

**Seattle-Tacoma International Airport
Ground Water Study**

Conceptual Flow Model Presentation

June 30, 1999

Department of Ecology

I. Introduction

II. Study Area

III. Data Collected

IV. Geology/Stratigraphy

V. Hydrogeology

VI. Preliminary Model Setup

Figures

Figure 1 - Project area map

STIA
Des Moines & Miller Creek
Bow Lake
City of Seattle Highline Well Field
Highline Water District Wells (Angle Lake and Des Moines)
Water District #54 Well Field

Figure 2 - AOMA map showing 13 Study Areas

- United Airlines Fuel Farm/Continental Airlines Fuel Farm (UNFUF/CONFF)
- Continental Airlines Hydrant System Closure (CONHS)
- Northwest Airlines Fuel Farm (NWBFF)
- Northwest Airlines Hydrant System Closure (NWABN)
- Northwest Airlines Hangar Tanks (NWFHT)
- South Satellite Baggage Tunnel (NW Airlines Hydrant Line)(NWHS2)
- Gate B2 (GATB2)
- Delta Airlines Fuel Farm (DELFF)
- Delta Airlines Auto-Gas Cluster Tanks (DELAG)
- Pan American Airlines Fuel Farm (PAFFF)
- Pan American Airlines Avgas Tanks (PAFAT)
- Budget Auto Facility (BDGPL)
- RAC Auto Facility (Hertz/National/Avis) (RACFT)

- Figure 3 - STIA Map showing airport environmental and geotechnical explorations
- Figure 4 - Regional Map showing Ground Water Wells and Cross Section Locations
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- Figure 5 - Stratigraphic Column & Nonemclature
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- Regional
-STIA
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Qva
Qc(3)
- Figure 10 - Hydrographs Qva Wells.
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AR 042506



Port of Seattle

**Seattle-Tacoma International Airport
Ground Water Study**

Conceptual Flow Model Presentation

Associated Earth Sciences, Inc.

S.S. Papadopoulos and Associates, Inc.

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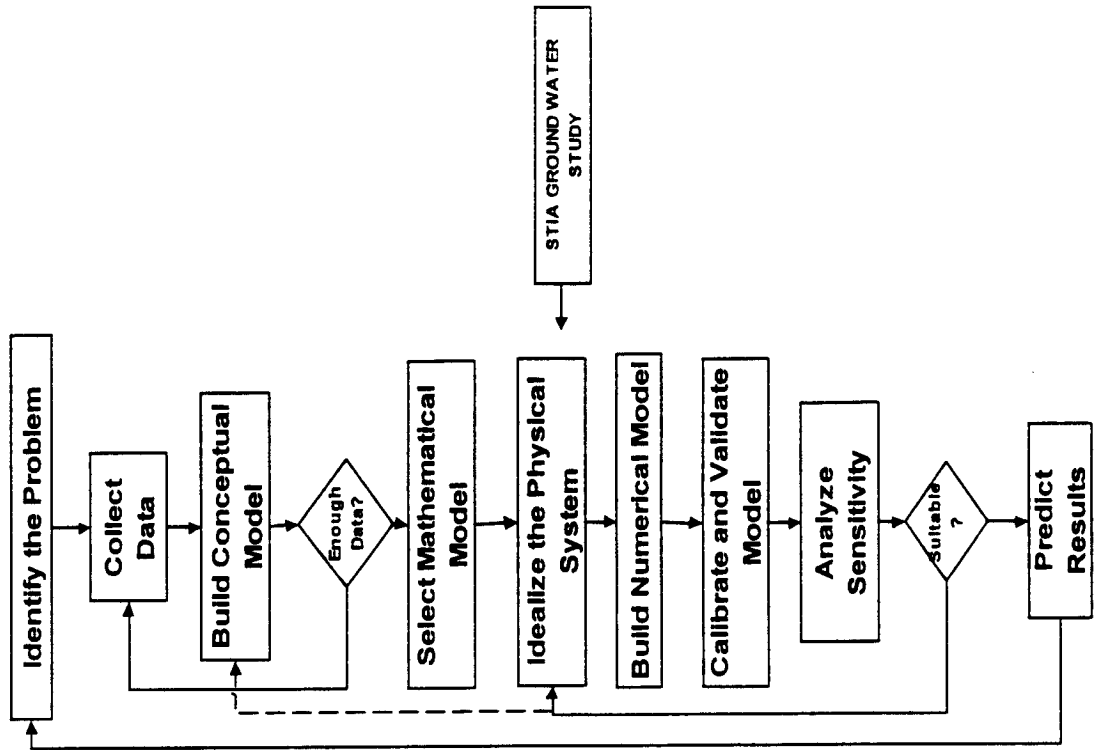
Define Model Objectives

- Provide information to design ground water monitoring well network (Ground Water Study Phase II)
- Evaluate Risk to Potential Receptors
 - Predict ground water flow to potential receptors
 - Predict contaminant concentrations reaching exposure points

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Seattle-Tacoma International Airport Ground Water Study

