HYDROGEOLOGIC STUDY

Lake Goodwin Landfill

Snohomish County, Washington

Converse Consultants NW

Geotechnical Engineering and Applied Earth Sciences

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Prepared for:

Snohomish County Public Works Department
Solid Waste Management Division

Converse Project No. 89-35228-10

July 8, 1991

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Mr. Ken Miller
Snohomish County Public Works Department
Solid Waste Management Division
2930 Wetmore Avenue
Everett, Washington 98201

Dear Ken:

Our Hydrogeologic Study report for the Lake Goodwin Landfill accompanies this letter. A copy of the Water-Vel program documentation and diskette by In-situ, Inc. was sent with our draft report. Four monitoring wells were installed at Lake Goodwin Landfill in this investigation. The monitoring wells were completed in an advance glacial outwash aquifer, at a depth of about 100 feet below ground surface. This was the first aquifer encountered beneath the site. Driller's logs for water supply wells in the area, on file with the Department of Ecology, indicate little use of this aquifer for water supply purposes. Most groundwater for domestic supply purposes is obtained from a significantly deeper aquifer.

Groundwater samples obtained from the monitoring wells did not indicate any parameters exceeding health-based drinking water standards. However, well LG-3 approaches the MCL for nitrate. A minor leachate impact may be affecting well LG-4, located at the northwest corner of the landfill, although additional monitoring will be required to confirm this. The possibility exists that leachate-impacted groundwater may be passing beneath the north end of the landfill, between wells LG-3 and LG-4. A recommendation is included for an additional monitoring well in this location.

The Water-Vel program by In-situ provides a model for updating groundwater flow direction and velocity. Additional instructions for the program are included in Appendix D of the report.

If you have any questions on the report or use and application of the Water-Vel program, please do not hesitate to call.

CONVERSE CONSULTANTS NW

John J. Strunk
Hydrogeologist

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Project Hydrogeologist

JJS/EWM/kpp

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INTRODUCTION

Purpose and Scope

The purpose of this investigation was to evaluate hydrogeologic conditions beneath the Lake Goodwin Landfill. Four groundwater monitoring wells were installed around the perimeter of the Lake Goodwin Landfill between October 13 and October 30, 1990. Final written authorization for this work was received on September 5, 1990 as part of a contract for hydrogeological services at five Snohomish County solid waste facilities. Existing geologic and well log data for the site vicinity was reviewed in a previous Converse report "Groundwater Monitoring Plan Lake Goodwin Landfill" dated August 31, 1989. That report included recommendations for monitoring well locations and construction.

Facility Description

The Lake Goodwin Landfill is located immediately west of Frank Waters Road in northwestern Snohomish County, about 1½ miles northwest of Lake Goodwin and about 5½ miles south of Stanwood (NE¼, Section 20, Township 31 North, Range 4 East). The landfill location is shown in Figure 1. The landfill is sited within a former County gravel pit. Waste disposed at the landfill reportedly consisted of municipal waste, including garbage and demolition debris, and some industrial waste. Debris filling at the site was terminated in September, 1982, and final cover placed during 1983. Apparently, the bottom and sides of the gravel pit were not lined prior to the start of filling, nor were engineered leachate or gas collection systems installed. Monitoring of groundwater quality directly beneath or adjacent to the site borders reportedly was not performed prior to this investigation.

REGIONAL SETTING

Physiography

The Lake Goodwin Landfill is located on a rolling topographic upland with elevations ranging from about 320 to 370 feet across the site. The upland surface is occupied by seven lakes, of which Lake Goodwin is the largest. The nearest lakes to the landfill are about 1/2 mile to the west and south. The area surrounding the landfill vicinity is primarily used for commercial forest production; however, population of the Lake Goodwin area is rapidly increasing as the land is subdivided into residential properties.

Surface Conditions

The footprint of the existing waste mound covers about 11.5 acres. In most places, the landfill cover is fairly well vegetated with grass, clover and weeds. A few Douglas fir have naturally reseeded in the fill cover material near the edge of the site. Small areas of bare, eroded soil occur on the graveled access road that crosses the fill. The site is surrounded by second growth forest on all sides except on the east and north, where the second growth has been clear cut. Some rutting of the landfill cap occurred during drilling operations. The County has plans to back-blade and reseed the rutted areas and continue maintenance of the existing cap.

Surface water was not observed at the site, but limited areas of intermittent surface water probably occur in closed topographic depressions during the wetter months of the year. Reportedly, leachate seepage was observed on the west and northwest perimeters of the landfill in 1980. While staking the monitoring well locations in August, 1989, probable leachate stains were noted on the ground surface in a drainage swale located on the northwest side of the landfill. It is recommended the County consider analysis of leachate components if surface leachate seepage is observed again at the landfill.

Climate

The Snohomish County area enjoys a maritime climate tempered by winds from the Pacific Ocean. Average annual precipitation measured at Arlington was about 46 inches for the 34-year period from 1951 through 1985, with most of the rainfall occurring between October and May. Mean annual temperature measured at Everett is about 50°F with a mean monthly low of 38°F occurring in January and mean monthly high of about 63°F in July and August.

Regional Geology

The Lake Goodwin Landfill is located in the Puget Sound Lowland physiographic province, which is bounded to the west by the Olympic Mountains and to the east by the Cascade Mountains. The oldest rock units in this area are pre-Tertiary metamorphic and igneous complexes consisting of greenstones, quartzites, schists, marbles and gneisses, into which granitic and some basic igneous rocks have intruded.

Overlying the pre-Tertiary complex along the west flank of the Cascade Mountains is a discontinuous zone of sedimentary and volcanic rocks of early Tertiary (mainly Eocene) age. Slightly younger Tertiary (Oligocene) sedimentary rocks outcrop locally in a bank 2 or 3 miles wide along the east edge of the Puget Sound Lowland. These rocks consist of medium-gray siltstones, yellowish sandstones, dark conglomerates, and light-colored shales.

Unconsolidated deposits, generally of glacial origin, overlie the Tertiary sedimentary bedrock. Minard (1985) reports exposures of coarse sand and gravel deposits, informally named Olympic Gravel, are present at the base of the bluff near the mouth of the Stillaguamish River Valley and overlooking Puget Sound near Kayak Point. Wood is locally present in the top of the unit.

Glacio-lacustrine clay and silt rest immediately above the Olympia Gravel, and in some locations, immediately overlie bedrock. These materials consist of a series of hard, evenly bedded brown and gray silt and clay, with thin sand and gravel beds. Peat occurs locally in the lower part of the unit. The materials were mapped by Minard (1985) as pre-glacial "Transitional Beds".

Above the silt-clay transitional beds, a sequence of deposits related to Vashon glaciation occur. A typical glacial sequence includes, in ascending order, glacio-lacustrine clay and silt, the advance outwash (sand and gravel meltwater deposits in front of the advancing glacier), glacial till (highly compacted "concrete-like" material that was deposited and overridden by glacial ice), and recessional outwash (sand and gravel meltwater deposits left by retreating glaciers).

Regional Hydrogeology

The approximate locations of wells on file at Washington State Department of Ecology or compiled by Newcomb (1952) are listed in Table 1 and indicated on Figure 1. With the exception of the George Elder well (20G) located near the landfill, the well locations were not field checked. Copies of the driller's logs for the wells shown on Figure 1 are included at the end of Appendix A. In our opinion, many additional drilled wells exist in the project vicinity but records for these wells are not publicly available.

Deep Aquifer

The regional aquifer of common beneficial use indicated by the well logs in the landfill vicinity is found in the lower section of the Transitional Beds and the underlying Olympia Gravels. Groundwater in this aquifer is apparently confined to semi-confined by the silt and clay units of the overlying Transitional Beds. The Transitional Beds as a whole are relatively impermeable but include water-bearing sand and gravel interbeds.

Static water level elevations measured in wells producing from the Transitional Beds/Olympia Gravels vary from about 200 to 300 feet in elevation east and northeast of the landfill, to about elevation 10 to 50 west of the landfill. This data indicates a generally westerly sloping groundwater gradient toward Puget Sound.

TABLE 1

WATER WELLS IN VICINITY OF LAKE GOODWIN LANDFILL[1]

Well Number	Owner of Record	Date Installed	Depth (feet)	Depth to Water (feet)	Interpreted Completion Zone / Remarks
Section 16					
16Q1	Don Paquette	5/21/82	131	85	Transitional Beds (?)
16Q2	Schead	4/6/87	159	--	Transitional Beds (?)
16Q3	Bonnie Christianson	3/30/87	161	--	Transitional Beds (?)
16P	Duneoin Industries	---	160	127	?
Section 17					
17D	Andrew Folden	---	15.6	13	Till / dug
17E	A. Bustad	8/22/88	156	134	?
Section 18					
18E1	A.H. Reinecke	---	225	187	hardness reported of 130 ppm
18E2	H. Peterson	5/21/87	210	158	Base of Transitional Beds (?)
18M	William A. Murrary, Jr.	6/10/81	230	126	Olympia Gravels (?)
18L	Earl Bivins	11/17/87	495	230	?
Section 19					
19A	Nina Randle	1/24/76	406	--	? / 16 lbs methane shut-in pressure reported at 300'
19G1	Bud Wessman	8/16/79	315	211	Olympia Gravels / wood 220-300'
19G2	Versel Nance	9/16/79	329	220	Olympia Gravels
19H	Jim Grandon	8/17/84	315	251	Olympia Gravels

[1]Sources: Well logs on file with Department of Ecology and Newcomb (1952). Well locations were not field checked.

