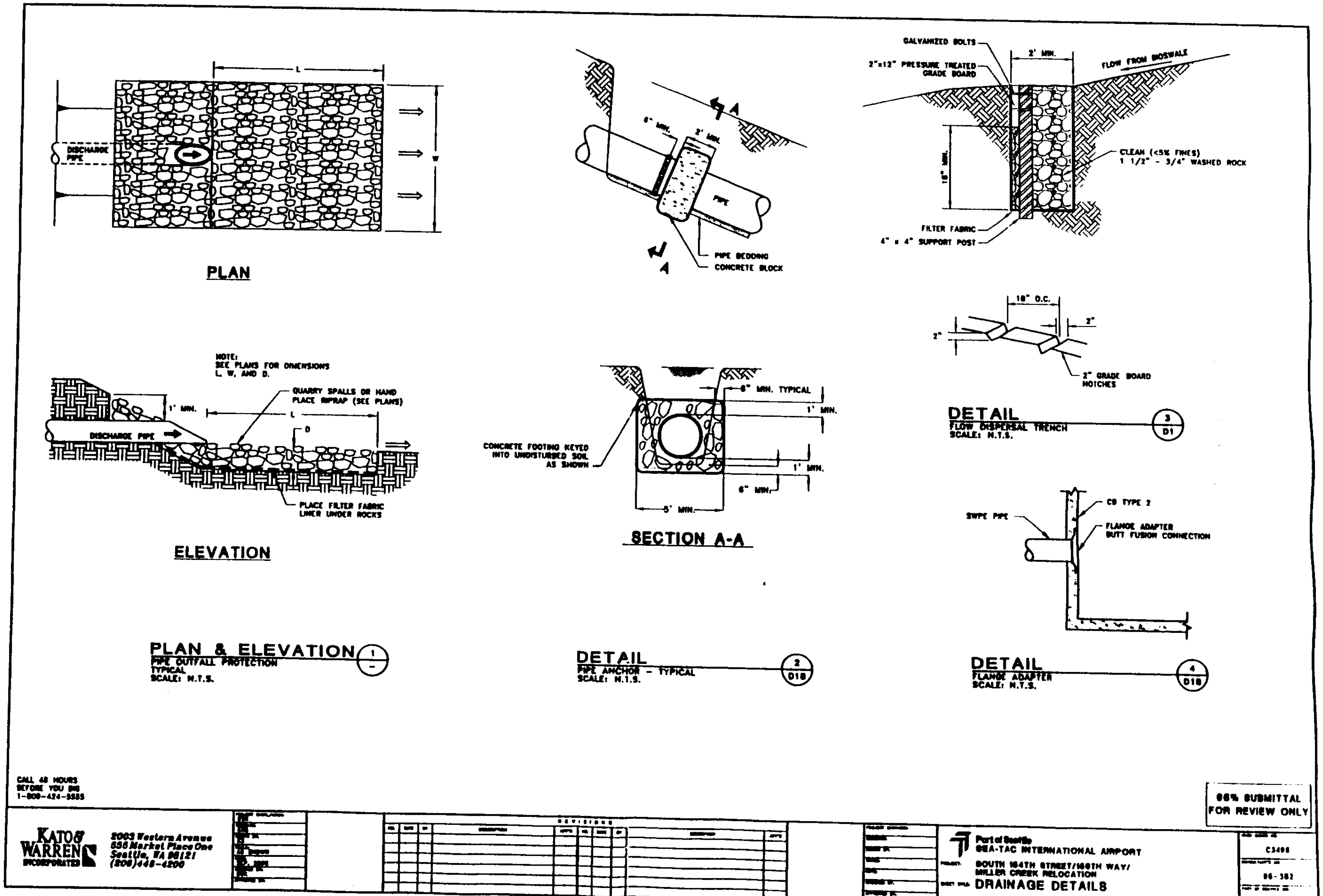


ROUND SOLID COVER MARKED "DRAIN" WITH LOCKING BOLTS, PER WSDOT STD. PLAN B-25 RIM ELEV PER PLAN & PROFILE. POSITION OPENING TO PROVIDE A MINIMUM 2-FOOT CLEARANCE BETWEEN STEPS AND ANY PART OF RISER OR SHEAR GATE.
PIPE SUPPORT
ADJUSTMENT SECTION (LEVELING BRICKS OR GRADE RINGS OPTIONAL)
4" MIN. 16" MAX.
6" MIN.
12" MIN.
CB TYPE 2 SEE PLAN FOR SIZE
OUTLET SIZE & I.E. PER PLAN
STEPS OR LADDER
1' MIN.
SHEAR GATE WITH CONTROL ROD (HOOK HANDLE TO MANHOLE STEP)
CMP RISER (OPEN ENDS) SIZE SAME AS OUTLET PIPE
NOTE: CONSTRUCT PER WSDOT STANDARD PLAN B-3, EXCEPT AS NOTED OTHERWISE.
ELEVATION
SPILL CONTROL O/W SEPARATOR
STA. 97+00, 28.0' LT.
STA. 115+80, 38.5' LT.
STA. 128+40, 47' RT.
SCALE: N.T.S.
1
D2,8,8
CB TYPE 2, 54"ø
12"ø LCPE
2' MIN.
CURB
PLAN
30"ø CMP
CB TYPE 2, 72"ø
30"ø CMP
30"ø CMP
12"ø LCPE ABOVE
CB TYPE 1L
NOTE:
1. INVERT ELEVATIONS, SEE PLAN
PLAN
CB TYPE 1L & CB TYPE 2, STA 137+50
SCALE: 1" = 2'
3
D10
THROUGH-CURB INLET FRAME, PER KCRS DWG. 2-016 FOR RIM ELEV., SEE PROFILE
SIDEWALK
ASPHALT
ADJUSTMENT SECTION (LEVELING BRICKS OR GRADE RINGS OPTIONAL)
4" MIN. 16" MAX.
PIPE SUPPORT
6" MIN.
6" MIN.
CB TYPE 2, 54"ø
I.E. PER PLAN
STEPS OR LADDER
1' MIN.
SHEAR GATE WITH CONTROL ROD (PROVIDE HOOK FOR HANDLE NEAR GRATE OPENING)
12"ø CMP RISER (OPEN ENDS)
NOTE: CONSTRUCT PER WSDOT STANDARD PLAN B-3, EXCEPT AS NOTED OTHERWISE.
ELEVATION
PLAN & ELEVATION
SPILL CONTROL O/W SEPARATOR
STA. 91+25, 21.66' LT.
SCALE: N.T.S.
2
D1
CALL 48 HOURS BEFORE YOU DIG 1-800-424-5555
KATO & WARREN INCORPORATED
2003 Western Avenue
555 Market Place One
Seattle, WA 98121
(206)448-4200
REVISIONS
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
SOUTH 154TH STREET/156TH WAY/
MILLER CREEK RELOCATION
DRAINAGE DETAILS
85% SUBMITTAL FOR REVIEW ONLY
C3486
96-382
STIA-9806-D22
XREFS:
DETAIL-SD1

AR 047328


INLET PIPE, SEE PLAN
CONCRETE SUMP BOX
SIDE WITH WING WALLS
BIOSWALE BOTTOM FOR WIDTH, SEE PLAN
QUARRY SPALL PAD L=4', W=BIOSWALE WIDTH, D=1'
NOTCHED WEIR
SIDE WITH WING WALLS
PIPE INLET, SEE PLAN
WING WALL OUTLINE
CONCRETE SUMP (4" WALL)
2" MIN. CLEARANCE
OUTFALL PIPE, I.E. SEE PLAN
8" MIN. SUMP
4" MIN. CRUSHED ROCK (5/8-INCH MINUS)
24" MIN.
SECTION A-A
QUARRY SPALLS
NOTCHED WEIR
4" MIN.
2" MIN. CLEARANCE
BIOSWALE I.E. SEE PLAN
BIOSWALE WIDTH, SEE PLAN
SECTION B-B
DETAIL
FLOW SPREADER - CONCRETE SUMP BOX TYPICAL
SCALE: N.T.S.
4 D2.6
BIOSWALE BOTTOM
6" MIN. AMENDED SOIL
6" MIN.
10"
6" MIN.
6"ø PVC PERFORATED PIPE (SDR 35) UNDERDRAIN CENTERED BENEATH SWALE
FILTER FABRIC, (4) SIDES
5/8" MINUS CLEAN DRAIN ROCK
ORIGINAL SOIL
DETAIL
BIOSWALE UNDERDRAIN PIPE
SCALE: N.T.S.
5 D2
18"ø OUTFALL PIPE FROM BIOSWALE #2
EX. GROUND
ORDINARY HIGH WATER MARK
MILLER CREEK
10' MIN.
ROCK PAD, MIN. 1' THICK
DETAIL
PIPE OUTFALL TO MILLER CREEK
SCALE: N.T.S.
6 D2
WIDTH PER PLANS
2%
BIOSWALE
2" CRUSHED SURFACING
6" MIN. DEPTH QUARRY SPALLS
COMPACTED SUBGRADE
DETAIL
BIOSWALE GRAVEL ACCESS ROAD TYPICAL CROSS-SECTION
SCALE: N.T.S.
7 D2.6
85% SUBMITTAL FOR REVIEW ONLY
KATO & WARREN INCORPORATED
2003 Western Avenue
888 Market Place One
Seattle, WA 98121
(206)448-4800
REVISIONS
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
SOUTH 154TH STREET/156TH WAY/ MILLER CREEK RELOCATION
DRAINAGE DETAILS
C3498
96-382
STIA-9808-073
DETAIL-S01

AR 047329


PLAN
DISCHARGE PIPE
L
W
NOTE:
SEE PLANS FOR DIMENSIONS
L, W, AND D.
QUARRY SPALLS OR HAND
PLACE RIPRAP (SEE PLANS)
1' MIN.
DISCHARGE PIPE
D
PLACE FILTER FABRIC
LINER UNDER ROCKS
ELEVATION
PLAN & ELEVATION
PIPE OUTFALL PROTECTION
TYPICAL
SCALE: N.T.S.
6" MIN.
2' MIN.
PIPE
A
PIPE BEDDING
CONCRETE BLOCK
CONCRETE FOOTING KEYED
INTO UNDISTURBED SOIL
AS SHOWN
6" MIN. TYPICAL
1' MIN.
1' MIN.
6" MIN.
5' MIN.
SECTION A-A
DETAIL
PIPE ANCHOR - TYPICAL
SCALE: N.T.S.
2
D18
GALVANIZED BOLTS
2"x12" PRESSURE TREATED
GRADE BOARD
2' MIN.
FLOW FROM BIOSWALE
18" MIN.
CLEAN (<5% FINES)
1 1/2" - 3/4" WASHED ROCK
FILTER FABRIC
4" x 4" SUPPORT POST
18" O.C.
2"
2"
2" GRADE BOARD
NOTCHES
DETAIL
FLOW DISPERSAL TRENCH
SCALE: N.T.S.
3
D1
SWPE PIPE
CB TYPE 2
FLANGE ADAPTER
BUTT FUSION CONNECTION
DETAIL
FLANGE ADAPTER
SCALE: N.T.S.
4
D18
CALL 48 HOURS
BEFORE YOU DIG
1-800-424-5555
85% SUBMITTAL
FOR REVIEW ONLY
KATO & WARREN INCORPORATED
2003 Western Avenue
655 Market Place One
Seattle, WA 98121
(206)448-4200
REVISIONS
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
SOUTH 154TH STREET/156TH WAY/
MILLER CREEK RELOCATION
DRAINAGE DETAILS
C3498
96-382
STIA-9805-D24
XREFS:

APPENDIX M

WATER QUALITY BMP COST ESTIMATES FOR AREAS DETERMINED TO BE NON-PRACTICABLE FOR RETROFITTING

ENGINEER'S ESTIMATE

Parametrix, Inc.	Job No. 556-2912-001-28	Date 6/8/00	Sheet 1 of 1
Project Title: SDE-4 WETVAULT			
Location: Seattle-Tacoma International Airport			
Owner: Port of Seattle			
Estimated By: P. McAvoy	Checked By: G. McDonald	Approved By:	

Item No	Description	Estimated Quantity	Unit	Unit Price Mat. & Lab	Estimated Amount
	SDE-4 VAULT				
1	MOBILIZATION (10 %)	LUMP SUM	L.S.	$405.830	$405.830
2	SDE-4 VAULT (454'x151'x8')	12.631	Acre Feet	$250.000	$3.157.750
3	SAW CUTTING ASPHALT CONC. PAVEMENT	300	L.F.	$5.00	$1.500
4	UTILITY ADJUSTMENT (STRUCTURES)	9	EACH	$5.000.00	$45.000
5	CONC. STORM DRAIN PIPE	200	L.F.	$50.00	$10.000
6	REMOVING CEM. CONC. PAVEMENT	0	C.Y.	$25.00	$0
7	REMOVING ASPH. CONC. PAVEMENT	555	S.Y.	$10.00	$5.550
8	REMOVE AND REPLACE SOD	1.820	C.Y.	$10.00	$18.200
9	STRUCTURE EXCAVATION	55.250	C.Y.	$10.00	$552.500
10	GRAVEL BACKFILL	8.000	C.Y.	$20.00	$160.000
11	CSBC -ROADWAY	175	TON	$20.00	$3.500
12	CSTC -ROADWAY	115	TON	$20.00	$2.300
13	APHALT CONC. PVMT.-ROADWAY	200	TON	$45.00	$9.000
14	LANDSCAPING(SOD)-ROADWAY	18.000	S.F.	$1.00	$18.000
15	TRAFFIC CONTROL/DETOURING-ROADWAY	LUMP SUM	L.S.	$75.000	$75.000
			Subtotal Items		$4.464.130
			Total Items		$4.464.130
			Sales Tax 8.4%)		$374.987
			Subtotal		$4.839.117
			Contingency (50%)		$2.419.558
	TOTAL				**$7.258.675**

Non-Prac_BMP_Cost_Est.xls

AR 047332

ENGINEER'S ESTIMATE

Parametrix, Inc.	Job No. 556-2912-001-28	Date 6/8/00	Sheet 1 of 2
Project Title: SDS-3 WETVAULTS			
Location: Seattle-Tacoma International Airport			
Owner: Port of Seattle			
Estimated By: P. McAvoy	Checked By: G. McDonald	Approved By	

Item No.	Description	Estimated Quantity	Unit	Unit Price Mat. & Lab	Estimated Amount
	SDS-3 VAULT 1				
1	MOBILIZATION (10 %)	LUMP SUM	L.S.	$108.350	$108.350
2	SDS-3 VAULT 1 (217'x72'x8')	2.870	Acre Feet	$250.000	$717.500
3	SAW CUTTING CEMENT CONC. PAVEMENT	225	L.F.	$16.00	$3.600
4	UTILITY ADJUSTMENT (STRUCTURES)	2	EACH	$5.000.00	$10.000
5	REMOVING CEM. CONC. PAVEMENT	6300	S.F.	$12.00	$75.600
6	CONSTRUCT NEW TAXIWAY (16" TH CONC)	6300	S.F.	$15.00	$94.500
7	STRUCTURE EXCAVATION	11.800	C.Y.	$10.00	$118.000
8	GRAVEL BACKFILL	2.090	C.Y.	$20.00	$41.800
9	LANDSCAPING(SOD)	22.500	S.F.	$1.00	$22.500
		Subtotal Items			$1.191.850
	SDS-3 VAULT 2				
1	MOBILIZATION (10 %)	LUMP SUM	L.S.	$28.400	$28.400
2	SDS-3 VAULT 2 (109'x36'x8')	0.730	Acre Feet	$250.000	$182.500
3	SAW CUTTING CEMENT CONC. PAVEMENT	0	L.F.	$16.00	$0
4	UTILITY ADJUSTMENT (STRUCTURES)	2	EACH	$5.000.00	$10.000
5	CONC. STORM DRAIN PIPE	325	L.F.	$50.00	$16.250
6	REMOVING CEM. CONC. PAVEMENT	250	S.F.	$12.00	$3.000
7	CONSTRUCT NEW TAXIWAY (16" TH CONC)	250	S.F.	$15.00	$3.750
8	STRUCTURE EXCAVATION	4.900	C.Y.	$10.00	$49.000
9	GRAVEL BACKFILL	625	C.Y.	$20.00	$12.500
10	LANDSCAPING(SOD)	7.000	S.F.	$1.00	$7.000
		Subtotal Items			$312.400
	SDS-3 VAULT 3				
1	MOBILIZATION (10 %)	LUMP SUM	L.S.	$195.336	$195.336
2	SDS-3 VAULT 3 (230'x77'x8')	3.253	Acre Feet	$250.000	$813.250
3	SAW CUTTING CEMENT CONC. PAVEMENT	810	L.F.	$16.00	$12.960
4	UTILITY ADJUSTMENT (STRUCTURES)	1	EACH	$5.000.00	$5.000
5	CONC. STORM DRAIN PIPE	150	L.F.	$50.00	$7.500
6	REMOVING CEM. CONC. PAVEMENT	34.750	S.F.	$12.00	$417.000
7	CONSTRUCT NEW TAXIWAY (16" TH CONC)	34.750	S.F.	$15.00	$521.250
8	STRUCTURE EXCAVATION	12.840	C.Y.	$10.00	$128.400
9	GRAVEL BACKFILL	2.400	C.Y.	$20.00	$48.000
10	LANDSCAPING(SOD)	0	S.F.	$1.00	$0
		Subtotal Items			$2.148.696
	SDS-3 VAULT 4				
1	MOBILIZATION (10 %)	LUMP SUM	L.S.	$63.005	$63.005
2	SDS-3 VAULT 4 (166'x55'x8')	1.692	Acre Feet	$250.000	$423.000
3	SAW CUTTING CEMENT CONC. PAVEMENT (RUNWAY)	500	L.F.	$25.00	$12.500
4	UTILITY ADJUSTMENT (STRUCTURES)	2	EACH	$5.000.00	$10.000
5	CONC. STORM DRAIN PIPE	400	L.F.	$50.00	$20.000
6	REMOVING CEM. CONC. PAVEMENT (RUNWAY)	1.250	S.F.	$15.00	$18.750
7	CONSTRUCT NEW RUNWAY (24" TH CONC)	1.250	S.F.	$20.00	$25.000
8	STRUCTURE EXCAVATION	8.200	C.Y.	$10.00	$82.000
9	GRAVEL BACKFILL	1.290	C.Y.	$20.00	$25.800
10	LANDSCAPING(SOD)	13.000	S.F.	$1.00	$13.000
		Subtotal Items			$693.055

continued on next page

ENGINEER'S ESTIMATE

Parametrix, Inc.	Job No 556-2912-001-28	Date 6/8/00	Sheet 2 of 2
Project Title SDS-3 WETVAULTS			
Location Seattle-Tacoma International Airport			
Owner Port of Seattle			
Estimated By P. McAvoy	Checked By G. McDonald	Approved By	

Item No.	Description	Estimated Quantity	Unit	Unit Price Mat. & Lab.	Estimated Amount
	10 INCH. DIA. CONC. STORM DRAIN PIPE				
1	MOBILIZATION (10 %)	LUMP SUM	L.S.	$23.218	$23.218
2	UTILITY ADJUSTMENT (STRUCTURES)	2	EACH	$5.000.00	$10.000
3	10 INCH. DIA. CONC. STORM DRAIN PIPE	2.580	L.F.	$30.00	$77.400
4	STRUCTURE EXCAVATION	1.500	C.Y.	$10.00	$15.000
5	GRAVEL BACKFILL FOR DRAIN	1.500	C.Y.	$25.00	$37.500
6	LANDSCAPING(REMOVE & REPLACE SOD)	10.450	S.F.	$1.00	$10.450
7	SAW CUTTING CEMENT CONC. PAVEMENT	980	L.F.	$16.00	$15.680
8	REMOVING CEM. CONC. PAVEMENT	2.450	S.F.	$12.00	$29.400
9	CONSTRUCT NEW TAXIWAY (16" TH CONC)	2.450	S.F.	$15.00	$36.750
			Subtotal Items		$255.398
	18 INCH. DIA. CONC. STORM DRAIN PIPE				
1	MOBILIZATION (10 %)	LUMP SUM	L.S.	$11.224.50	$11.225
2	UTILITY ADJUSTMENT (STRUCTURES)	2	EACH	$5.000.00	$10.000
3	18 INCH. DIA. CONC. STORM DRAIN PIPE	575	L.F.	$40.00	$23.000
4	STRUCTURE EXCAVATION	320	C.Y.	$10.00	$3.200
5	GRAVEL BACKFILL FOR DRAIN	320	C.Y.	$25.00	$8.000
6	LANDSCAPING(REMOVE & REPLACE SOD)	1.150	S.F.	$1.00	$1.150
7	SAW CUTTING CEMENT CONC. PAVEMENT (TAXIWAY)	370	L.F.	$16.00	$5.920
8	SAW CUTTING CEMENT CONC. PAVEMENT (RUNWAY)	320	L.F.	$25.00	$8.000
9	REMOVING CEM. CONC. PAVEMENT (TAXIWAY)	925	S.F.	$12.00	$11.100
10	REMOVING CEM. CONC. PAVEMENT (RUNWAY)	800	S.F.	$15.00	$12.000
11	CONSTRUCT NEW TAXIWAY (16" TH CONC)	925	S.F.	$15.00	$13.875
12	CONSTRUCT NEW RUNWAY (24" TH CONC)	800	S.F.	$20.00	$16.000
			Subtotal Items		$123.470
			Total Items		$4.724.869
			Sales Tax 8.4%)		$396.889
			Subtotal		$5.121.757
			Contingency (50%)		$2.560.879
	TOTAL				**$7.682.636**

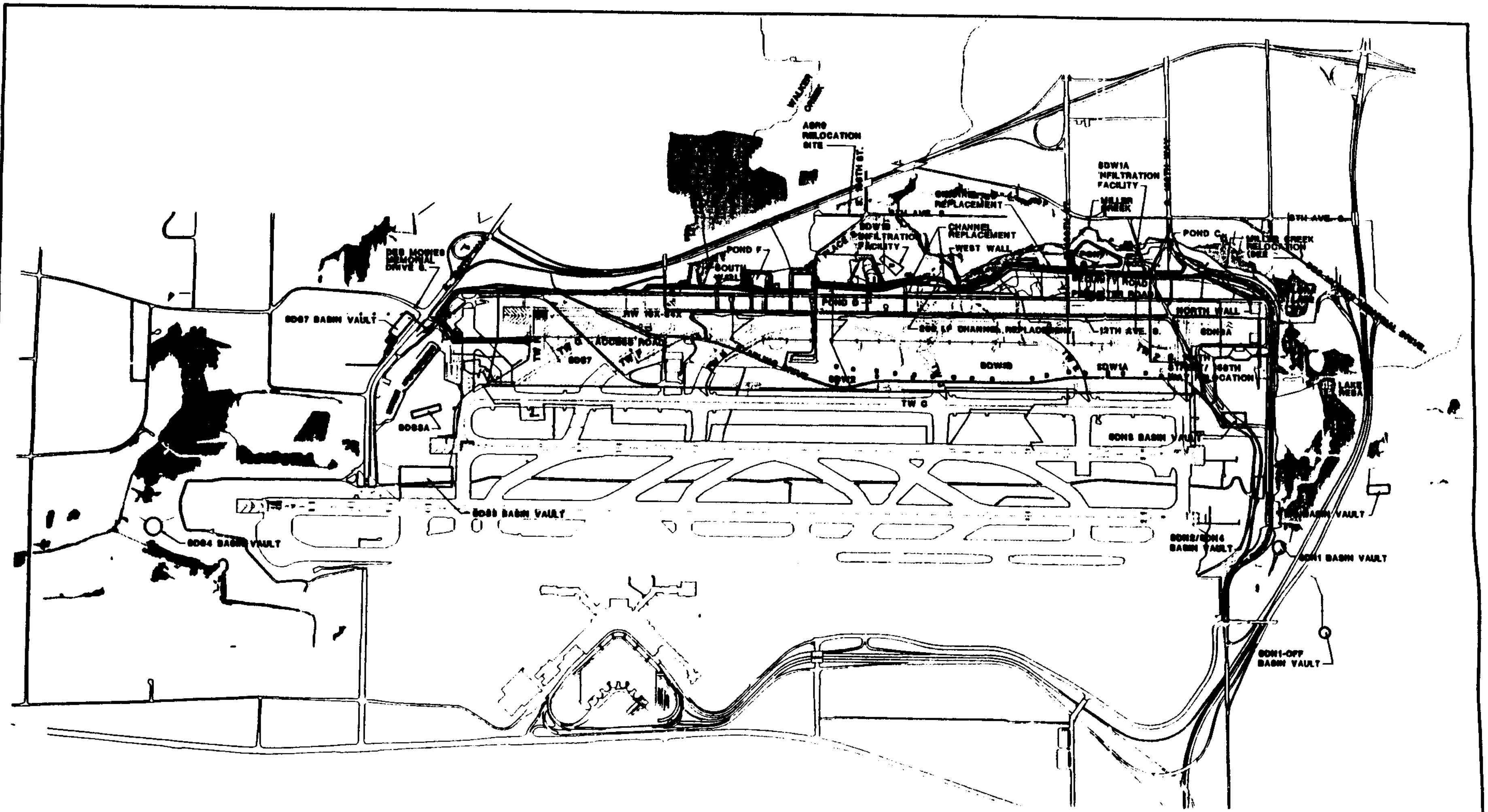
AR 047334

APPENDIX Q

PROPOSED STORMWATER CONVEYANCE FIGURES

GRADING AND DRAINAGE PLAN

Plan Ref. No.	Sheet Title
C109	GRADING AND DRAINAGE LAYOUT
C110	GRADING AND DRAINAGE PLAN
C111	GRADING AND DRAINAGE PLAN
C112	GRADING AND DRAINAGE PLAN
C113	GRADING AND DRAINAGE PLAN
C114	GRADING AND DRAINAGE PLAN
C115	GRADING AND DRAINAGE PLAN
C116	GRADING AND DRAINAGE PLAN
C117	GRADING AND DRAINAGE PLAN
C118	GRADING AND DRAINAGE PLAN
C119	GRADING AND DRAINAGE PLAN
C120	GRADING AND DRAINAGE PLAN
C121	GRADING AND DRAINAGE PLAN
C122	GRADING AND DRAINAGE PLAN
C123	GRADING AND DRAINAGE PLAN
C124	GRADING AND DRAINAGE PLAN
C125	GRADING AND DRAINAGE PLAN
C126	GRADING AND DRAINAGE PLAN
C127	GRADING AND DRAINAGE PLAN
C128	GRADING AND DRAINAGE PLAN
C129	GRADING AND DRAINAGE PLAN
C130	GRADING AND DRAINAGE PLAN