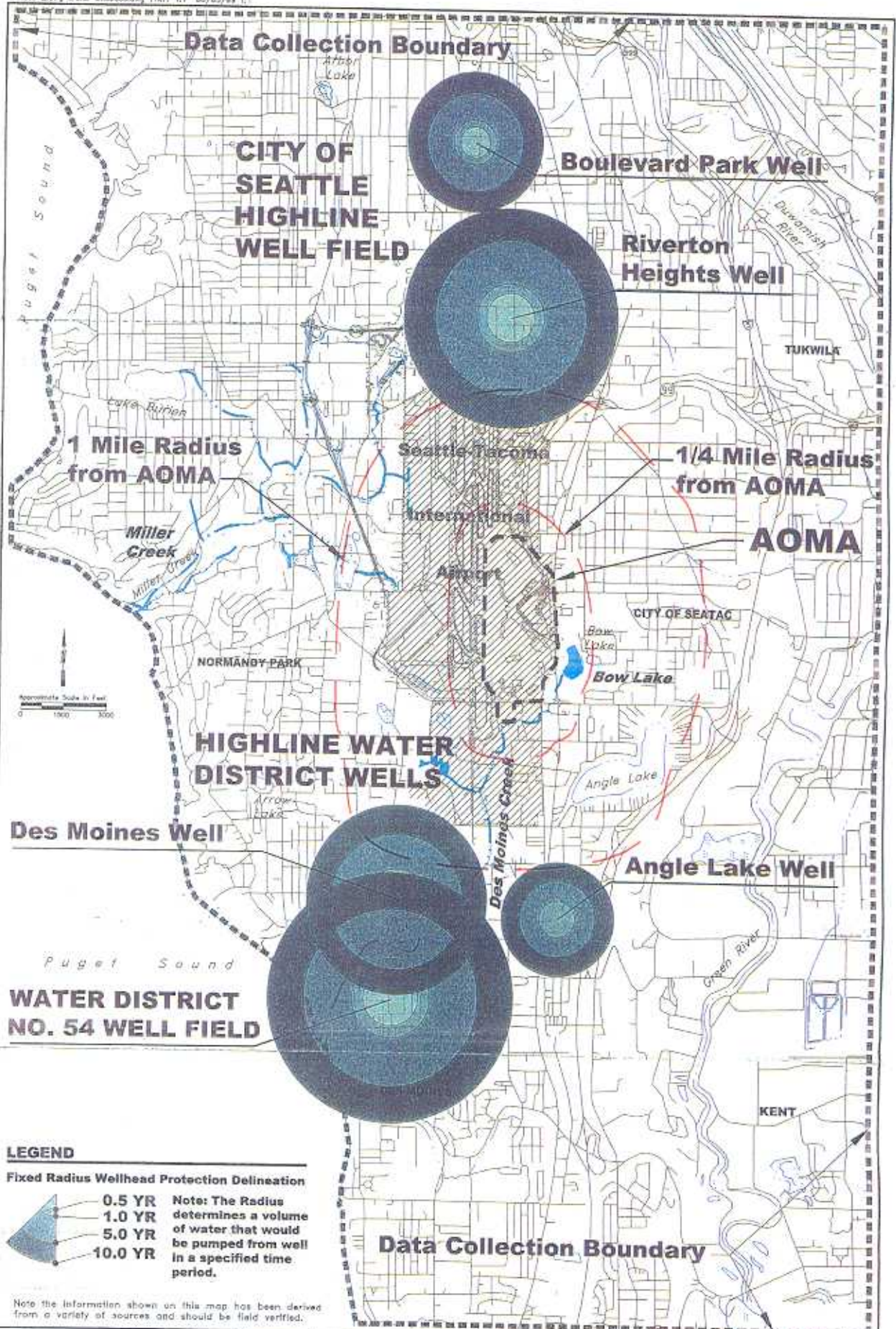
Modeling Process



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Existing Geologic and Hydrogeologic Data

- Areal Extent of Study Area
- Geologic Data (Boring Logs)
- Hydrogeologic Data (Water Levels and Hydraulic Parameters)
- Hydrologic Data (Streams, Springs, Rainfall, Infiltration)
- Chemical Data (Chemicals of Concern, Extent, Sources, Properties)
- Reports by Other Consultants and Public Agencies (SKCGW Mgt. Plan, USGS SW King Co. GW Rpt., Seahurst Metro Alignment, Seattle Highline Well Field Rpts., STIA Master Plan EIS, Over 50 Rpts. on AOMA Sites . . .)



LEGEND

Fixed Radius Wellhead Protection Delineation

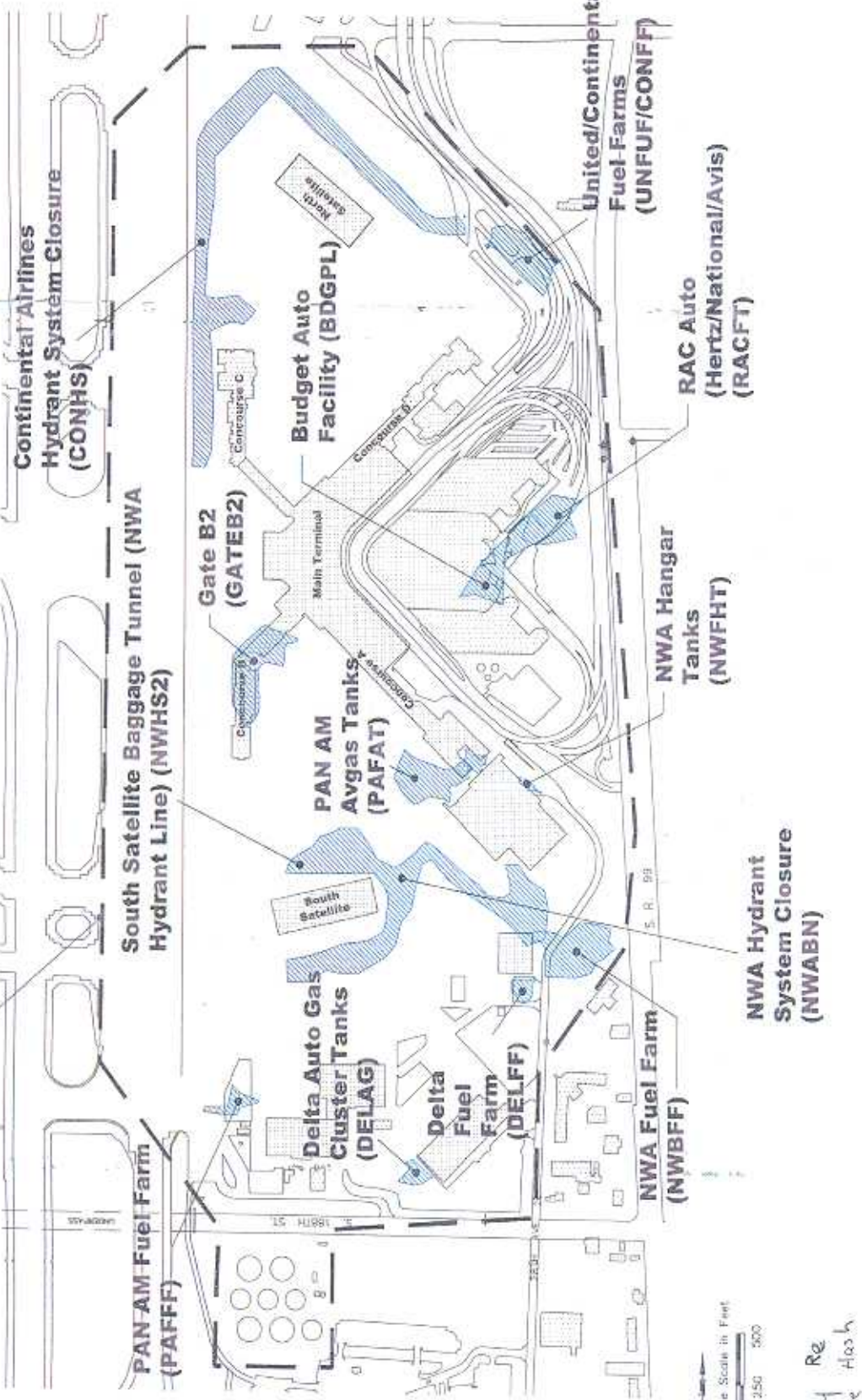
0.5 YR
 1.0 YR
 5.0 YR
 10.0 YR

Note: The Radius determines a volume of water that would be pumped from well in a specified time period.