Table 1 (continued)

Well Number	Owner of Record	Date Installed	Depth (feet)	Depth to Water (feet)	Interpreted Completion Zone / Remarks
Section 20					
20B	William Sinn	---	16	9.1	Till / dug
20G	George Elder	8/27/82	301	270	Olympia Gravels
20K	Elliott Tanner	4/20/88	409	342	?
20Q	Robert Hiatt	12/1/80	238	195	Transitional Beds
Section 21					
21F	---	---	23.1	11.4	Till / dug
21K	M. Lewis	---	22.3	9.3	Till / dug
21L	M. Lewis	---	14	11.9	Till / dug
21N	Pocshcel & Schultz	8/8/79	220	180	Olympia Gravels (?)

[1]Sources: Well logs on file with Department of Ecology and Newcomb (1952). Well locations were not field checked.

Intermediate Aquifer

The lower portion of the advance outwash comprises an intermediate aquifer system. The saturated thickness of this aquifer is reported to range from 20 to 65 feet (Entranco, 1986), although some driller's logs (for example, well 19H, Jim Grandon) indicate the advance outwash may be unsaturated in places. Where water does occur in the advance outwash, it is apparently perched on the underlying Transitional Beds. Groundwater monitoring wells at the landfill were installed in this aquifer. Water levels in these wells were about 100 feet below ground surface. Well logs on file with the Department of Ecology do not indicate any substantial use of this aquifer for water supply within a one-mile radius of the landfill.

Shallow Aquifer

Less common sources of water appear to be shallow dug wells that penetrate perched groundwater zones in the glacial till, which provide a limited groundwater resource. It is not known how many dug wells are still presently used. Many of the dug wells are reported to become not usable during part of the year, when groundwater levels drop below the bottom of the well. The locations of dug wells reported by Newcomb are shown on Figure 1 and logs are included in Appendix A.

Static water levels in dug wells were reported by Newcomb to vary in depth from about 5 to 20 feet below the ground surface. As shallow groundwater occurs mostly in irregular lenses of sand, weathered till, and sandy zones in the till, shallow groundwater flow directions in the till are complex and difficult to predict.

SITE CHARACTERIZATION

Groundwater conditions at Lake Goodwin Landfill have been investigated by the following explorations:

1) Field geologic reconnaissance.

2) Geologic logging (Appendix A) and hydraulic monitoring and testing (Appendix B) of groundwater monitoring wells.

3) Sampling and field and laboratory analysis of water quality from monitoring wells (Appendix C).

Details of exploration procedures and data tabulations are presented in the appendices cited above. Monitoring well construction details are included in Appendix A and summarized in Table 2. Locations of borings are shown in Figure 2.

Site Geology

The subsurface geologic conditions are presented in the geologic logs of borings (Appendix A) and are depicted in the two cross sections shown in Figures 3 and 4. The lines of section are shown in Figure 2.

Advance outwash sand and gravel was encountered from ground surface to about elevation 140 feet (relative to local datum; refer to Appendix A for explanation of datum) throughout most of the site, a thickness of about 110 feet. Logged descriptions of the outwash material include textures ranging from silty sand to gravel.

Glacial till was encountered in monitoring well LG-2, located on the elevated southwest portion of the site. Till is present in that area from ground surface to a depth of about 20 feet and was comprised of dense, sandy silt.

Boring LG-3 was drilled within the limits of refuse at the northwest corner of the fill area (Figure 2). Cloth, glass, wood and metal fragments were found in a matrix of reworked outwash and till from ground surface to a depth of about 15 feet.

TABLE 2

MONITORING WELL COMPLETION

Well	Date Installed	Ground Surface Elevation[1] (feet)	Top of 2-inch Well Casing Elevation[1] (feet)	Total Depth[2] (feet)	Screened Depth[2] (feet)	Screened Elevation[1] (feet)	Depth[2] to Top of Silt or Clay Aquitard (feet)	Elevation[1] of Top of Silt or Clay Aquitard	Geologic Material at Screened Interval
LG-1	10/15/90	239.6	240.41	97.0	82-92	147.6-157.6	93	146.6	Advance Outwash
LG-2	10/29/90	269.4	270.15	127.0	104-124	145.4-165.4	127	142.4	Advance Outwash
LG-3	10/25/90	241.7	242.52	103.0	81-101	140.7-160.7	101	140.7	Advance Outwash
LG-4	10/31/90	207.4	208.16	75.5	53.5-73.5	153.9-133.9	60	147.4	Advance Outwash

[1]Elevations based on arbirtary datum of 200 feet in landfill vicinity

[2]All depths measured from ground surface

The deepest geologic unit encountered at the site was fine-grained clay, silt, or clayey silt. The depths and elevations of this unit in the monitoring wells are listed in Table 2. The fine-grained texture of this unit and its probable position in the lower portion of the advance outwash or upper portion of the Transitional Beds suggests it was deposited in a locally ponded environment. Borings on the west side of the landfill encountered this unit at an elevation about 5 feet lower than the borings on the east side, indicating a slight westward dip. However, the geometry of this unit is probably more complex than it appears from the limited number of stratigraphic control points. Because of the uncertainty of the depositional environmental of this unit, it referenced in this report as "glacio-lacustrine (?) sediments".

Descriptions of the geologic units encountered at Lake Goodwin Landfill are summarized below.

Glacial Till
Very dense, brown-gray, sandy silt with scattered medium to coarse-grained, rounded to subrounded gravel. Till was encountered in only one boring, LG-2.

Advance Outwash
Fine to coarse sand, silty and gravelly sand, and sandy gravel; lenses of silt and clayey silt; dry in upper boring to saturated below water table; well-sorted with alternating layers of sand and gravel; gravel ranges from pebble to cobble.

Glacio-Lacustrine (?) Sediment
Clay, clayey silt, silt, and gravelly clay; very fine grained; gray; thinly laminated; very moist to saturated.

Groundwater

Four monitoring wells were installed in the uppermost aquifer capable of yielding monitorable quantities of groundwater. Dedicated Hydrostar pneumatic sampling pumps were installed in each well. Table 2 presents the monitoring well completion data, including screen depths, elevations, and the type of geologic material screened. Pump intake depths are included in Table A-1. All wells were completed in groundwater within the advance outwash aquifer perched on the glacio-lacustrine (?) silt/clay layer. The base of the wells

extend into the upper surface of the glacio-lacustrine (?) silt/clay layer. One shallow soil boring (LG-4S) was advanced to explore for shallow, perched groundwater with a hollow stem auger rig. This well was located approximately ten feet from LG-4. No groundwater was encountered and the boring was abandoned. The boring log is included in Appendix A.

Advance Outwash Aquifer

Unconfined aquifer conditions were observed in all wells screened in the advance outwash sand and gravel aquifer. Groundwater levels encountered at the time of drilling did not change appreciably with time. This and a thick unsaturated outwash zone above the water table suggest that the advance outwash aquifer behaves in an unconfined condition at the landfill.

Water well reports for water supply wells in the vicinity of the Lake Goodwin Landfill suggest a deep regional aquifer completed in the base of the Transitional Beds or in the upper portion of the Olympia inter-glacial deposits at a depth of 250 to 300 feet. The nearest water supply well identified in Washington State Department of Ecology files was well 20G owned by George Elder. The location of this well is shown in Figure 1 and the driller's log for this well is included at the end of Appendix A. This well had a reported depth to water of 270 feet, at a ground surface elevation estimated at approximately 40 feet higher than the landfill. Driller's logs for wells completed in the deep regional aquifer suggest a westerly groundwater flow direction discharging in the bluffs above Puget Sound.

Water level data and groundwater flow suggest the completion zone of the groundwater monitoring wells is perched above the deep regional aquifer. Monitoring wells at the landfill were completed approximately 100 feet above the groundwater depth estimated from water well reports for the deep regional aquifer. The groundwater flow direction beneath the landfill, evaluated from the monitoring wells, trends north-northeast rather than westerly toward Puget Sound, as suggested from deeper water well reports near the landfill. These data suggest that the monitoring wells at the landfill are completed in an aquifer perched on the underlying silt and clay layer.

Groundwater Flow Direction

A groundwater flow map is presented in Figure 2. Table 3 contains groundwater elevation data for each monitoring well. The groundwater contours or equipotential lines shown on Figure 2 represent lines of equal hydraulic head. The direction of groundwater flow can be determined by drawing flow lines perpendicular to the contour lines. Equipotential lines for the perched, advance outwash aquifer suggest that the groundwater flow direction is north-northeast across the site toward an unnamed stream shown on Figure 1. The hydraulic gradient is relatively shallow at the landfill, varying from 0.003 to 0.005. The unnamed stream has an elevation approximately 100 feet lower than the landfill and is incised in advance outwash (Minard, 1985), suggesting it may serve as a groundwater discharge zone for the advance outwash aquifer.