PLAN
GRADING AND DRAINAGE LAYOUT
1" = 600'

SCALE 1"=600'

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT

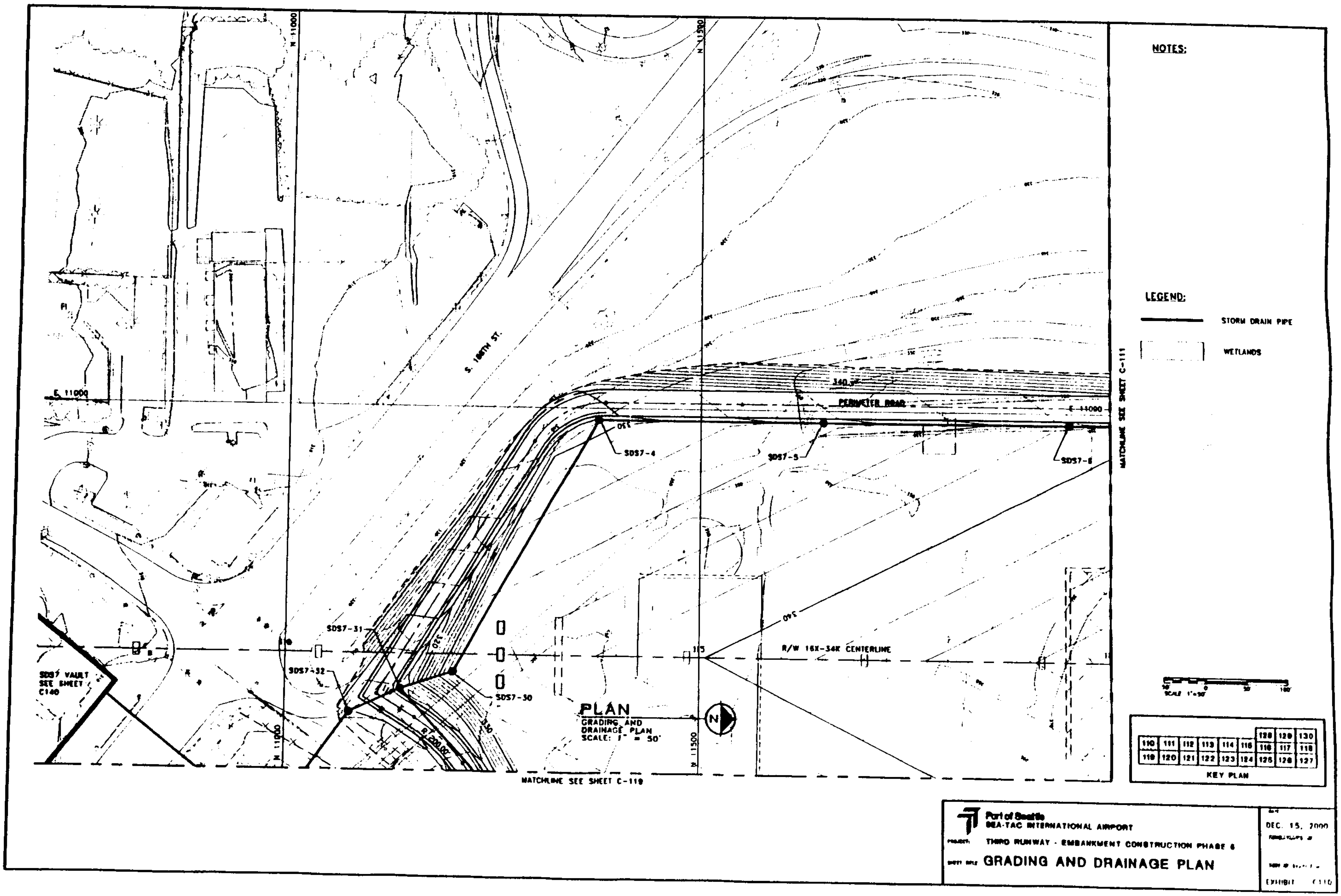
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6

GRADING AND DRAINAGE LAYOUT

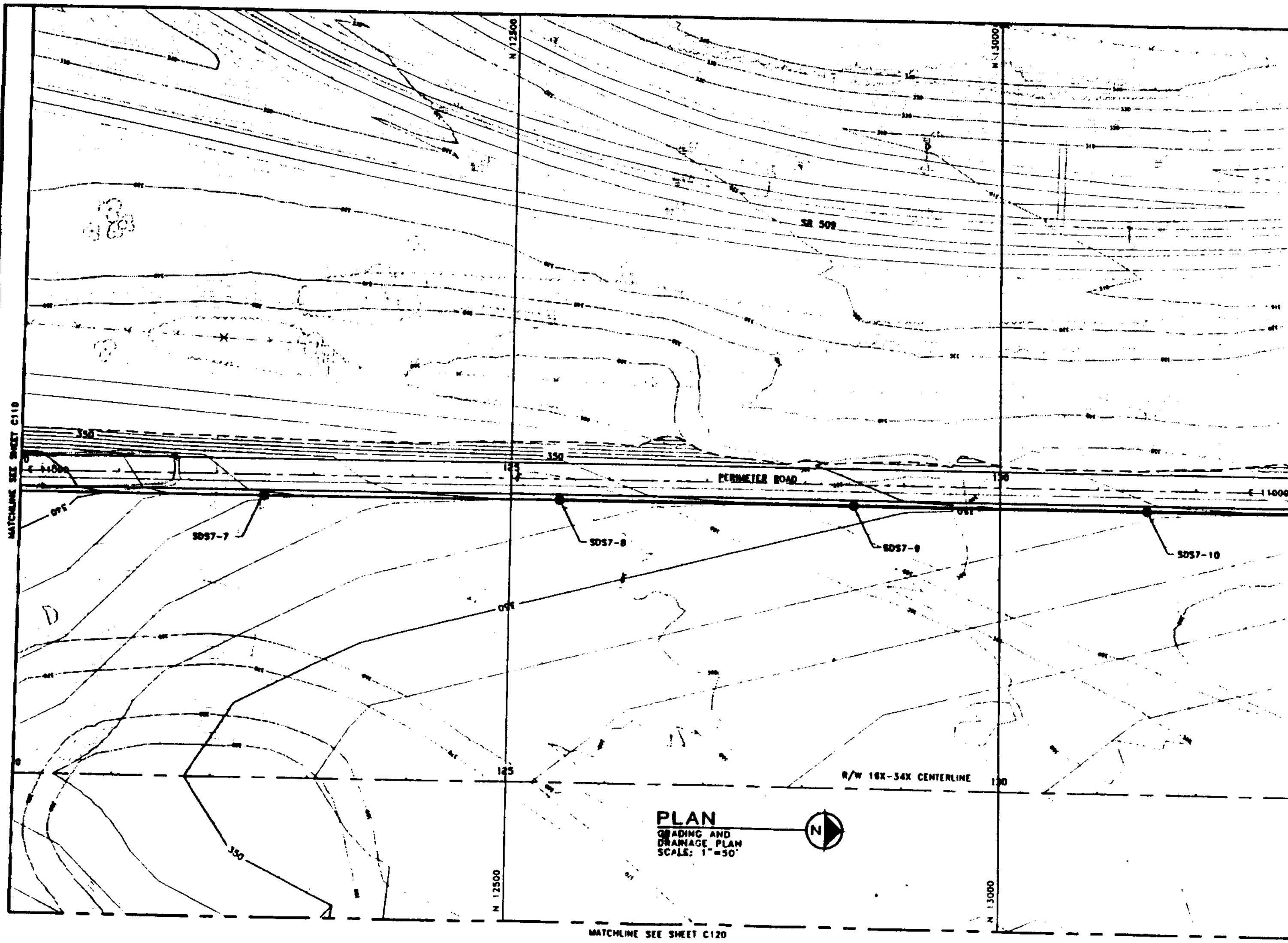
DEC. 15, 2000

EXHIBIT C103

AR 047337


NOTES:
LEGEND:
STORM DRAIN PIPE
WETLANDS
KEY PLAN
110 111 112 113 114 115 116 117 118
119 120 121 122 123 124 125 126 127
128 129 130
SCALE 1"=50'
MATCHLINE SEE SHEET C-111
MATCHLINE SEE SHEET C-119
PERIMETER ROAD
S. 188TH ST.
R/W 16X-34X CENTERLINE
SDS7-4
SDS7-5
SDS7-6
SDS7-30
SDS7-31
SDS7-32
SDS7 VAULT SEE SHEET C140
N 11000
N 11500
E 11000
PLAN
GRADING AND DRAINAGE PLAN
SCALE: 1" = 50'
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6
GRADING AND DRAINAGE PLAN
DEC. 15, 2000
EXHIBIT C110

AR 047338



NOTES:

LEGEND:

STORM DRAIN PIPE

WETLANDS

SCALE 1"=50'

						128	129	130
110	111	112	113	114	115	116	117	118
119	120	121	122	123	124	125	126	127

KEY PLAN

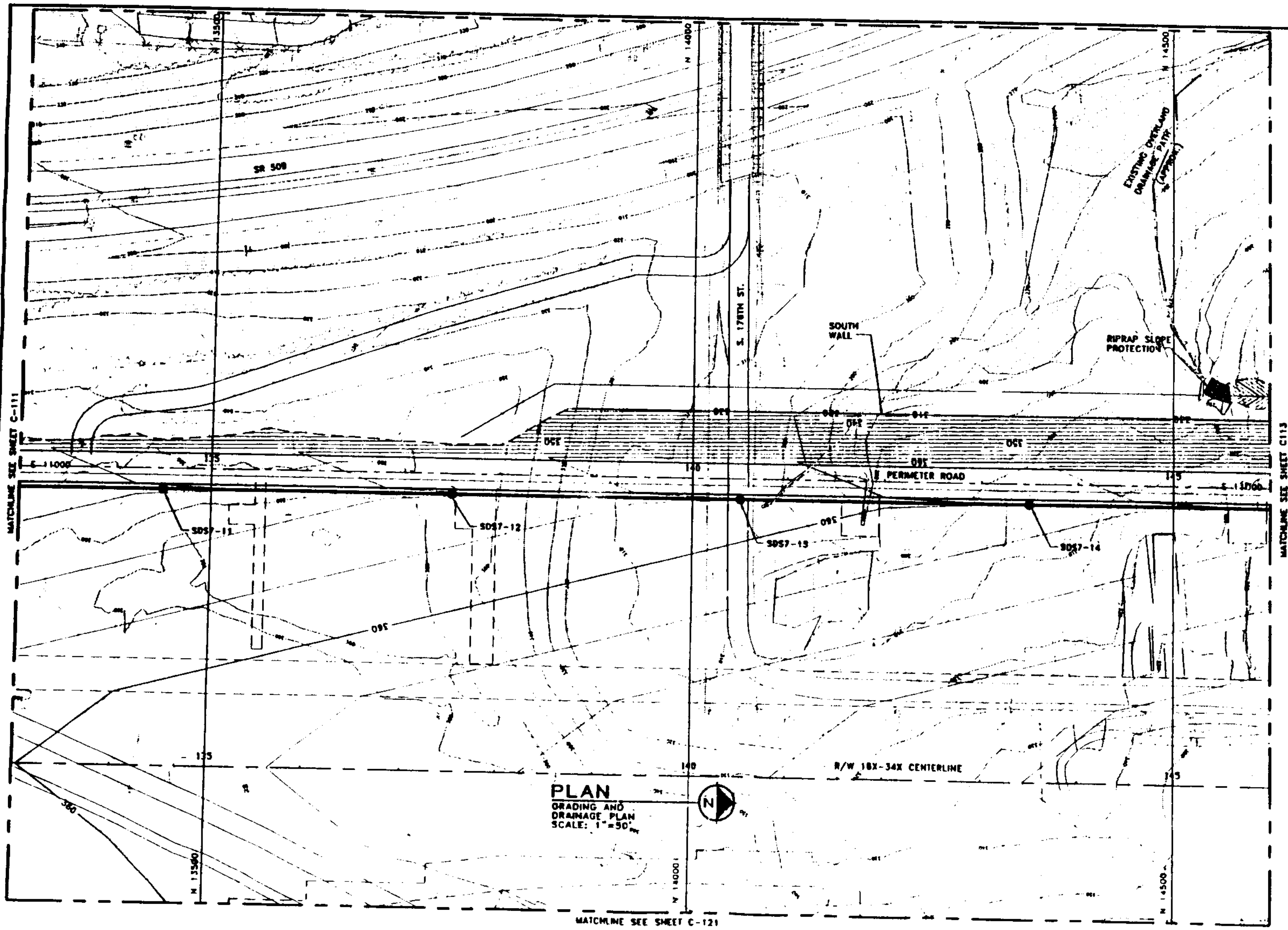
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT

PROJECT: THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6

SHEET TITLE: GRADING AND DRAINAGE PLAN

DEC. 15, 2000

EXHIBIT C111



PLAN
GRADING AND DRAINAGE PLAN
SCALE: 1"=50'

NOTES:

LEGEND:

STORM DRAIN PIPE

WETLANDS

						128	129	130
110	111	112	113	114	115	116	117	118
119	120	121	122	123	124	125	126	127

KEY PLAN

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT

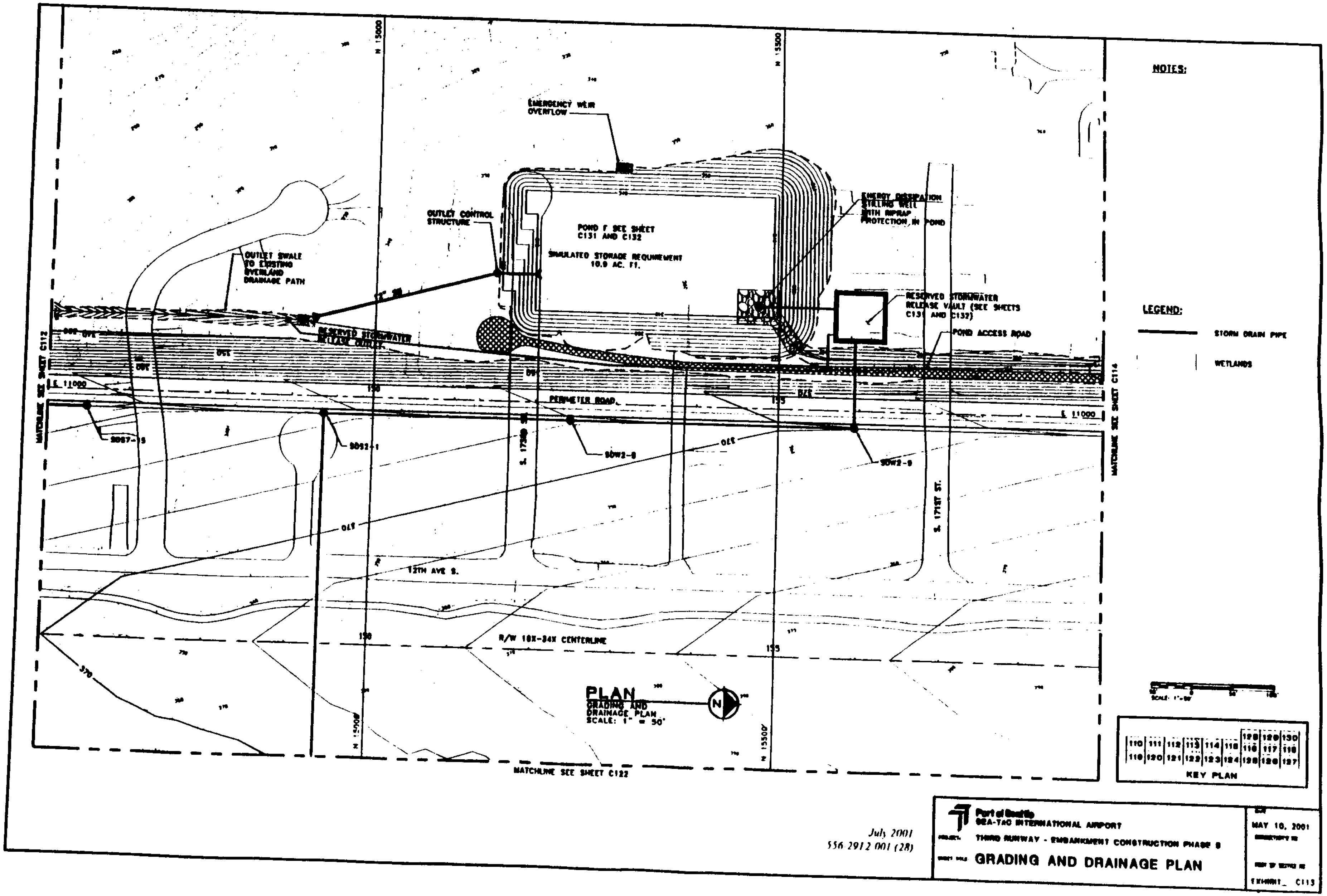
PROJECT: THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6

SHEET TITLE: GRADING AND DRAINAGE PLAN

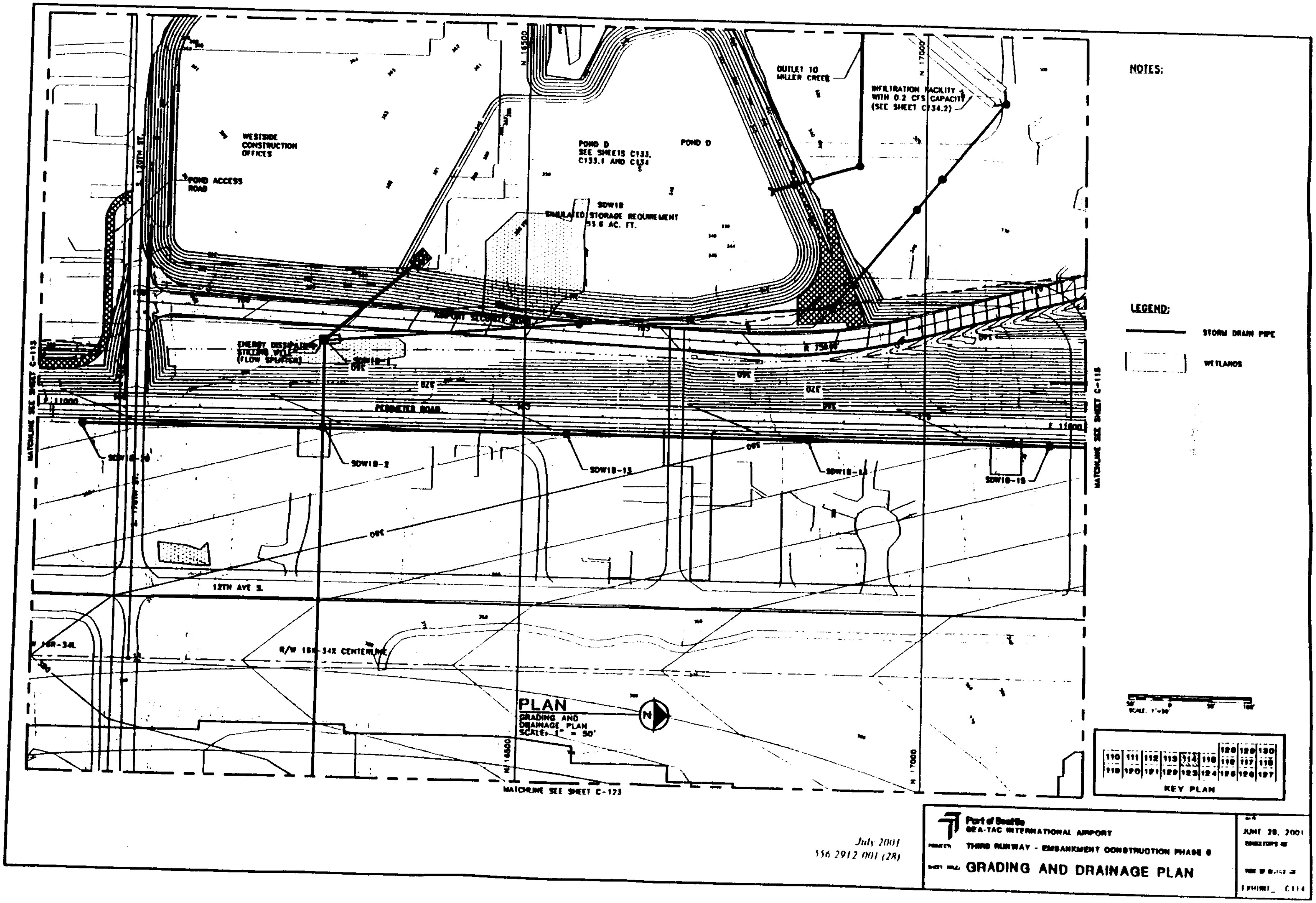
DEC. 15, 2000

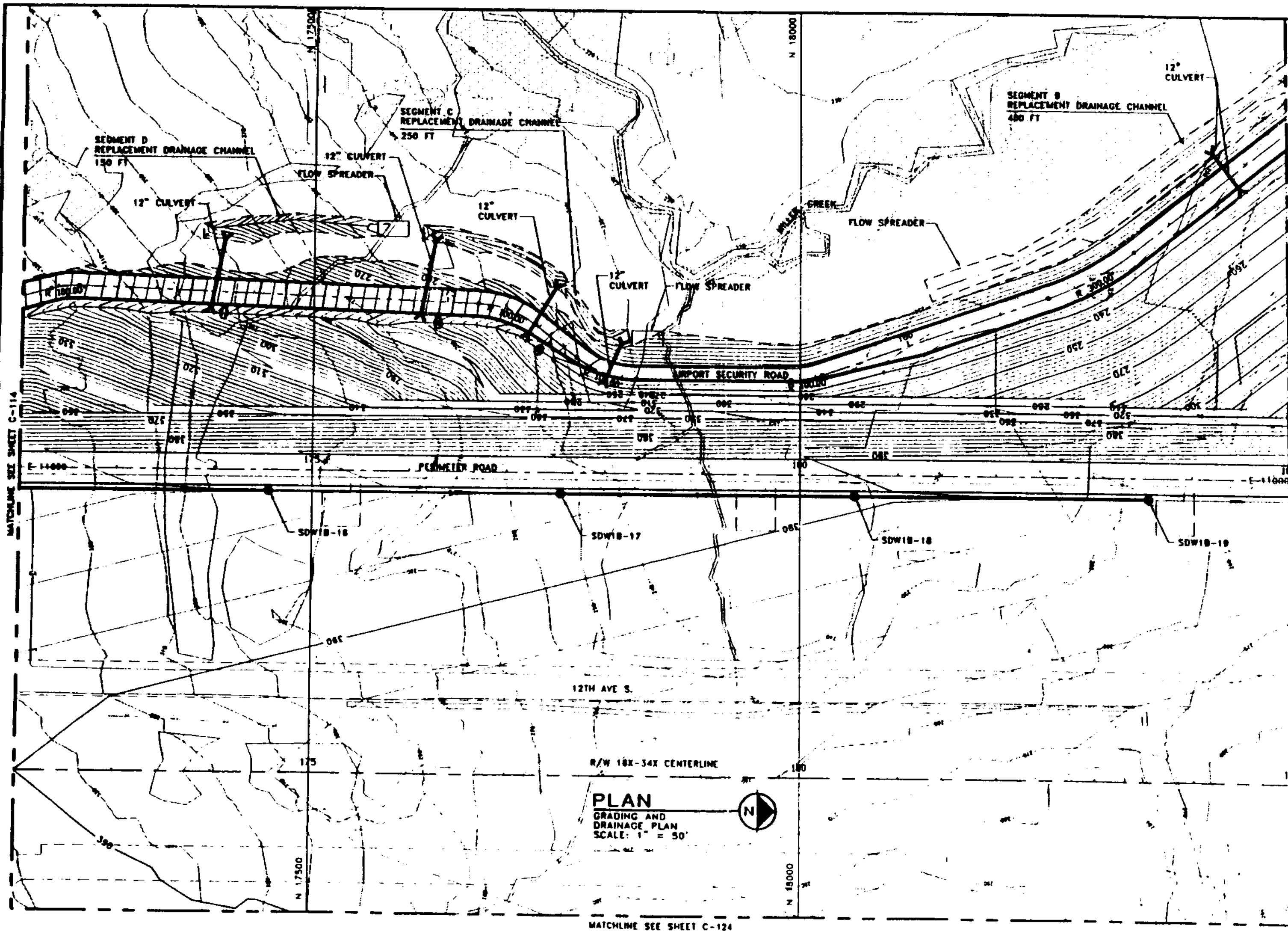
EXHIBIT C112

AR 047340


NOTES:
LEGEND:
STORM DRAIN PIPE
WETLANDS
EMERGENCY WEIR OVERFLOW
ENERGY DISSIPATION STILLING WELL WITH RIPRAP PROTECTION IN POND
OUTLET CONTROL STRUCTURE
POND F SEE SHEET C131 AND C132
SIMULATED STORAGE REQUIREMENT 10.9 AC. FT.
OUTLET SWALE TO EXISTING OVERLAND DRAINAGE PATH
RESERVED STORMWATER RELEASE OUTLET
RESERVED STORMWATER RELEASE VAULT (SEE SHEETS C131 AND C132)
POND ACCESS ROAD
PERIMETER ROAD
S. 173RD ST.
S. 171ST ST.
12TH AVE S.
R/W 18X-34X CENTERLINE
SDW2-8
SDW2-9
SD92-1
SD87-15
N 15000
N 15500
E 11000
MATCHLINE SEE SHEET C112
MATCHLINE SEE SHEET C114
MATCHLINE SEE SHEET C122
PLAN
GRADING AND DRAINAGE PLAN
SCALE: 1" = 50'
KEY PLAN
110 111 112 113 114 115 128 129 130
119 120 121 122 123 124 125 126 127
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 8
GRADING AND DRAINAGE PLAN
MAY 10, 2001
EXHIBIT C113
July 2001
556 2912 001 (28)