Note the information shown on this map has been derived from a variety of sources and should be field verified.

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AOMA Boundary



Key
Re Blue Hash



DATE: 04/06/78
REVISION: 02/78

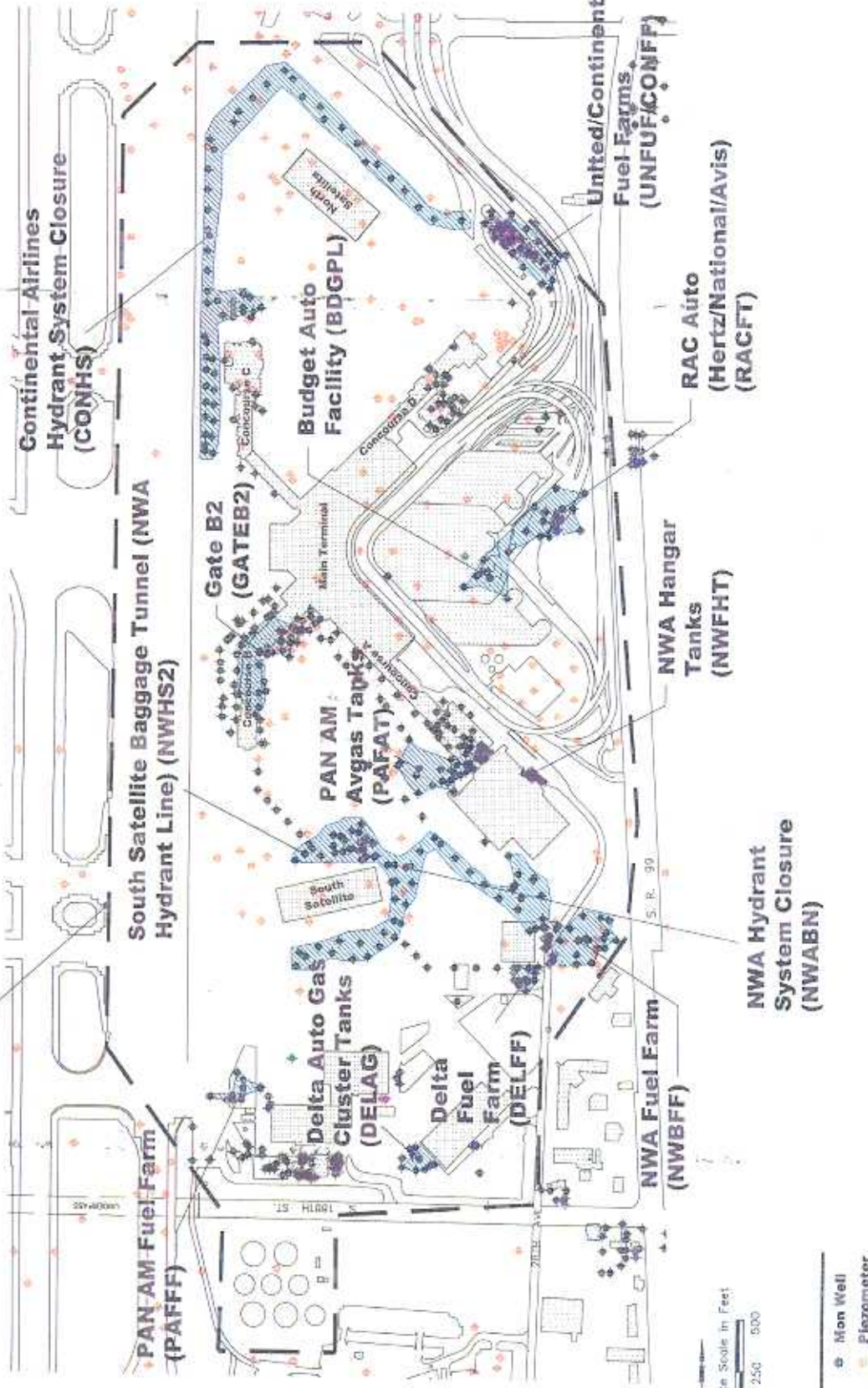
Airport Operations and Maintenance Area (AOMA)
Ground Water Study
Seattle - Tacoma International Airport

SCALE: 1" = 100'
FIGURE NO: 2a

AR 042512

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AOMA Boundary



- LEGEND**
- ⊕ Boring
 - ⊕ Cone Pen
 - ⊕ Extr Well
 - ⊕ Gas Probe
 - ⊕ Gootech
 - ⊕ Mon Well
 - ⊕ Piezometer
 - ⊕ Rec Well
 - ⊕ Unknown