TABLE 3

STATIC WATER ELEVATIONS

Monitoring Well	2-inch Casing Top Elevation (feet)	Date	Time	Static Water Level Depth (feet)	Static Water Level Elevation[1] (feet)
LG-1	240.41	10/28/90	09:00	87.74	152.67
		2/25/91	08:30	86.88	153.53
		3/13/91		86.67	153.74
LG-2	270.15	10/28/90	09:00	116.94	153.21
		2/25/91	08:30	116.31	153.84
		3/15/91		116.17	153.98
LG-3	242.52	10/28/90	08:30	90.89	151.63
		2/25/91	09:00	86.99	155.53
		3/13/91		89.66	152.86
LG-4	208.16	2/25/91	08:30	56.25	151.91
		3/15/91		55.95	152.21

[1]Elevations are relative to arbitrary 200 feet datum in landfill vicinity

Aquifer Properties

Hydraulic properties of the perched, advance outwash aquifer at the Lake Goodwin site were tested. Aquifer properties were analyzed by pump tests of wells LG-1, LG-3, and LG-4. Test results are presented below; the aquifer test procedures are described in Appendix B.

Well	Analysis Method	Transmissivity (ft^2/day)	Hydraulic Conductivity (ft/day)
LG-1	Cooper & Jacob, 1946	469.0	104.2
LG-3	Cooper & Jacob, 1946	1588.0	144.4
LG-4	Cooper & Jacob, 1946	576.0	38.4

The geometric mean of hydraulic conductivity estimates for advance outwash wells at the site is 83.3 ft/day, typical of clean sand and the upper limit of silty sand (Freeze and Cherry, 1979). The range of values varied from 38.4 to 144.4 ft/day (Table 3). The geometric mean of more than one hydraulic conductivity estimate from the same flow system is the best indicator of the overall effective hydraulic conductivity because the value takes into account the anisotropy of the aquifer matrix. The geometric mean lies between the harmonic mean, representative of the hydraulic conductivity parallel to permeability boundaries (e.g., along bedding), and the arithmetic mean, representative of the hydraulic conductivity perpendicular to permeability boundaries (e.g., across bedding) (Bouwer, 1978).

Groundwater Velocity

An estimate of groundwater flow velocity was made for the advance outwash aquifer using a modified form of Darcy's Law, as shown below:

$$\upsilon = \frac{KI}{\eta_e}$$

Where:
υ = Groundwater Velocity (L/t)
K = Hydraulic Conductivity (L/t)
I = Hydraulic Gradient (L/L)
η_e = Effective Porosity (Dimensionless)

Assuming an effective porosity of 0.20, a hydraulic conductivity of 83.3 ft/day (from pump test results), and a hydraulic gradient of 0.004 ft/ft (estimated from hydraulic head data), the average linear velocity for groundwater flow in the advance outwash aquifer at the site was estimated to be about 1.6 ft/day.

At the request of Snohomish County, the groundwater flow direction and velocity were also calculated using a computer model called Water-Vel (In-Situ, Inc.). The purpose of the computer model is to enable the County to provide annual updates of groundwater flow direction and velocity. Water Vel results indicate a groundwater flow velocity of 1.24 ft/day, which compares favorably with the hand-calculated velocity. Appendix D provides an explanation of the program and input parameters.

GROUNDWATER QUALITY

Snohomish County personnel collected a single groundwater sample from each monitoring well at the Lake Goodwin Landfill on December 17, 1990 for analysis of parameters listed in the Minimum Functional Standards (MFS) and on December 27, 1990 for priority pollutant compounds. The samples were submitted to Laucks Testing Laboratories, located in Seattle , Washington. Parameters analyzed in the laboratory included:

A. Parameters and constituents stated in WAC 173-304-490 (MFS parameters):

Parameters	Constituents
pH	chloride (300.0)
specific conductance	nitrate, nitrite, ammonia
chemical oxygen demand	sulfate
total organic carbon	dissolved iron (236.1)
total coliform	dissolved manganese (243.1)
	dissolved zinc (289.1)

B. Priority pollutant inorganics and organics:

Inorganic Compounds	Organic Compounds
13 priority pollutant metals	Organochlorine Pesticides and PCBs (8080)
total phenol	Semivolatile Organics (8270)
cyanide	Volatile Organics (8240)

Field measured parameters are presented in Table 4. Laboratory-reported analytical results and analytical test methods are listed in Appendix C and detected concentrations are summarized in Tables 5 and 6.

TABLE 4
FIELD-MEASURED PARAMETERS

Well Number	Date	pH	Specific Conductance (μmhos @ 25°C)	Temperature (°C)
LG-1	12/27/90	6.69	244	9.7
LG-2	12/27/90	7.42	195	8.5
LG-3	12/27/90	6.79	1010	11.9
LG-4	12/27/90	6.62	360	9.0

Water Quality Standards

Standards for several inorganic and organic chemicals have been promulgated by the U.S. Environmental Protection Agency (EPA). These standards are listed in Tables 5 and 6. The Maximum Contaminant Level (MCL) is the maximum permissible level of a contaminant in water delivered to any user of a public water system. National Secondary Maximum Contaminant Level (SMCL) are federally non-enforceable regulations used to control non-health-based factors that affect the aesthetic qualities of water such as taste, odor, or staining characteristics. No health based drinking water standards were exceeded in the groundwater samples obtained from Lake Goodwin Landfill.

Background Conditions

Because many of the parameters measured to evaluate leachate-impacted groundwater occur naturally, data can be collected to represent natural background conditions. Monitoring data can then be compared to background levels to determine if the sample parameter is elevated. Chloride, nitrate, nitrite, specific conductance, and sulfate appear to be the best indicator parameters of landfill effects on water quality. The relative concentration for this set of parameters is generally consistent with the groundwater flow pattern shown in Figure 2.

TABLE 5
MFS MONITORING PARAMETERS – ANALYTICAL RESULTS

PARAMETER	LG-1	LG-2	LG-3	LG-4	MCL	SMCL
AMMONIA as N (mg/l)	<0.01	<0.01	<0.01	0.01	--	--
CHEMICAL OXYGEN DEMAND (mg/l)	<10	<10	<10	<10	--	--
CHLORIDE (mg/l)	9	7	51	10	--	250
HARDNESS AS CaCO3 (mg/l)	170	76	360	170	--	--
DISSOLVED IRON (mg/l)	<0.05	<0.05	<0.05	<0.05	--	0.3
DISSOLVED MANGANESE (mg/l)	0.005	0.032	0.016	0.004	--	0.05
NITRATE as N (mg/l)	1.2	0.5	9.7	1.6	10	--
NITRITE as N (mg/l)	<0.005	<0.005	0.008	<0.005	--	--
SPECIFIC CONDUCTANCE (umohs/cm)	240	180	1000	350	--	700
SULFATE as SO4 (mg/l)	24	10	110	22	--	250
TOTAL COLIFORM (MPN per 100ml)	17	70	8	7	--	*
TOTAL ORGANIC CARBON (mg/l)	3.1	2.7	6.7	1.8	--	--
DISSOLVED ZINC (mg/l)	0.007	0.01	0.006	0.011	--	5
pH	6.8	7.2	6.7	6.6	--	6.5-8.5

*No more than 5% of the samples may be positive. For systems collecting fewer than 40 samples/mo., no more than 1 sample may be positive (USEPA).

TABLE 6

SUMMARY OF PRIORITY POLLUTANT ANALYTICAL RESULTS

PARAMETER	DATE	LG-1	LG-2	LG-3	LG-4	MCL	SMCL
DISSOLVED METALS							
CHROMIUM (ug/l)	12/27/90	15	10	12	6.6	50	--
COPPER (ug/l)	12/27/90	2.9	4	7	1.5	1300**	1000
NICKEL (ug/l)	12/27/90	7.2	3.6	15	4.4	100**	--
ZINC (ug/l)	12/27/90	2.9	3.3	2.8	3	--	5000
DI-N-BUTYL PHTHALATE (ug/l)	12/27/90	1	<1	1	<1	--	--
ACETONE (ug/l)	12/27/90	22*	18*	13*	59*	--	--

*11 ug/l present in method blank

**Proposed or tenative MCL

Monitoring well LG-2, located hydraulically upgradient of the landfill, had the lowest value for each of the five indicator parameters with the values close to groundwater quality conditions reported by Newcomb (1952) for the advance outwash aquifer. Other parameters were not considered good leachate indicators because either regional concentrations showed considerable variation or they were not present in detectable concentrations. Well LG-2 is considered to be indicative of background conditions.

Groundwater Quality

Water quality parameters were slightly elevated in wells LG-1 and LG-4 compared to background conditions measured in well LG-2 (Table 5). Well LG-1 is located east of the landfill also hydraulically upgradient (Figure 2). Water quality parameters in this well were slightly elevated in some parameters compared to LG-2, but probably still within the range of natural background conditions.

