EXPANDED EXTRACTION SYSTEM
TECHNICAL MEMORANDUM
PORT OF OLYMPIA

915 Washington St, NE
Olympia, Washington

IT Corporation Project 105560

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A Development of Groundwater Hydraulic Control Extraction Well Locations and Flowrates (Landau, Inc.)

1.0 Introduction

The preferred long-term cleanup alternative for the Upland portion of the Cascade Pole Company (CPC) site is containment with a slurry wall, site cap, and hydraulic containment. The slurry wall and a groundwater extraction and treatment system have already been installed at the site as an interim remedial action. In conjunction with construction of the sediment containment cell during the summer of 2000, the existing groundwater extraction system will be expanded and upgraded to maintain hydraulic containment. The purpose of the expanded system will be to maintain an inward gradient within the boundary of the slurry wall. A number of the existing wells (monitoring, extraction, and piezometer) that will be affected by construction of the new sediment containment cell will be extended or abandoned in accordance with regulatory requirements. The expanded system will consist of extraction wells, pumps, piping, instrumentation, and controls needed to maintain hydraulic containment. The existing treatment system will continue to be used to treat extracted water prior to discharging off-site. This Technical Memorandum presents the design concepts and criteria that will be used to prepare the detailed drawings and specifications.

2.0 System Description

The objective of the extraction system is to maintain an inward hydraulic gradient to prevent overtopping the site slurry wall. Because the new sediment containment cell will be located above portions of the existing extraction system, several Extraction and Recovery Wells (EW and RW) will be removed and abandoned. New groundwater extraction wells will then be installed to maintain hydraulic containment. The new extraction wells will operate as a complete system in conjunction with the existing Containment Wells (CW) to convey extracted fluids to the existing treatment system.

2.1 Conceptual Plan

The proposed layout of the expanded extraction system is depicted in Figure 1, Extraction Piping Layout Plan. As shown therein, five new extraction wells (CW-7 through CW-11) will be installed for pumping water to maintain hydraulic containment within the slurry wall. Well CW-7 will be installed outside and south of the berm, and wells CW-8 through CW-11 will be installed on top of the berm. Additionally, four catch basins will be installed to collect water from within and around the sediment containment cell. Process equipment, including submersible pumps, piping, valves, instrumentation, and controls, will be installed to extract and convey fluids to the existing treatment system.

The expanded extraction system will consist of the following design features:

- Existing Wells and Debris – Twenty-seven existing wells that will be affected by construction activities and miscellaneous concrete foundations and debris within the new sediment containment cell footprint will be removed;
- Existing Extraction System – Five wells in the existing extraction system will be maintained for groundwater extraction. Modifications to the piping and well casings will be made to allow continued operation;
- New Extraction Wells – Five new groundwater extraction wells will be installed for hydraulic containment, with the locations and flowrates determined by hydraulic modeling;
- Expanded Extraction System Pumps – Six submersible extraction pumps will be installed (five in the new extraction wells and one in a catch basin located outside the containment cell) and operated as a system to remove water and dissolved-phase product;
- Expanded Extraction System Conveyance Piping – Piping will be installed to direct extracted and collected fluids to the existing treatment system;
- Electrical Distribution System – An independent electrical system, capable of accommodating the existing CW extraction pump motor starters, will be installed to supply power for the expanded extraction system;

- Instrumentation and Control System – Equipment will be installed to monitor operating parameters and automatically control system operation; and
- Existing Monitoring Wells – Six existing wells within the footprint of the new sediment containment cell will be raised above the final constructed grade to use for monitoring hydraulic containment. Of these, two extend into the lower aquifer.

2.2 Miscellaneous Debris Demolition and Removal

This involves demolishing all concrete foundations and, along with other concrete rubble and miscellaneous debris within the footprint of the sediment containment cell, transporting to a common disposal area on site.

2.3 Existing Well Abandonment

A total of 27 existing wells will be abandoned in accordance with WAC 173-160-560, Abandonment of Resource Protection Wells, by pulling the casing and pressure grouting the borehole. Monitoring wells MW-03D and MW-04D are installed into the lower aquifer, with an outer casing grouted from grade to the aquitard. As the deeper inner casing is removed, grout will be installed within the borehole to seal the upper and lower aquifers across the aquitard. Then, the inner and outer casings will be removed and the borehole will be grouted to grade. Also, the final grade for three of these wells (EW-12, MW-04S, and MW-04D) will be lowered.

All removed well construction materials will be transported to a common storage area on site. This includes the well casings, screens, monuments, and concrete pads. Also, pumping equipment associated with the abandoned EW and RW wells will be removed and stored in a common area on site. These include wooden sheds, air pumps, hoses and piping, electrical power, and associated pumping auxiliaries.

2.4 Existing Monitoring Wells and Extraction System Modifications

Table 1 identifies existing wells that will be affected by construction of the new sediment containment cell. Of these, eight wells will continue to be used to verify containment is maintained inside the slurry wall. Provisions will be required to protect and extend six of these wells because the final constructed elevation will be higher than the current elevation. This will require installing concrete culverts around the well casing, adding casing extensions, and backfilling the annular space with compacted native soil up to the final grade. A surface seal and monument will complete the well above grade. Wells EW-3 and EW-5 will also be used for hydraulic monitoring; however, modifications should not be required since they are located just outside the berm.

The portion of the existing groundwater extraction system impacted by construction of the new sediment containment cell will be abandoned except for the DNAPL trench sumps (TS-1 and TS-2). For possible future use, spare piping will be installed during construction of the expanded extraction system. This will include a 1-inch galvanized steel line (wrapped with 20 mil pipe tape) and a ½-inch Teflon hose. One end will terminate at TS-1 and the other end will connect into the existing supply and return piping near catch basin CB-1. The hose will be pulled through a secondary containment pipe to prevent inadvertent leakage into the berm. Existing extraction wells EW-8, EW-14, and EW-16 will remain in-service for groundwater extraction, and new piping will be installed from the wells to the connection point near CB-1 for the existing piping (Figure 1).

2.5 Expanded Extraction System Well Installation

A numerical groundwater flow model was used to determine the well locations and estimated extraction rates for the expanded extraction system. Details of the modeling analysis are provided in Attachment A. The objective of the modeling effort was to determine the minimum number of extraction wells necessary to maintain an inward gradient within the boundary of the slurry wall. Based on the model results, five new extraction wells (CW-7 through CW-11) will be required in addition to the existing six containment wells.

The five extraction wells will be installed and operated as a complete system along with the existing extraction system to remove any water that accumulates in and around the sediment containment cell as a result of rain infiltration and groundwater flow. Additionally, four catch basins will be installed to collect water from within and around the cell. All extracted and collected fluids from the wells and catch basins will be conveyed to the existing treatment system. Because the expanded extraction system will be used for hydraulic containment rather than product recovery, the new wells will be located outside the known location of the free NAPL plume. As a result, following abandonment of the affected EW and RW wells, the contaminant load to the treatment system will be reduced.

The extraction wells will be installed in accordance with Washington State Department of Ecology regulations as specified in WAC-173-160, Washington State Minimum Standards for Construction and Maintenance of Wells. The wells will extend from the aquitard to within 2 feet from the final berm grade. Geoprobe borings will be performed prior to installing the new wells to determine subsurface lithology for finalizing the well design.

2.6 Expanded Extraction System Pumps

New extraction wells CW-7 through CW-11 will contain dedicated, electrically operated, submersible pumps that discharge into a main header (Figure 1). The header will be installed below ground and convey the extracted fluids to the existing treatment system. For operational redundancy, the pumps will be the same as those used in the existing CW system (Grundfos Redi-Flo4 Model 5E12). If necessary, a stainless steel shroud will be installed over the pump inlet to increase water velocity and heat removal capacity for the motor.

Water from the catch basins will be discharged into an existing surface water discharge header. An existing site pump (Grundfos Submersible Model 60S75-13) will be installed in catch basin CB-1 to pump water from the interconnected catch basins to the existing treatment system. This will include sediment drainage and rain water from the subsurface trenches inside the sediment containment cell and surface water outside the cell.