AR 047341


NOTES:
LEGEND:
STORM DRAIN PIPE
WETLANDS
WESTSIDE CONSTRUCTION OFFICES
POND ACCESS ROAD
POND D SEE SHEETS C133, C133.1 AND C134
POND D
SDW1B SIMULATED STORAGE REQUIREMENT 53.6 AC. FT.
OUTLET TO MILLER CREEK
INFILTRATION FACILITY WITH 0.2 CFS CAPACITY (SEE SHEET C134.2)
AIRPORT SECURITY ROAD
ENERGY DISSIPATING STILLING WELL (FLOW SPLITTER)
PERIMETER ROAD
SDW1B-2
SDW1B-13
SDW1B-15
12TH AVE S.
R/W 16X-34X CENTERLINE
MATCHLINE SEE SHEET C-113
MATCHLINE SEE SHEET C-115
MATCHLINE SEE SHEET C-123
PLAN
GRADING AND DRAINAGE PLAN
SCALE: 1" = 50'
KEY PLAN
July 2001
556 2912 001 (28)
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6
GRADING AND DRAINAGE PLAN
JUNE 28, 2001



NOTES:

LEGEND:

STORM DRAIN PIPE

WETLANDS

							128	129	130
110	111	112	113	114	115	116	117	118
119	120	121	122	123	124	125	126	127

KEY PLAN

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT

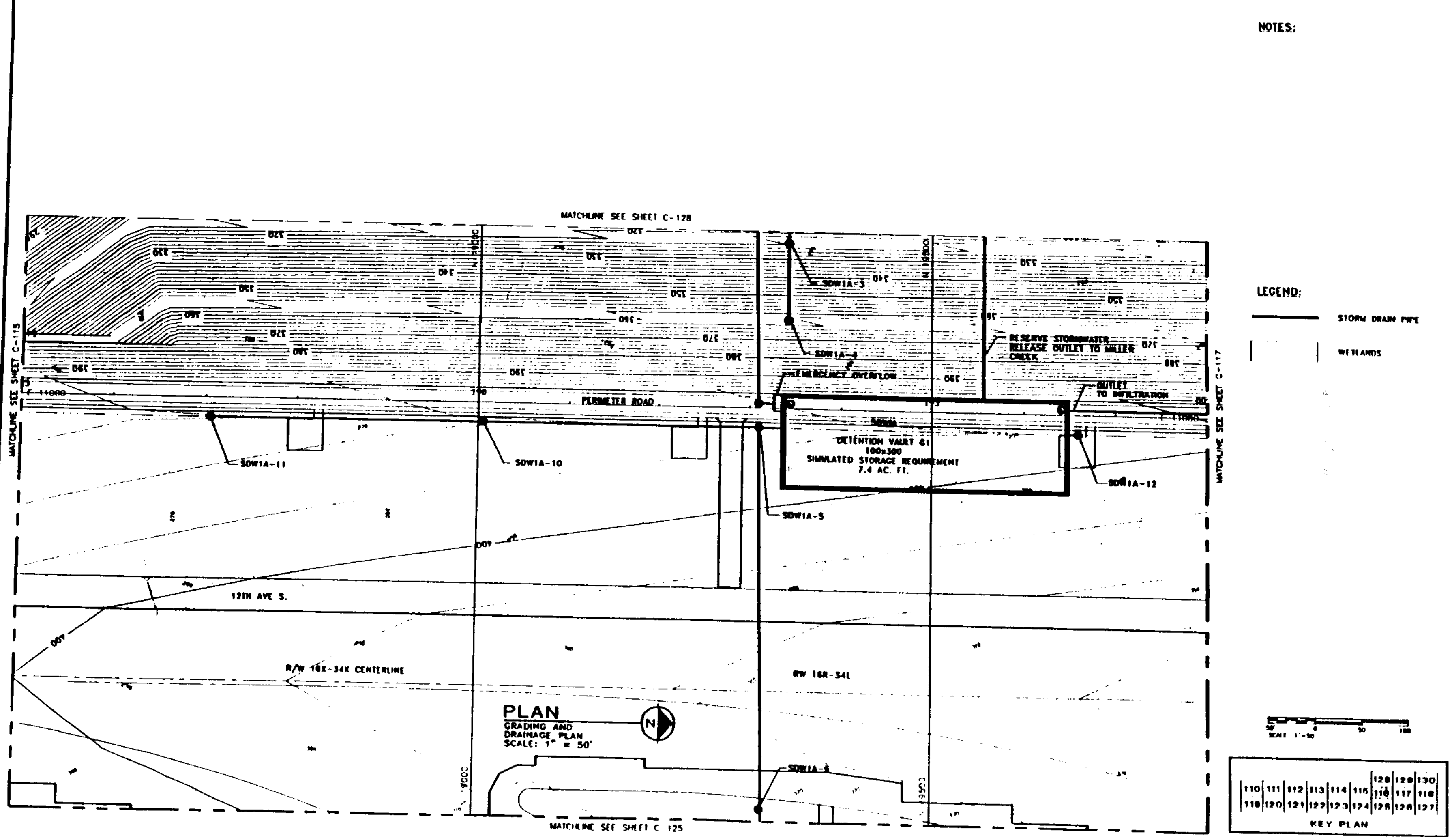
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 8

GRADING AND DRAINAGE PLAN

DEC. 15, 2000

EXHIBIT C-115

AR 047343



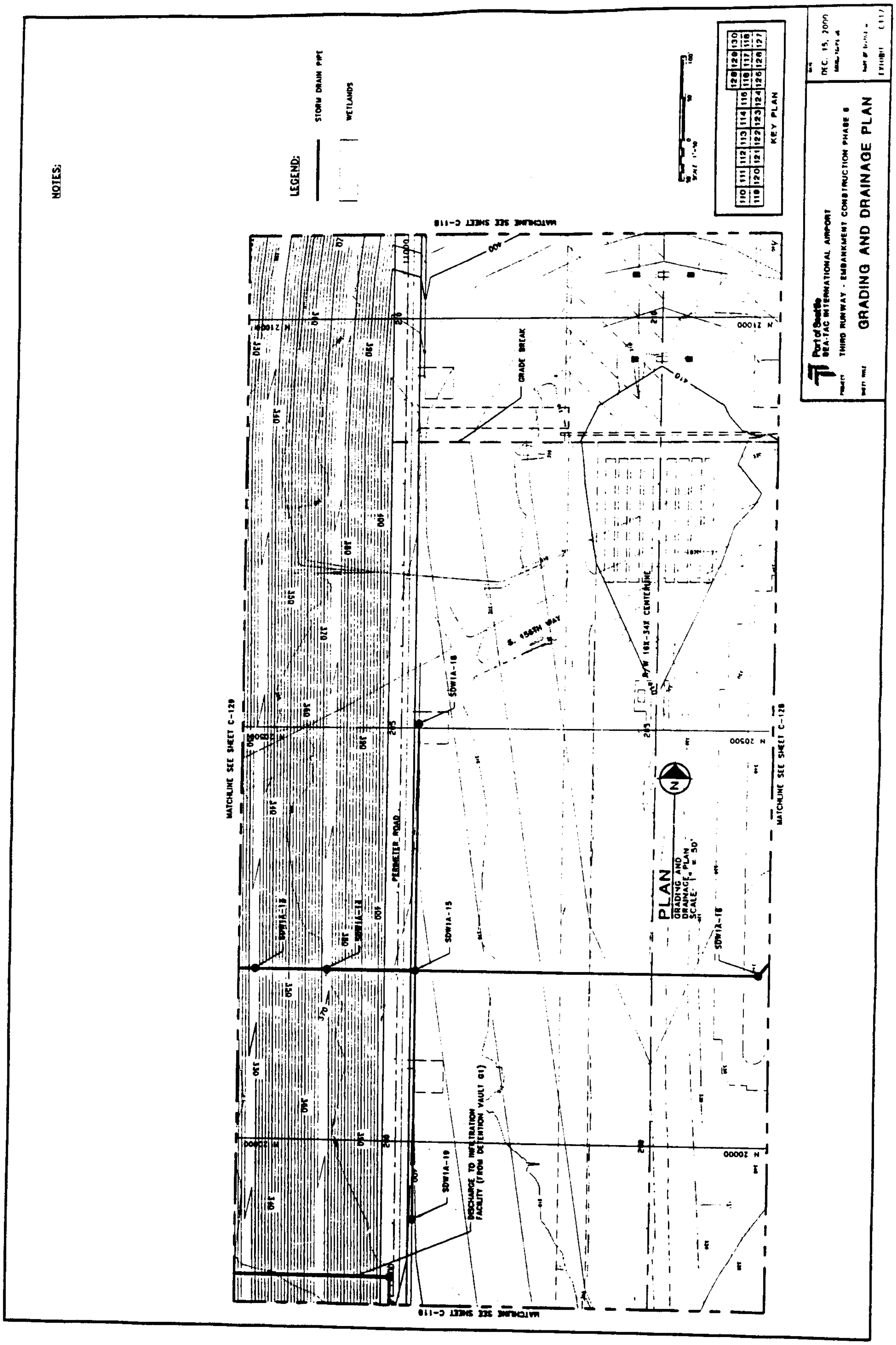
July 2001
556 2912 001 (28)

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 5

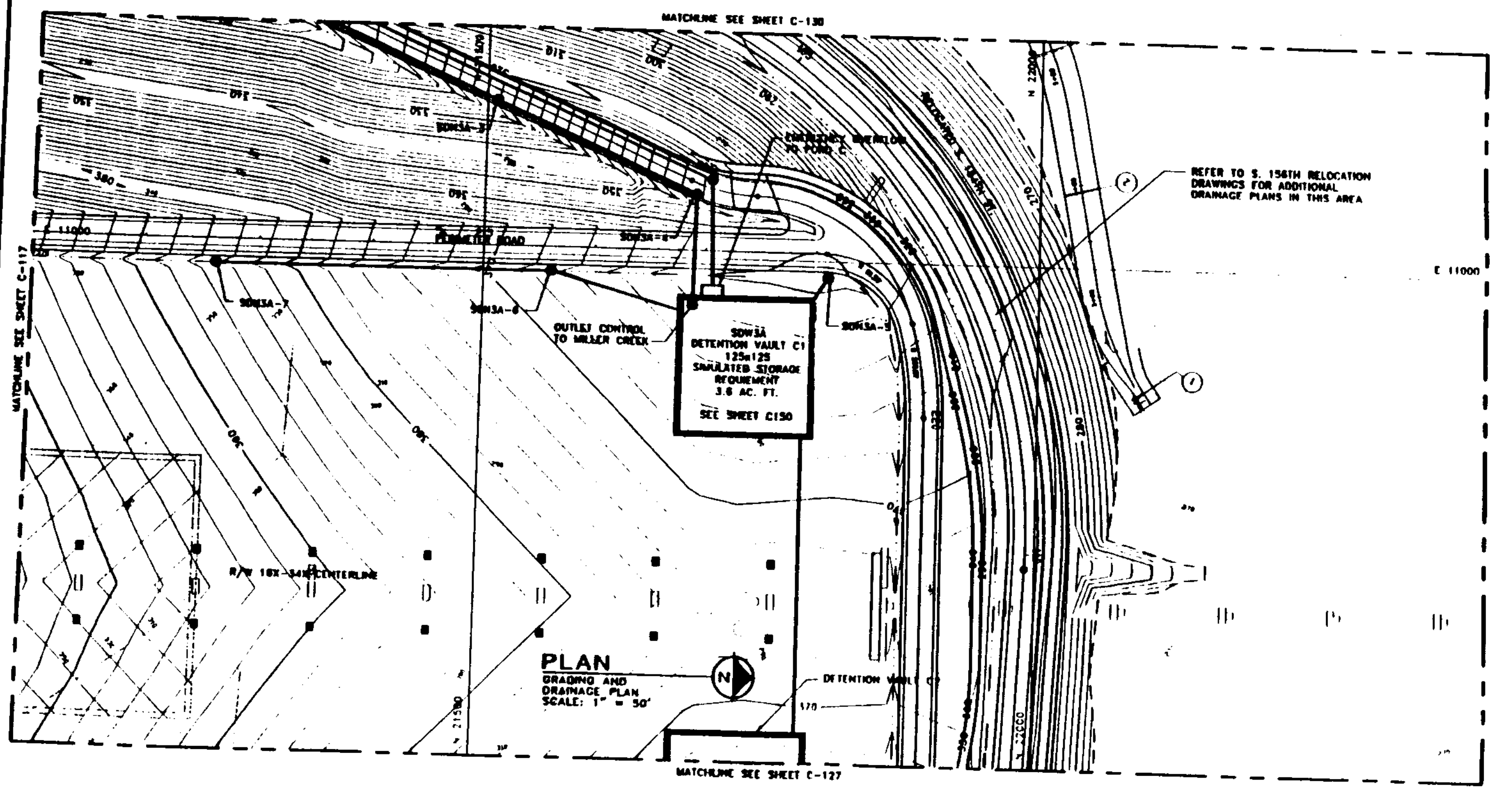
GRADING AND DRAINAGE PLAN

JUNE 28, 2001

AR 047344


NOTES:
LEGEND:
STORM DRAIN PIPE
WETLANDS
KEY PLAN
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6
GRADING AND DRAINAGE PLAN
DEC. 15, 2000
PLAN
GRADING AND DRAINAGE PLAN
SCALE: 1" = 50'
MATCHLINE SEE SHEET C-118
MATCHLINE SEE SHEET C-128
GRADE BREAK
S. 156TH WAY
PERIMETER ROAD
SDW1A-15
SDW1A-16
SDW1A-18
SDW1A-19
DISCHARGE TO INFILTRATION FACILITY (FROM DETENTION VAULT G1)
N 21000
N 20500
N 20000

NOTES:



PLAN
GRADING AND DRAINAGE PLAN
SCALE: 1" = 50'

LEGEND:

STORM DRAIN PIPE

WETLANDS

KEY PLAN

						128	129	130
110	111	112	113	114	115	116	117	118
119	120	121	122	123	124	125	126	127

July 2001
556 2912 001 (28)

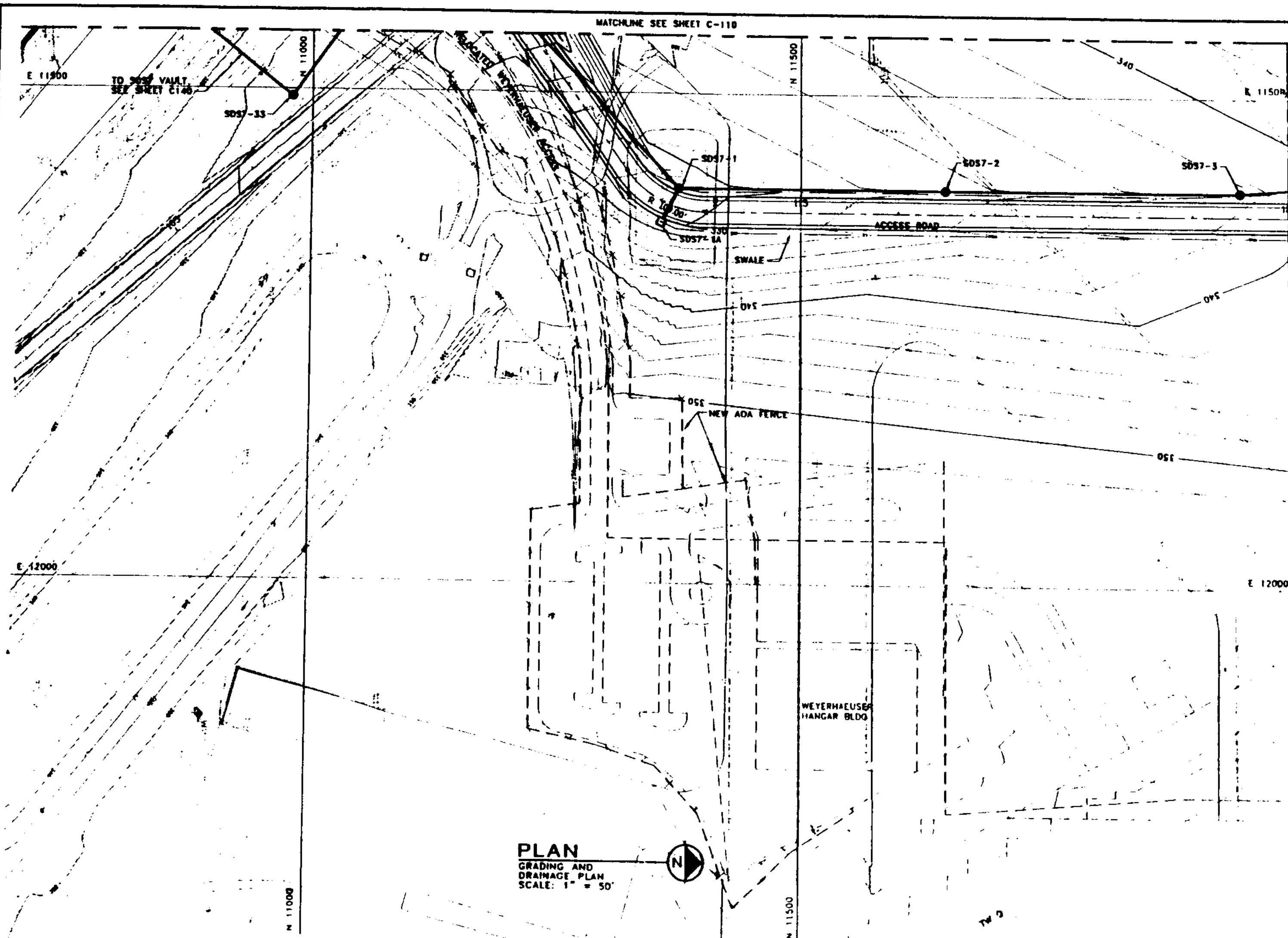
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6

GRADING AND DRAINAGE PLAN

JUNE 11, 2001

EXHIBIT C118

...\permit\BV_C118.dwg, 08/11/01 02:25:25 PM, NHatcher



NOTES:

LEGEND:

STORM DRAIN PIPE

WETLANDS

110	111	112	113	114	115	116	117	118
119	120	121	122	123	124	125	126	127
						128	129	130

KEY PLAN

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT

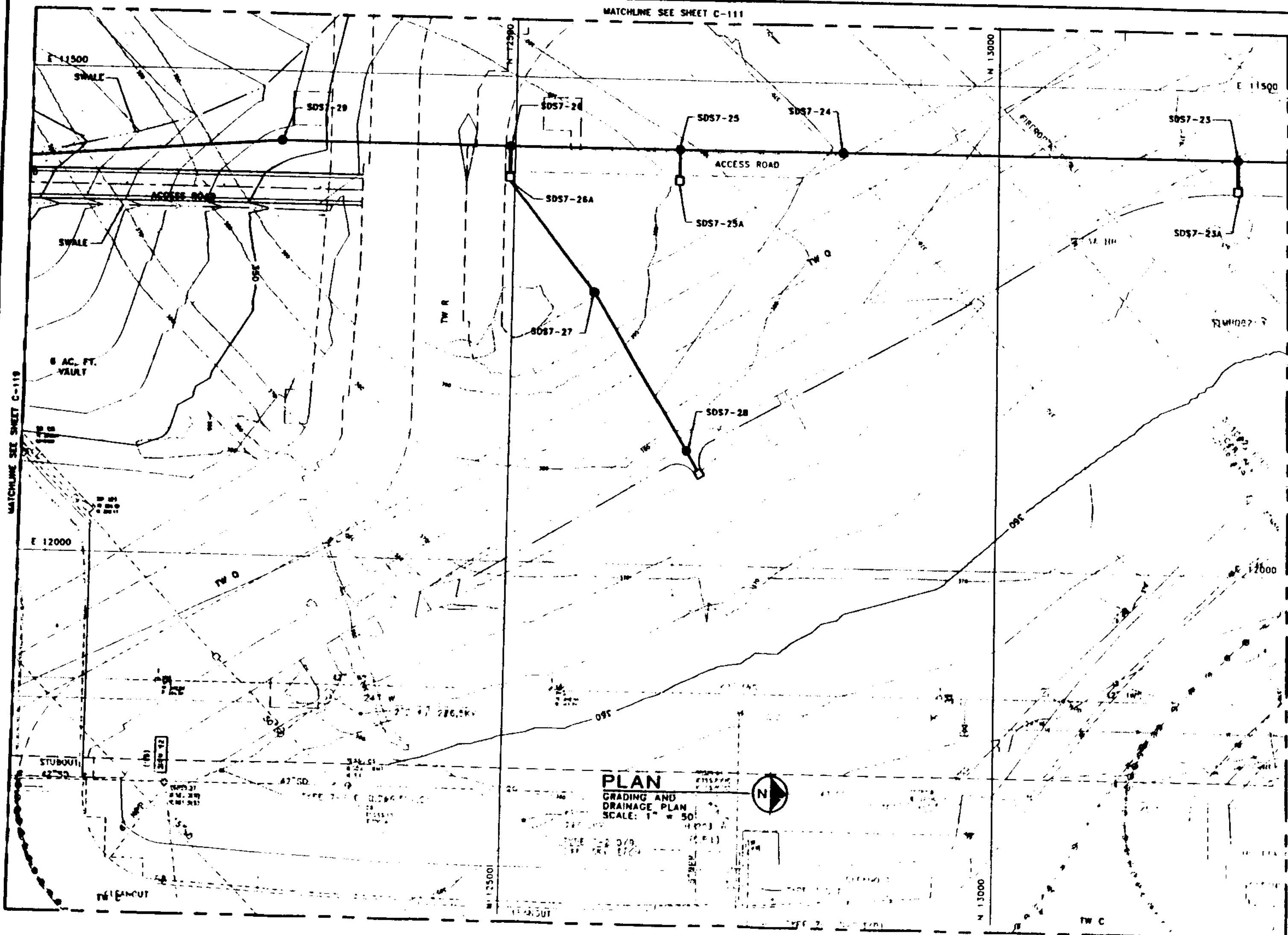
PROJECT THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 5