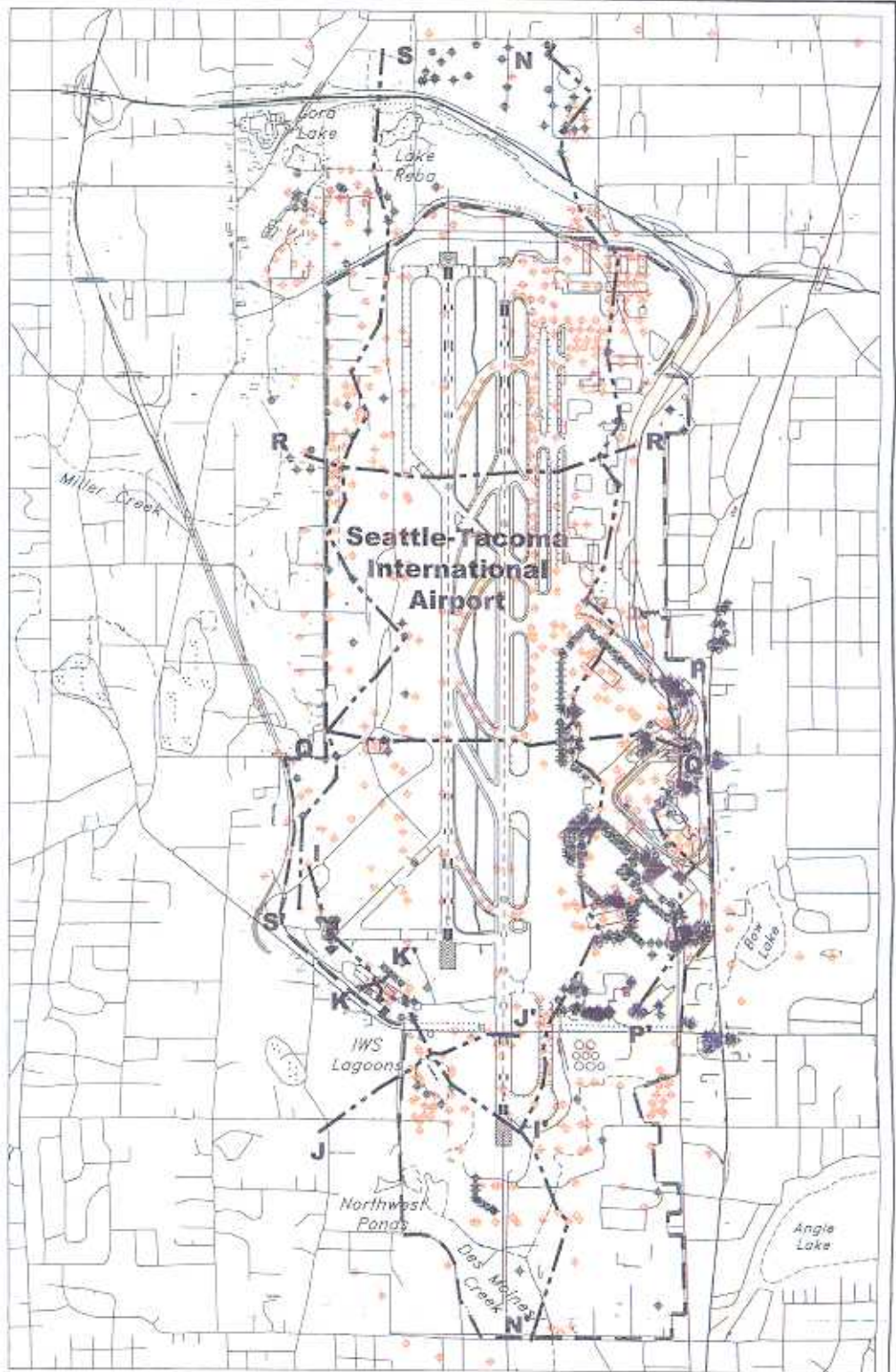
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ISSUED: 09/08/99
REVISED: 07/78/99

Airport Operations and Maintenance Area (AOMA)
Ground Water Study
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PROJECT NO.
897004
PAGE NO.
2b