2.7 Expanded Extraction System Wellheads

Extraction well casings will terminate within 2 feet from the final berm grade with a grooved pipe end. The wellhead assembly will connect to the top of the casing using an easily removable grooved fitting (Victaulic Model 40 nipple with Style 78 coupling, or equal). The wellhead assembly will be vented to atmosphere and have ports for pump discharge and liquid level measurements. Pressure gauges, flow transducers, and valves will be installed in-line with the pump discharge. Unions will be installed to allow subsequent removal for future modifications when the sediment containment cell is permanently capped. Branch lines will be insulated and heat traced for cold weather protection.

Each wellhead will be enclosed in a concrete vault (Utility Vault, Modified Model 504-LA, or equal). To allow vehicular access on top of the berm, the vaults will be installed grade-flush with high-density traffic-rated access hatches (LW Products, Inc. Model HS-4A, or equal). Any water that accumulates at the bottom of the vault will drain back into the sediment containment cell.

2.8 Expanded Extraction System Conveyance Piping

Branch lines and headers will convey the discharge from extraction wells CW-7 through CW-11 and catch basin CB-1 to the existing treatment system as shown on Figure 1. From the vaults, the piping will be installed in underground trenches with tracer wire for subsequent locating. Due to its proximity to existing well CW-6, the discharge from CW-7 will be connected to the existing extraction system. This will require crossing an access road, utility corridor (power, telephone, and water), and storm drain lines.

New piping will be installed in the berm for extraction wells CW-8 through CW-11. For future flexibility, the headers will be sized for 20 gpm to accommodate a 100% increase in flowrate in the event additional extraction wells are necessary for hydraulic containment. Based on the results of pressure loss calculations, 1-inch diameter branch lines and 3-inch diameter headers will be sufficient to maintain the total pipe pressure drop below 1.5 psi. The piping will be compatible with water containing dissolved concentrations of LNAPL (petroleum hydrocarbons) and DNAPL (creosote, PCP, and PAH) with occasional free product. Previous analytical data indicate average concentrations below 10 ppm (PCP) and 7 ppm (PAH), with a maximum of 15 ppm (PCP). To preclude potential erosion of the berm due to leakage, the headers will be routed through 10-inch diameter secondary containment pipes.

2.9 Electrical Distribution System

The expanded extraction system will receive power from the existing on-site electrical service (480 vac, 3 phase, 400 amp) via an existing 200 amp disconnect. The system will be sized to potentially integrate the motor starters for existing extraction wells CW-1 through CW-6 with the new loads. The distribution system, which will include circuit breakers, starters, disconnects, transformers, and associated panels, will be installed on an electrical rack in a temporary water-tight steel building located adjacent to the existing electrical shed. The purpose of this is to accommodate future relocation of the treatment compound. Due to its proximity to CW-6, the conductor cables for CW-7 will be installed in existing underground conduits between the electrical shed and extraction well CW-6. All other electrical and control cables will be routed in new underground conduits from the electrical distribution system through a grade-flush, bottomless concrete vault (Utility Vault, Modified Model 504-LA, or equal) to the various loads (Figure 1). The vault will be located in an area where there may be vehicular traffic. Therefore, a high-density traffic-rated access hatch will be installed (LW Products, Inc. Model HS-4A, or equal). A minimum of 40 feet of wire for each load will be coiled in the vault to allow for future relocation of the electrical distribution system. Also, for CW-8 through CW-11, a minimum of 10 ft of wire will be coiled in the associated well vault to accommodate a potential shift in the final grade for the permanent cap.

2.10 Control and Monitoring System

A microprocessor-based programmable logic controller (PLC) will be used to operate the submersible pumps. Level transducers (Instrumentation NW Model PS9800 with BV-9000 atmospheric pressure compensator, or equal) will be installed in extraction wells CW-7 through CW-11 and catch basin CB-1 to provide analog input signals to the PLC. Based on the level setpoints (adjustable in the PLC program logic), the PLC will start the pumps when their respective level is at the high setpoint and stop the pumps when their respective level reaches the low setpoint. The pumps will also be capable of manual operation. The PLC will provide alarm callouts for emergency and abnormal conditions.

Through a man-machine-interface (MMI) graphical display, the PLC will also provide real-time status of operating parameters. These include water levels, flowrates, and pump status. As with the water levels, analog signals will be input to the PLC using in-line flow meters (EMCO In-line Turbine Model TLS-04-15F-S-22-PAQ, or equal) at the discharge of each pump.

The PLC and MMI display will be located in the temporary electrical building with the electrical distribution system. Seal-offs and intrinsic safety barriers will isolate the hazardous and non-hazardous environments.

3.0 Design Criteria

The following design criteria represent the objectives and performance requirements to which the expanded extraction system will be designed.

3.1 Objective

The objective of the expanded extraction system is to maintain an inward hydraulic gradient to prevent overtopping the slurry wall. The system will consist of extraction wells, pumps, conveyance piping, instrumentation, and controls to remove accumulated groundwater and rainfall within the cell. Also, water from sediment drainage and rain will be collected in subsurface trenches that gravity drain to catch basins. All water removed from the sediment containment cell will be conveyed to the existing treatment system for contaminant removal prior to off-site discharge.

3.2 Existing Wells

Construction of the new sediment containment cell will impact a total of 40 existing wells (Table 1). Of these, 27 will be abandoned, 8 will be maintained for hydraulic monitoring, and 5 will be maintained for groundwater extraction. Modifications will be necessary for wells having changes to the final grade.

3.3 Hydraulic Containment

The expanded extraction system will be designed to provide hydraulic containment within the boundary of the slurry wall. As such, the wells will be located outside the known location of the free NAPL plume, and equipment will be sized to ensure an inward gradient. A sufficient number of new extraction wells will be added to keep the water table elevation below the top of the slurry wall (between elevations 15.5 and 16.5 feet). Details of the modeling results are provided in Attachment A. Model assumptions include:

- Southwestern half of the site is paved with asphalt
- Horizontal hydraulic conductivities of the upper aquifer, aquitard, and lower aquifer are 2.5×10^{-3}, 1×10^{-6}, and 5×10^{-3} cm/sec, respectively
- Average pumping rate from the new extraction wells is slightly less than 2 gpm each
- Monthly precipitation, evapotranspiration, and runoff are equal to the monthly Olympia averages for the period 1942 through 1995 obtained from the National Oceanographic and Atmospheric Administration

The following design requirements will apply to the new extraction wells:

• Flowrate	1.5 gpm to 2 gpm
• Dimensions	35 ft total length, 8-in diameter
• Casing Material	Carbon steel
• Screen Material	Stainless steel
• Screen Size	0.020-in, wire-wrapped, 10 ft length
• Sand Pack	20/40 Colorado Silica
• Sump	5 ft length, 8-in diameter

3.4 Extracted Fluids

The expanded extraction system will be for extraction of water with dissolved-phase contaminants within and around the sediment containment cell. However, because of the lateral extent and potential migration of the subsurface contaminant plume, the extracted fluids may contain free product (DNAPL and LNAPL). The design basis assumes the extracted fluids are primarily water with a maximum dissolved-phase contaminant concentration of 10 ppm PCP and 7 ppm PAH. Small quantities of free product will not adversely impact system operation. Each well is estimated to produce between 1 and 2 gpm, with a maximum flowrate of 5 gpm. The total flowrate from the expanded extraction system is estimated to be 10 gpm (2 gpm per well). Combined with the current 15 gpm flowrate from CW-1 through CW-6, the total groundwater flowrate would then be approximately 25 gpm. The existing treatment system's bioreactor can handle a maximum of 30 gpm depending on the contaminant load. It is expected that influent concentrations will be reduced from current levels because a portion of the existing groundwater extraction system will be abandoned. Due to potential impacts from dissolved and free phase contaminants, wells will be constructed of carbon steel casings and stainless steel screens; conveyance piping will be HDPE.

In addition to groundwater extraction, water will be collected from within and around the sediment containment cell. Rainwater and sediment drainage inside the cell will gravity drain to a central catch basin (CB-1) via a network of perforated pipe. Outside the cell, surface water will be collected by catch basins, which also gravity drain to CB-1. Isolation valves will be installed to throttle flow into CB-1 as needed. From CB-1 the water will be pumped via an existing surface water pipe to the treatment system. If contaminant concentrations are sufficiently low, the water can bypass the bioreactor and be processed through existing particulate filters and carbon units at a maximum flowrate of 60 gpm.