SHEET TITLE GRADING AND DRAINAGE PLAN

DEC. 15, 2000

EXHIBIT

AR 047347



NOTES:

LEGEND:

STORM DRAIN PIPE

WETLANDS

SCALE 1"=50

110	111	112	113	114	116	116	117	118
119	120	121	122	123	124	125	126	127

128 129 130

KEY PLAN

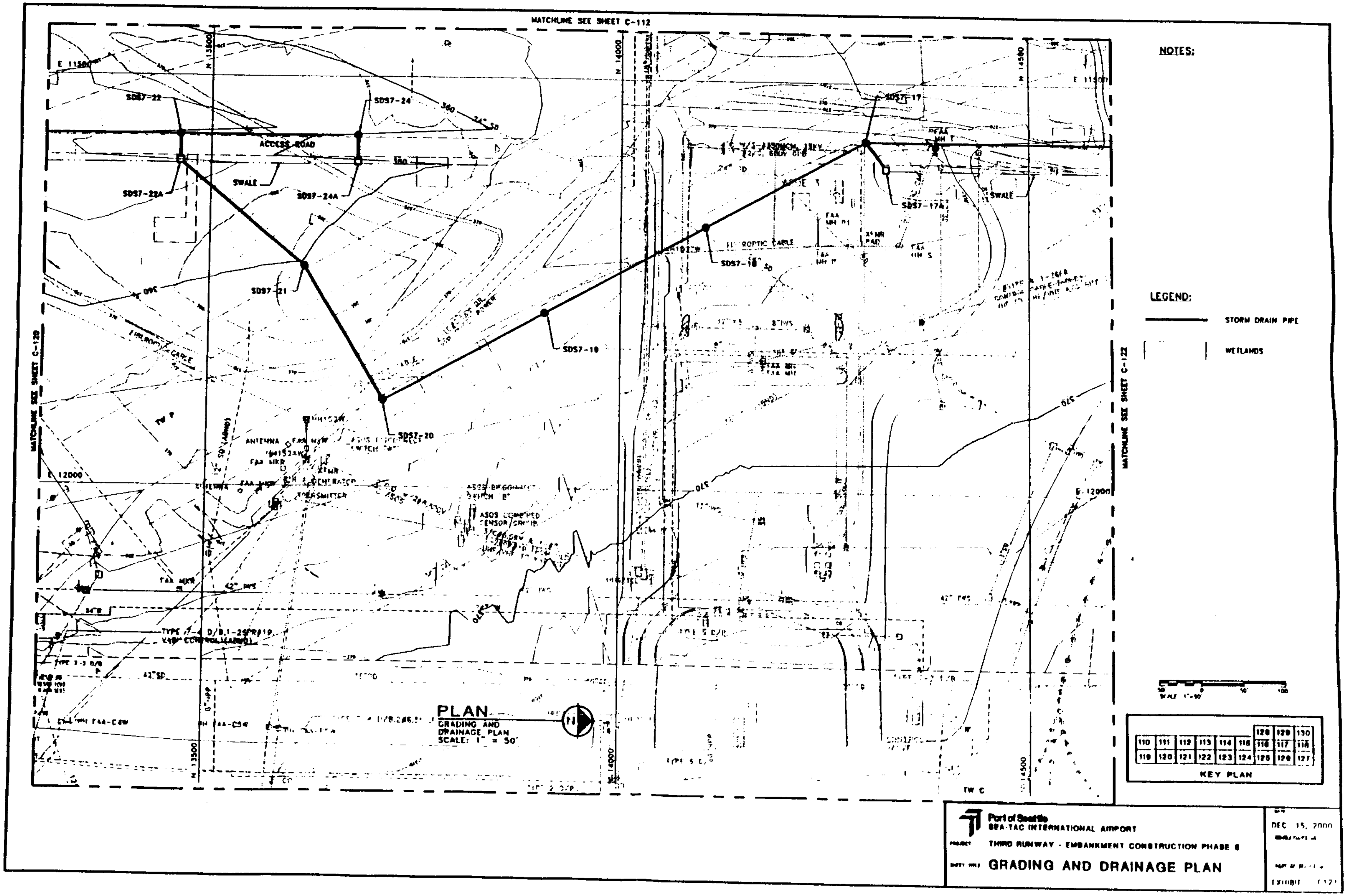
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT

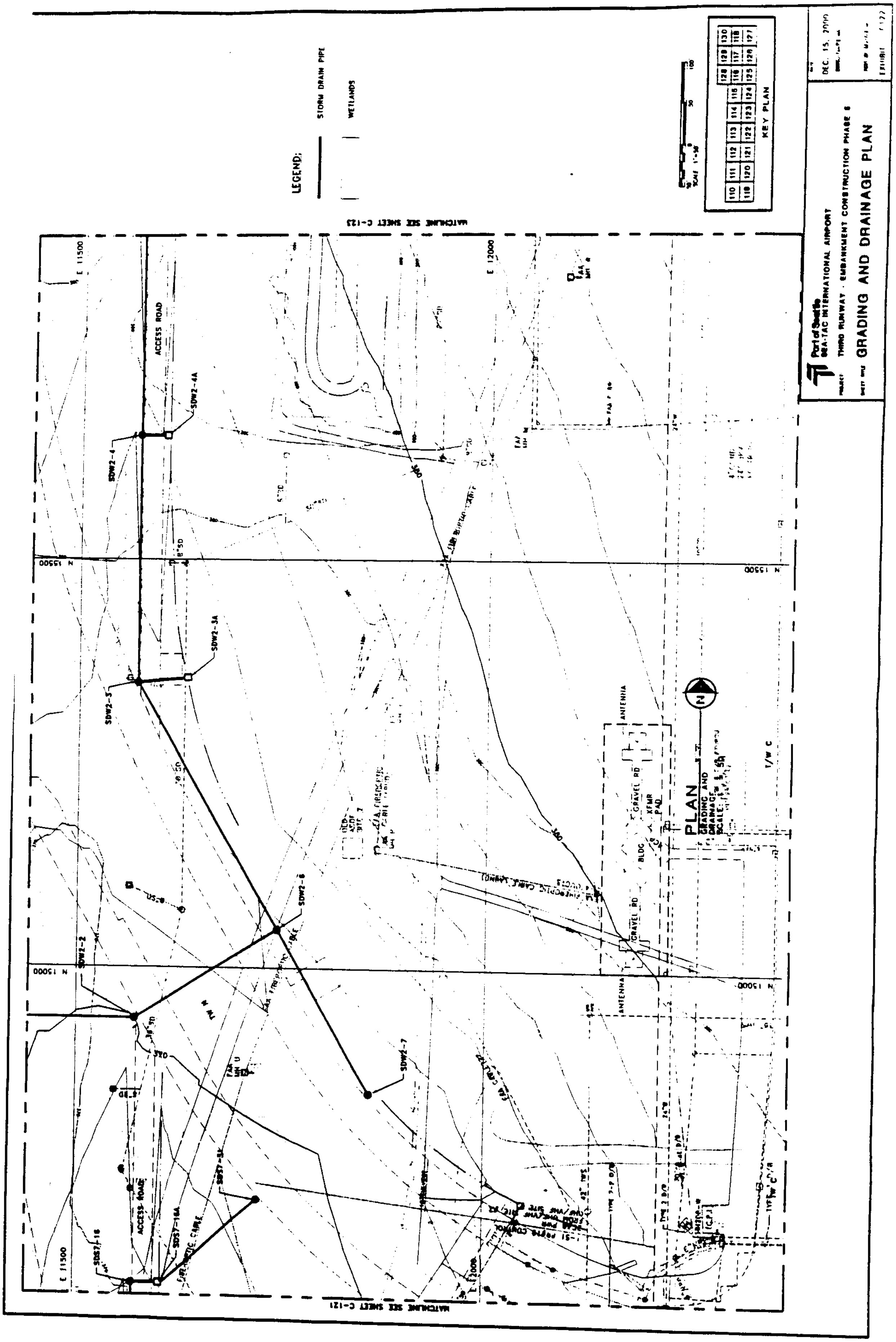
PROJECT: THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6

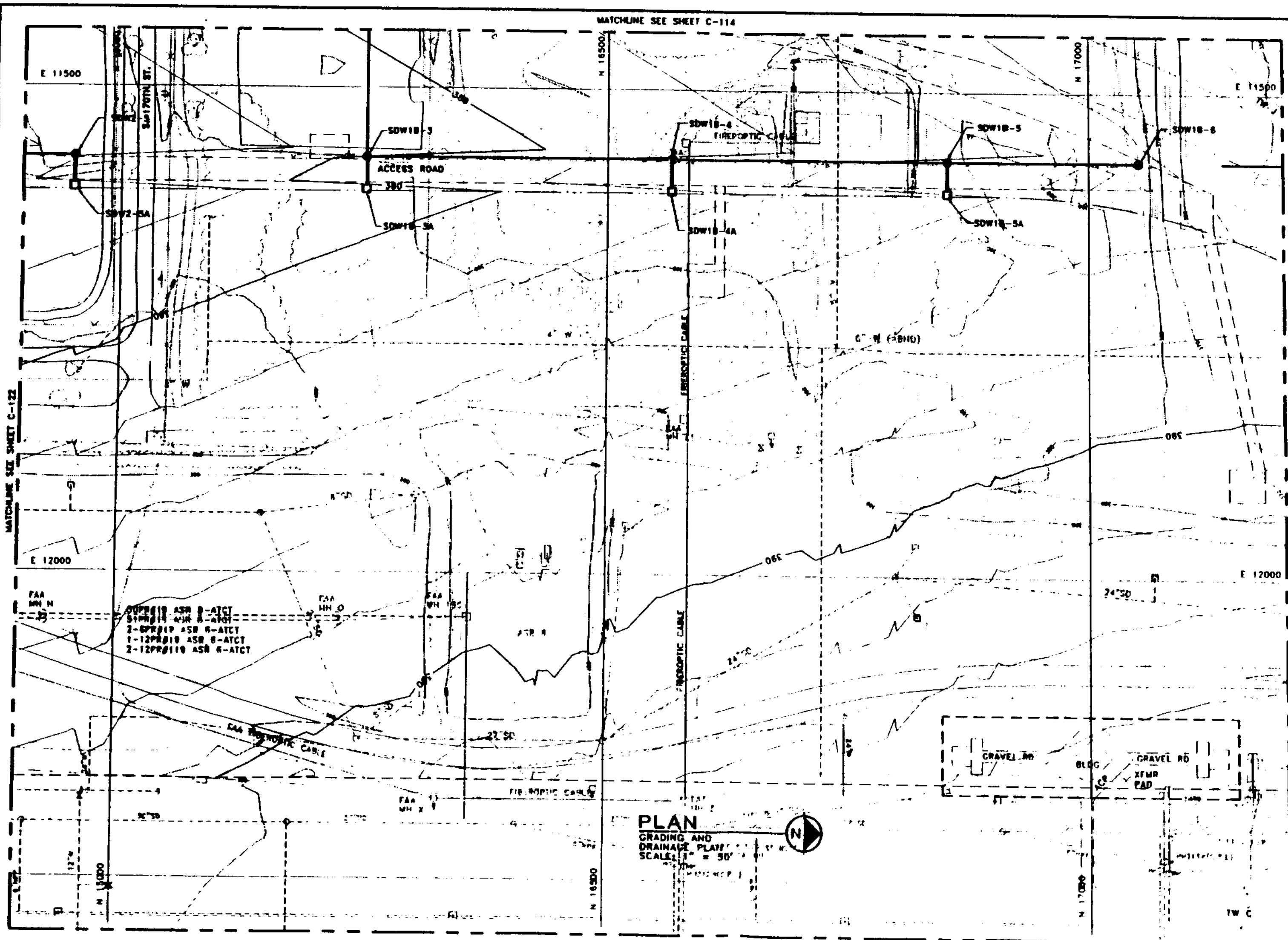
SHEET TITLE: **GRADING AND DRAINAGE PLAN**

DEC. 15, 2000

EXHIBIT


MATCHLINE SEE SHEET C-112
MATCHLINE SEE SHEET C-120
MATCHLINE SEE SHEET C-122
NOTES:
LEGEND:
STORM DRAIN PIPE
WETLANDS
KEY PLAN
110 111 112 113 114 115 116 117 118
119 120 121 122 123 124 125 126 127
128 129 130
SDS7-17
SDS7-17A
SDS7-18
SDS7-19
SDS7-20
SDS7-21
SDS7-22
SDS7-22A
SDS7-24
SDS7-24A
ACCESS ROAD
SWALE
N 13500
N 14000
N 14500
E 11500
E 12000
PLAN
GRADING AND DRAINAGE PLAN
SCALE: 1" = 50'
TW C
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6
GRADING AND DRAINAGE PLAN
DEC. 15, 2000


LEGEND:
STORM DRAIN PIPE
WETLANDS
KEY PLAN
MATCHLINE SEE SHEET C-123
MATCHLINE SEE SHEET C-121
ACCESS ROAD
SDW2-4
SDW2-4A
SDW2-3A
SDW2-5
SDW2-6
SDW2-7
SDW2-2
SDS7-1B
SDS7-1A
SDS7-3A
N 13500
N 13000
E 11500
E 12000
ANTENNA
GRAVEL RD
BLDG
KFMR PAD
T/W C
PLAN
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6
GRADING AND DRAINAGE PLAN
DEC. 15, 2000



NOTES:

LEGEND:

STORM DRAIN PIPE

WETLANDS

SCALE 1"=50'

110	111	112	113	114	115	116	117	118
119	120	121	122	123	124	125	126	127
						128	129	130

KEY PLAN

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT

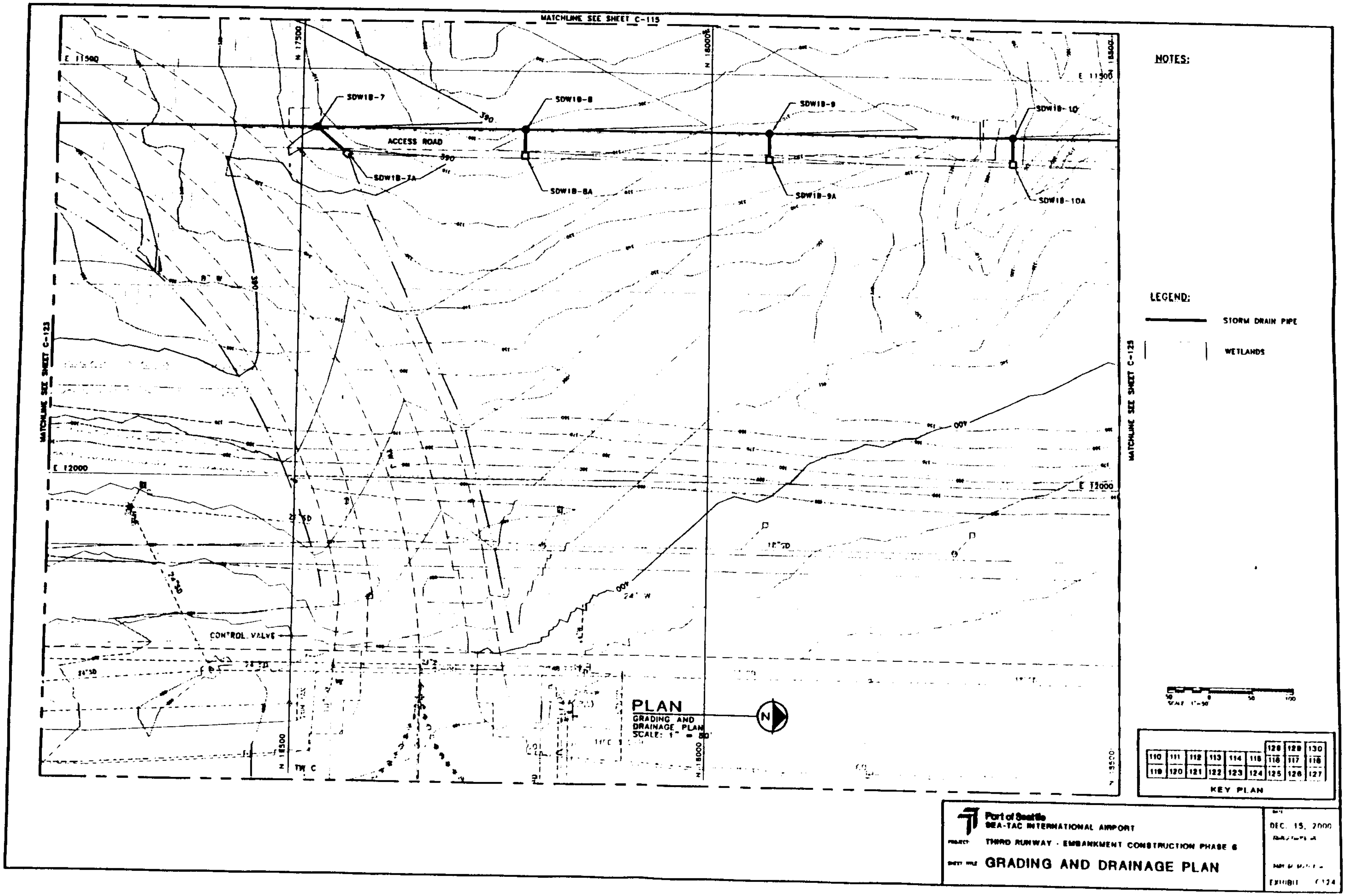
PROJECT: THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6

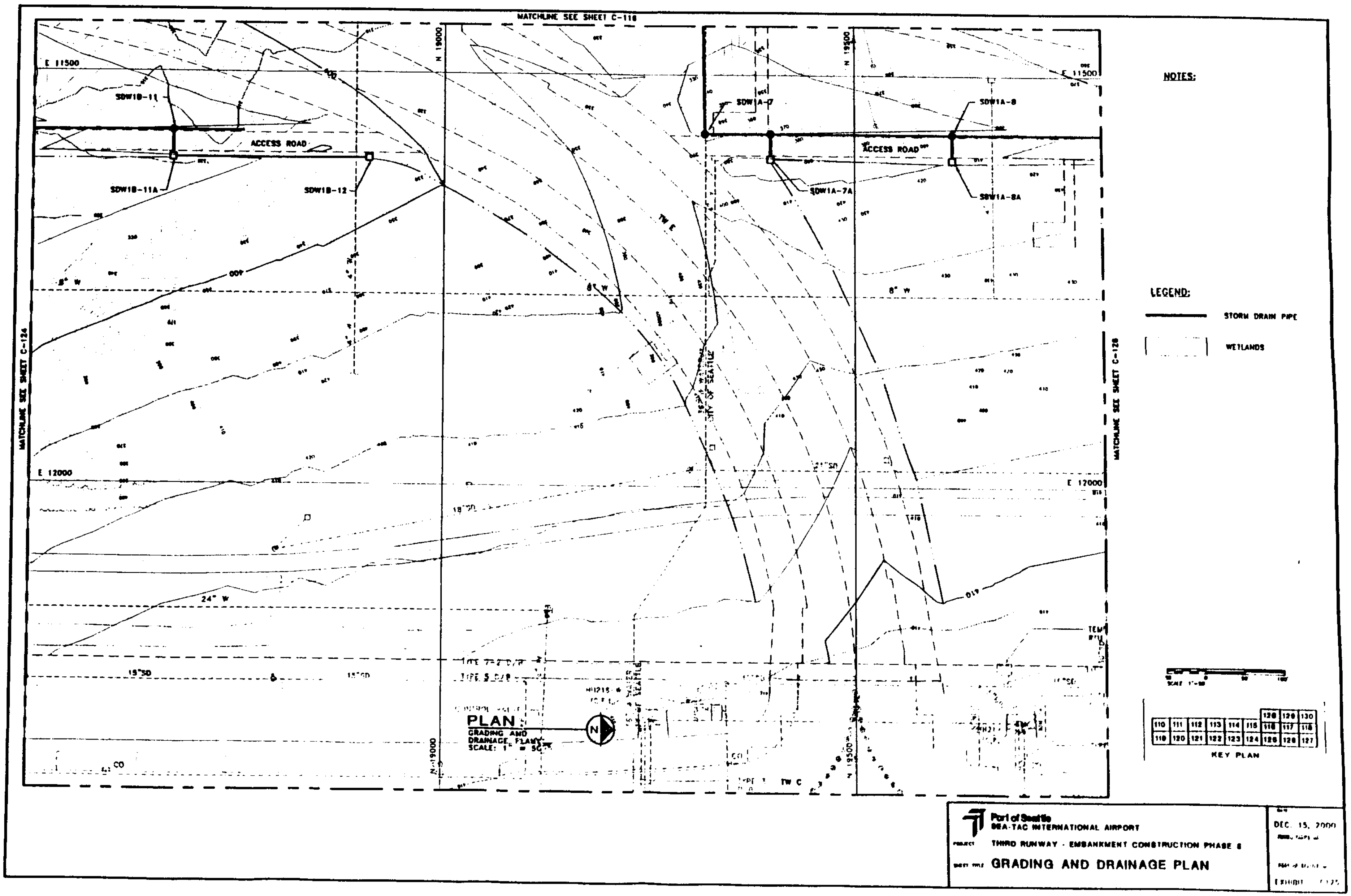
SHEET TITLE: **GRADING AND DRAINAGE PLAN**