AR 042513

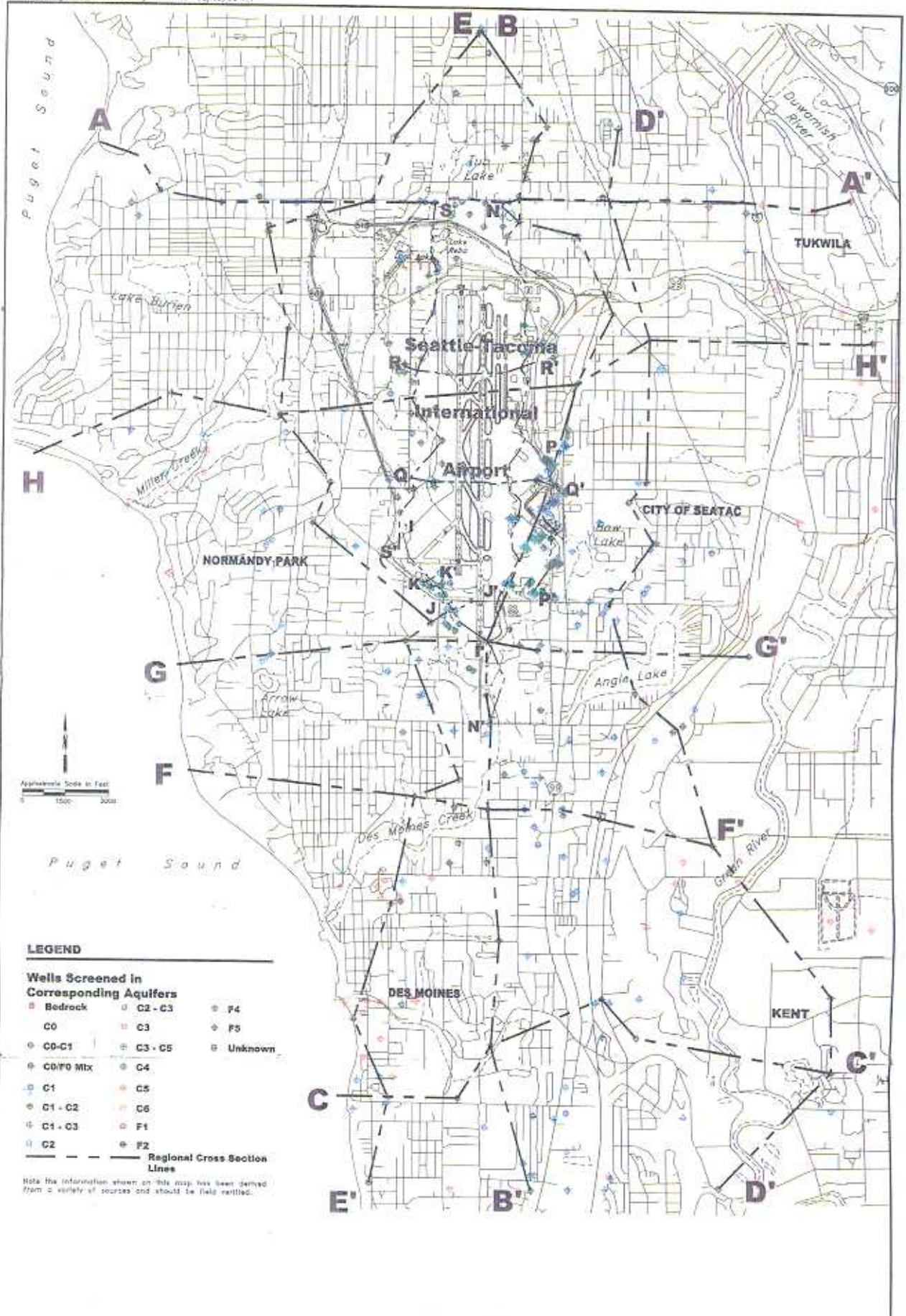


LEGEND

- ◆ Boring
- Cone Pen
- ⊖ Extr Well
- ⊖ Gas Probe
- ⊖ Mon Well
- ⊖ Piezometer
- ⊖ Rec Well
- ⊖ Geotech
- STIA Area Cross Section Line
- STIA Area Boundary

Note the information shown on this map has been derived from a variety of sources and should be field verified.

AR 042514



LEGEND



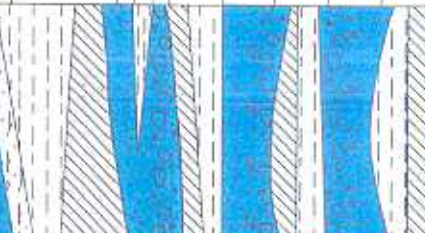
Wells Screened in Corresponding Aquifers

● Bedrock	○ C2 - C3	○ P4
○ C0	○ C3	○ P5
○ C0-C1	○ C3 - C5	○ Unknown
○ C0/P0 Mix	○ C4	
○ C1	○ C5	
○ C1 - C2	○ C6	
○ C1 - C3	○ F1	
○ C2	○ F2	

--- Regional Cross Section Lines

Note: The information shown on this map has been derived from a variety of sources and should be field verified.

AR 042515

Geologic Group	Proposed Seattle Map Unit	Geologic Unit Name	Schematic Geologic Column	Hydro-Stratigraphic Unit	South King Co. Ground Water Mgmt. Plan Unit	Model Condition
Post Glacial Deposits	Qyal Qoal	Recent Alluvium (fine and coarse grained)		C0 and F0 (Mixed Order)	Qal and Qvr	Perched Aquifers and Aquitards
	Qvri Qvr	Recessional Outwash (fine and coarse grained)				
Fraser Glacial Deposits	Qvt	Vashon Glacial Till		F1	Qvt	Aquitard
	Qvas Qvag	Advance Outwash "Esperance Sand"				
	Qtb	Transition Beds "Lawton Clay"				
Pre-Fraser Glacial and Non-glacial Deposits	Qpfc	Olympic Non-glacial, Pleistocene Outwash, and Windley Non-glacial Deposits		C2 C2F C2	Gc(C) "Intermediate Aquifer"	Aquifer
	Qpff	Older Pre-Fraser Deposits (fine grained)		F3	G(C) "Shallow Aquifer"	Aquitard
	Qpfc	Older Pre-Fraser Deposits (coarse grained)		C3	Gc(A) "Deep Aquifer"	Aquifer
	Qpff	Older Pre-Fraser Deposits (fine grained)		F4	G(C) "Deep Aquifer"	Aquitard
	Qpfc	Older Pre-Fraser Deposits (coarse grained)		C4		Aquifer
	Qpff	Older Pre-Fraser Deposits (fine grained)		F5		Aquitard
	Qpfc and Qpff	Additional Coarse Grained units and Fan Grained units			C5, F6, C5	
Bedrock	Tu	Tertiary Bedrock	7	Br	Tbr	Aquitard



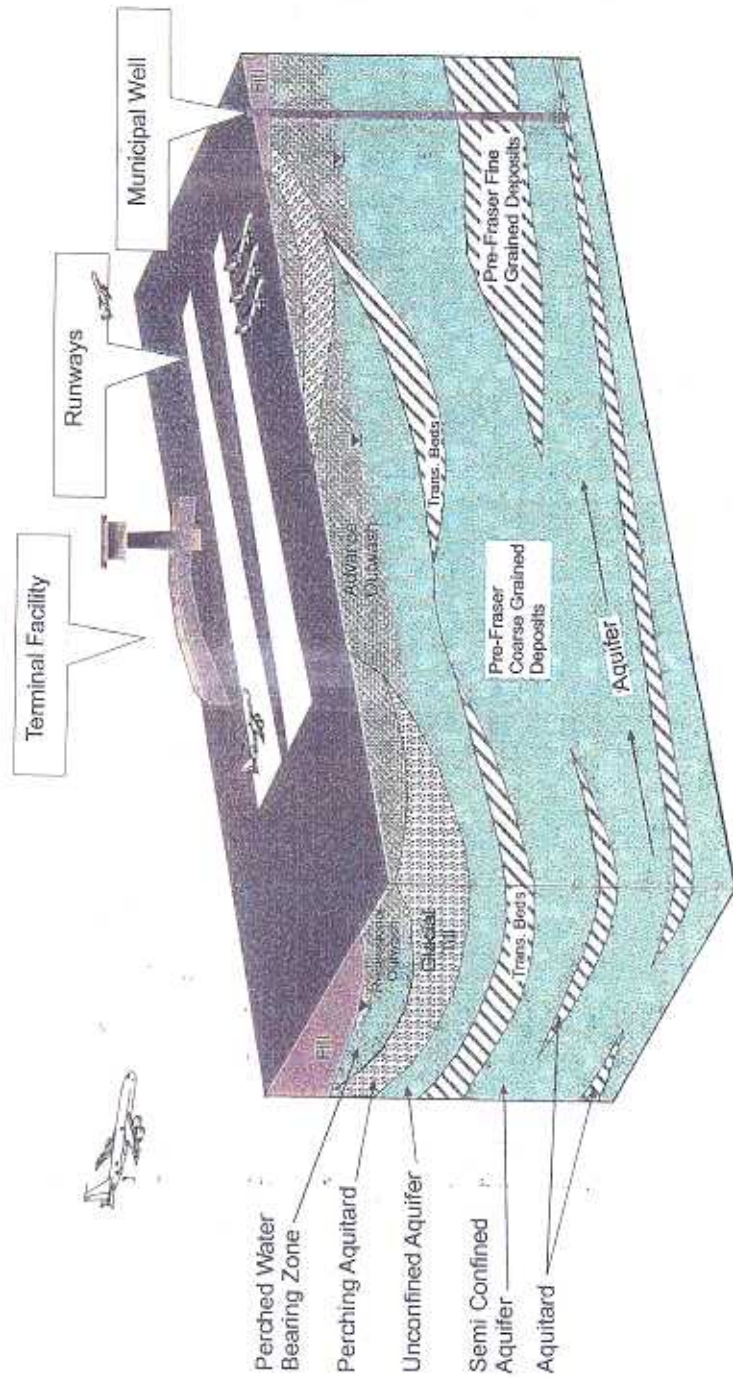
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DATE: 04/07/08
REVISION: 1-5/08