The following design requirements will apply to the extraction pumps:

<u>Extraction Pumps for Wells CW-7 through CW-11</u>

- Operating Flowrate — 1.2 to 7.0 gpm
- Operating Head — 100 ft to 310 ft
- Electrical Requirements — 480 vac, 3-phase, 0.5 hp
- Material — Stainless steel

<u>Extraction Pump for Catch Basin CB-1</u>

- Operating Flowrate — 40 to 75 gpm
- Operating Head — 370 ft to 220 ft
- Electrical Requirements — 480 vac, 3-phase, 7.5 hp
- Material — Stainless steel

The following design requirements will apply to the conveyance piping:

<u>Extraction Wells CW-7 through CW-11</u>

- Maximum Flowrate — 5 gpm (branch line); 20 gpm (header)
- Minimum Fluid Temperature — 20°F
- Maximum Fluid Temperature — 140°F
- Maximum Pressure — 150 psig (carrier); 60 psig (containment)
- Allowable Pipe Pressure Drop — 5 psi
- Maximum Fluid Velocity — 3 ft/sec
- Operating Life — 50 years
- Material — HDPE SDR 11 (carrier); HDPE SDR 26 (containment)
- Pipe Diameter — 1-in (branch line); 3-in (header)
- Fluid — Water with dissolved PCP/PAH (10/7 ppm)

<u>Extraction Wells EW-8, EW-14, and EW-16</u>

- Maximum Flowrate — 1 gpm (branch line); 5 gpm (header)
- Minimum Fluid Temperature — 20°F
- Maximum Fluid Temperature — 140°F
- Maximum Pressure — 150 psig (carrier); 60 psig (containment)
- Allowable Pipe Pressure Drop — 5 psi
- Maximum Fluid Velocity — 3 ft/sec
- Operating Life — 5 years
- Material — Galvanized steel (supply); Teflon (return); HDPE SDR 26 / Galvanized steel (containment)
- Pipe Diameter — 1-in (supply), ½ -in (return); 10-in/2-in (containment)
- Fluid — Water with dissolved and free phase PCP/PAH

3.5 Flexibility

Provisions will be provided to add additional wells if needed for hydraulic containment and allow future hot spot treatment and relocation of the treatment system if required. Also, because the final grades for the berm and site have yet to be determined, the design will accommodate a potential shift in either direction.

The following design requirements will apply to the expanded extraction system:

- Piping will be capable of accommodating a 100% increase in extracted fluid flowrate
- Material for piping, valves, equipment, and wells will be compatible with *in situ* treatment processes that use high temperature fluids (steam) or ozone
- Wellhead assemblies will be installed with unions
- Well vaults will have removable lids for installing risers
- Electrical vault will be installed with risers and a removable lid
- Excess electrical and control cables will be coiled in the electrical and wellhead vaults
- Concrete foundations, rubble, miscellaneous debris, and abandoned wells within the footprint of the new sediment containment cell will be removed

3.6 Existing Treatment System

The boundaries for the expanded extraction system are from wells CW-7 through CW-11 and catch basin CB-1 to the inlet of the existing treatment system. Depending on the influent concentrations, the water will be directed through the bioreactors or the filter/carbon units.

The following design requirements will apply to the existing treatment system:
- Maximum flowrate through the bioreactor is 30 gpm
- Maximum flowrate through the filter and carbon units is 60 gpm
- Existing CW system flowrate is 15 gpm

3.7 Electrical Distribution System

All new equipment shall be connected to a dedicated 200 amp electrical distribution system adjacent to the existing 400 amp main service.

The following design requirements will apply to the new electrical distribution system:

<u>General</u>	
Rating	NEMA-4X
Ambient Temperature	20°F to 140°F
<u>Electrical Building</u>	
Dimensions	8 ft X 20 ft X 8 ft
<u>Electrical Vault</u>	
Dimensions	4 ft, 8-in X 4 ft, 8-in X 4 ft, 2-in
Risers	Minimum 24-in installed on top of vault
Lid Rating	H-30 traffic-rated

3.8 Ambient Conditions

The expanded extraction system will be designed to operate in a minimum ambient temperature of 20°F as per data from the Western Regional Climate Center.

3.9 Wellheads

The wellheads will be installed grade-flush to allow vehicular traffic on top of the berm. Modifications may be required prior to installation of the permanent cap, depending on the final grade and berm construction. This may entail extending the well casing and all mechanical and electrical connections.

The following design requirements will apply to the wellheads:

<u>Vault</u>	
Dimensions	4 ft, 8-in X 4 ft, 8-in X 4 ft, 2-in
Lid Rating	H-30 traffic-rated
<u>Well Cap</u>	
Material	Galvanized carbon steel
Ports	1-in discharge, 1-in level, ¾-in probe, ¼-in vent

Piping

Dimensions	1-in
Material	Galvanized carbon steel
Insulation	1-in thick FOAMGLAS Super "K"
Heat Trace	To be determined

3.10 Process Information

The expanded extraction system will have the capability to provide real-time data on operating performance and hydraulic containment. Sensors will be required to monitor water levels, well flowrates, and pump operation. Alarms will warn the operator of emergency or abnormal conditions.

The following design requirements will apply to the control and monitoring system:

Equipment Rating	NEMA 4X
Fluid	Water with dissolved PCP/PAH (10/7 ppm)
Fluid Temperature	20°F to 140°F
Level Transducer	0 to 50 psia, stainless steel, Teflon cable
Flow Transmitter	0.75 to 7.5 gpm linear, totalizer, stainless steel, flanged

3.11 Control of Spills and Discharges

Design features will be included to ensure an inadvertent release of contaminated water does not occur. These include using secondary containment piping, level switches with remote indication, setpoint adjustments, and alarm functions to monitor water levels within the new extraction wells, and heat-trace circuits to prevent pipe failure from freezing. Also, each extraction pump will have separate controls and valves to allow leak isolation if necessary.

4.0 Construction

Measures will be taken to ensure the system is constructed in strict compliance with design drawings, documents, and specifications.

4.1 Documentation

Construction activities will be documented in field notes, inspection forms, test reports, photographs, and equipment and material submittals. All approved deviations from the design drawings and specifications will be reviewed and approved by the Project Engineer.

4.2 Inspections and Tests

Prior to equipment delivery, technical data submittals will be reviewed and approved to confirm that the construction equipment and material meet the design requirements. As the work progresses, inspections will be conducted to ensure compliance with the design drawings and specifications. Testing will then be conducted following construction to verify system operation.