Water quality downgradient of the east side of the fill area was monitored by well LG-4. This monitoring point had slightly higher concentrations of indicator parameters than upgradient wells LG-1 and LG-2. A relatively minor impact to groundwater from landfill leachate may be affecting this well, but additional sampling will be necessary for confirmation.

The indicator parameters were most elevated in well LG-3, consistent with its hydraulic location. This well lies downgradient of a relatively larger portion of fill material than well LG-4. In addition, approximately 15 feet of refuse mixed with daily cover material was encountered during the drilling of LG-3, making this well susceptible to directly downward migrating leachate.

Specific conductance in this well was measured at 1000 μmhos/cm compared to 180 μmhos/cm in background well LG-2. Other indicator parameters ranged from 5 to 10 times greater than their respective background concentrations, with the exception of nitrate, which was 20 times the background concentration. With the exception of nitrate in this well, no other monitoring wells indicate contamination approaching primary drinking water standards.

CONCLUSIONS

1. Groundwater was encountered in advance outwash material at a depth of about 100 feet below ground surface. This uppermost aquifer is perched above the deeper, regional aquifer on a silt or clayey aquitard. All monitoring wells terminate in the aquitard. Wells LG-1, LG-2 and LG-3 were terminated in the silt and/or clay, while in well LG-4 the aquitard consisted of lenses of clay and silt within a silty sand.

2. Groundwater flow direction in the uppermost aquifer is north-northeast at a calculated velocity of about 1.6 ft/day.

3. Wells LG-1 and LG-2 are located upgradient and are indicative of background water quality conditions. Well LG-2 is most likely to be continuously representative of background conditions.

4. The greatest leachate impact to groundwater was observed at well LG-3. No health based standards were exceeded in any of the wells, although nitrate approaches the MCL of 10 mg/l in well LG-3. Four priority pollutant metal compounds were detected in all wells: chromium, copper, nickel and zinc. However, only copper and nickel appear to have a relationship to landfill leachate.

RECOMMENDATIONS

1. The Water-Vel model appears appropriately suited for updating groundwater flow velocity and direction. This model could be used by County staff in the future for calculating these parameters.

2. Because of the relatively flat groundwater gradient, it is recommended static water level measurements be obtained with an electronic sounder instead of the differential pressure gages (refer to Appendix A for further discussion).

3. If surface leachate seepage is observed again in the drainage swale on the west side of the fill area, the County should obtain samples to evaluate leachate components.

4. It is our understanding that the County will perform quarterly monitoring of the existing wells for MFS parameters and semi-annual sampling for priority pollutants. If no significant change in water quality is observed in well LG-1 after the first year, we recommend sampling of this well be terminated. This well should continue to be used for groundwater level measurements and evaluation of groundwater flow direction and velocity.

5. The possibility exists leachate-impacted groundwater is passing beneath the north end of the landfill between wells LG-3 and LG-4. An additional well installed at the location indicated on Figure 2 is recommended to evaluate this. The well should be completed in the advance outwash with the screened interval extending 10 feet into the aquifer and 10 feet above the aquifer. This well could be overdrilled to a depth of about 200 feet to determine the depth and continuity of the aquitard.

6. The deeper, regional aquifer beneath the landfill may be recharged by seepage through the aquitard underlying the uppermost aquifer. If sampling of the existing wells or the proposed well indicates an MCL has been exceeded, consideration should be given to completing three deep

monitoring wells to monitor potential impacts to the regional aquifer. Geologic conditions encountered when overdrilling the proposed well should be evaluated to determine if monitoring of the deep aquifer is necessary. If the deep wells are necessary, two wells should be located on the west side and an upgradient well should be located in the vicinity of LG-1. The two wells on the west side should be located outside the extent of refuse.

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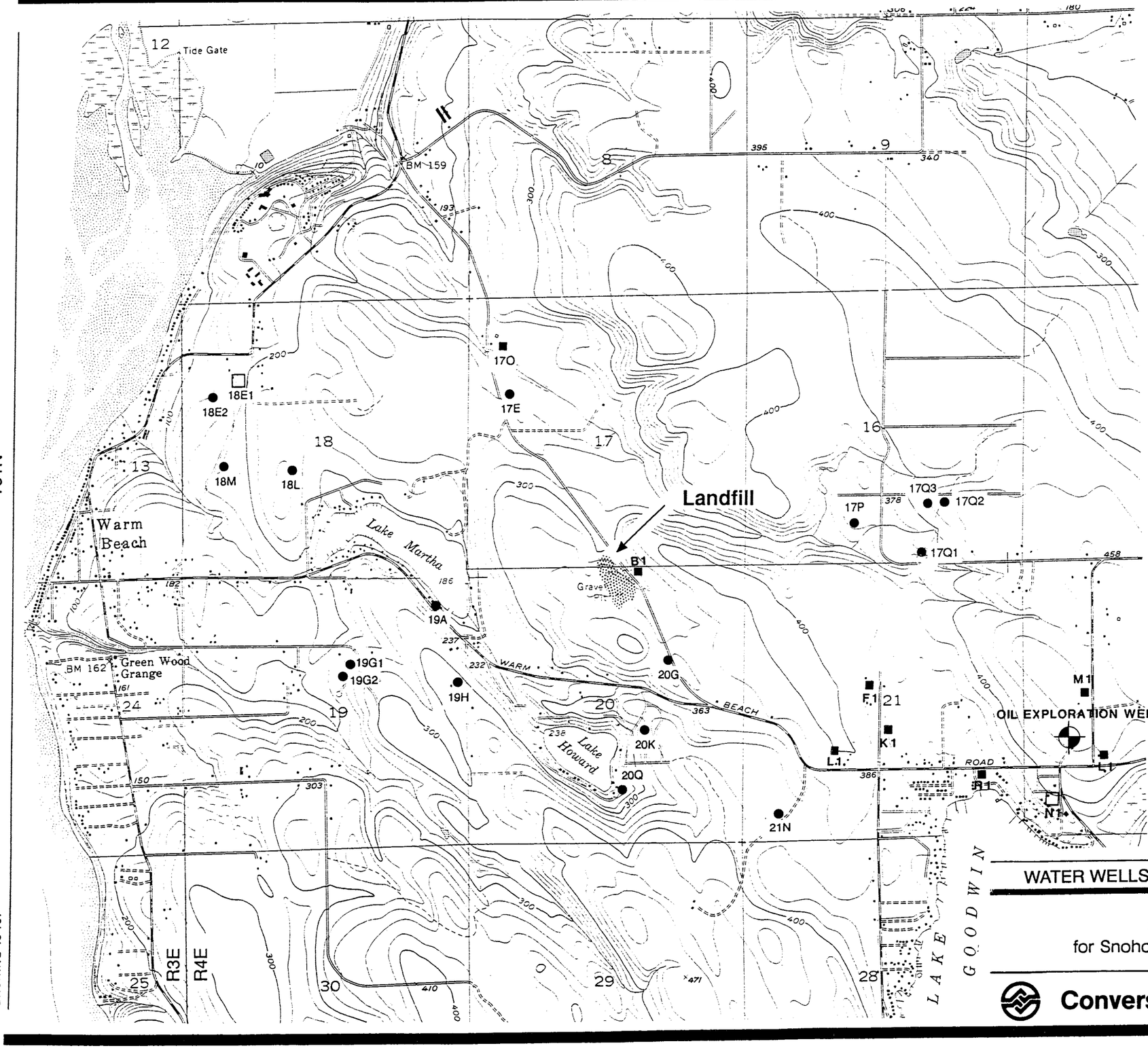
T31N



LEGEND

- APPROXIMATE WASTE FILL AREA
- 24 — APPROXIMATE LOCATION OF DRILLED WELL WITH DRILLER LOG
- L1 — APPROXIMATE LOCATION OF HAND DUG WELL (NEWCOMB 1952)
- M2 — APPROXIMATE LOCATION OF DRILLED WELL (NEWCOMB 1952)

REFERENCE: Base map compiled from portion of USGS 7 1/2' STANWOOD, WASHINGTON QUADRANGLE