PROJECT #:
097016
PAGE #:
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Conceptual Hydrostratigraphic Framework
Ground Water Study
Seattle - Tacoma International Airport

AR 042516



Date: 08/08/99
 Designed/Dwn: JJS/BLB

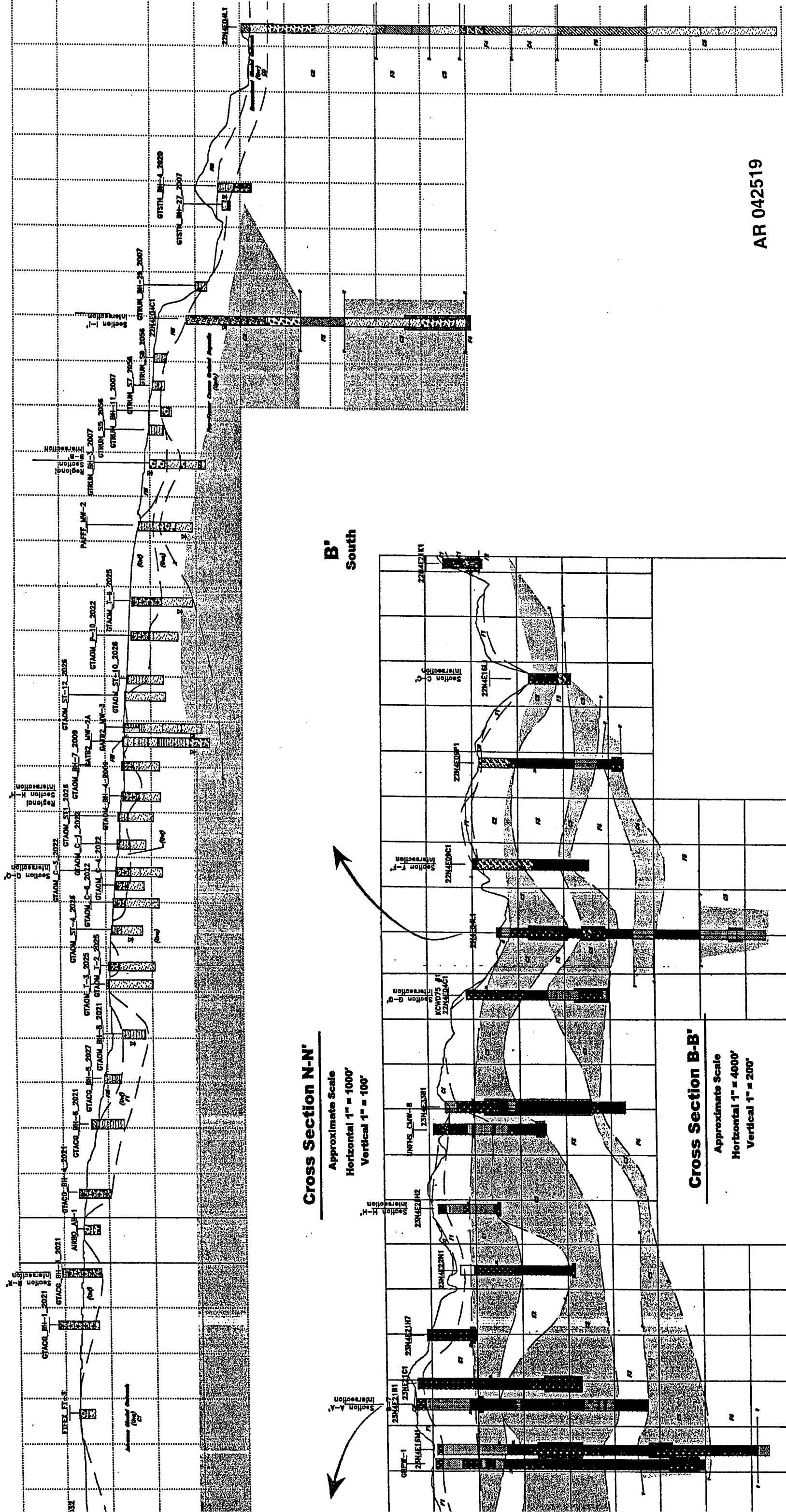
**Conceptual Model
 Ground Water Study
 Seattle - Tacoma International Airport**

Project No: Bv97016

Figure No: 6

AR 042517

N'
South



Cross Section N-N'

Approximate Scale
Horizontal 1" = 1000'
Vertical 1" = 100'

Cross Section B-B'

Approximate Scale
Horizontal 1" = 4000'
Vertical 1" = 200'