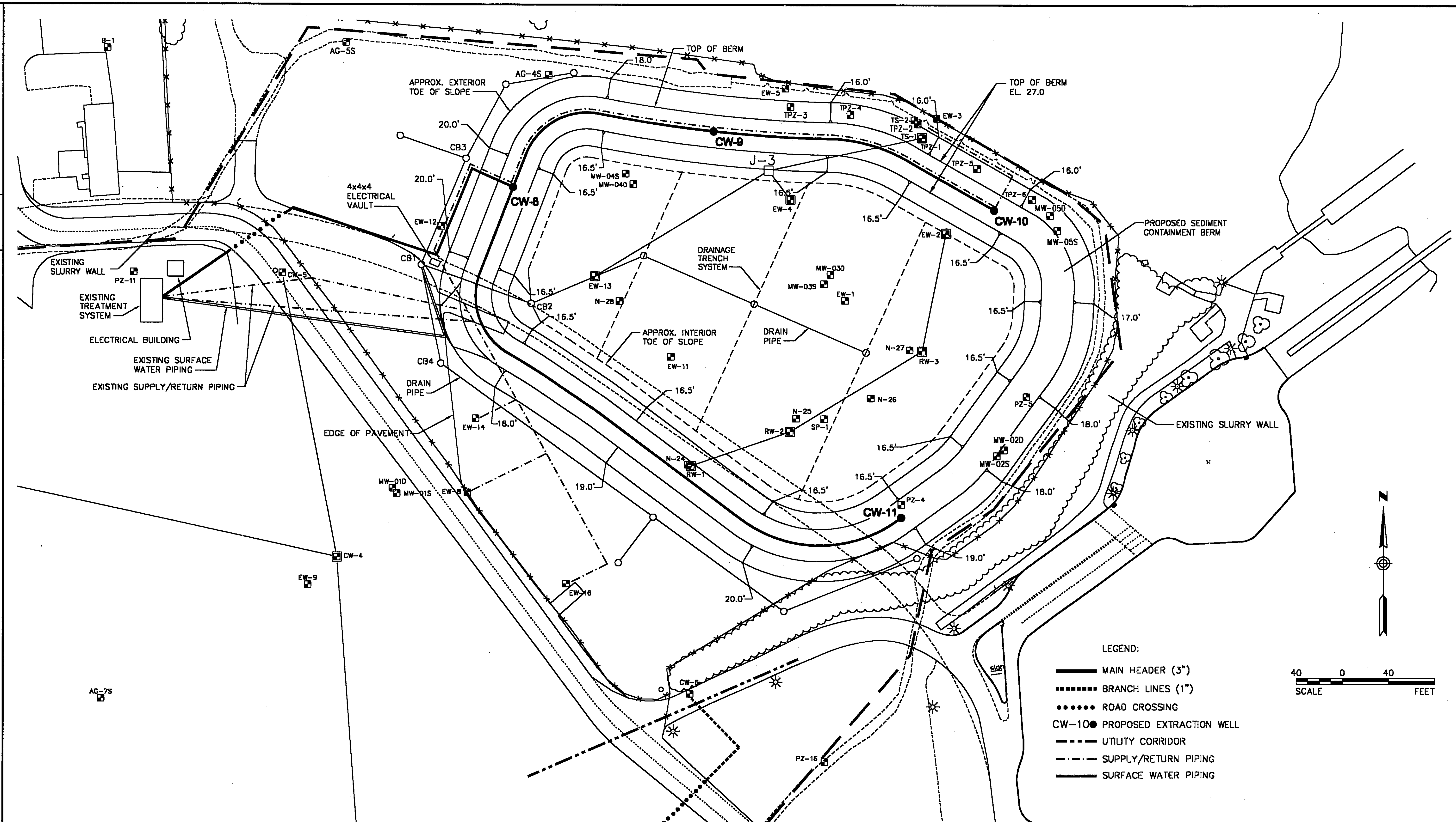
5.0 Safety Measures

All work will be in accordance with applicable local, state, and federal requirements. With respect to safety, this includes, but is not limited to, OSHA and WISHA. A site-specific Safety Plan will be written to address safety requirements for each phase of the work. All construction workers will be qualified to work on hazardous waste sites, with a current 40 hour hazardous waste operator training certificate. Personnel protection equipment will include, as a minimum, hard hats, steel-toe boots, safety-glasses, and traffic vests. Dust mitigation efforts and ambient air monitoring will be conducted daily to minimize the spread of airborne contaminants and ensure respirators are donned when required. Also, vendor manuals for rental and installed equipment will be reviewed prior to use or installation to ascertain the associated safety requirements. Each day, and prior to performing any major task, a safety meeting will be conducted to review the planned work, specific hazards, and potential impacts.

Table 1

Wells Impacted by New Sediment Containment Cell

No.	Well	Disposition
1.	AG-4S	Maintain for Hydraulic Monitoring
2.	AG-5S	Maintain for Hydraulic Monitoring
3.	EW-1	Abandon
4.	EW-2	Abandon
5.	EW-3	Protect for Hydraulic Monitoring
6.	EW-4	Abandon
7.	EW-5	Protect for Hydraulic Monitoring
8.	EW-8	Maintain for Groundwater Extraction
9.	EW-11	Abandon
10.	EW-12	Abandon
11.	EW-13	Abandon
12.	EW-14	Maintain for Groundwater Extraction
13.	EW-16	Maintain for Groundwater Extraction
14.	MW-02S	Maintain for Hydraulic Monitoring
15.	MW-02D	Maintain for Hydraulic Monitoring
16.	MW-03S	Abandon
17.	MW-03D	Abandon
18.	MW-04S	Abandon
19.	MW-04D	Abandon
20.	MW-05S	Maintain for Hydraulic Monitoring
21.	MW-05D	Maintain for Hydraulic Monitoring
22.	N-24	Abandon
23.	N-25	Abandon
24.	N-26	Abandon
25.	N-27	Abandon
26.	N-28	Abandon
27.	PZ-4	Abandon
28.	PZ-5	Abandon
29.	RW-1	Abandon
30.	RW-2	Abandon
31.	RW-3	Abandon
32.	SP-1	Abandon
33.	TPZ-1	Abandon
34.	TPZ-2	Abandon
35.	TPZ-3	Abandon
36.	TPZ-4	Abandon
37.	TPZ-5	Abandon
38.	TPZ-6	Abandon
39.	TS-1	Maintain for Possible Future Use
40.	TS-2	Maintain for Possible Future Use



OFFICE RENTON | DRAWING NUMBER 105560

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EXTRACTION PIPING LAYOUT PLAN
PORT OF OLYMPIA
CASCADE POLE SITE

DESIGNED BY			CHECKED BY	CHARLIE EISCHEN	2/00
DRAWN BY	MLP	2/00	APPROVED BY		
SCALE: 1" = 40'	DRAWING NO. FIGURE 1		SHEET NO.		REVISION NO.

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Softdesk Project: N:\SDSK\PROJ\<none> Dimscale: 40 Ltscale: 25 Pltscale: 1

ATTACHMENT A

Landau Associates
Environmental and Geotechnical Services

MEMORANDUM

TO: Mr. Richard Reis, P.E., The IT Group

FROM: Lawrence D. Beard, P.E., Li Ma, Ph.D., Landau Associates, Inc.

DATE February 4, 2000

RE: **DEVELOPMENT OF GROUNDWATER HYDRAULIC CONTROL EXTRACTION WELL LOCATIONS AND FLOW RATES CASCADE POLE SITE OLYMPIA, WASHINGTON**

INTRODUCTION

Landau Associates has prepared this technical memorandum to present the conceptual design for the extraction well locations and flow rates for groundwater hydraulic control at the Cascade Pole site in Olympia, Washington. The hydraulic control system is being redesigned at this time because the Port plans to abandon the portion of the existing hydraulic control system that is located in the vicinity of the proposed sediment containment cell. The abandoned portion of the existing groundwater hydraulic control system will be replaced during construction of the sediment containment cell. The conceptual design for the groundwater hydraulic control system included the following tasks:

- Performing a qualitative calibration of the groundwater model based on existing groundwater elevation data, under existing pumping and pavement conditions.
- Identifying the locations of extraction wells and pumping rates under existing site pavement conditions (short term scenario).
- Identifying the locations of extraction wells and pumping rates under fully paved (or capped) site conditions (long term scenario).

The short term scenario represents conditions that are expected to exist until final paving and sediment containment capping occurs following sediment dredging. Sediment dredging is presently planned for 2001 and final capping will likely occur in 2002, or later. The conceptual design is based on well locations and extraction rates needed to achieve the short term and long term containment goals discussed in a subsequent section of this memorandum.

SITE DESCRIPTION AND PROJECT BACKGROUND

The Cascade Pole site is located on the northeastern portion of a peninsula that extends northward into Budd Inlet in Olympia, Washington (Figure 1). The site is owned by the Port of Olympia (Port) and is the location of former wood treating facilities that were leased and operated since the early 1940s by a number of different entities, the most recent of which was the Cascade Pole Company (CPC). Wood treating operations at the site ceased in 1986, and the wood treatment plant and associated aboveground structures were removed from the site in mid 1990.

The existing hydraulic control system consists of two separate units. The original system is located in the northeast portion of the site, and is intended to provide hydraulic containment and to recover free product. As previously stated, the original system will be abandoned prior to construction of the sediment containment cell, and will be replaced by an extraction system whose primary objective is hydraulic control. A supplemental hydraulic control system consisting of six wells (CW-1 through CW-6) was constructed in 1998/1999 to assist with hydraulic control in the southwest portion of the site. These six existing wells will remain in place.

Because of the difficulty in protecting wells during placement of sediment in the sediment containment cell, proposed wells will be located outside the active portion of the sediment containment cell. Additionally, because the primary objective of the new groundwater extraction system is hydraulic control, proposed extraction wells are located outside the area of known nonaqueous phase liquid (NAPL) presence. The limit of NAPL presence was based on the *Hydrogeological Site Investigation* (Fluor Daniel GTI, 1999).