DEC. 15, 2000

EXHIBIT C123

AR 047351


MATCHLINE SEE SHEET C-115
MATCHLINE SEE SHEET C-123
MATCHLINE SEE SHEET C-125
E 11500
E 12000
N 17500
N 18000
N 18500
SDW1B-7
SDW1B-7A
SDW1B-8
SDW1B-8A
SDW1B-9
SDW1B-9A
SDW1B-10
SDW1B-10A
ACCESS ROAD
390
400
CONTROL VALVE
TW C
PLAN
GRADING AND DRAINAGE PLAN
SCALE: 1" = 50'
NOTES:
LEGEND:
STORM DRAIN PIPE
WETLANDS
KEY PLAN
110 111 112 113 114 115 116 117 118 128 129 130
119 120 121 122 123 124 125 126 127
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6
GRADING AND DRAINAGE PLAN
DEC. 15, 2000
EXHIBIT C124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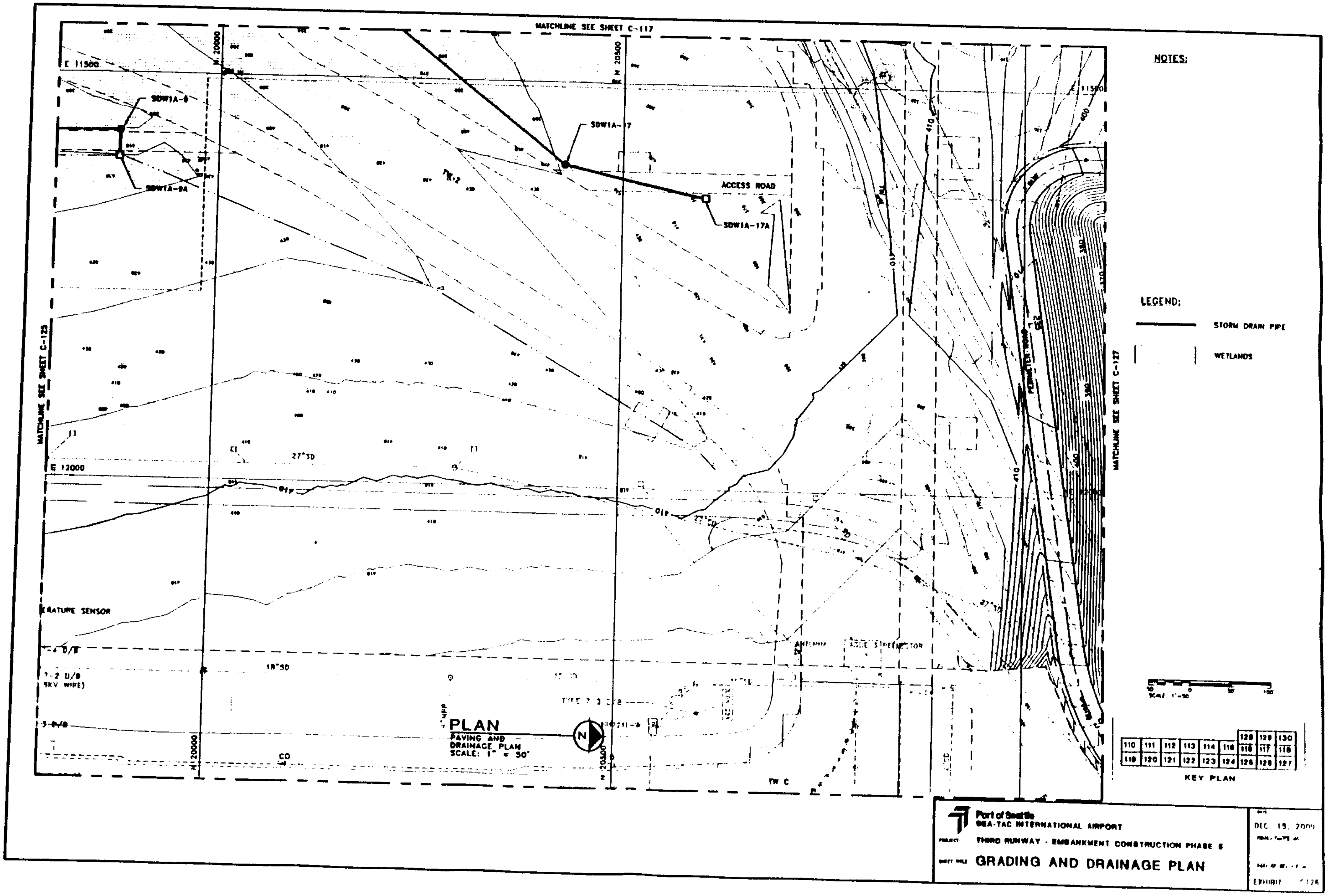
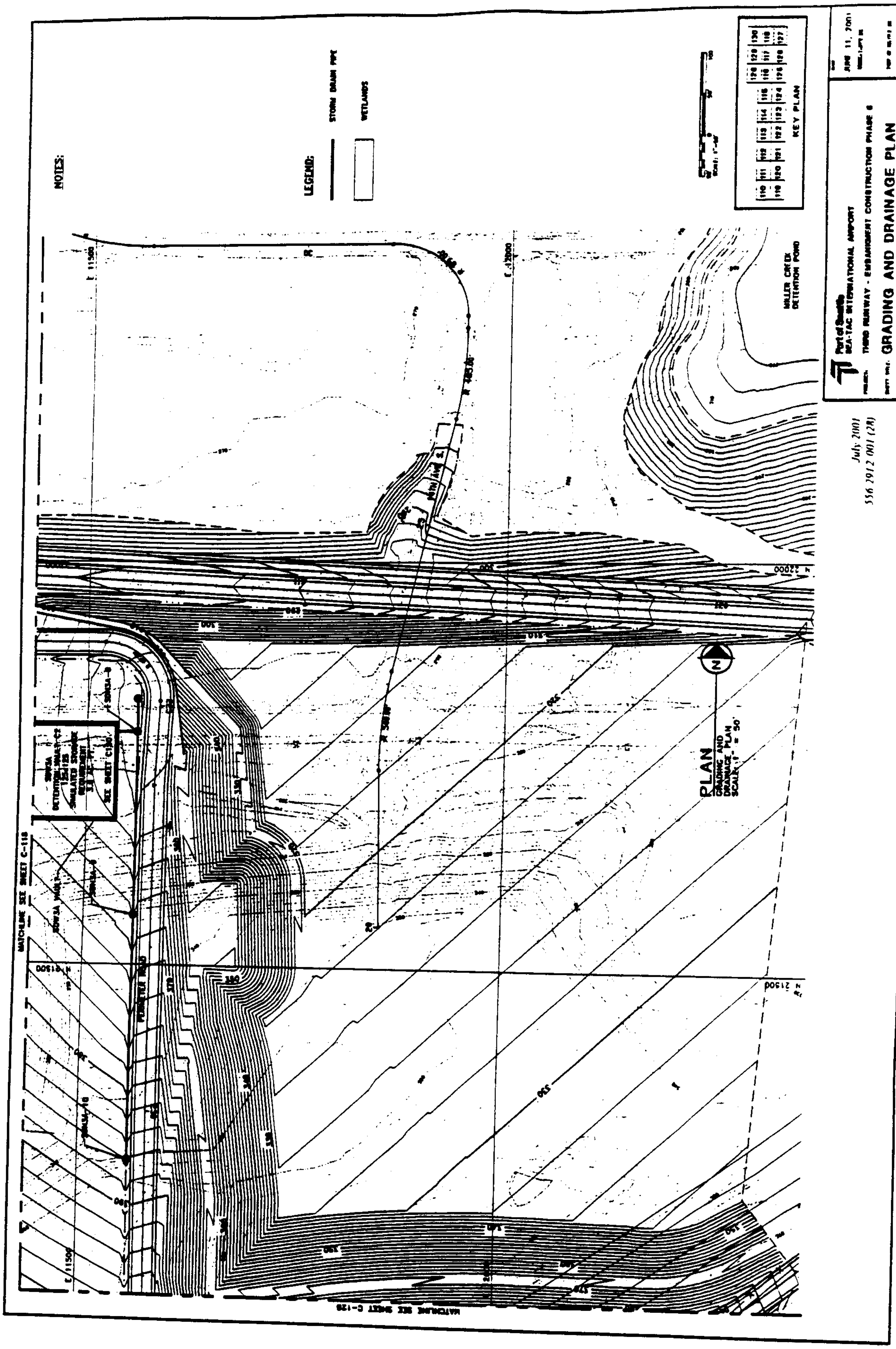
MATCHLINE SEE SHEET C-124
MATCHLINE SEE SHEET C-128
N 19000
N 19500
E 11500
E 12000
SDW1B-11
SDW1B-11A
SDW1B-12
SDW1A-7
SDW1A-7A
SDW1A-8
SDW1A-8A
ACCESS ROAD
TW E
TW C
CITY OF SEATTLE
24" W
8" W
PLAN
GRADING AND DRAINAGE PLAN
SCALE: 1" = 50'
NOTES:
LEGEND:
STORM DRAIN PIPE
WETLANDS
KEY PLAN
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 8
GRADING AND DRAINAGE PLAN
DEC. 15, 2000

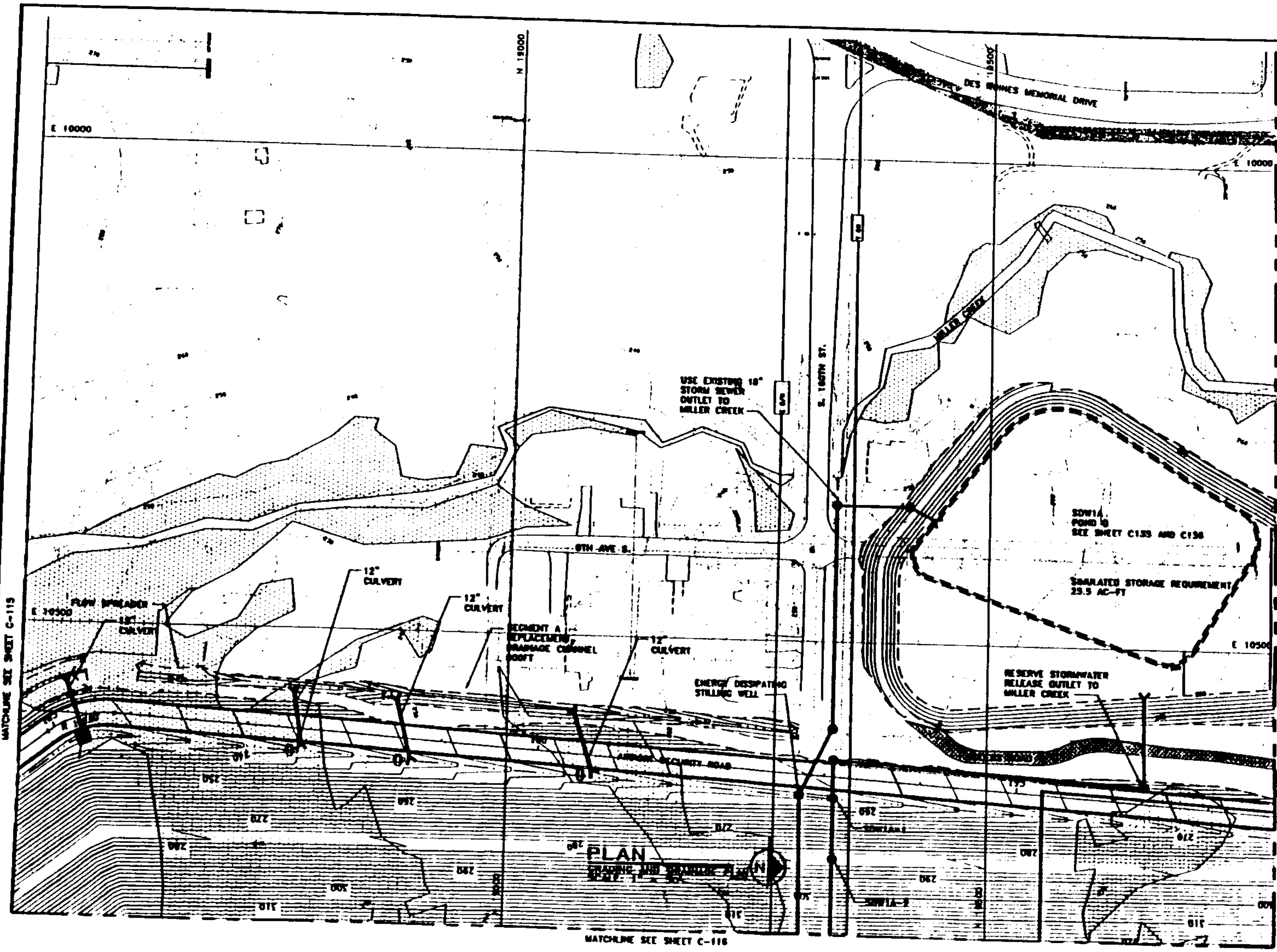
AR 047353


MATCHLINE SEE SHEET C-117
MATCHLINE SEE SHEET C-125
MATCHLINE SEE SHEET C-127
NOTES:
LEGEND:
STORM DRAIN PIPE
WETLANDS
SDW1A-8
SDW1A-9A
SDW1A-7
SDW1A-17A
ACCESS ROAD
PERIMETER ROAD
E 11500
E 12000
N 20000
N 20500
PLAN
PAVING AND DRAINAGE PLAN
SCALE: 1" = 50'
TW C
KEY PLAN
110 111 112 113 114 115 116 117 118
119 120 121 122 123 124 125 126 127
128 129 130
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6
GRADING AND DRAINAGE PLAN
DEC. 15, 2000

AR 047354


NOTES:
LEGEND:
STORM DRAIN PIPE
WETLANDS
KEY PLAN
MILLER CREEK DETENTION POND
PLAN
GRADING AND DRAINAGE PLAN
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6
GRADING AND DRAINAGE PLAN
July 2001
556 2912 001 (28)

AR 047355



NOTES:

LEGEND:

STORM DRAIN PIPE

WETLANDS

110	111	112	113	114	115	128	129	130
118	120	121	122	123	124	125	126	127

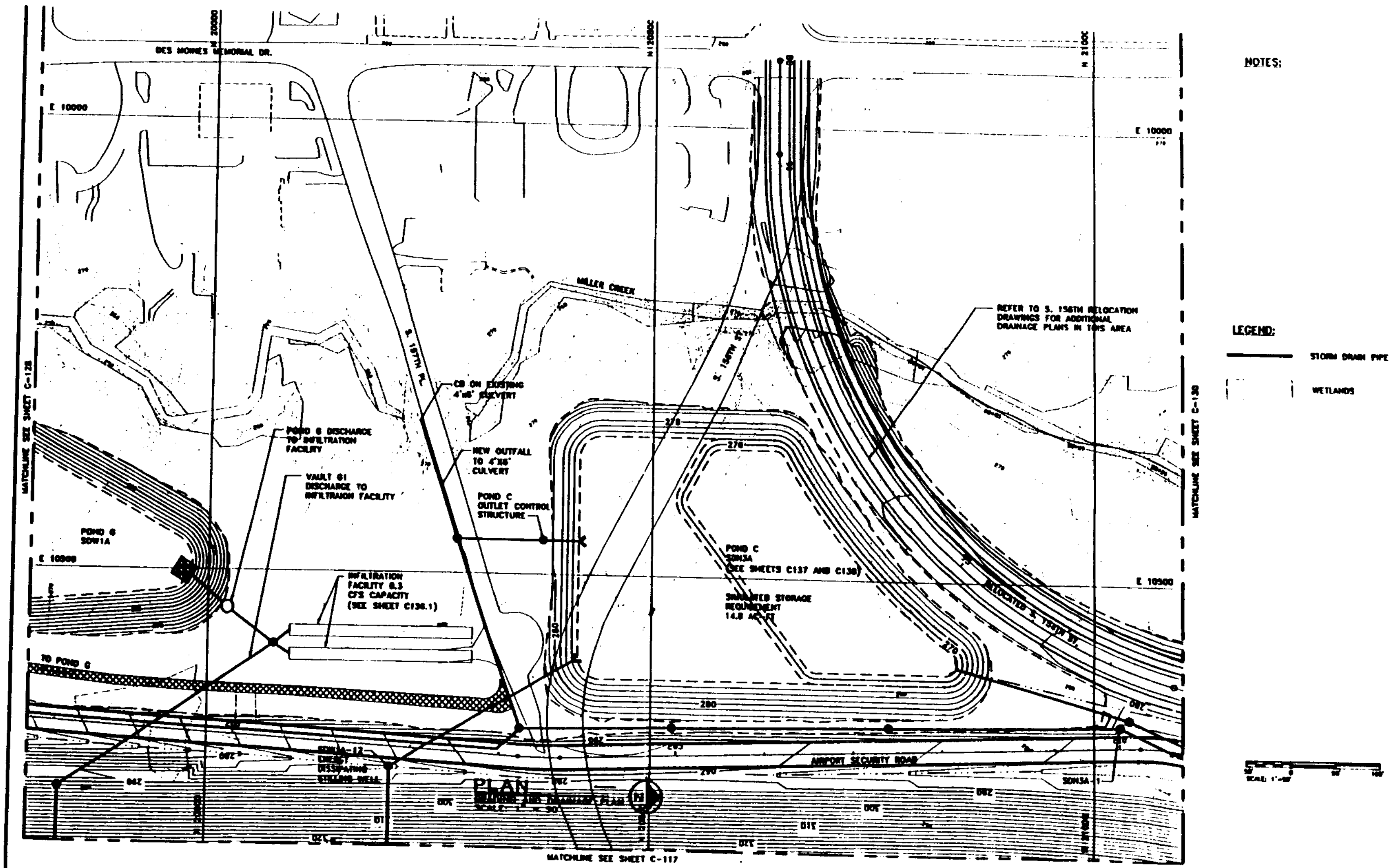
KEY PLAN

July 2001
556 2912 001 (28)

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6
GRADING AND DRAINAGE PLAN

JUNE 28, 2001

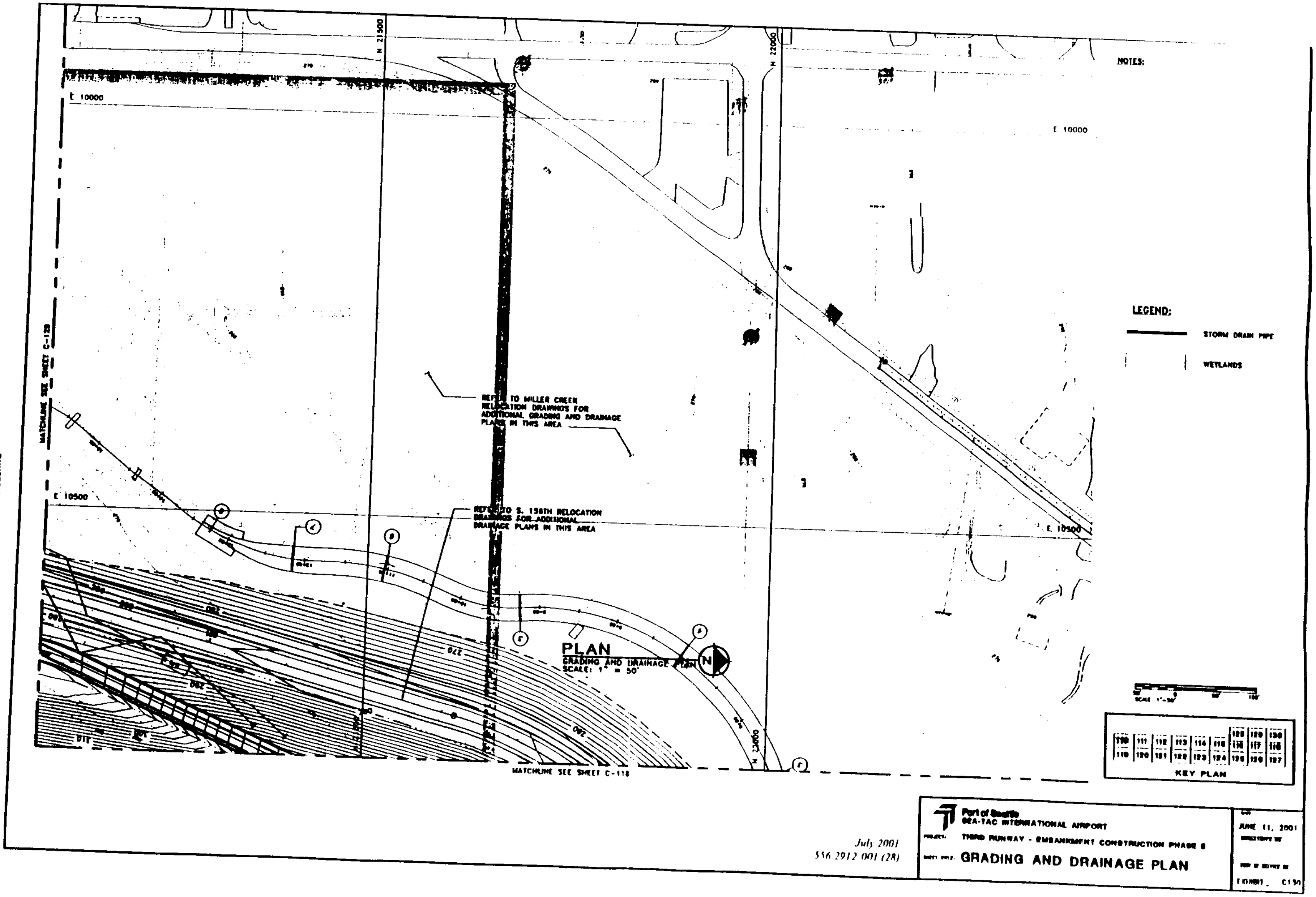
EXHIBIT C128



July 2001
556 2912 001 (28)

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT: THIRD RUNWAY - EMBANKMENT CONSTRUCTION PHASE 6
SHEET TITLE: GRADING AND DRAINAGE PLAN
JUNE 11, 2001
EXHIBIT C129

AR 047357



July 2001
556 2912 001 (28)

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AR 047358

APPENDIX W

ENERGY DISSIPATION DESIGN CRITERIA AND PARAMETERS

Seattle Tacoma International Airport
Third Dependent Runway
Energy Dissipation

Design Criteria and Parameters

Background and History

The subject of energy dissipation at the bottom of slopes is a very important issue for the Port of Seattle for both the long-term stability and maintenance of the embankment and for protection of the adjacent natural resources. Erosion at the toe of the slope will be avoided through a design approach that is based on national and regional experience with these facilities.

The design has been developed following the guidelines in the U.S. Department of Transportation. Federal Highway Administration, Hydraulic Engineering Circular No 14 titled "Hydraulic Design of Energy Dissipaters for Culverts and Channels" September 1983 (referenced as "Circular No.14" below). This is a current energy dissipation design reference containing 18 possible alternatives to address a wide range of design conditions. These alternatives draw from the wide range of modeling and operation experience of the Corps of Engineers. U.S. Bureau of Reclamation, U.S. Forest Service, Colorado State University, and others around the nation.

Though storm sewer designs are typically based on the peak flow for the 10-year, 24-hour design storm. the design of the permanent energy dissipation will be based on the 100-year, 24-hour design storm.

Phased construction of the runway embankment included provisions for energy dissipation in the form of corrugated, high density polyethylene pipe anchored to the surface of the embankment down to a short run on a flat slope before discharging to a riprap lined ditch. Drops have been down 2 (horizontal) to 1 (vertical) slopes as high as 90 feet. At least one design 10-year recurrent storm event storm was exceeded during the time that those pipes have been in place and demonstrated satisfactory performance of those temporary conveyance systems.

Proposed Measures

Circular No.14 primarily focuses on dissipating energy in culvert to channel transitions and in steep channels. The embankment project has steep slope storm sewer discharges, down the typically 2:1 embankment slopes, either directly to detention facilities or to flat sloped closed systems at the toe of the slope. Refer to the attached table for a summary of the design data relative to the stormwater discharge points.

The general approach has evolved into having a closed stormwater conveyance system that caries the flow down the slope for energy dissipation. The down-slope pipe will meet the guidelines as provided in the 1998 King County Surface Water Design Manual (Table 4.2.1.A Maximum Slopes and Velocities).

Where the storm sewer discharges directly to detention facilities, erosion at the bottom of the earthen pond will be prevented through the following design approaches:

- Natural or Forced Hydraulic Jumps
- Impact Basins
- Stilling Wells
- Riprap
- Roughness Elements to Increase Pipe Resistance Near the Outlet (combined with one of the measures above)

Where the steep storm sewer pipe discharges to flat sloped closed systems, manhole lid blow-off and erosion will be prevented through the following design approaches:

- Impact Basins
- Stilling Wells
- Roughness Elements to Increase Pipe Resistance Near the Outlet (combined with one of the measures above)

Each of these design approaches is feasible and constructable using the Circular No. 14 guidelines. Selection will be based on the physical space available, cost and ease of maintenance for each location.

Hydrology

Peak discharge rates for the 100-year, 24-hour design storm has been calculated based on the proposed pavement, airfield grading, and storm sewer layout. The calculated peak discharge rates are set and not likely to change more than 5 percent in final design. The Governor certified drainage boundaries set the total contributing areas for most of the basins.

Two subbasins in Millar Creek (SDW1A and SDN3A) are combined in the calculations. This is the worst case scenario for the outlet to Pond G. The likely alternate design would have runoff from subbasin SDN3A conveyed to Pond C within a closed stormwater conveyance system that will be located within the Security Road with a slope of 15 percent. If this conveyance alternate is selected the flow rate would reduce in the Pond G system and the slope transition within the Security Road is gradual enough that energy dissipation is not seen a significant issue.

Conclusion

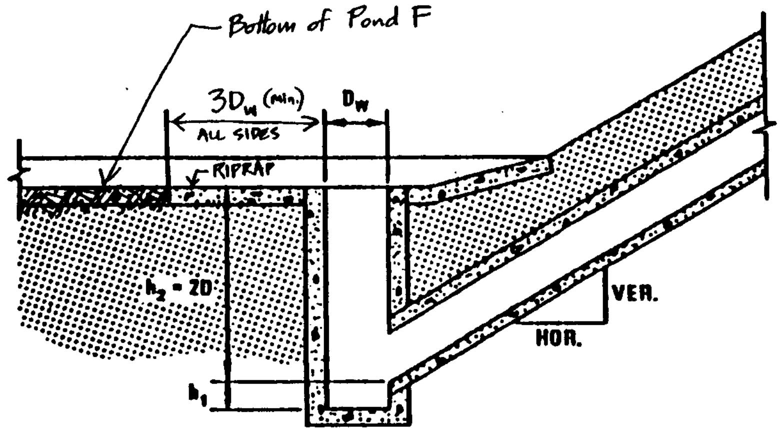
For the purposes of permit review, calculation are attached to demonstrate that the Corp of Engineers Stilling Well, as described in Chapter X-B of Circular No. 14 (attached for the reviewer's convenience), will work in the three locations where energy dissipation is a concern. This approach was selected for its simplicity, satisfactory operation for a wide range of flows (up to $Q/D^{5/2} < 10.0$), and ease of construction. King County has also indicated that they have had good experience with this system in this region. The Port may further refine or substitute another energy dissipation concept during final design to provide an equal or superior energy dissipation system.