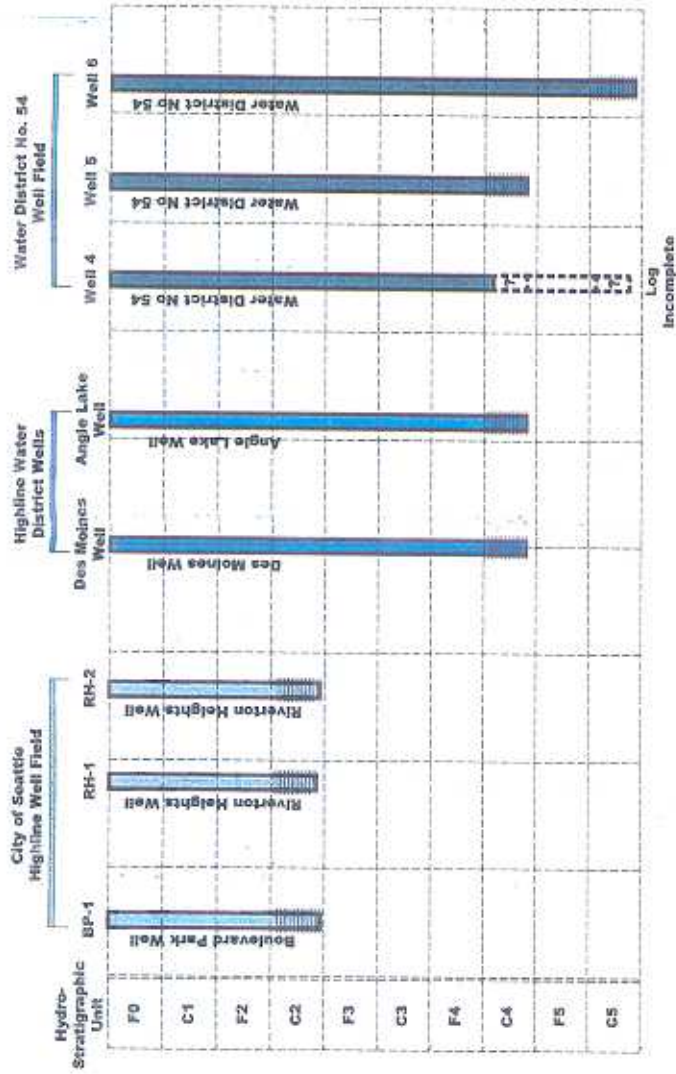
AR 042519



Representative North-South Cross Sections
Ground Water Study
Seattle - Tacoma International Airport

DATE: 06/06/99
DESIGNED/DWG: JJS/RLB

PROJECT NO. 8937016
FRAME NO. 7b



Pumping Summaries

City of Seattle Highline Well Field

Well	Pumping Rate	Pumping Duration
Riverton No. 1	3200 gpm	3mos.-yr, no recharge
Riverton No. 2	1800 gpm	3mos.-yr, no recharge
Boulevard Park No. 1	2000 gpm	3mos.-yr, no recharge

- Second well at Boulevard Park proposed

- Aquifer Storage and Recovery (ASR) program - Injection water to intermediate aquifer if water levels do not return to static or prepumping levels by May of any year.

Highline Water District

Well	Pumping Rate	Pumping Duration
Des Moines Well	1200 gpm	5 days/wk, 8 hrs/day
Angle Lake Well	1200 gpm	5 days/wk, 8 hrs/day

District may increase pumping duration to 24 hours per day seasonally, pending sustainability testing.

Water District No. 54

Well	Pumping Rate	Pumping Duration
Well No. 4	3200 gpm	25 millions gallons
Well No. 5	1800 gpm	90 millions gallons
Well No. 6	2000 gpm	32 millions gallons

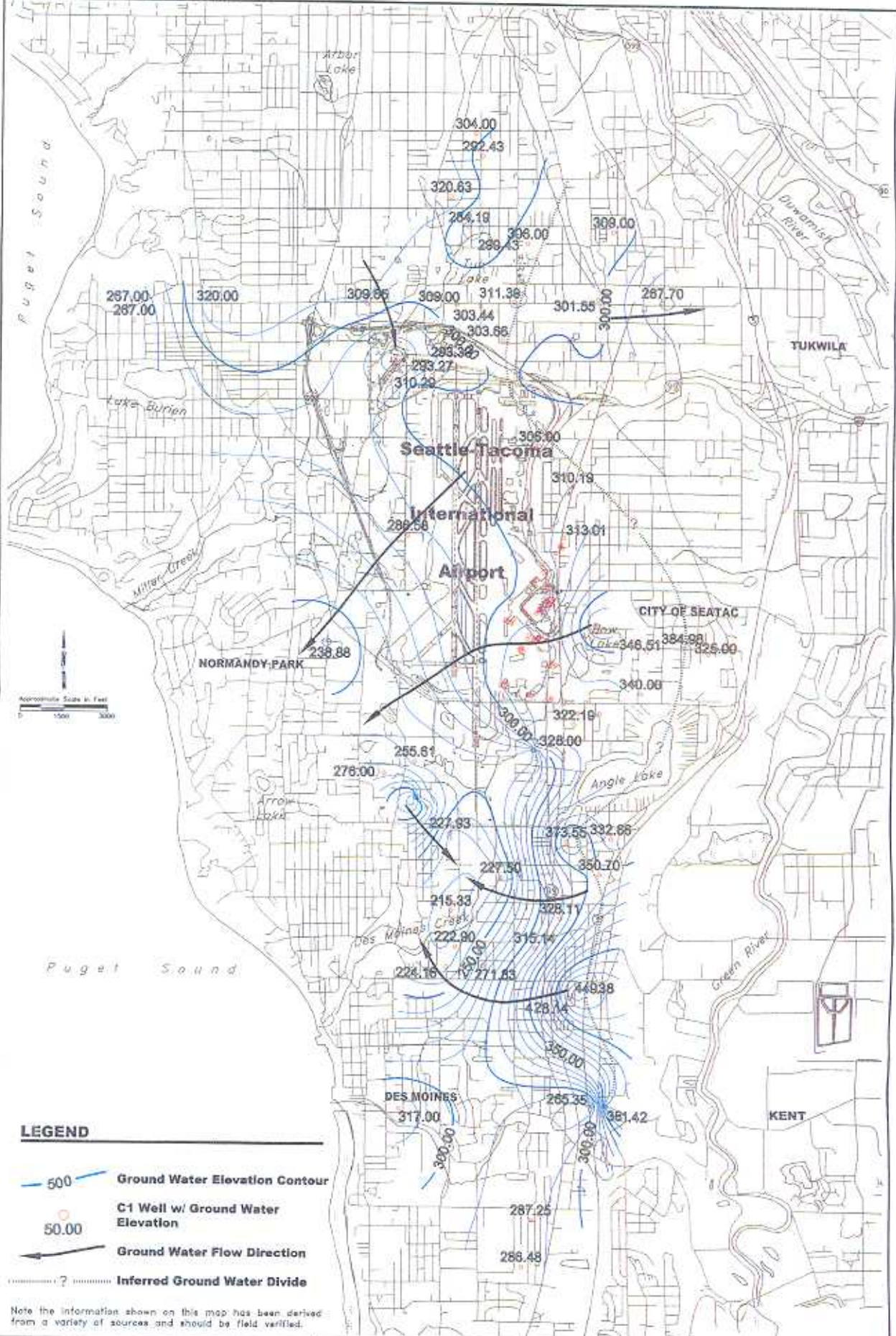
AR 042520



DATE: 06/07/19
 DRAWN BY: JAC/JLS

PROJECT NO.: 100701
 TITLE: AR 042520

Summary of Public Water Supply Wells
 Ground Water Study
 Seattle - Tacoma International Airport



- LEGEND**
- Ground Water Elevation Contour
 - C1 Well w/ Ground Water Elevation
 - Ground Water Flow Direction
 - Inferred Ground Water Divide

Note the information shown on this map has been derived from a variety of sources and should be field verified.