HYDRAULIC CONTROL SYSTEM GOALS

The goals for the hydraulic control system were previously described in the conceptual design for groundwater hydraulic control (Landau Associates 1997). The short term goal of the hydraulic control system is to prevent overtopping of the wall throughout the containment area. As such, model targets for short term performance consist of maximum groundwater elevations of 15.5 to 16.5 ft above mean lower low water (MLLW), depending on adjacent slurry wall top elevation. The long-term goal of the hydraulic control system is to create inward and upper ward hydraulic gradients throughout the containment area. Long-term modeling targets consist of achieving elevations below mean sea level (about 8 ft MLLW) near wall segments adjacent to the West Bay and East Bay of Budd Inlet (which will achieve lateral inward gradients throughout the site), and achieving groundwater elevations below elevation 13 ft throughout the site (which will achieve an upward hydraulic gradient between the upper and lower aquifers). The upward gradient target of 13 ft is based on the lower aquifer minimum groundwater elevation observed over about the last two years (ThermoRetec, October 1998 Data).

MODEL SETUP

The conceptual design for groundwater hydraulic control was performed using the numerical groundwater flow model previously developed for the site (Landau Associates 1996, Landau Associates

1997). The numerical model was developed using Visual MODFLOW (version 2.7.2) computer software, hydrogeologic data collected during previous site investigations, and best professional judgement from experience on other projects.

The model soil-bentonite slurry wall hydraulic conductivity is 1x10-7 cm/s based on post-construction testing, and the wall thickness is 30 inches based on as-built conditions. The model consists of three aquifer layers: upper unconfined aquifer, aquitard, and lower confined aquifer, with thickness of 23 ft, 12 ft, and 36 ft, respectively. The model horizontal hydraulic conductivities are 2.5x10-3 cm/s for the upper aquifer, 1x10-5 cm/s for aquitard, and 5x10-3 cm/s for lower aquifer. The model vertical hydraulic conductivities are 1.25x10-3 cm/s for upper aquifer, 1x10-6 cm/s for aquitard, and 5x10-4 cm/s for lower aquifer. The aquitard vertical hydraulic conductivity was increased from 5x10-7 cm/s (in the previous version of the model) to 1x10-6 cm/s based on interpretation of laboratory data provided by the IT Group. All extraction wells were screened in the upper aquifer. The supplemental hydraulic control system design memorandum should be reviewed for a more detailed description of model development (Landau Associates 1996).

The model assumes that the recharge is 10 percent and 100 percent of net precipitation for paved and unpaved areas, respectively. The net precipitation was estimated as total precipitation minus evapotranspiration and runoff, based on average monthly precipitation data downloaded from NOAA web site for Olympia, Washington station collected between 1942 to 1995. The maximum extraction rate for each well was assumed to be 2 gpm, which represents a reasonably conservative (low) estimate based on observed average pumping rates for the existing system.

MODEL CALIBRATION

A detailed quantitative calibration on the model was not performed prior to conceptual design due to limited flow rate data for individual wells and variations in operational conditions. However, a qualitative calibration under current conditions was performed. A total of 13 existing wells were used in the calibration, including the six supplemental hydraulic control system wells (CW-1 to CW-6) and eight wells from the original hydraulic control/NAPL recovery system (EW4, EW8, EW11, EW13, EW14, RW2, RW3, and TS-1).

Extraction rates were based on the best estimates from the information provided by the Port. The total model extraction rate was 16 gpm, and Table 1 listed the extraction rate assumed for each extraction well. The model flow rate for supplemental control system wells was set at 0.5 gpm because these wells were operated for only a small portion of the 210 day model period. The calibration target was to compare model-simulated water table elevations with the measured values for the same time frame, and July 1999 was selected as the calibration target period. The model-simulated groundwater elevation contours for July 1999 are shown on Figure 2, and the groundwater elevation contours based on measured values are presented on Figure 3. The simulated groundwater elevation contours compare favorably with the measured values, in terms of both the shape of the water table and the actual elevation values. Both simulated and actual groundwater elevation contours are relatively flat for the paved area in the west portion of the site, with a well defined cone of depression in the northeast portion of the site. The calibration results indict that the model is sufficiently sensitive to the site pumping and recharge conditions to function as an effective tool for design of the groundwater hydraulic control system.

MODEL RESULTS FOR SHORT TERM SCENARIO

The groundwater extraction system modeled to achieve the short term goals for groundwater hydraulic control consists of the six existing wells associated with the supplemental hydraulic control system (CW-1 through CW-6) and five new wells (CW-7 to CW-11). Four of new extraction wells are located within the crest of the proposed sediment containment cell berm in the northeast portion of the site (CW-7 to CW-10). One additional extraction well (CW-11) was located in the southern portion of the groundwater containment area to address the high water table present in that vicinity. The proposed well locations for groundwater extraction system are shown on Figure 4.

A combined groundwater extraction rate of about 20 gpm (1.8 to 2 gpm per well) was required to achieve the short term goal of not overtopping the bentonite slurry cutoff wall. Model-predicted groundwater elevation contours after 420 days of pumping are shown on Figure 5 and individual well pumping rates are provided in Table 1. According to model-simulated hydrographs, 420 days after the start of pumping represents peak groundwater elevations for the simulation period of 1500 days. These peak elevations represent a reasonable worst case scenario for meeting the short-term goal. As illustrated on Figure 5, groundwater elevations are below the top of the slurry wall throughout the site.

MODEL RESULTS FOR LONG TERM SCENARIO

The groundwater extraction system developed to achieve the long term goals for groundwater hydraulic control consists of the same wells as in short term scenario, as shown on Figure 4. For the long term simulation, the model was modified such that the entire site was capped. The model-predicted groundwater elevations after pumping for 1500 days (about 4 years) at a combined groundwater extraction rate of 11 gpm (1 gpm per well) is shown on Figure 6. As illustrated on Figure 6, groundwater elevations are below the target elevations (8 ft near the shoreline and 13 ft throughout the site). It should be noted that the steep hydraulic gradients immediately inside and adjacent to portions of the slurry wall are an artifact of the numerical model. Modeling results indicate that water table elevations inside the slurry wall continue to decrease after the hydraulic control goals are achieved, suggesting that a smaller extraction rate will suffice to maintain the groundwater elevations once target drawdowns are achieved.

DESIGN RECOMMENDATIONS

Based on the results of groundwater modeling, we recommend that up to five additional wells be added to the groundwater hydraulic control system to replace the wells planned for abandonment prior to construction of the sediment containment cell. It is not known whether CW-11 will be needed to achieve short term hydraulic control goals because the supplemental hydraulic control system wells have not operated uninterrupted for an extended period of time and because existing extraction well CW-6 is completed in a former dredge fill dike embankment that may extend its radius of influence significantly beyond that of other site wells. As a result, CW-11 is considered a provisional well, and water levels in the southeast corner of the site will be monitored through June 2000 to determine whether CW-11 is needed.

For planning purposes, the groundwater treatment system should be designed to accommodate the model-predicted extraction rate of 20 gpm plus a reasonable factor of safety to address above normal precipitation and potential variations in site material properties. Based on existing system performance, we anticipate that a treatment system design capacity of 25 to 30 gpm will be sufficient to address these considerations.

Although model simulations predict that 5 additional wells will be sufficient to achieve short term and long term goals for hydraulic control, site fill materials are heterogeneous. The hydraulic control system should be designed with sufficient flexibility to allow additional extraction wells to be added to the system if site heterogeneities result in localized areas that do not achieve the goals for hydraulic control.

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This memorandum was prepared by Landau Associates for the exclusive use of the IT Group for design of the hydraulic control system for the Cascade Pole site in Olympia, Washington. The use of this report by any other party is prohibited without the express, written consent of Landau Associates. The analysis, recommendations, and conclusions presented in this memorandum are consistent with the standard of practice for environmental services in place at the time and location these services were provided. No other warranty, express or implied, is applicable.

We appreciate the opportunity to provide these services to the IT Group and look forward to our continuing collaboration on the Cascade Pole Project. Please contact us if you have any questions regarding the contents of this memorandum.