Existing construction methods are operating satisfactorily and future construction contracts will include energy dissipation features. Construction staging could potentially place these features earlier to ensure that they are in place at the base of the embankment to enhance the corrugated HDPE pipe and ditch lining provisions for higher slope heights. Circular No. 14 notes that the Corp of Engineers Stilling Well "may also be useful as a temporary erosion control device during construction" and that it "will operate with moderate to high concentrations of sand and silt" (p. X-B-1). This ability for service as a temporary construction device will be a factor in the selection of the energy-dissipating device.

SEA-TAC THIRD RUNWAY EMBANKMENT CONSTRUCTION
STORMWATER DISCHARGE DOWN SLOPE

Basin	Receiving Waters	Pond Name	Runway Basline	Contributing Area (Ac)	100-year Flowrate (cfs)	Height of Drop (ft)	Slope (Ft/Ft)	Downstream Condition
SDS7	**Des Moines Creek**	SDS7	106	91.3	41.7	13	0.155	Closed system (180' flat slope) to detention vault. No energy dissipation issues anticipated.
SDW2	**Walker Creek**	F	153	39.8	17.5	18	0.133	Direct discharge to detention pond. Energy dissipation issues potential addressed at bottom of pond.
SDW1B	**Miller Creek**	D	167	82.2	36.3	26	0.500	Closed system (100' flat slope) to detention pond. Energy dissipation issues potential address at base of 2:1 slope.
SDW1A & SDN3A	**Miller Creek**	G & C	197	64.0	32.8	140	0.500	Closed system (430' flat slope) to detention pond. Energy dissipation issues potential addressed at base of 2:1 slope for worst case scenario single down-slope discharge.

SDW2 **STILLING WELL - Corps of Engineers** **10-B**

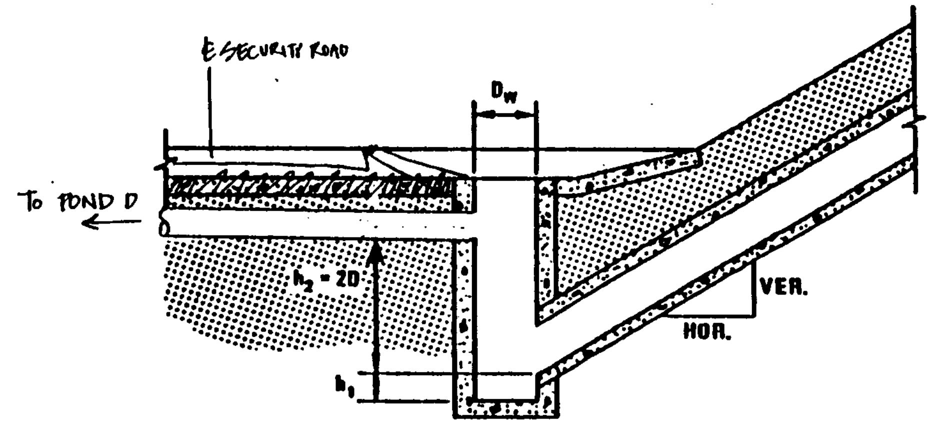


D	Q	Slope	DW	h_1/D_W	h_1	h_2	h_W		
24"	17.5	0.133	2D use 48"	0.15	7" use 12"	48"	5'		

WITH 24"ϕ, ENTRANCE CONTROLS BACKWATER
PER 1998 SWDM FIGURE 4.3.1.B, HW/D = 1.27 ⇒ HW = 2.5 ft.

CHECK $Q/D^{5/2} < 10.0$: $17.5/(2)^{2.5} = 3.09 < 10.0$ ∴ WITHIN DESIGN LIMITS

SDW1B **STILLING WELL - Corps of Engineers** 10-B



D	Q	Slope	DW	h_1/D_W	h_1	h_2	h_W		
30"	36.3	2:1 0.500	2.5D 6.25' use 6.5'ϕ	0.42	2.73' use 3'	5'	8'		

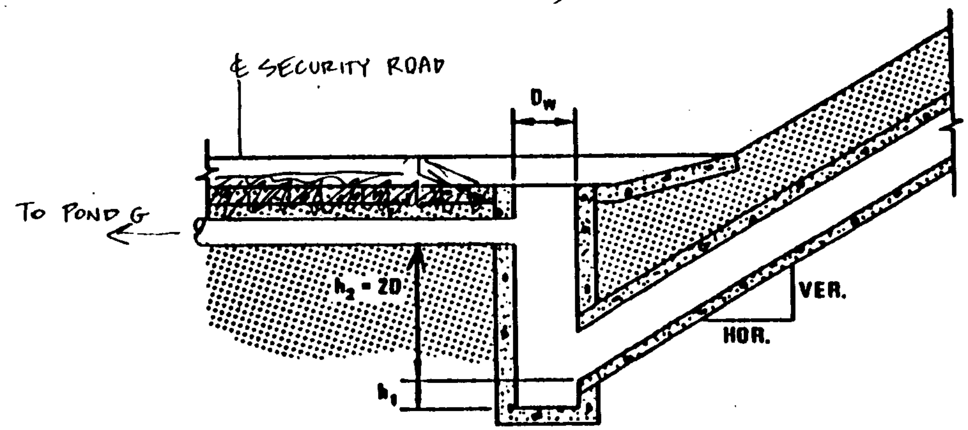
WITH 30"ϕ, ENTRANCE CONTROLS BACKWATER
PER 1998 SWDM FIGURE 4.3.1.B, HW/D = 1.6 ⇒ HW = 3.75'

CHECK CRITICAL DEPTH IN PIPE : 2.1' < 2.5' ✓

PIPE OUT Q = 36.3 v = 3 fps min.
USE 36" @ S = 0.005: Capacity = 47.2 cfs v = 6.67
USE STANDARD RIPRAP TREATMENT AT DISCHARGE TO POND D

COMBINED SDW1A & SDN3A **STILLING WELL - Corps of Engineers** 10-B

(INDIVIDUAL DISCHARGES WOULD BE SMALLER)



D	Q	Slope	DW	h_1/D_W	h_1	h_2	h_W		
30"	32.8	2:1 0.500	2D 5'	0.42	2.1'	2.5'	4.6'		

WITH 30"φ, ENTRANCE CONTROLS BACKWATER
PER 1998 SWDM FIGURE 4.3.1.B, HW/D = 1.45 ⇒ HW = 3.63'

CHECK CRITICAL DEPTH IN PIPE: 1.9' < 2.5' ✓

PIPE OUT Q = 32.8 v = 3 fps min.

USE 36" @ S = 0.005 : CAPACITY = 47.2 cfs v = 6.67
USE STANDARD RIP RAP TREATMENT AT DISCHARGE TO POND G

HNTB The HNTB Companies	Made by A.D. Black	Date 8/10/00	Job Number 20764-DS-001
	Checked by RCElslip	Date 8/16/00	Sheet Number 1
Calculations For SEA 3rd Runway	Backchecked by	Date	

SDS7 Total Area = 3975027 sq ft = 91.25 Ac. (CADD measure)

Runway Pavement = 1553770 − 107239 ~~= 1446531 sq ft = 33.20 Ac~~ + 121120 = 1567651 sq.ft.

Perimeter Road Pvmt = [(12400 − 11000) + (14935 − 10900)] 32 = 173920 sq ft.
Access Rd Pvmt 1660' × 24' = 39,840

Total Proposed Impervious = 1567651 + 173920 = ~~1741571~~ 1781411 sq ft = ~~40 Ac~~ 40.9 Ac

Tc Calculation

Path through inlet SDS7-29A

150'	sheet flow on TW-N	s = 0.01	250
100'	sheet flow on infield	s = 0.0150	330
330'	intermittent on infield	s = 0.0150	
3500'	stm. swr conveyance	s = 0.0077	3250

Path through inlet SDS7-18

160'	sheet flow on runway	s = 0.01
100'	sheet flow on w. grass	s = 0.015
90'	intermittent — " —	s = 0.015
200'	ditch conveyance	s = 0.0077
4150'	stm. swr. conveyance	s = 0.0077

ME111-0793

==

BASIN SUMMARY

```
BASIN ID: SDS7          NAME:
SBUH METHODOLOGY
TOTAL AREA.......:  92.15 Acres      BASEFLOWS:   0.00 cfs
RAINFALL TYPE....:   TYPE1A                    PERV             IMP
PRECIPITATION....:   4.00 inches     AREA..:   51.25 Acres   40.90 Acres
TIME INTERVAL....:    10.00 min      CN....:   85.00          98.00
                                     TC....:   48.22 min     36.61 min
ABSTRACTION COEFF:   0.20
TcReach - Sheet    L: 250.00 ns:0.1500 p2yr: 2.00 s:0.0150
TcReach - Shallow  L: 370.00 ks:11.00 s:0.0150
TcReach - Channel L:3250.00 kc:42.00 s:0.0077
impTcReach - Sheet    L: 150.00 ns:0.0110 p2yr: 2.00 s:0.0100
impTcReach - Sheet    L: 100.00 ns:0.1500 p2yr: 2.00 s:0.0150
impTcReach - Shallow L: 330.00 ks:11.00 s:0.0150
impTcReach - Channel L:3500.00 kc:42.00 s:0.0077
PEAK RATE:  41.71 cfs   VOL:   23.33 Ac-ft   TIME:    490 min
```

HNTB The HNTB Companies	Made by A. D. Black	Date 8/10/00	Job Number 20764-DS-001
	Checked by RC Elslip	Date 8/16/00	Sheet Number 2
Calculations For SEA 3rd Runway	Backchecked by	Date	

SDW2   Total Area = ~~1942982 sq ft~~ 1735838 sq ft = ~~44.6 Ac.~~ 39.8 Ac   (CADD measure)

Runway Pvmt = 412 228 sq ft

Perimeter Rd Pvmt = (15950 - 14935) 32 = 32 480 sq ft.

Total imp. = 412228 + 32 480 = 444 708 sq. ft. = ~~10.2 Ac~~

+ Access Rd Pvmt = 900 × 24' = 21,600

466,308 sq. ft. = 10.7 Ac.

Tc Calculation — through SDW2-5A

Pervious Area

200' sheet flow on infield   s = 0.015

470' intermittent flow on infield   s = 0.015

265' ditch flow e. of access road   s = 0.0077

2030' stm swr conveyance   s = 0.005

Impervious Area

200' sheet flow on runway   s = 0.01

190' intermittent flow on infield   s = 0.015

250' ditch flow w. of access road   s = 0.0077

2000' stm swr conveyance   s = 0.005

ME111-0793

AR 047369

==

BASIN SUMMARY

```
BASIN ID: SDW2          NAME:
SBUH METHODOLOGY
TOTAL AREA.......:   39.80 Acres     BASEFLOWS:    0.00 cfs
RAINFALL TYPE....:     TYPE1A                   PERV          IMP
PRECIPITATION....:    4.00 inches    AREA..:   29.10 Acres   10.70 Acres
TIME INTERVAL....:      10.00 min    CN....:   85.00         98.00
                                     TC....:   44.38 min    18.94 min
ABSTRACTION COEFF:    0.20
TcReach - Sheet    L: 200.00 ns:0.1500 p2yr: 2.00 s:0.0150
TcReach - Shallow L: 470.00 ks:11.00 s:0.0150
TcReach - Channel L: 265.00 kc:17.00 s:0.0077
TcReach - Channel L:2030.00 kc:42.00 s:0.0050
impTcReach - Sheet    L: 200.00 ns:0.0110 p2yr: 2.00 s:0.0100
impTcReach - Shallow L: 190.00 ks:11.00 s:0.0150
impTcReach - Channel L: 250.00 kc:17.00 s:0.0177
impTcReach - Channel L:2000.00 kc:42.00 s:0.0050
PEAK RATE:  17.51 cfs   VOL:    9.32 Ac-ft   TIME:     480 min
```

HNTB The HNTB Companies	Made by A.D. Black	Date 8/10/00	Job Number 20764-DS-001
	Checked by KC Elsl...	Date 8/16/00	Sheet Number 3
Calculations For SEA 3rd Runway	Backchecked by	Date	

SDW1B

Total Area = ~~419143 sq ft~~ = ~~96.7 Ac.~~
3579820 sq ft. = 82.2 Ac. (plateau only)

Runway Pvmt. = 242428 + 809733 = 1052161 sq ft

Perimeter Rd Pvmt = (18720 - 1595) 32 = 88640 sq ft

~~Total Pvmt~~

Acces Rd Pvmt = (1450 + 820) 24 = 54480

Total Imp. Area = 1,195,281 sq. ft. = 27.4 Ac.

Tc Calculation

Pervious Area (through SDW1B-12)

250' sheet flow on infield s = 0.015
300' intermittent shallow on infield s = 0.015
2720' stm swr conveyance s = 0.0077
700 stm swr conveyance s = 0.005

Impervious Area

300' sheet flow on TW E s = 0.02
650' ditch flow s. of TW E s = 0.02
2720' stm swr ∥ to Runway s = 0.0077
700' stm swr @ s = 0.005

ME111-0793

AR 047371

```
==========================================================================
                              BASIN SUMMARY

BASIN ID: SDW1B          NAME:
SBUH METHODOLOGY
TOTAL AREA.......:   82.20 Acres      BASEFLOWS:    0.00 cfs
RAINFALL TYPE....:     TYPE1A                    PERV              IMP
PRECIPITATION....:    4.00 inches     AREA..:   54.80 Acres    27.40 Acres
TIME INTERVAL....:     10.00 min      CN....:   85.00           98.00
                                      TC....:   48.88 min      24.43 min
ABSTRACTION COEFF:    0.20
TcReach - Sheet   L: 250.00 ns:0.1500 p2yr: 2.00 s:0.0150
TcReach - Shallow L: 300.00 ks:11.00 s:0.0150
TcReach - Channel L:2720.00 kc:42.00 s:0.0077
TcReach - Channel L: 700.00 kc:42.00 s:0.0050
impTcReach - Sheet   L: 300.00 ns:0.0110 p2yr: 2.00 s:0.0200
impTcReach - Channel L: 650.00 kc:17.00 s:0.0200
impTcReach - Channel L:2720.00 kc:42.00 s:0.0077
impTcReach - Channel L: 700.00 kc:42.00 s:0.0050
PEAK RATE:  36.31 cfs   VOL:  19.82 Ac-ft   TIME:    490 min
```

HNTB The HNTB Companies	Made by A.D. Black	Date 8/10/00	Job Number 20764 DS-001
	Checked by PC Ellis	Date 8/16/00	Sheet Number 4
Calculations For SEA 3rd Runway	Backchecked by	Date	

SDW1A + SDN3A   Total Area = 2073640 + 716341
2 789 981 sq ft = 64.0 Ac

SDW1A Runway Pvmt 945093 - 106818 = 838,275 sq ft
SDN3A Runway Pvmt. 142825 sq ft.
Perimeter Rd Pvmt. (20850 - 18720) 32 = 68 160 sq ft
~~(23300 - 20850) 32 = 78 400 sq ft~~
Access Rd. Pvmt. 1000' x 24' = 24 000 sq ft.
Total Imp Area = 1,151,660 sq ft = 26.4 Ac.

Tc Calc   Path through SDN3A-7

Impervious

210' sheet flow on Blast Pad 8%
40' Sheet flow off Blast Pad on grass 8%
260' Shallow flow on infield 8%
240' Ditch (grass) to SDN3A-7 7%
3,230 pipe flow 0.77%

Pervious

~~350~~ 250 Sheet flow 8%
70 Shallow flow 8%
120 Ditch flow ~~7%~~
1080 Pipe flow 0.5%
2450 Pipe flow 0.77%

ME111-0783

AR 047373

BASIN SUMMARY

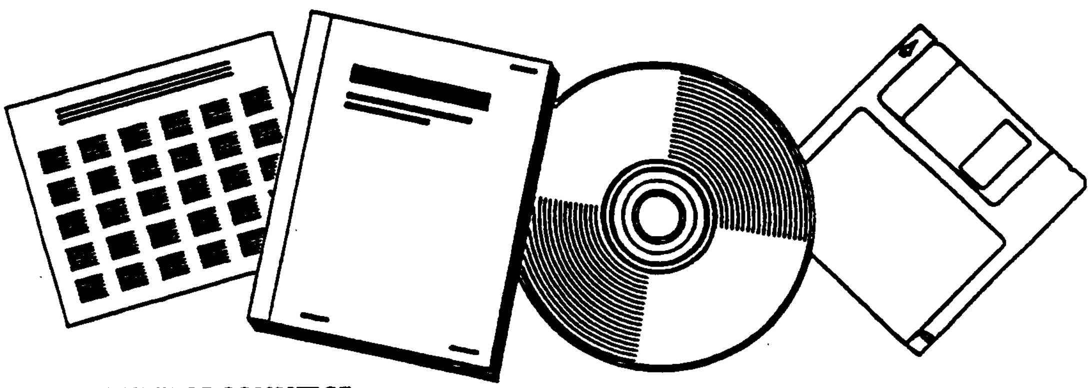
```
BASIN ID: SDW1A        NAME:
SBUH METHODOLOGY
TOTAL AREA.......:  64.00 Acres     BASEFLOWS:   0.00 cfs
RAINFALL TYPE....:    TYPE1A                   PERV           IMP
PRECIPITATION....:   4.00 inches    AREA..:    37.60 Acres    26.40 Acres
TIME INTERVAL....:     10.00 min    CN....:    85.00          98.00
                                    TC....:    32.78 min      21.90 min
ABSTRACTION COEFF:   0.20
TcReach - Sheet   L: 250.00 ns:0.1500 p2yr: 2.00 s:0.0800
TcReach - Shallow L:  70.00 ks:11.00 s:0.0800
TcReach - Channel L: 120.00 kc:17.00 s:0.0700
TcReach - Channel L:1080.00 kc:42.00 s:0.0050
TcReach - Channel L:2450.00 kc:42.00 s:0.0077
impTcReach - Sheet   L: 210.00 ns:0.0110 p2yr: 2.00 s:0.0800
impTcReach - Sheet   L:  40.00 ns:0.1500 p2yr: 2.00 s:0.0800
impTcReach - Shallow L: 260.00 ks:11.00 s:0.0800
impTcReach - Channel L: 240.00 kc:17.00 s:0.0700
impTcReach - Channel L:3230.00 kc:42.00 s:0.0077
PEAK RATE:  32.83 cfs  VOL:  15.98 Ac-ft  TIME:    480 min
```

PB86180205

HYDRAULIC DESIGN OF ENERGY DISSIPATORS FOR CULVERTS AND CHANNELS

FEDERAL HIGHWAY ADMINISTRATION
WASHINGTON, DC

SEP 83



U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

AR 047375

X-B. CORPS OF ENGINEERS STILLING WELL

The design of this type of stilling well energy dissipator is based on model tests conducted by the Corps of Engineers. (X-B-1 and 2)

The dissipator has application where debris is not a serious problem. It will operate with moderate to high concentrations of sand and silt but is not recommended for areas where quantities of large floating or rolling debris is expected unless suitable debris-control structures are utilized. Its greatest potential, as far as highways are concerned, is at the outfalls of storm drains, median, and pipe down drains where little debris is expected. It may also be useful as a temporary erosion control device during construction.

Design Recommendations

The design is straightforward. Once the size and discharge of the incoming pipe are determined, figure X-B-1 is used to select the stilling well diameter (D_W). The model tests indicated that satisfactory performance can be maintained for $Q/D^{5/2}$ ratios as large as 10.0, with stilling well diameters of one, two, three, and five times that of the incoming conduits. These ratios were used to define the curves shown in figure X-B-1.

The tests also indicated that there is an optimum depth of stilling well below the invert of the incoming pipe. This depth is determined by entering figure X-B-2 with the slope of the incoming pipe and using the stilling well diameter (D_W) previously obtained from figure X-B-1.

The height of the stilling well above the invert is fixed at twice the diameter of the incoming pipe (2D). This dimension results in satisfactory operation and is practical from a cost standpoint; however, if increased, greater efficiency will result.

Tailwater also increases the efficiency of the stilling well. Whenever possible, it should be located in a sump or depressed area.

It is recommended that riprap or other types of channel protection be provided around the stilling well outlet and for a distance of at least $3D_W$ downstream.

The outlet may also be covered with a screen or grate for safety. However, the screen or grate should have a clear opening area of at least 75 percent of the total stilling well area and be capable of passing small floating debris such as cans and bottles.

Design Procedures

(1) Select approach pipe diameter (D) and discharge (Q).

(2) Obtain well diameter (D_W) from figure X-B-1.

(3) Calculate the culvert slope = (Vertical/horizontal distance). The depth of the well below the culvert invert (h_1) is determined from figure X-B-2.

(4) The depth of the well above the culvert invert (h_2) is equal to 2(D) as a minimum but may be greater if the site permits.

(5) The total height of the well (h_W) = h_1+h_2.

Example Problem

Given: 24" CMP downdrain on a 2:1 slope carrying a Q = 15 cfs

Find: Stilling well dimensions

Solution:

(1) D=2 ft., Q=15 cfs
(2) From figure X-B-1 D_W=1.5D=3 ft.
(3) Slope=1/2=.5, h_1/D_W=.42 from figure X-B-2
h_1=.42(3.0)=1.26 ft., Use h_1=1.3 ft.
(4) h_2=2(D)=2(2)=4 ft.
(5) h_W= h_1+h_2=1.3+4=5.3 ft.

X-B-1. IMPACT-TYPE ENERGY DISSIPATOR FOR STORM-DRAINAGE OUTFALLS STILLING WELL DESIGN, U. S. Army Corps of Engineers, Technical Report No. 2-620 March 1963, WES, Vicksburg, Mississippi.

X-B-2. Grace, J. L., Pickering, G. A., EVALUATION OF THREE ENERGY DISSIPATORS FOR STORM DRAIN OUTLETS, U.S. Army WES, HRB 1971, Washington, D.C.