AR 042521

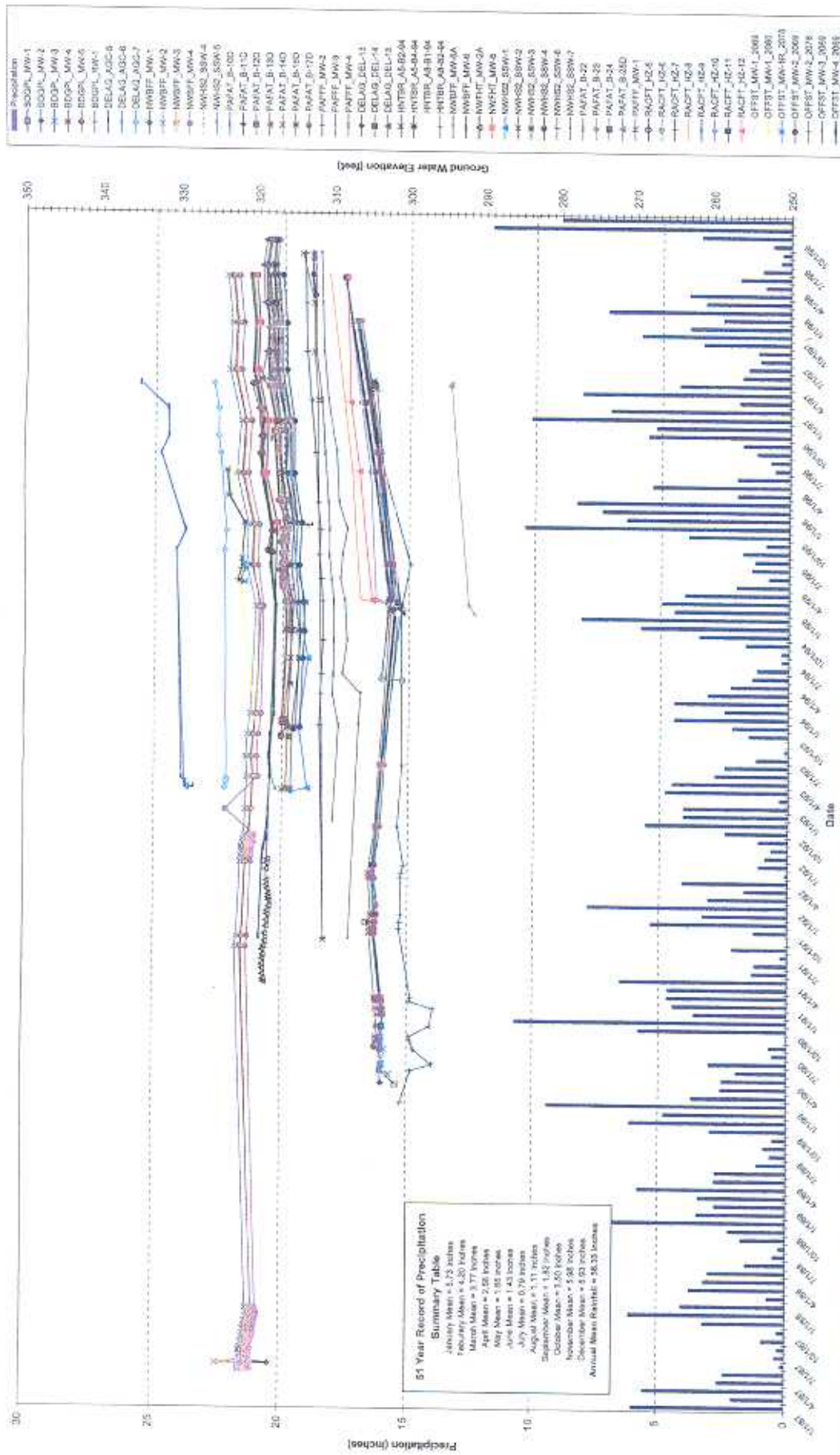


Figure 10
Ground Water Level Measurements - STIA Monitoring Wells Completed in 'CI' (Qrs) Aquifer
 Ground Water Study
 Seattle - Tacoma International Airport

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Figure 11
Summary of Aquifer Parameters

Ground Water Study
Seattle-Tacoma International Airport

Aquifer		Specific Capacity (gpm/ft)	Transmissivity (ft²/d)	Hydraulic Conductivity (ft/d)	Storativity
C1 (Qva)	Min	4	1686	5.90E-02	9.00E-02
	Average	NA	NA	38.7	NA
	Max	4	1686	113.4	9.00E-02
	Number	1	1	17	1
C2 (Qc(3))	Min	1	45	2.15E-01	2.00E-05
	Average	23	15203	71.1	8.14E-04
	Max	105	66850	141.9	5.10E-03
	Number	13	22	2	14
C3 (Qc(4))	Min	4	254	NA	NA
	Average	14	2779	NA	NA
	Max	34	4479	NA	NA
	Number	5	4	0	0

NA: Not applicable. Number of values less than or equal to 1.

Preliminary Model Setup

- **Geographical Coverage**
- **Preliminary Grid Setup**
- **Potential Boundary Conditions**



Summary of Presentation

- **Complex Glacial & Non-Glacial Stratigraphy**
- **Multiple Aquifers**
 - **Interconnection of Aquifer Units (i.e. C1/C2)**
- **Public Drinking Water Supply Wells Completed in Deep Aquifers**
- **Surface Water Features**
- **Regional Ground Water Flow Direction (West/Southwest at STIA)**
- **Little Seasonal Ground Water Fluctuation in C1 (Qva) Aquifer**
- **Hydraulic Parameters**
- **Modeling Approach**

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