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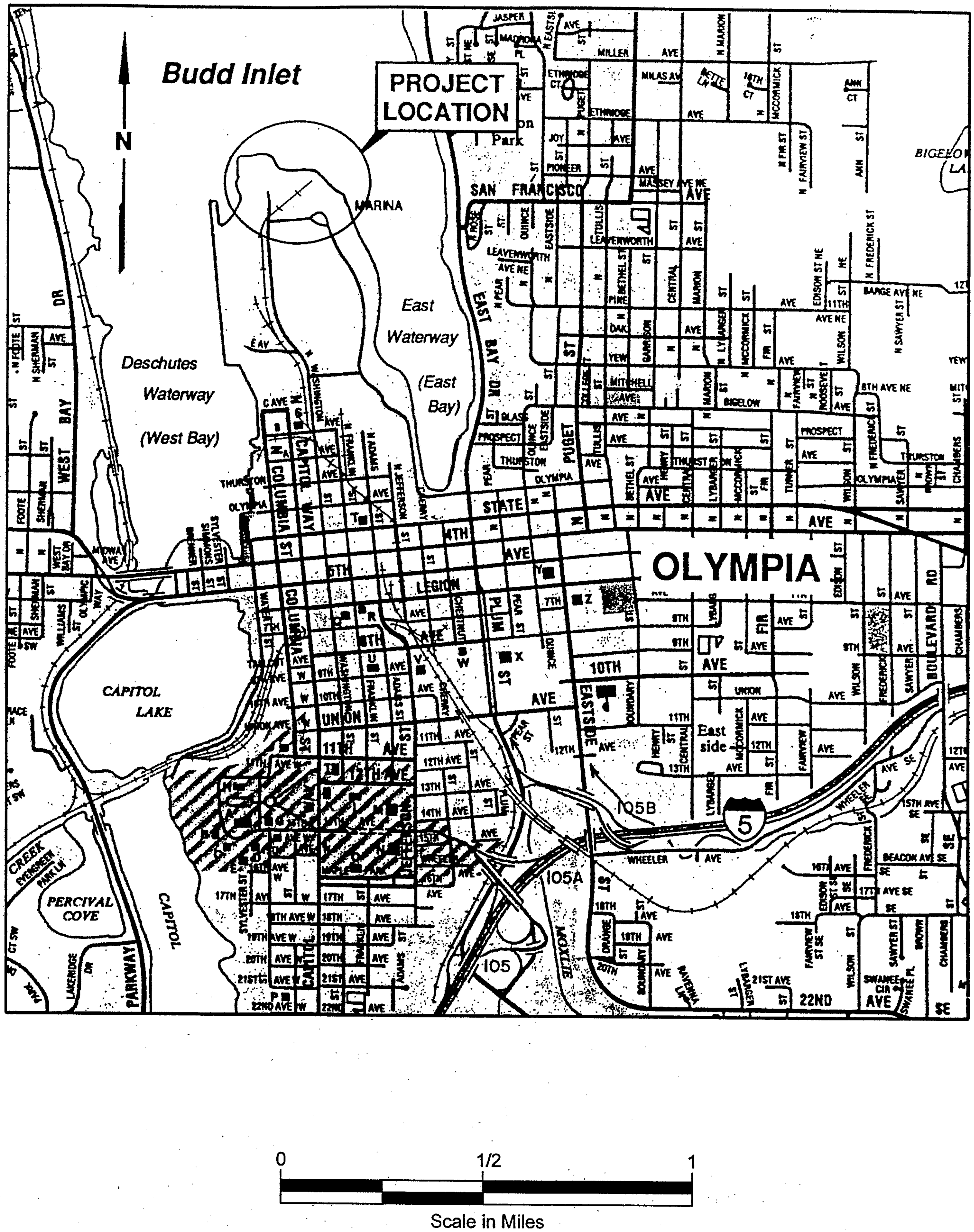
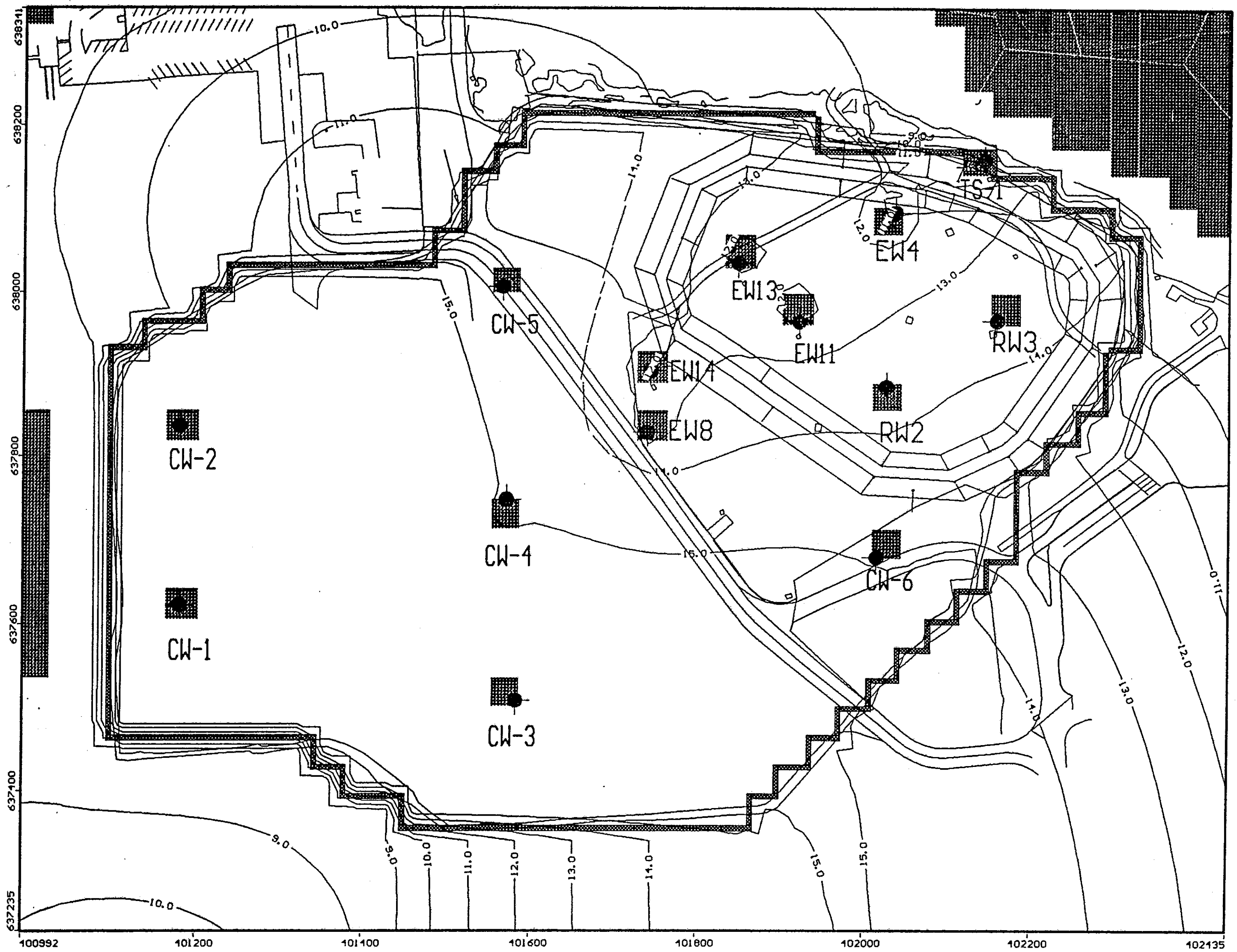