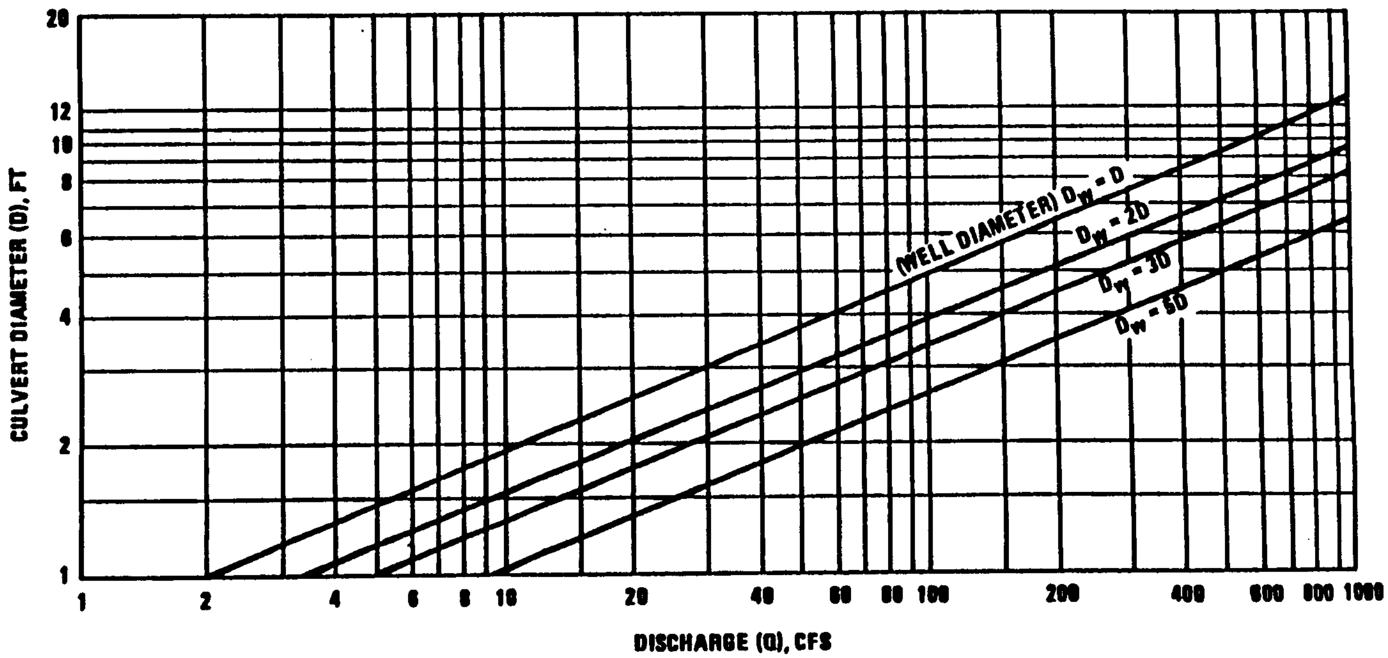


FIGURE X-B-1. STILLING WELL DIAMETER (D_W) FROM REFERENCE X-B-1

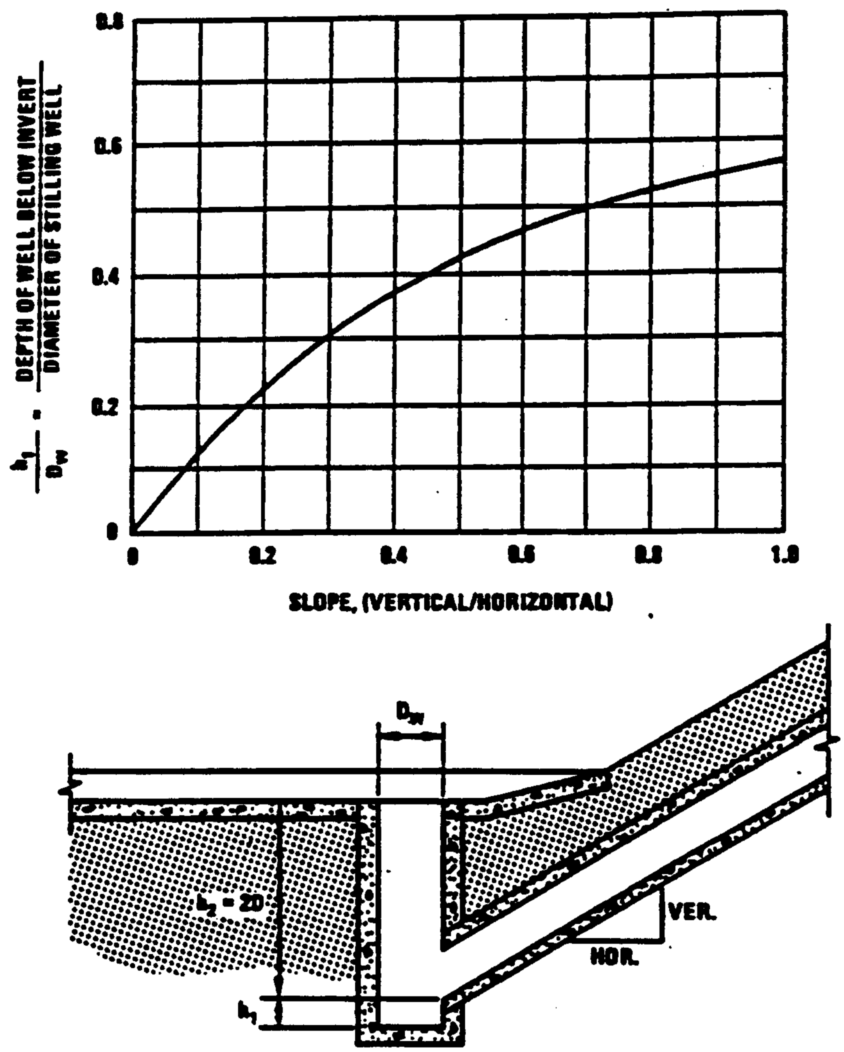


FIGURE X-B-2. STILLING WELL HEIGHT FROM REFERENCE X-B-1

APPENDIX Z

IWS LAGOON STORAGE CAPACITY MODELING

TABLE OF CONTENTS

LIST OF TABLES

1. IWS CONTINUOUS SIMULATION

1.1 INTRODUCTION

A continuous simulation of the Industrial Waste System (IWS) was performed using the King County Runoff Time Series (KCRTS) to:

- Confirm that overflows will not occur under the future configuration of the IWS (simulated over the 50-year KCRTS period of record);
- Estimate the treatment rate at which one overflow would occur when the 50-year KCRTS period of record is simulated; and
- Estimate the treatment rate at which two overflows would occur.

1.2 APPROACH AND ASSUMPTIONS

The following assumptions were used for the analyses:

- With recent improvements to the Industrial Waste Water Treatment Plant (IWTP), the maximum IWS treatment and discharge rate exceeds 4.0 mgd (6.2 cfs).
- The total lagoon storage (for Lagoons 1, 2, and 3) will be increased to approximately 76.9 million gallons by the end of 2001. Lagoon 3 is currently being enlarged as an element of the All Known Available and Reasonable Treatment (AKART) alternative, which is required the Port's National Pollutant Discharge Elimination System (NPDES) Permit. The final storage of Lagoon 3 will be no less than the design volume of 72 million gallons. Upon completion, the effective volume is expected to exceed the design volume, with a final volume of 72 to 76 million gallons. The design volume of 72 million gallons was used for this analysis.
- The hydraulic capacity of the existing 18-inch outfall was determined to be at least 6.3 mgd (see Appendix O, Case 1). This exceeds the current and proposed future maximum treatment rate of 4 mgd. Additionally, approximately 75 feet of effluent line upstream of the effluent manhole was replaced in 1996 (Kennedy/Jenks 1998) and a portion of the 18-inch effluent line under Lagoon 3 is scheduled to be replaced in 2001. These improvements will increase the capacity of the outfall to 7.1 mgd (see Appendix O, Case 2).
- Land use for the IWS in 2006 is summarized in Table Z-1. This land use is conservative because pump stations were modeled to direct 100 percent of flows to the IWS; flows greater than the 6-month flow rate actually overflow from some of these facilities to the Storm Drain System (SDS). Although this analysis accounts for all major planned additions to the IWS, approximately 16 acres of additional impervious area were included in this analysis to allow for future unplanned area additions.

Table Z-1. IWS configuration (land use, storage, treatment rate, and discharge rate).

Parameter	Value
Land Use	
Till Grass	16.53 acres
Outwash Grass	8.16 acres
Airport Fill	0.01 acres
Wetland	0.01 acres
Impervious Area	410.00 acres
TOTAL	**434.71 acres**
Storage Volume	
Lagoon 1	1.6 mg
Lagoon 2	3.3 mg
Lagoon 3	72.0 mg
TOTAL	**76.9 mg = 236.0 ac-ft**
Treatment Rate	**4.0 mgd**
Outfall Discharge Capacity	**7.1 mgd**

2. IWS LAGOON STORAGE CAPACITY MODELING

2.1 CONFIRMATION OF ZERO OVERFLOWS

A single-outlet reservoir file was set up in KCRTS representing the total lagoon storage and treatment rate. In the reservoir file, the processing rate linearly increases to the maximum of 6.2 cfs, at which time Lagoon 1 is full (this assumption is conservative, as the maximum treatment rate is normally attained as soon as the treatment facility is started, when Lagoon 1 is less than full). After Lagoon 1 is full, the maximum processing rate was held constant at 6.2 cfs.

The IWS 2006 time series was routed through the reservoir to confirm that the peak reservoir storage was not exceeded. As shown in the attached KCRTS reservoir setup, the peak storage attained for the 50-year KCRTS period of record (208 ac-ft) does not exceed the total IWS lagoon storage capacity of 236 ac-ft, thus no overflows occur.

2.2 TREATMENT RATE AT WHICH ONE OVERFLOW OCCURS

To determine the treatment rate at which one overflow would occur, a double-outlet reservoir was used. The treatment rate was represented as a constant discharge from the first outlet (ramped up as described above). Overflow was represented by the second outlet's discharge, which did not occur until the pond reached full volume. The overflow discharge rate was arbitrarily set at 1.0 cfs to indicate that overflow was occurring (only a positive-negative indicator of overflow was required).

The IWS 2006 time series file was routed through the two-outlet reservoir. A trial-and-error process was performed, examining the KCRTS reservoir routing output (attached) to bracket the flow rate at which overflow would occur. This treatment rate was approximately 3.05 mgd (1.97 cfs), with overflow occurring in water year (WY) 1997.

2.3 TREATMENT RATE AT WHICH TWO OVERFLOWS OCCUR

To determine the treatment rate at which two overflows would occur, a double-outlet reservoir was used. The treatment rate was represented as a constant discharge from the first outlet. Overflow was represented by the second outlet's discharge, which did not occur until the pond reached full volume. Then the overflow discharge rate was arbitrarily set at 1.0 cfs to indicate that overflow was occurring (only a positive-negative indicator of overflow was required). The KCRTS reservoir input and reservoir routing results are attached.

The IWS 2006 time series file was routed through the two-outlet reservoir. A trial-and-error flow-frequency analysis was performed on the second outlet's time series to determine the treatment rate at which overflow would occur in only one year (but not in two or more different years). This treatment rate was approximately 2.68 mgd (4.15 cfs), with overflow occurring only in WY 1956 (see attached KCRTS output and hydrograph). The hydrograph from WY 1956 was extracted and analyzed to determine how many overflows occurred during that year (only one overflow occurred).

Using flow frequency analysis and extracted hydrographs, the trial-and-error process was extended to determine the rate at which two overflows would occur in 1956, or at which overflows would occur in two separate years. Two overflows occurred during the 50-year KCRTS period of record at a treatment rate of approximately 2.35 mgd (4.10 cfs). Both overflows occurred in WY 1956 (see attached KCRTS output and hydrograph).

KCRTS TIME SERIES INPUT: IWS 2006 LAND USE

```
+-Land Use Summary-----------------------------------------------
|Till Forest                 0.00 acres
|Till Pasture                0.00 acres
|Till Grass                 16.53 acres
|Airport Fill                0.01 acres
|Outwash Forest              0.00 acres
|Outwash Pasture             0.00 acres
|Outwash Grass               8.16 acres
|Wetland                     0.01 acres
|Impervious                410.00 acres
|--------------------------------------------------------------|
|         Total Area :     434.71 acres
|       Scale Factor :       1.00       Hourly       Historic   |
|--------------------------------------------------------------|
|
|   Time Series: iws2006                                        |
|--------------------------------------------------------------|
```

KCRTS ONE-OUTLET RESERVOIR SETUP AND RESERVOIR ROUTING RESULTS
IWS 2006 LAGOON STORAGE AND TREATMENT RATE

```
One Outlet Reservoir Routing File

 Stage      Discharge        Storage         Perm-Area
 (Ft)         (CFS)          (Cu-Ft)          (Sq-Ft)
  0.00        0.000               0.                0.
  0.10        6.190          213875.                0.
 10.00        6.190        10279374.                0.

    0.00 Ft           : Base Reservoir Elevation
    0.0 Minutes/Inch: Average Perm-Rate


                           KCRTS Command
                           -------------
               Route through a SINGLE (1) outlet Reservoir
               -------------------------------------------
                          Loading Reservoir File:iwsres.RS1   :
                       Loading Time Series File:iws2006.tsf  50

                Reservoir Routing [Single Outlet]
 Computing Series:iws1.tsf
   Years Complete: 50
                     Inflow/Outflow Analysis
                     -----------------------
   Peak Inflow Discharge:     168.40 CFS at  6:00 on Jan  9 in 1990
  Peak Outflow Discharge:       6.19 CFS at  2:00 on Jan  3 in 1997
    Peak Reservoir Stage:       8.81  Ft
     Peak Reservoir Elev:       8.81  Ft
  Peak Reservoir Storage: 9065779.    Cu-Ft
                        :     208.122 Ac-Ft
                           Storing Time Series File:iws1.tsf  50

                     Routing Complete
```

KCRTS TWO-OUTLET RESERVOIR ROUTING RESULTS
TO DETERMINE ONE OVERFLOW
IWS 2006 LAGOON STORAGE WITH 3.03 MGD TREATMENT RATE

```
                              KCRTS Command
                              -------------
                  Route through a DOUBLE (2) outlet Reservoir
                  -------------------------------------------
                                  Loading Reservoir File:iwsres2.RS2  :
                                Loading Time Series File:iws2006.tsf  50

                     Reservoir Routing [Double Outlet]
 Computing Series:iwstreat.tsf
       and Series:iwsover.tsf
   Years Complete: 50
                          Inflow/Outflow Analysis
                          -----------------------
   Peak Inflow Discharge:    168.40 CFS at  6:00 on Jan  9 in 1990
 Peak A-Outflow Discharge:     4.70 CFS at  2:00 on Jan  3 in 1997
 Peak B-Outflow Discharge:     1.00 CFS at  2:00 on Jan  3 in 1997
    Peak Reservoir Stage:     10.02  Ft
     Peak Reservoir Elev:     10.02  Ft
  Peak Reservoir Storage: 9635228.    Cu-Ft
                        :    221.194 Ac-Ft
                                Storing Time Series File:iwstreat.tsf  50
                                 Storing Time Series File:iwsover.tsf  50

                               Routing Complete
```

**KCRTS TWO-OUTLET RESERVOIR ROUTING RESULTS
TO DETERMINE ONE OVERFLOW
IWS 2006 LAGOON STORAGE WITH 3.06 MGD TREATMENT RATE**

```
                         KCRTS Command
                         -------------
              Route through a DOUBLE (2) outlet Reservoir
              -------------------------------------------
                           Loading Reservoir File:iwsres2.RS2    :
                         Loading Time Series File:iws2006.tsf  50

                 Reservoir Routing (Double Outlet)
Computing Series:iwstreat.tsf
     and Series:iwsover.tsf
  Years Complete: 50
                      Inflow/Outflow Analysis
                      -----------------------
  Peak Inflow Discharge:    168.40 CFS at  6:00 on Jan  9 in 1990
Peak A-Outflow Discharge:     4.75 CFS at  3:00 on Jan  3 in 1997
Peak B-Outflow Discharge:    0.000 CFS at  3:00 on Jan  3 in 1997
    Peak Reservoir Stage:    10.00  Ft
     Peak Reservoir Elev:    10.00  Ft
  Peak Reservoir Storage: 9620638.  Cu-Ft
                        :   220.859 Ac-Ft
                          Storing Time Series File:iwstreat.tsf  50
                           Storing Time Series File:iwsover.tsf  50

                       Routing Complete
```

KCRTS TWO-OUTLET RESERVOIR SETUP AND RESERVOIR ROUTING RESULTS TO DETERMINE TWO OVERFLOWS IWS 2006 LAGOON STORAGE WITH 2.68 MGD TREATMENT RATE

```
Two Outlet Reservoir Routing File

  Stage       Discharge           Storage          Perm-Area
  (Ft)          (CFS)             (Cu-Ft)           (Sq-Ft)
             A          B
   0.00    0.000     0.000              0.               0.
   0.10    4.150     0.000         213875.               0.
  10.00    4.150     0.000       10279374.               0.
  10.01    4.150     1.000       10279375.               0.
  20.00    4.150     1.000       20000000.               0.

     0.00 Ft            : Base Reservoir Elevation
     0.0 Minutes/Inch: Average Perm-Rate

-------------------------------------------------------------------------------
                           KCRTS Command
                           -------------
              Route through a DOUBLE (2) outlet Reservoir
              -----------------------------------------
                        Loading Reservoir File:iwsres2.RS2    :
                      Loading Time Series File:iws2006.tsf   50

                 Reservoir Routing [Double Outlet]
 Computing Series:iwstreat.tsf
       and Series:iwsover.tsf
   Years Complete: 50
                      Inflow/Outflow Analysis
                      -----------------------

   Peak Inflow Discharge:     168.40 CFS at  6:00 on Jan  9 in 1990
Peak A-Outflow Discharge:       4.15 CFS at 14:00 on Jan  6 in 1956
Peak B-Outflow Discharge:       1.00 CFS at 14:00 on Jan  6 in 1956
    Peak Reservoir Stage:      10.16  Ft
     Peak Reservoir Elev:      10.16  Ft
  Peak Reservoir Storage:10429023.    Cu-Ft
                        :     239.417 Ac-Ft
                          Storing Time Series File:iwstreat.tsf   50
                           Storing Time Series File:iwsover.tsf   50

                           Routing Complete
```

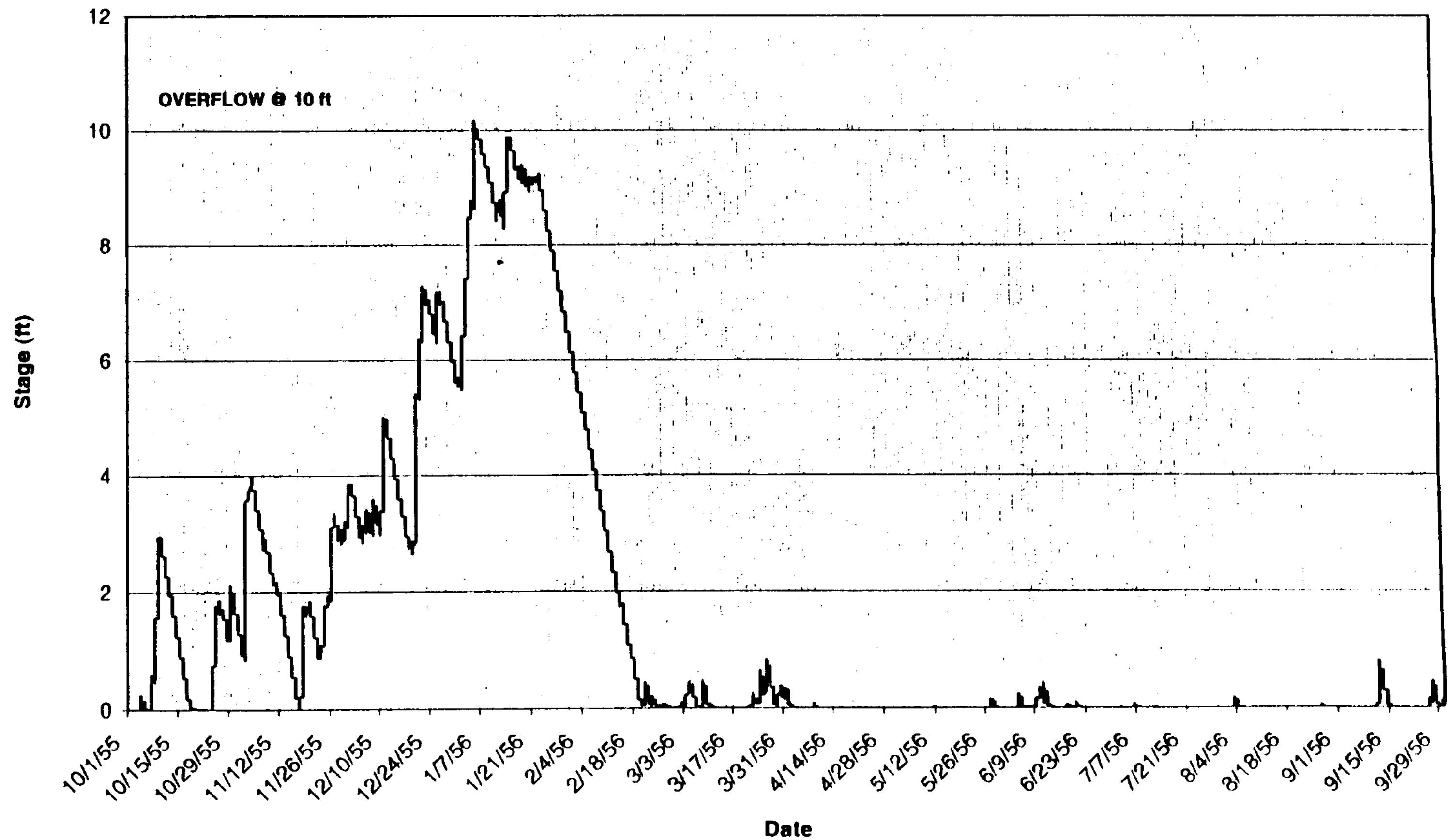
KCRTS FLOW FREQUENCY ANALYSIS
FOR IWS 2006 LAGOON STORAGE WITH 2.68 MGD TREATMENT RATE
OVERFLOW IN YEAR 1956 ONLY
(ONE OVERFLOW IN 1956; SEE THE FOLLOWING STAGE CHART)

Flow Frequency Analysis
Time Series File:iwsover.tsf
Project Location:Sea-Tac DMoines

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.000	42	2/22/49 22:00	1.00	10.16	1	89.50	0.989
0.000	21	1/27/50 3:00	0.000	9.59	2	32.13	0.969
0.000	4	2/10/51 20:00	0.000	9.18	3	19.58	0.949
0.000	47	2/04/52 7:00	0.000	8.92	4	14.08	0.929
0.000	5	2/07/53 9:00	0.000	8.85	5	10.99	0.909
0.000	36	1/23/54 1:00	0.000	8.69	6	9.01	0.889
0.000	38	2/08/55 7:00	0.000	8.41	7	7.64	0.869
1.00	1	1/06/56 14:00	0.000	8.19	8	6.63	0.849
0.000	31	3/10/57 4:00	0.000	7.10	9	5.86	0.829
0.000	30	1/17/58 9:00	0.000	6.91	10	5.24	0.809
0.000	40	11/24/58 8:00	0.000	6.43	11	4.75	0.789
0.000	9	12/15/59 15:00	0.000	6.31	12	4.34	0.769
0.000	19	11/24/60 18:00	0.000	6.14	13	3.99	0.749
0.000	46	12/24/61 6:00	0.000	5.88	14	3.70	0.729
0.000	26	11/30/62 20:00	0.000	5.75	15	3.44	0.709
0.000	14	11/19/63 19:00	0.000	5.75	16	3.22	0.690
0.000	12	12/01/64 10:00	0.000	5.59	17	3.03	0.670
0.000	23	1/14/66 1:00	0.000	5.44	18	2.85	0.650
0.000	16	1/28/67 8:00	0.000	5.29	19	2.70	0.630
0.000	34	1/20/68 21:00	0.000	5.26	20	2.56	0.610
0.000	33	12/11/68 10:00	0.000	4.90	21	2.44	0.590
0.000	17	1/27/70 5:00	0.000	4.85	22	2.32	0.570
0.000	28	12/10/70 20:00	0.000	4.73	23	2.22	0.550
0.000	7	3/14/72 7:00	0.000	4.73	24	2.13	0.530
0.000	10	12/27/72 21:00	0.000	4.58	25	2.04	0.510
0.000	20	12/27/73 21:00	0.000	4.50	26	1.96	0.490
0.000	41	12/27/74 8:00	0.000	4.07	27	1.89	0.470
0.000	35	12/04/75 3:00	0.000	4.04	28	1.82	0.450
0.000	43	8/26/77 8:00	0.000	4.04	29	1.75	0.430
0.000	24	12/15/77 20:00	0.000	4.04	30	1.70	0.410
0.000	50	11/19/78 10:00	0.000	3.98	31	1.64	0.390
0.000	3	12/22/79 4:00	0.000	3.95	32	1.59	0.370
0.000	27	12/30/80 23:00	0.000	3.82	33	1.54	0.350
0.000	18	10/08/81 22:00	0.000	3.64	34	1.49	0.330
0.000	29	1/08/83 6:00	0.000	3.60	35	1.45	0.310
0.000	45	11/24/83 9:00	0.000	3.55	36	1.41	0.291
0.000	37	11/11/84 9:00	0.000	3.48	37	1.37	0.271
0.000	25	1/19/86 1:00	0.000	3.42	38	1.33	0.251
0.000	13	11/27/86 1:00	0.000	3.36	39	1.30	0.231
0.000	32	12/10/87 8:00	0.000	3.34	40	1.27	0.211
0.000	39	11/25/88 2:00	0.000	3.26	41	1.24	0.191
0.000	11	1/09/90 18:00	0.000	2.93	42	1.21	0.171
0.000	8	11/24/90 19:00	0.000	2.77	43	1.18	0.151

0.000	22	2/01/92	0:00	0.000	2.68	44	1.15	0.131
0.000	48	3/23/93	9:00	0.000	2.57	45	1.12	0.111
0.000	49	2/17/94	22:00	0.000	2.52	46	1.10	0.091
0.000	15	12/27/94	21:00	0.000	2.44	47	1.08	0.071
0.000	6	2/09/96	7:00	0.000	2.33	48	1.05	0.051
0.000	2	1/03/97	3:00	0.000	1.83	49	1.03	0.031
0.000	44	10/30/97	12:00	0.000	1.67	50	1.01	0.011