1 2000 FEET
SCALE

WATER WELLS IN VICINITY OF LAKE GOODWIN LANDFILL

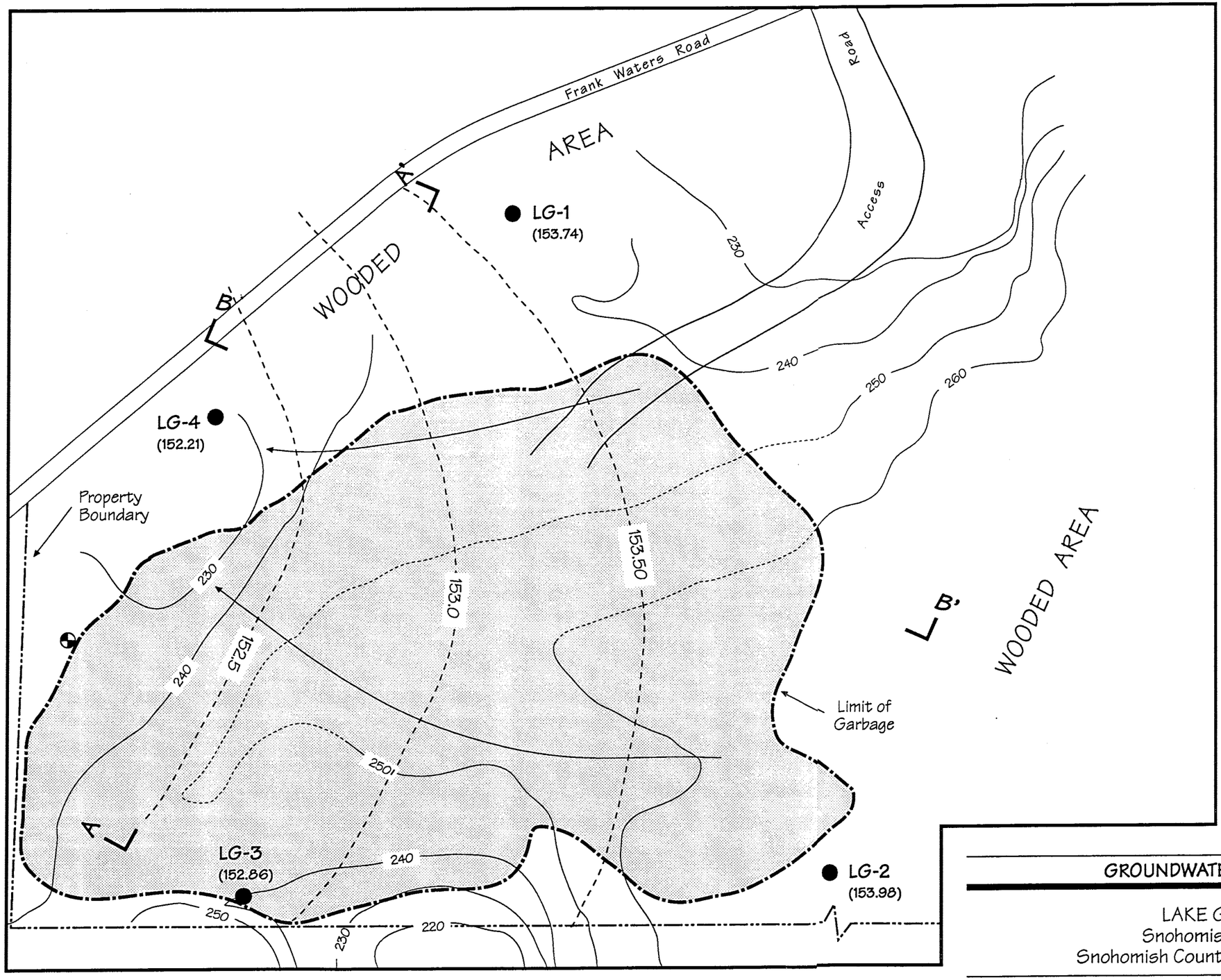
LAKE GOODWIN LANDFILL
Snohomish County, Washington
for Snohomish County Department of Public Works

Project No. 89-35228-10

Figure No. 1

Converse Consultants NW Geotechnical Engineering and Applied Earth Sciences

BRUNING 40-107



N

Legend

LG-1 (153.74) — Monitoring Well Location and No. with Static Water Level Elevation (in feet relative to assumed 200 foot datum)

Proposed Well Location

152.5 — Interpolated Contours of Potentiometric Surface (in feet relative to assumed 200 foot datum)

240 — Controlled Elevation Contours (in feet, contour interval 10 feet)

250 — Interpolated Elevation Contours (in feet, contour interval 10 feet)

Scale

0 100'

Source: *Lake Goodwin Dump Closure —Site Plan, 1981*

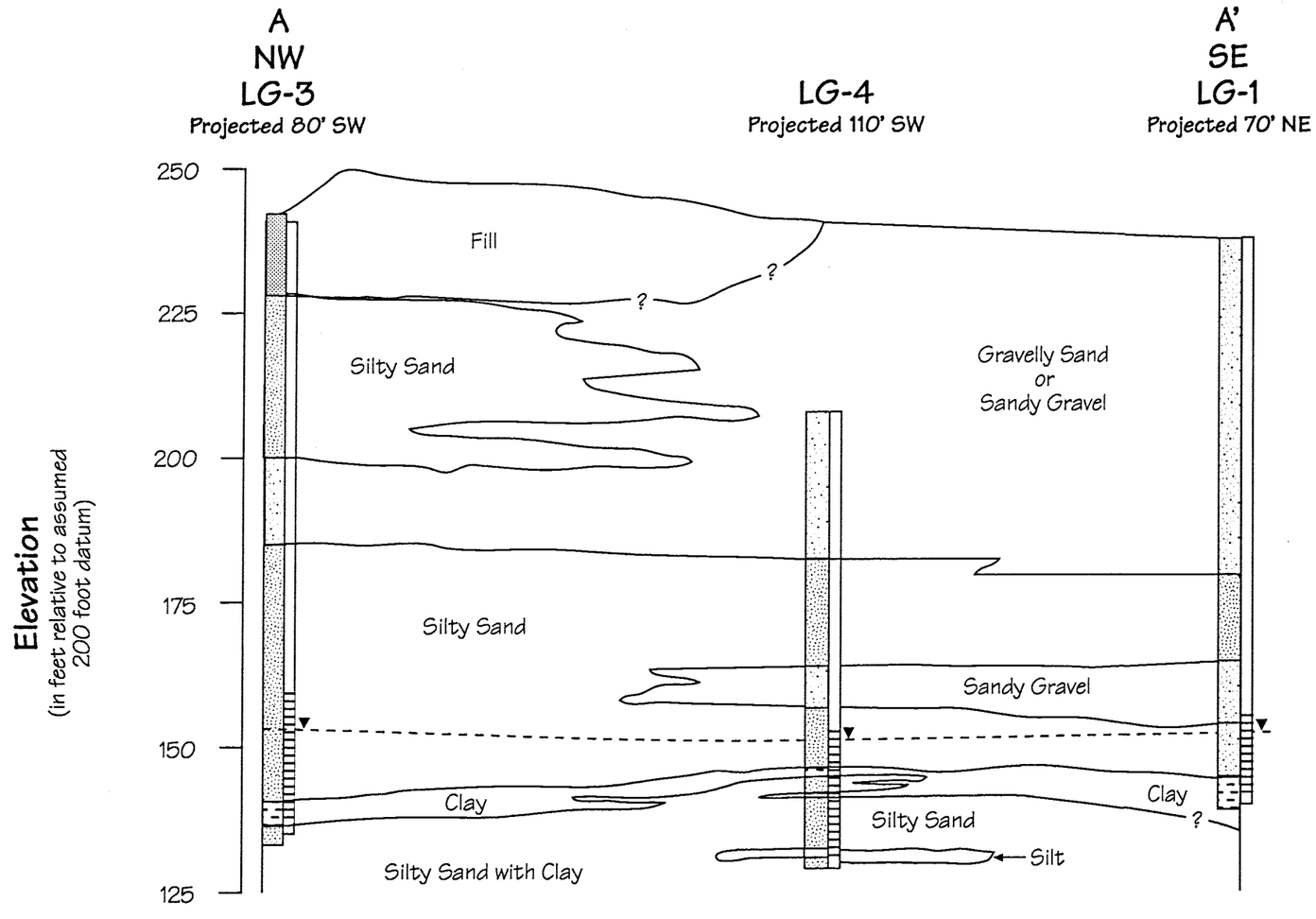
GROUNDWATER ELEVATION CONTOURS

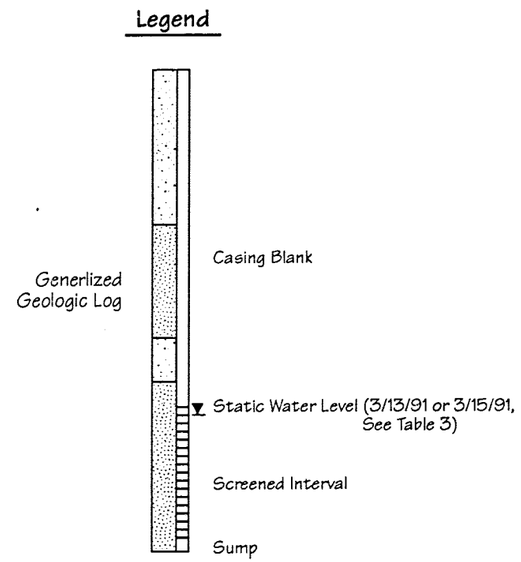
LAKE GOODWIN LANDFILL
Snohomish County, Washington
Snohomish County Department of Public Works

Project No. 89-35228-10

Figure No. 2

Converse Consultants NW Geotechnical Engineering and Applied Earth Sciences





Scale

25'

100'

4X Vertical Exageration

Source:

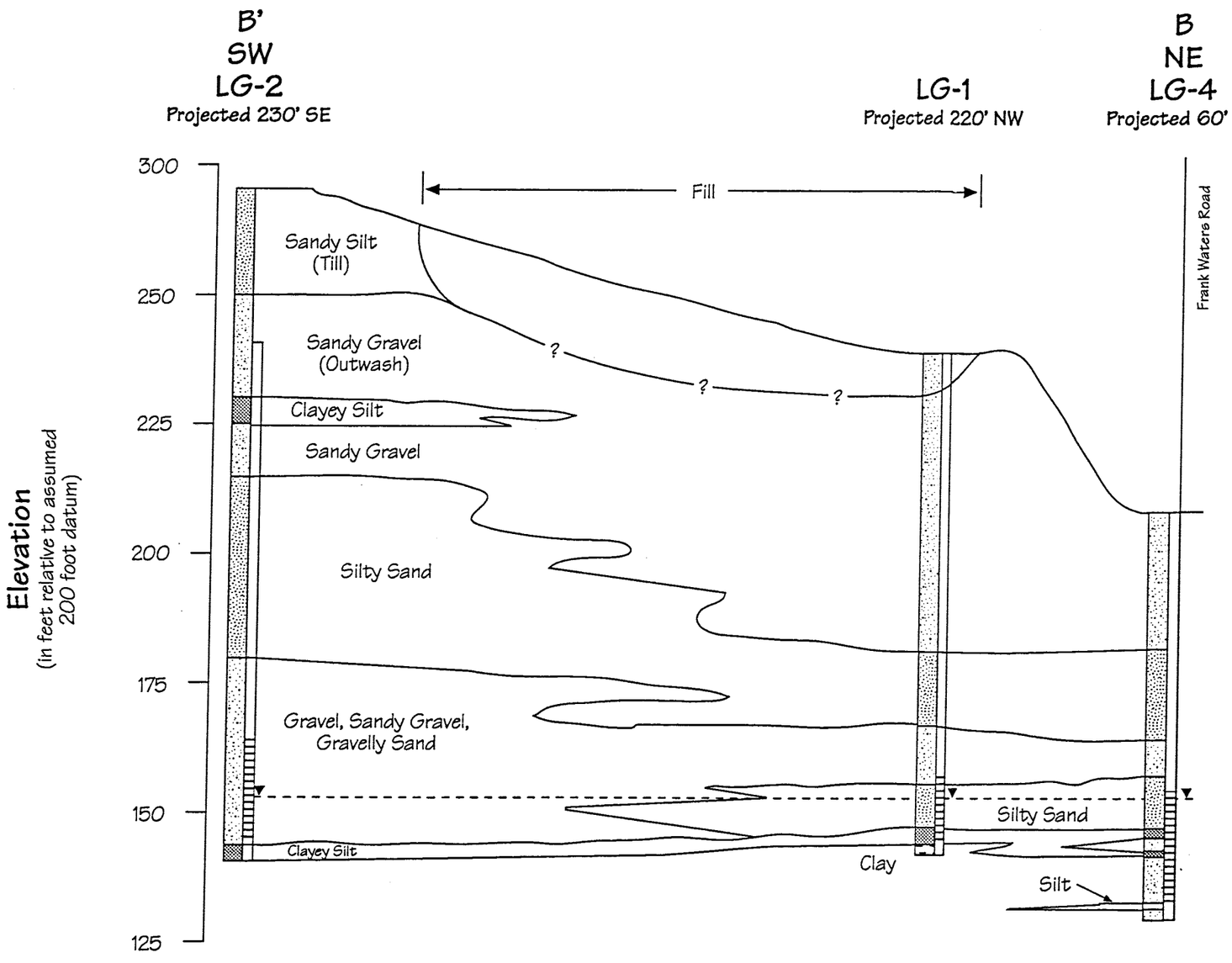
GEOLOGIC CROSS-SECTION A-A'

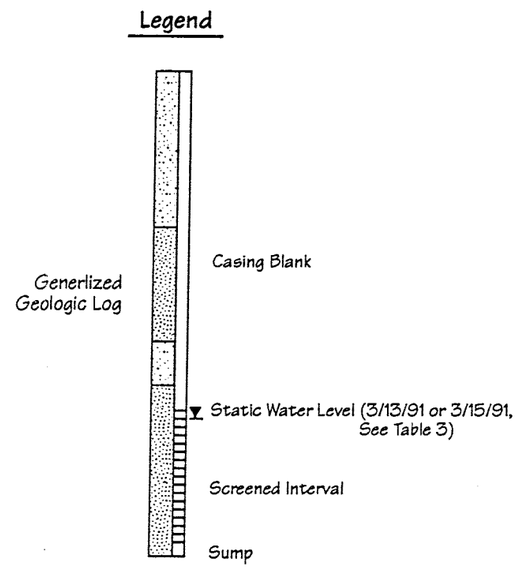
LAKE GOODWIN LANDFILL
Snohomish County, Washington
Snohomish County Department of Public Works

Project No.
89-35228-10

Figure No.
3

Converse Consultants NW Geotechnical Engineering and Applied Earth Sciences





Scale

25'

100'

4X Vertical Exaggeration

Source:

GEOLOGIC CROSS-SECTION B-B'

LAKE GOODWIN LANDFILL
Snohomish County, Washington
Snohomish County Department of Public Works

Project No.
89-35228-10

Figure No.
4

Converse Consultants NW Geotechnical Engineering and Applied Earth Sciences

Appendix A

APPENDIX A

MONITORING WELL INSTALLATIONS AND BORING LOGS

Four groundwater monitoring wells, LG-1 through LG-4, were drilled around the perimeter of the Lake Goodwin Landfill between October 15 and 30, 1990. In addition, one boring, LG-4S, was drilled to investigate potential shallow perched groundwater. No shallow groundwater was encountered and this wells was subsequently abandoned. Boring LG-4S was located approximately 20 feet from well LG-4.

WELL LOCATIONS

Well locations are shown in Figure 2. Wells LG-1 through LG-3 were drilled first. The locations of these wells were selected based on the preliminary hydrogeologic assessment report (Converse, 1989). During drilling, it was recognized that perched groundwater, substantially shallower than indicated on the water well reports for nearby domestic supply wells, was present beneath the landfill. Wells LG-1, LG-2, and LG-3 were surveyed by Converse on November 29, 1990 and the groundwater flow direction was estimated based on the surveyed elevations and static water level measurements. Well LG-4 was then sited in a downgradient location based on this analysis.

Surveyors from Snohomish County Public Works Department surveyed the top of the 2-inch-diameter stainless steel casing on January 2, 1991. Surveyed elevations for the wells are presented in Table 2. An arbitrary datum of 200 feet was assigned to a temporary benchmark on Frank Water Road, in the vicinity of well LG-4.

Boring and well completion diagrams are included at the end of this appendix. In addition, the well logs shown on Figure 1 are included at the end of the boring logs. Hydraulic test methods are presented in Appendix B.

DRILLING AND SAMPLING

Ponderosa Drilling of Spokane, Washington, under contract to John Mathes, drilled the four borings installed in this investigation using a CP 7000 truck-mounted drill rig. They advanced the borings with air rotary methods using a 6-inch-diameter tricone bit. Six-inch inside diameter (I.D.) steel casing was used to temporarily seal the borings during drilling.

Drilling equipment was decontaminated using a steam cleaner prior to the beginning of the project, between borings, and at the conclusion of the project. Water used during drilling was obtained from a nearby hydrant. Prior to use, a sample of the water (LG-F) was collected by Snohomish County Solid Waste Management Division personnel and analyzed for MFS parameters. Analytical testing results are included in Appendix C for sample LG-F. Air from the rig was tested prior to use for benzene, toluene, ethylbenzene, and total xylenes. None of these compounds were detected in the analytical testing.

All drilling and sampling operations were continuously observed by a hydrogeologist from Converse Consultants NW. Classifications and descriptions of soil were recorded and additional information, such as drilling action and drillers comments, were also recorded. Drilling operations were monitored between 20-foot runs for organic vapors, combustible gases, hydrogen sulfide, hydrogen cyanide, and carbon monoxide using a photoionization detector, an explosimeter, a hydrogen sulfide meter, and Dräeger tubes, respectively.

Soil samples were captured at 5-foot intervals or less from a cyclone using a stainless steel strainer. Soil samples were placed in a wide mouth polyethylene container. All samples recovered in the field were classified and described according to their geologic mode of origin and their textural characteristics. Soil samples from 5 feet below ground surface, immediately above the water table, and immediately below the water table were submitted for testing of MFS parameters at an analytical laboratory. Results of these analyses are presented in Appendix C.

MONITORING WELL INSTALLATIONS

Monitoring wells were installed following completion of drilling and sampling operations. The final monitoring well assemblies are shown on the boring logs.

All monitoring well casing and screen sections consisted of 2-inch-diameter threaded joint, Schedule 5S Type 316 stainless steel. Well screen slot size was 0.01-inch slot. A 5-foot bottom sump with a threaded end cap was attached to the bottom of the screened interval of each well as a sediment trap. Two stainless steel centralizers were placed above and below the screened interval. The casing assembly was installed through the 6-inch-diameter temporary casing. The temporary casing was pulled back using a combination of hydraulic lift and casing hammer.