Cascade Pole /Techmemo / T:\5700\001\010\Fig3 (PC) 1/13/2000

Vicinity Map

Figure 1

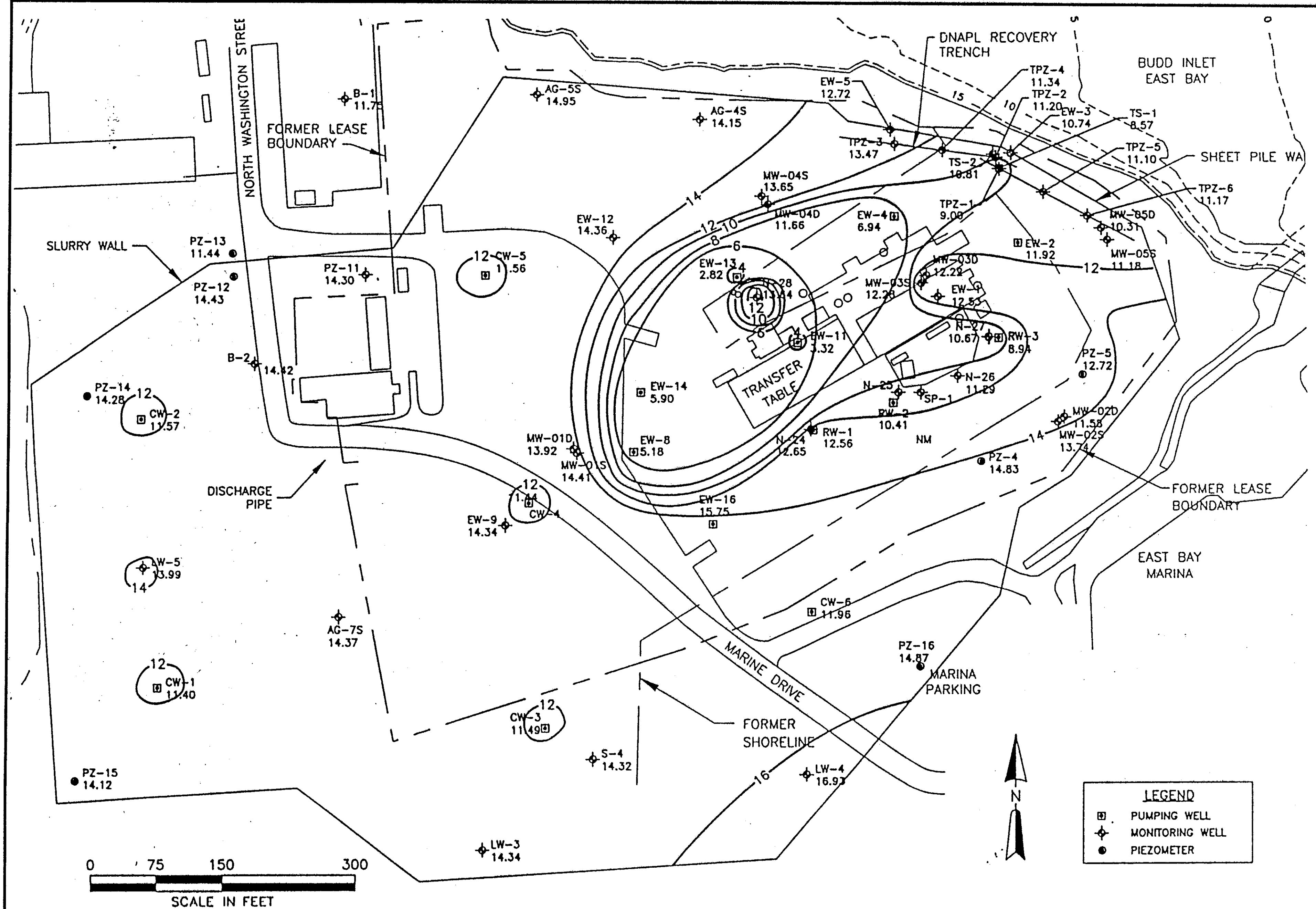
Cascade Pole/Techmemo | T:\570\001\010\FIG2.DWG (A) 1/19/2000



Qualitive Calibration-Groundwater Elevations for Current Conditions (July 99)

Figure 2

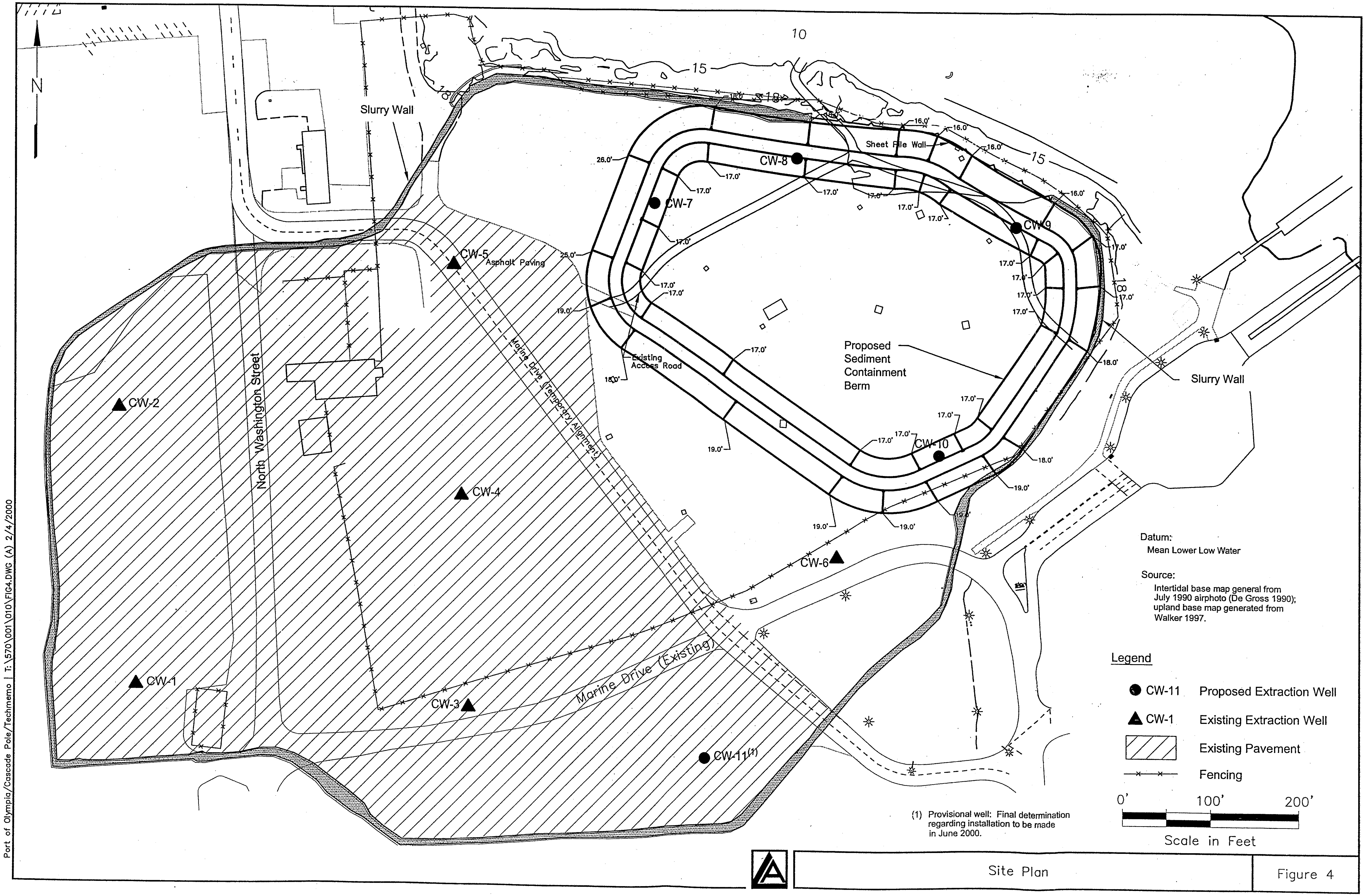
Cascade Pole/Techmemo | T:\570\001\010\FIG3.DWG (A) 1/19/2000



(Source: Thermo Retec, 1999)