IWS Overflow Analysis WY 1956
Treatment Rate 2.68 mgd



KCRTS TWO-OUTLET RESERVOIR SETUP AND RESERVOIR ROUTING RESULTS TO DETERMINE TWO OVERFLOWS IWS 2006 LAGOON STORAGE WITH 2.65 MGD TREATMENT RATE

```
Two Outlet Reservoir Routing File

  Stage      Discharge            Storage          Perm-Area
  (Ft)         (CFS)              (Cu-Ft)           (Sq-Ft)
             A         B
   0.00    0.000     0.000              0.                 0.
   0.10    4.100     0.000         213875.                 0.
  10.00    4.100     0.000       10279374.                 0.
  10.01    4.100     1.000       10279375.                 0.
  20.00    4.100     1.000       20000000.                 0.

      0.00 Ft          : Base Reservoir Elevation
      0.0 Minutes/Inch: Average Perm-Rate

--------------------------------------------------------------------------------
                             KCRTS Command
                             -------------
                 Route through a DOUBLE (2) outlet Reservoir
                 -------------------------------------------
                               Loading Reservoir File:iwsres2.RS2    :
                             Loading Time Series File:iws2006.tsf   50

                      Reservoir Routing [Double Outlet]
 Computing Series:iwstreat.tsf
       and Series:iwsover.tsf
   Years Complete: 50
                           Inflow/Outflow Analysis
                           -----------------------
   Peak Inflow Discharge:     168.40 CFS at  6:00 on Jan  9 in 1990
 Peak A-Outflow Discharge:      4.10 CFS at 14:00 on Jan  6 in 1956
 Peak B-Outflow Discharge:      1.00 CFS at 14:00 on Jan  6 in 1956
     Peak Reservoir Stage:     10.43  Ft
      Peak Reservoir Elev:     10.43  Ft
  Peak Reservoir Storage:10687904.    Cu-Ft
                         :    245.361 Ac-Ft
                              Storing Time Series File:iwstreat.tsf  50
                               Storing Time Series File:iwsover.tsf  50

                            Routing Complete
```


AR 047393

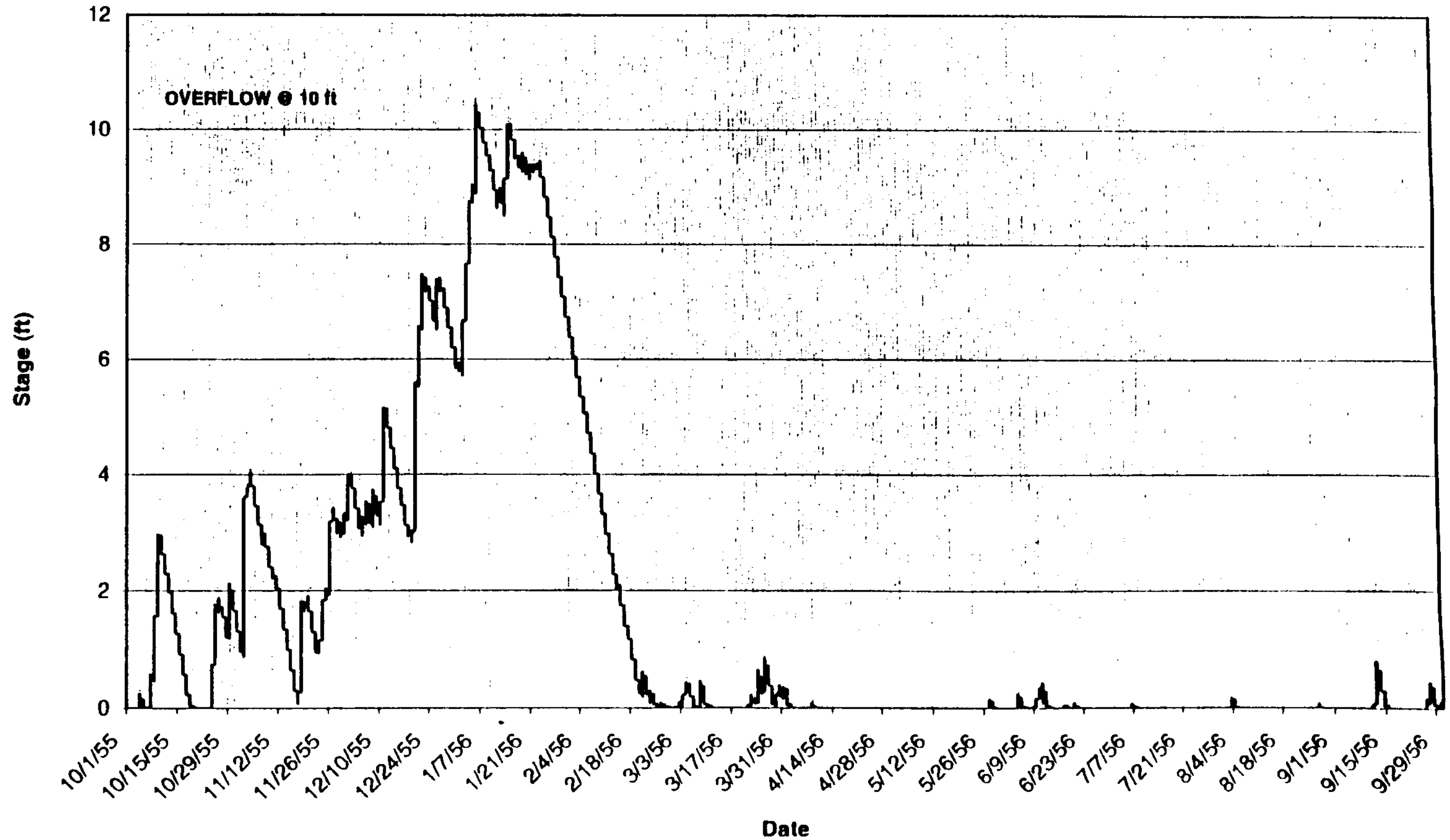
KCRTS FLOW FREQUENCY ANALYSIS
FOR IWS 2006 LAGOON STORAGE WITH 2.65 MGD TREATMENT RATE
OVERFLOW IN YEAR 1956 ONLY
(TWO OVERFLOWS IN 1956; SEE THE FOLLOWING STAGE CHART)

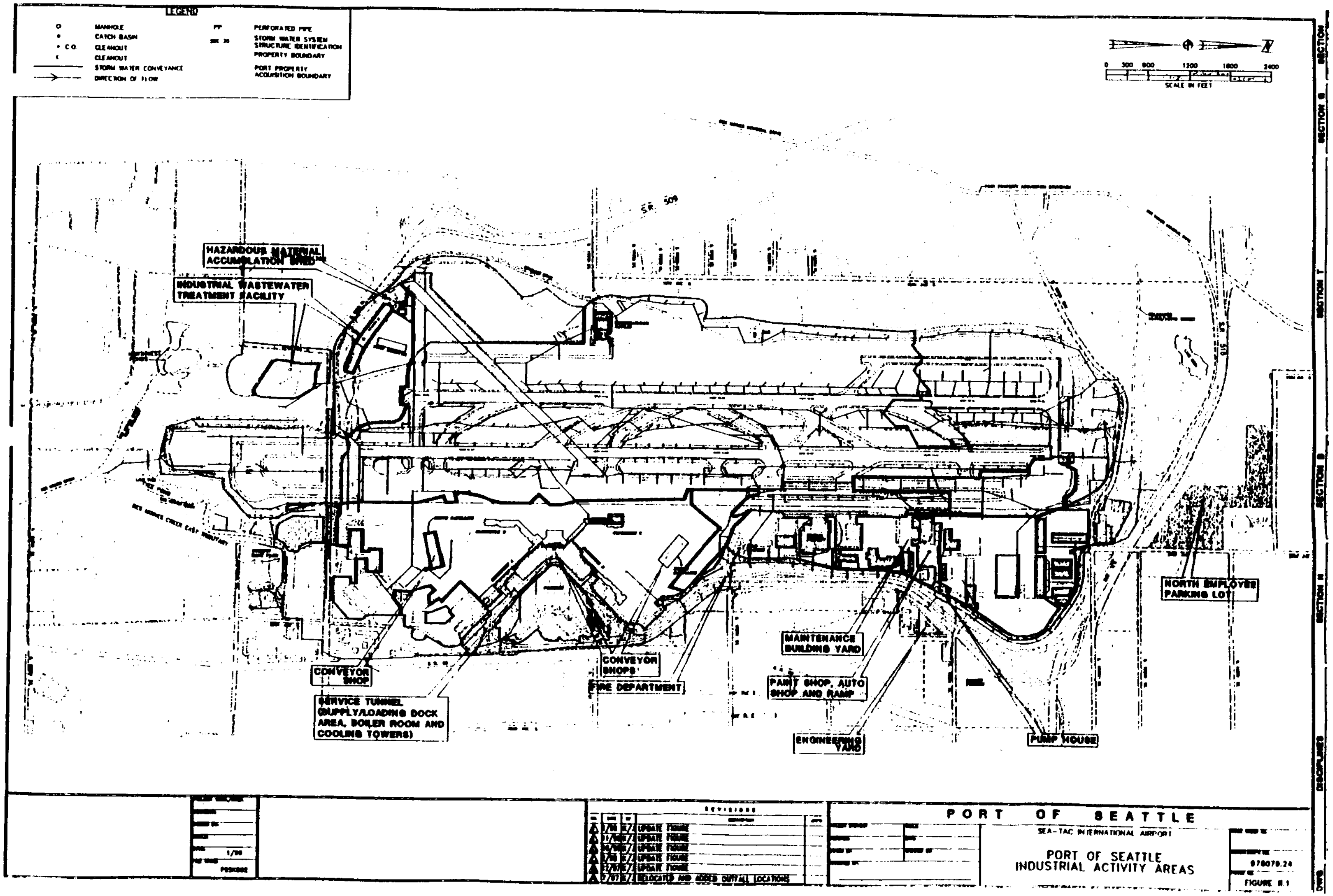
Flow Frequency Analysis
Time Series File:iwsover.tsf
Project Location:Sea-Tac DMoines

---Annual Flow Rate (CFS)	Peak Rank	Flow Rates--- Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.000	42	2/22/49 22:00	1.00	10.43	1	89.50	0.989
0.000	21	1/27/50 3:00	0.000	9.61	2	32.13	0.969
0.000	3	2/10/51 20:00	0.000	9.28	3	19.58	0.949
0.000	47	2/04/52 7:00	0.000	9.22	4	14.08	0.929
0.000	6	2/07/53 9:00	0.000	9.09	5	10.99	0.909
0.000	35	1/23/54 1:00	0.000	9.01	6	9.01	0.889
0.000	39	2/08/55 7:00	0.000	8.48	7	7.64	0.869
1.00	1	1/06/56 14:00	0.000	8.26	8	6.63	0.849
0.000	31	3/10/57 4:00	0.000	7.22	9	5.86	0.829
0.000	28	1/17/58 9:00	0.000	6.96	10	5.24	0.809
0.000	40	11/24/58 8:00	0.000	6.45	11	4.75	0.789
0.000	9	12/15/59 15:00	0.000	6.35	12	4.34	0.769
0.000	20	2/25/61 3:00	0.000	6.18	13	3.99	0.749
0.000	46	12/24/61 6:00	0.000	6.08	14	3.70	0.729
0.000	26	11/30/62 20:00	0.000	6.01	15	3.44	0.709
0.000	15	11/19/63 19:00	0.000	5.80	16	3.22	0.690
0.000	12	12/01/64 10:00	0.000	5.65	17	3.03	0.670
0.000	23	1/14/66 1:00	0.000	5.49	18	2.85	0.650
0.000	14	1/28/67 8:00	0.000	5.47	19	2.70	0.630
0.000	34	1/20/68 21:00	0.000	5.37	20	2.56	0.610
0.000	33	12/11/68 10:00	0.000	5.05	21	2.44	0.590
0.000	17	1/27/70 5:00	0.000	4.88	22	2.32	0.570
0.000	29	12/10/70 21:00	0.000	4.82	23	2.22	0.550
0.000	7	3/14/72 7:00	0.000	4.75	24	2.13	0.530
0.000	10	12/27/72 21:00	0.000	4.59	25	2.04	0.510
0.000	19	12/27/73 21:00	0.000	4.56	26	1.96	0.490
0.000	41	12/27/74 8:00	0.000	4.11	27	1.89	0.470
0.000	36	12/04/75 3:00	0.000	4.07	28	1.82	0.450
0.000	43	8/26/77 8:00	0.000	4.07	29	1.75	0.430
0.000	24	12/15/77 20:00	0.000	4.06	30	1.70	0.410
0.000	50	11/19/78 10:00	0.000	4.04	31	1.64	0.390
0.000	4	12/22/79 4:00	0.000	3.99	32	1.59	0.370
0.000	27	12/30/80 23:00	0.000	3.87	33	1.54	0.350
0.000	18	10/08/81 22:00	0.000	3.69	34	1.49	0.330
0.000	30	1/08/83 6:00	0.000	3.63	35	1.45	0.310
0.000	45	11/24/83 9:00	0.000	3.62	36	1.41	0.291
0.000	37	11/11/84 9:00	0.000	3.53	37	1.37	0.271
0.000	25	1/19/86 1:00	0.000	3.46	38	1.33	0.251
0.000	13	11/27/86 1:00	0.000	3.43	39	1.30	0.231
0.000	32	12/10/87 8:00	0.000	3.43	40	1.27	0.211
0.000	38	11/25/88 2:00	0.000	3.26	41	1.24	0.191
0.000	11	1/09/90 18:00	0.000	2.96	42	1.21	0.171
0.000	8	11/24/90 19:00	0.000	2.78	43	1.18	0.151

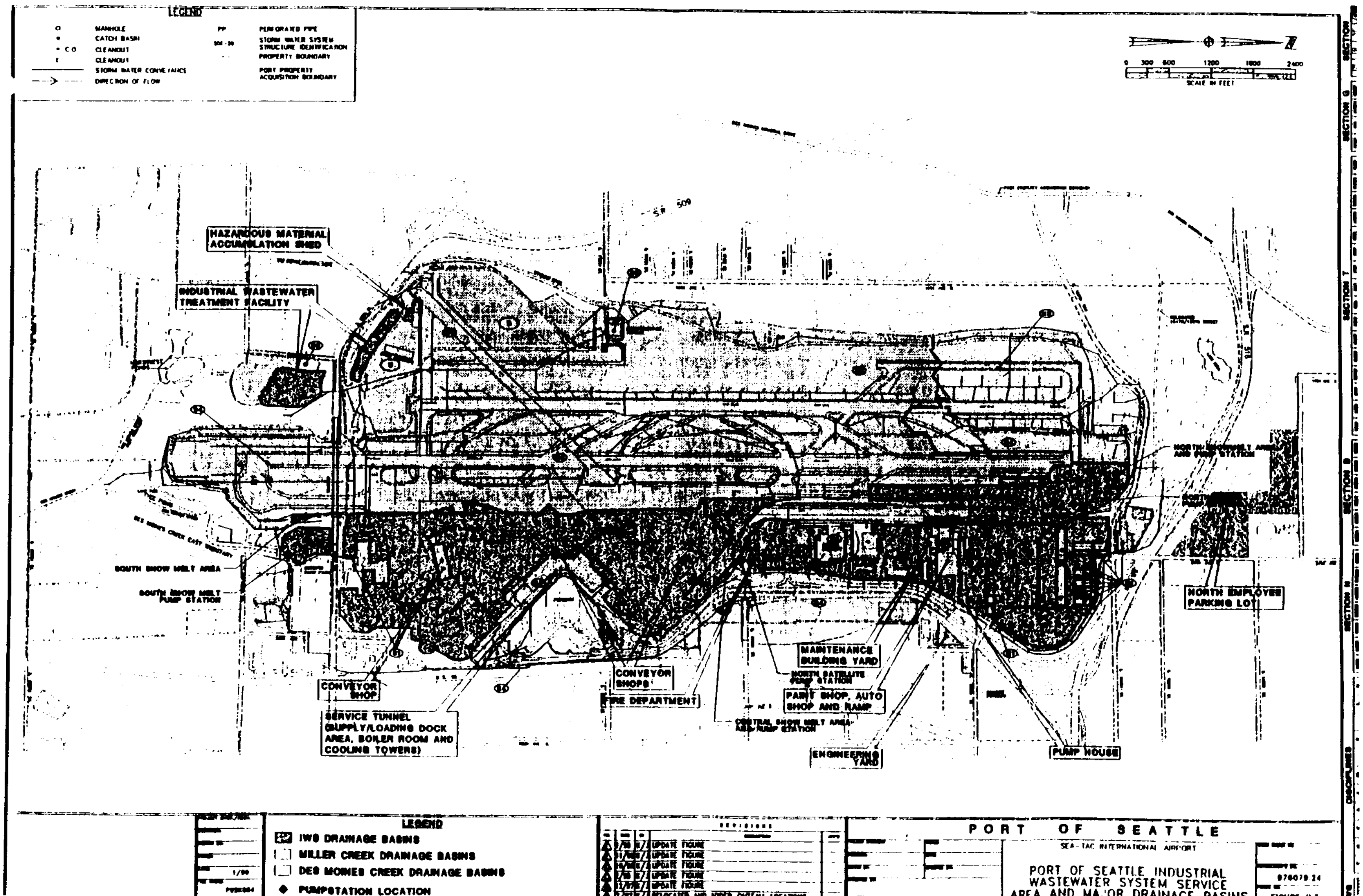
0.000	22	2/01/92	0:00	0.000	2.69	44	1.15	0.131
0.000	48	3/23/93	9:00	0.000	2.67	45	1.12	0.111
0.000	49	2/17/94	22:00	0.000	2.55	46	1.10	0.091
0.000	16	12/27/94	21:00	0.000	2.46	47	1.08	0.071
0.000	5	2/09/96	7:00	0.000	2.34	48	1.05	0.051
0.000	2	1/03/97	3:00	0.000	1.85	49	1.03	0.031
0.000	44	10/30/97	12:00	0.000	1.68	50	1.01	0.011

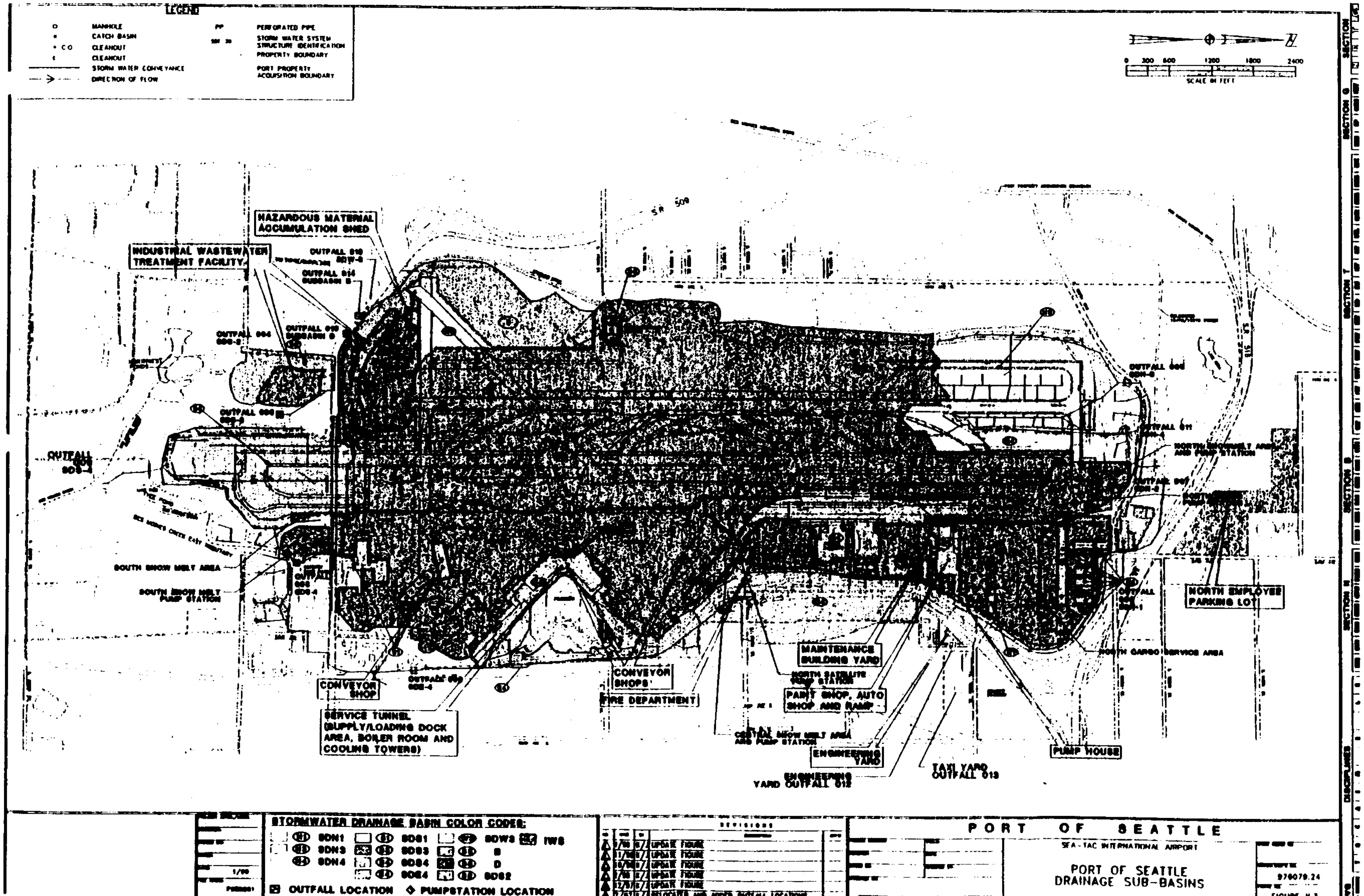
IWS Overflow Analysis: WY 1956
Treatment Rate 2.65 mgd




LEGEND
MANHOLE
CATCH BASIN
CLEANOUT
CLEANOUT
STORM WATER CONVEYANCE
DIRECTION OF FLOW
PERFORATED PIPE
STORM WATER SYSTEM STRUCTURE IDENTIFICATION
PROPERTY BOUNDARY
PORT PROPERTY ACQUISITION BOUNDARY
0 300 600 1200 1800 2400
SCALE IN FEET
S.R. 509
HAZARDOUS MATERIAL ACCUMULATION SHED
INDUSTRIAL WASTEWATER TREATMENT FACILITY
CONVEYOR SHOP
SERVICE TUNNEL (SUPPLY/LOADING DOCK AREA, BOILER ROOM AND COOLING TOWERS)
CONVEYOR SHOPS
FIRE DEPARTMENT
MAINTENANCE BUILDING YARD
PAINT SHOP, AUTO SHOP AND RAMP
ENGINEERING YARD
PUMP HOUSE
NORTH EMPLOYEE PARKING LOT
SECTION
SECTION G
SECTION T
SECTION B
SECTION H
DISCIPLINES
REVISIONS
UPDATE FIGURE
RELOCATED AND ADDED OUTFALL LOCATIONS
PORT OF SEATTLE
SEA-TAC INTERNATIONAL AIRPORT
PORT OF SEATTLE
INDUSTRIAL ACTIVITY AREAS
978079.24
FIGURE II.1

AR 047397


LEGEND
MANHOLE
CATCH BASIN
CLEANOUT
STORM WATER CONVEYANCE
DIRECTION OF FLOW
PERFORATED PIPE
STORM WATER SYSTEM STRUCTURE IDENTIFICATION
PROPERTY BOUNDARY
PORT PROPERTY ACQUISITION BOUNDARY
SCALE IN FEET
0 300 600 1200 1800 2400
HAZARDOUS MATERIAL ACCUMULATION SHED
INDUSTRIAL WASTEWATER TREATMENT FACILITY
S.R. 509
S.R. 518
SOUTH SNOW MELT AREA
SOUTH SNOW MELT PUMP STATION
CONVEYOR SHOP
SERVICE TUNNEL (SUPPLY/LOADING DOCK AREA, BOILER ROOM AND COOLING TOWERS)
CONVEYOR SHOPS
FIRE DEPARTMENT
CENTRAL SNOW MELT AREA AND PUMP STATION
MAINTENANCE BUILDING YARD
NORTH SATELLITE PUMP STATION
PAINT SHOP, AUTO SHOP AND RAMP
ENGINEERING YARD
PUMP HOUSE
NORTH EMPLOYEE PARKING LOT
SECTION Q
SECTION T
SECTION B
SECTION N
DISCIPLINES
LEGEND
IWS DRAINAGE BASINS
MILLER CREEK DRAINAGE BASINS
DES MOINES CREEK DRAINAGE BASINS
PUMPSTATION LOCATION
REVISIONS
UPDATE FIGURE
RELOCATED AND ADDED OUTFALL LOCATIONS
PORT OF SEATTLE
SEA-TAC INTERNATIONAL AIRPORT
PORT OF SEATTLE INDUSTRIAL WASTEWATER SYSTEM SERVICE AREA AND MAJOR DRAINAGE BASINS
FIGURE II 2



PORT OF SEATTLE

SEA-TAC INTERNATIONAL AIRPORT

PORT OF SEATTLE
DRAINAGE SUB-BASINS

976079.24

FIGURE H.3