Colorado silica sand (U.S. sieve size 10/20) was placed from the bottom of the well to approximately 7 feet above the top of the well screen. A 5-foot-thick bentonite chip seal (Medium PureGold bentonite chips) was placed at the top of the sand pack. Both the sand pack and bentonite chip seal were placed by hand and allowed to settle in place. The filter pack was sounded continuously during installation. The depth to the top of the sand pack and bentonite seal was checked with a weighted fiberglass tape.

A high solids bentonite slurry (high solids bentonite clay grout) was placed with a tremie pipe on top of the bentonite chip seal. A cement grout (Portland cement types 1 and 2) was tremied on top of the high solids bentonite slurry. Bentonite was added to the cement grout mixture to reduce shrinkage. The cement grout was brought to within about 3 feet below ground surface.

A 10-inch-diameter, steel, locking, protective casing was set in place with concrete. The protective casing extended from 3 feet below ground surface to 14 inches above the top of the monitoring well. The top of each monitoring well was cut off 0.79 foot above ground surface. Concrete was added inside the protective casing to ground surface. A padlock supplied by Snohomish County Solid Waste Management Division was used to lock all protective casings. Concrete traffic barriers were placed in a triangular arrangement around the protective casing.

WELL DEVELOPMENT

The monitoring wells were developed by overpumping with an air-lift pump, a hand pump, or a bailer until the groundwater was relatively clear and free of suspended material. The wells, completed in the advance outwash sand and gravel, developed in a relatively short period of time.

Additional development was performed on well LG-3. Cement bentonite grout was found in the inside of the casing of this well at the 20-foot casing blank joint. Apparently, the jarring action of the casing hammer caused the joint to loosen. Upon discovering the grout seepage, the driller was able to tighten the joint about one-half turn. In order to flush the grout out of the blank, a packer was placed beneath the joint at about 40 feet below ground surface. The upper portion of the well casing was then alternately flushed, the packer was partially deflated and used to swab the 20-foot joint, the packer was removed and cleaned, and the packer replaced to 45 feet and the casing flushed again. This procedure was repeated for approximately 1 hour. During development, pH was carefully monitored. pH decreased from about 9.0 in the initial measurement to a stabilized measurement of about 7.0.

DEDICATED SAMPLING PUMPS

Hydrostar dedicated pneumatic sampling pumps and differential pressure gauges were installed in all of the monitoring wells. Intake depths of the Hydrostar pumps are listed in Table A-1 and shown on the boring logs. Groundwater levels are determined utilizing a Differential Pressure Gauge (DPG), which measures the pressure exerted by the groundwater within a small diameter air tube. The depth to groundwater below ground surface is calculated by the following relationship.

$$ATD - X$$

Where: X = digital reading on the DPG converted from inches to feet
ATD = Air tube orifice depth (feet)

Table A-1 lists the installation parameters of the air lines and groundwater depths obtained on February 25, 1991.

Alternatively, groundwater level measurements can be made using an electrical sounder through an access port at the top of the casing cap. Hand measurements are recommended at Lake Goodwin Landfill over the DPG. A minor lack of sensitivity could potentially result in significant errors in calculating the groundwater gradient under such low gradient conditions. In addition, well LG-2 has been observed venting air. Pressure build up in this well could result in erroneous measurements with the DPG.

The gas venting from LG-2 was field-tested for methane, total organic vapors, carbon dioxide and hydrogen sulfide. None of these constituents were detected. The gas had no odor and is believed to be air. The discharge is intermittent and may be related to barometric pressure changes.

TABLE A-1
Snohomish County Lake Goodwin Landfill
Groundwater Level Data from Air Tube

MONITORING WELL	DATE	HYDROSTAR INTAKE DEPTH (FEET)	AIR TUBE DEPTH (FEET)	DPG READING (FEET)	DEPTH TO WATER (FEET)	TOP OF PROTECTIVE SURFACE CASING ELEVATION (FEET)	TOP OF WELL CASING ELEVATION (FEET)	GROUND SURFACE ELEVATION (FEET)	WATER ELEVATION (FEET)
LG-1	2/25/91	91.00	89.79	4.13	85.66	242.08	240.41	239.6	153.9
LG-2	2/25/91	120.00	118.79	0.07	118.72	271.82	270.15	269.4	150.7
LG-3	2/25/91	94.00	92.79	4.22	88.57	244.19	242.52	241.7	153.1
LG-4	2/25/91	61.00	59.79	3.92	55.87	209.83	208.16	207.4	151.5

NOTES: 1. DEPTHS MEASURED FROM GROUND SURFACE
2. ELEVATIONS RELATIVE TO ARBITRARY 200 FT DATUM

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-1	1 of 3

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 240.41
Surface Elevation: 240
Water Level Elev.: 153
Start Date: October 13, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 15, 1990
Drilling Method: Air Rotary

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
	locking 10" steel protective casing Quikcrete annular seal					Topsoil
						ADVANCE GLACIAL OUTWASH SILTY SAND; brown; fine to very coarse sand, some granules; dry; loose
5	well casing, 2" ID Type 316 stainless steel					hard drilling, large boulder
	cement grout annular seal					SILTY SANDY GRAVEL; gravel cobble to small boulder in size
10						
15						SILTY SANDY GRAVEL; cobble-size gravel
20						SANDY GRAVEL; brown; trace silt; coarse to very coarse sand; well rounded to subrounded gravel, pebble to small cobble in size
25						SANDY GRAVEL; brown; trace silt; medium to very coarse sand; subangular to rounded gravel, granule to pebble size
30						increasing silt, some fine sand
						increasing sand
35	high solids bentonite slurry					VERY SANDY GRAVEL; brown; gravel granule with some pebbles

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel
- Water Level (date measured)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties
- Water Level (ATD)

Logged by: EWM
Approved by: EWM

Figure No. A-1

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-1	2 of 3

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 240.41
Surface Elevation: 240
Water Level Elev.: 153
Start Date: October 13, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 15, 1990
Drilling Method: Air Rotary

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
						ADVANCE GLACIAL OUTWASH SAND; medium to coarse; trace silt; some gravel, pebble size
45						increasing fines
50						SAND; gray-brown; medium to coarse; some fine sand and silt
						GRAVELLY SAND; gray-brown; some silt; medium to coarse sand; gravel granule to small pebble size
55						
						SILTY SAND; brown; fine to medium
60						
65						few pebbles; less silt
70	bentonite pellets					no gravel; increasing silt grades gravelly
75	10/20 silica sand filter pack					SANDY GRAVEL; gravel is pebble to small cobble size, mostly subangular, clasts are quartz, siltstone, granitic, volcanic rock fragments

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel
- Water Level (date measured)
- Water Level (ATD)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties

Logged by: EWM
Approved by: EWM

Figure No. A-1

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-1	3 of 3

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 240.41
Surface Elevation: 240
Water Level Elev.: 153
Start Date: October 13, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 15, 1990
Drilling Method: Air Rotary

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
						ADVANCE GLACIAL OUTWASH
						SANDY GRAVEL; some silt; gravel pebble to cobble size
85	well screen 2" ID Type 316 stainless steel, 0.01" slot					CLAYEY SILTY SANDY GRAVEL; brown; water
	3/13/91 ATD					
90	Hydrostar pump intake					VERY SILT CLAYEY SAND; brown; coarse to very coarse sand; gravel granule size; possible water
						GLACIO-LACUSTRINE (?)
	sediment trap, Type 316 stainless steel					SILT; trace clay
95						GRAVELLY CLAY; gray; gravel pebble size, in clay matrix
	threaded end plug					
	cave in					
100						Total depth, 100 feet
						*Elevations relative to arbitrary 200 feet datum
105						
110						
115						

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel
- Water Level (date measured)
- Water Level (ATD)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties

Logged by: EWM
Approved by: EWM

Figure No. A-1

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-2	1 of 4

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 270.15
Surface Elevation: 269
Water Level Elev.: 153
Start Date: October 27, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 29, 1990
Drilling Method: Air Rotary

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
	locking 10" steel protective casing Quikcrete annular seal					GLACIAL TILL
5	well casing, 2" ID Type 316 stainless steel					SANDY SILT WITH GRAVEL; brown-gray; medium to coarse gravel, rounded to subrounded; moist
	cement grout annular seal					
10						increasing sand
15						increasing gravel
						ADVANCE GLACIAL OUTWASH
20						SANDY GRAVEL; gray-brown; some silt; medium to coarse sand; rounded to subrounded gravel, granule to pebble size
25						
30						SANDY GRAVEL; brown; less silt
35						SANDY GRAVEL; increasing amounts of coarse sand

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel
- Water Level (date measured)
- Water Level (ATD)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties

Logged by: JJS
Approved by: EWM

Figure No. A-2

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-2	2 of 4

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 270.15
Surface Elevation: 269
Water Level Elev.: 153
Start Date: October 27, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 29, 1990
Drilling Method: Air Rotary