Retec 7/99 Groundwater Contour Map

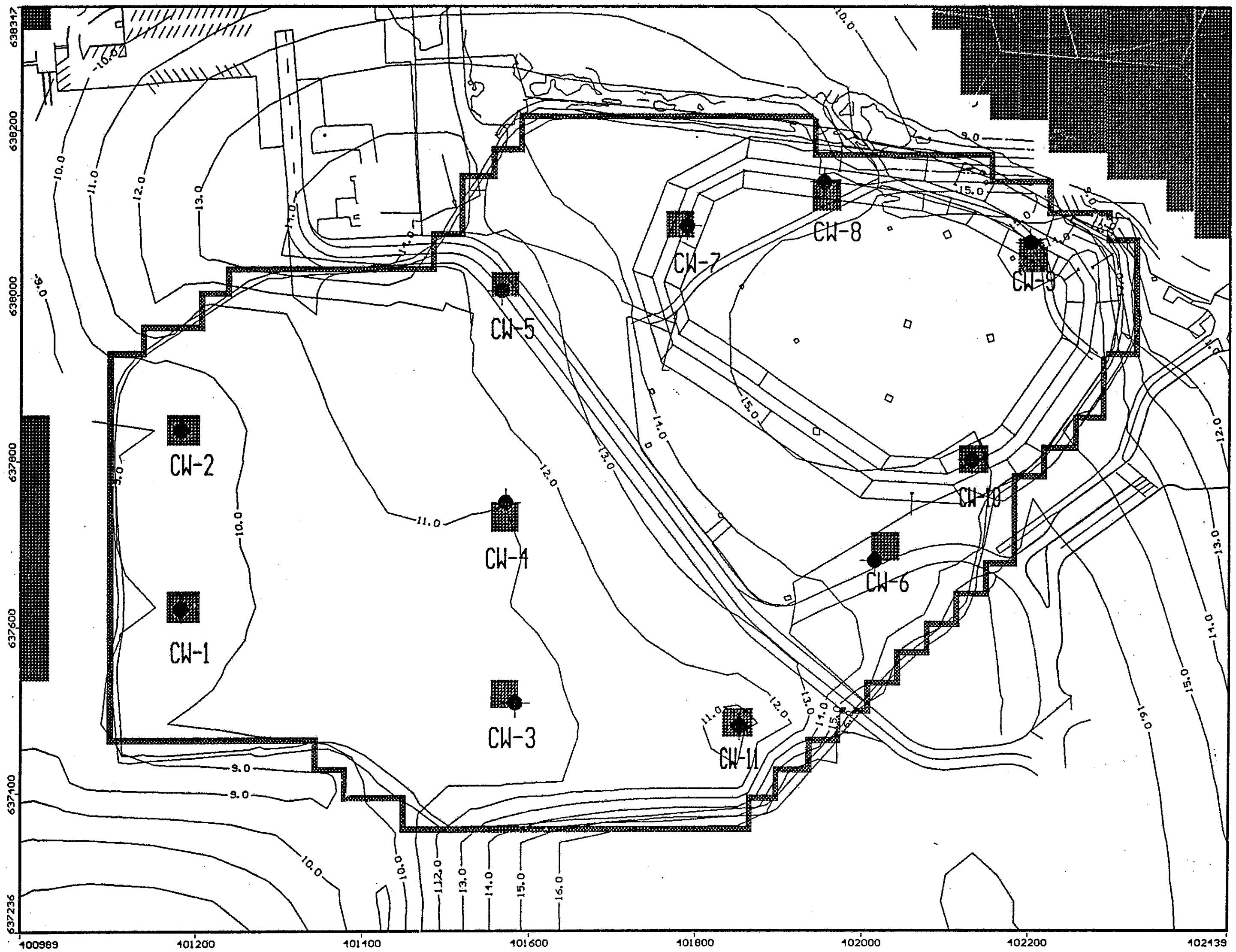
Figure 3



Site Plan

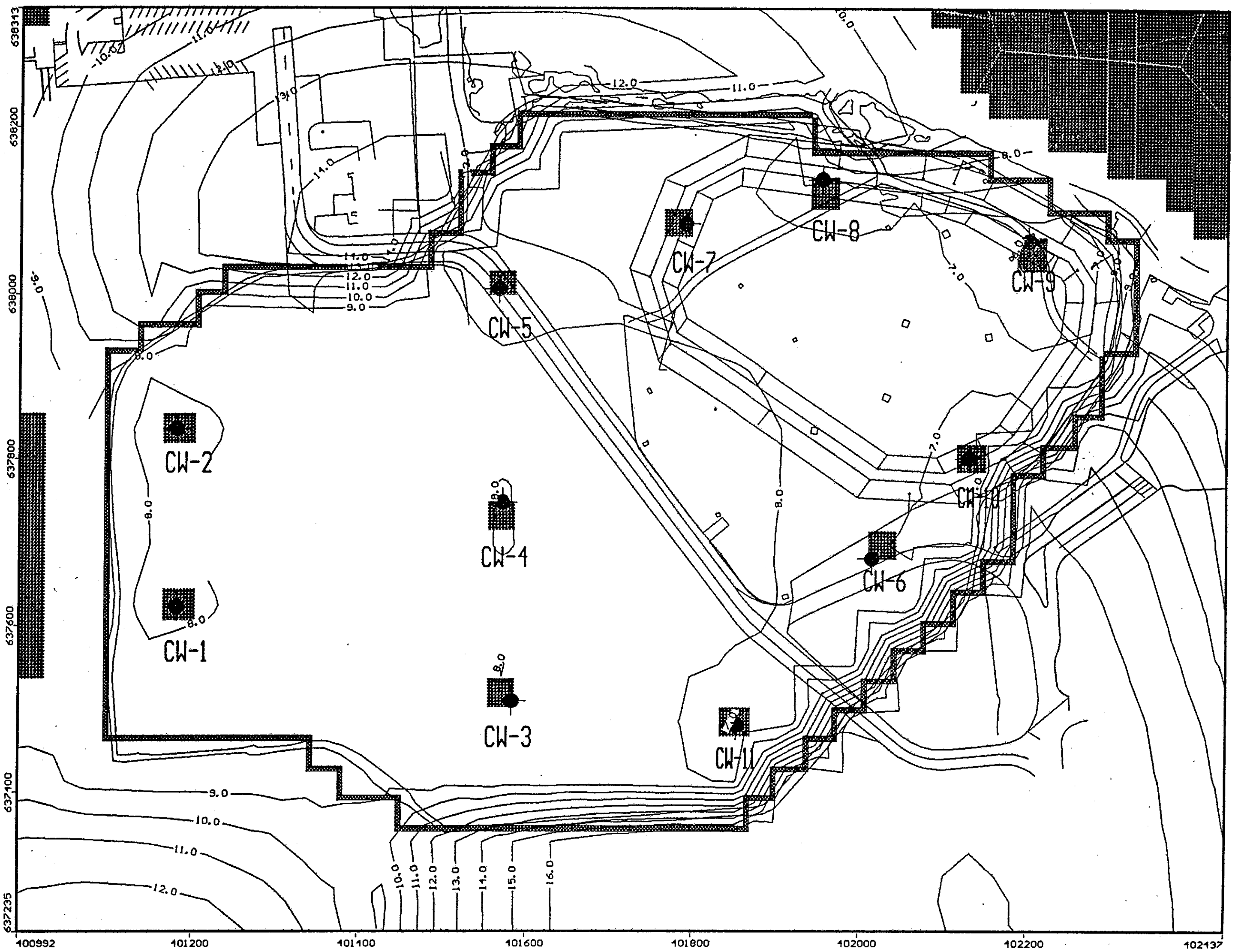
Figure 4

Port of Olympia/Cascade Pole/Techmemo | T:\570\001\010\FIG4.DWG (A) 2/4/2000



Model-Predicted Groundwater Elevation for Short-Term Scenario
(420 days,Q=20 gpm)

Figure 5



Model-Predicted Groundwater Elevation for Long-Term Scenario
(1500 days, Q=11 gpm)

Figure 6

TABLE 1
SIMULATED PUMPING RATES FOR EXISTING AND PROPOSED EXTRACTION WELLS

Well ID	Pumping Rates Short-Term gpm	Long-Term gpm	Calibration gpm
CW-1	1.8	1.0	0.5
CW-2	1.8	1.0	0.5
CW-3	1.8	1.0	0.5
CW-4	1.8	1.0	0.5
CW-5	1.8	1.0	0.5
CW-6	1.8	1.0	0.5
CW-7	1.8	1.0	N/A
CW-8	2.0	1.0	N/A
CW-9	2.0	1.0	N/A
CW-10	1.8	1.0	N/A
CW-11	1.8	1.0	N/A
EW-4	N/A	N/A	2.0
EW-8	N/A	N/A	2.0
EW-11	N/A	N/A	2.0
EW-13	N/A	N/A	2.0
EW-14	N/A	N/A	2.0
RW-2	N/A	N/A	1.0
RW-3	N/A	N/A	1.0
TS-1	N/A	N/A	1.0