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
						ADVANCE GLACIAL OUTWASH CLAYEY SILT; rust-brown; little fine gravel; very fine grained
45						SILTY GRAVEL; brown; fine silt; granule to coarse gravel
						increasing sand
50	high solids bentonite slurry					SILTY SANDY GRAVEL; brown; unsorted; fine to coarse sand; rounded to angular gravel
						SILTY SAND; brown; fine to medium; few to little gravel; well sorted
55						
60						SILTY SAND; brown; medium to coarse sand
65						increasing brown silt - clayey silt
70						SILTY SANDY GRAVEL; brown; fine to coarse sand; medium to coarse gravel, few pebble size; unsorted
						SILTY SAND; gray-brown; little gravel; fine to coarse sand
75						

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel

Water Level (date measured)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties

Water Level (ATD)

Logged by: JJS
Approved by: EWM

Figure No. A-2

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-2	3 of 4

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 270.15
Surface Elevation: 269
Water Level Elev.: 153
Start Date: October 27, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 29, 1990
Drilling Method: Air Rotary

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
						ADVANCE GLACIAL OUTWASH
						SAND; brown; medium to coarse; well sorted
85						
90	bentonite pellets					grades more silty sand
95						SAND; brown; grades coarser
	10/20 silica sand filter pack					GRAVEL; gray; coarse to pebble size
100						GRAVEL; gray-brown; some coarse sand; rounded to subrounded gravel, granule to pebble size
105	well screen, 2" ID Type 316 stainless steel, 0.01" slot					grades more sand
110						grades more pebbles; well rounded
115	ATD 3/15/91					grades to coarse sandy gravel, gray
						grades more sand

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel

Lab Tests:
- S - Soil Properties
- C - Chemical Properties

Water Level (date measured)
Water Level (ATD)

Logged by: JJS
Approved by: EWM

Figure No. A-2

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-2	4 of 4

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 270.15
Surface Elevation: 269
Water Level Elev.: 153
Start Date: October 27, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 29, 1990
Drilling Method: Air Rotary

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
	Hydrostar pump intake					ADVANCE GLACIAL OUTWASH GRAVELLY SAND; gray; fine to coarse sand; gravel granule to pebble size
125	sediment trap, Type 316 stainless steel					grades coarser sand and gravel
	threaded end plug					GLACIO-LACUSTRINE (?) CLAYEY SILT; gray
130	heave 127 to 131 feet					
						Total depth, 131 feet *Elevations relative to arbitrary 200 feet datum
135						
140						
145						
150						
155						

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel
- Water Level (date measured)
- Water Level (ATD)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties

Logged by: JJS
Approved by: EWM

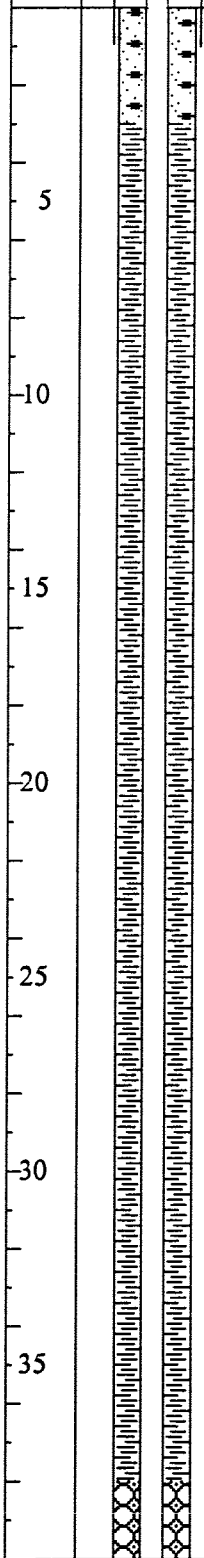
Figure No. A-2

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-3	1 of 3

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 245.52
Surface Elevation: 242
Water Level Elev.: 151
Start Date: October 23, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 25, 1990
Drilling Method: Air Rotary



Description
Topsoil
FILL refuse mixed with gravel
Refuse; brown and black; minor gravel and wood fragments; refuse consists of cloth, metal, glass fragments; moist
GRAVEL; brown; some refuse; granule to pebble size; wet
SILTY SAND; gray-brown; some clay and gravel; cloth fragments; medium sand
ADVANCE GLACIAL OUTWASH SILTY SAND; minor gravel; few twig fragments; medium to coarse sand
SILTY GRAVELLY SAND; gray; medium to very coarse sand
SILTY SAND; brownish-gray; fine to medium sand
decreasing silt

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel

Water Level (date measured)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties

Water Level (ATD)

Logged by: EWM
Approved by: EWM

Figure No. A-3

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-3	2 of 3

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 245.52
Surface Elevation: 242
Water Level Elev.: 151
Start Date: October 23, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 25, 1990
Drilling Method: Air Rotary

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
						ADVANCE GLACIAL OUTWASH SAND; gray-brown; minor silt; fine to medium sand
	high solids bentonite slurry					SILTY GRAVELLY SAND; gray; fine to coarse sand; gravel granule to pebble size
45						GRAVELLY SAND
50						GRAVELLY SAND; gray-brown; trace silt; medium to coarse sand; gravel granule to pebble size
55						SILTY SAND; gray-brown; fine to medium sand, trace coarse
60						
65						
70	bentonite pellets					
75						increasing silt
	10/20 silica sand filter pack					

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel

Water Level (date measured)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties

Water Level (ATD)

Logged by: EWM
Approved by: EWM

Figure No. A-3

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-3	3 of 3

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 245.52
Surface Elevation: 242
Water Level Elev.: 151
Start Date: October 23, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 25, 1990
Drilling Method: Air Rotary

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
						ADVANCE GLACIAL OUTWASH SILTY SAND (continued)
85	well screen, 2" ID Type 316 stainless steel, 0.01" slot					SILTY SAND; gray-brown; fine to some medium sand grades coarser
90	3/13/91 ATD					SILTY SAND; gray-brown; with minor pebbles; fine to medium sand, some coarse
95	Hydrostar pump intake					SILTY SAND; with minor pebbles grades siltier
100	sediment trap, Type 316 stainless steel threaded end plug					GLACIO-LACUSTRINE (?) SANDY SILTY CLAY; gray; dense occasional silty clay stringers
105	heave 103 to 107 feet					CLAYEY SILT SAND; brown; with silty clay stringers; very fine to fine sand grades more clay
110						Total depth, 107 feet *Elevations relative to arbitrary 200 feet datum
115						

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel
- Water Level (date measured)
- Water Level (ATD)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties

Logged by: EWM
Approved by: EWM

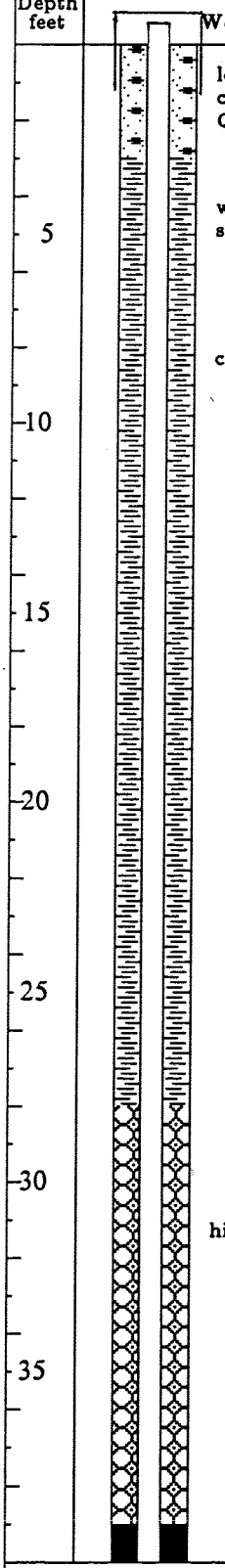
Figure No. A-3

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-4	1 of 2

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 208.16
Surface Elevation: 207
Water Level Elev.: 143
Start Date: October 29, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 30, 1990
Drilling Method: Air Rotary



Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
						ADVANCE GLACIAL OUTWASH
5						SILTY SAND WITH GRAVEL; brown; weathered; fine to medium sand; well rounded to subrounded gravel; dry
10						SILTY SAND WITH GRAVEL; gray-brown; medium to coarse sand; rounded to subrounded gravel, granule to pebble size
15						less gravel, well sorted
20						SAND; gray-brown; some gravel; few silt; medium to coarse sand, well sorted; rounded to angular gravel, coarse to cobble size
25						SILTY SAND; brown; few gravel; fine to medium sand
30						
35						grades to coarse sand
						grades to gravelly sand

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel

Lab Tests:
- S - Soil Properties
- C - Chemical Properties

Water Level (date measured)
Water Level (ATD)

Logged by: JJS
Approved by: EWM

Figure No. A-4

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-4	2 of 2

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing): 208.16
Surface Elevation: 207
Water Level Elev.: 143
Start Date: October 29, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 30, 1990
Drilling Method: Air Rotary

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
	bentonite pellets					ADVANCE GLACIAL OUTWASH GRAVELLY SAND; gray-brown; little silt; medium to coarse sand; coarse gravel
45						GRAVEL; gray; some sand; well rounded to subangular gravel, granule to cobble size
	10/20 silica sand filter pack					SILTY SAND; gray; with some gravel; fine to medium
50						
55	3/15/91 well screen, 2" ID Type 316 stainless steel, 0.01" slot					SILTY SAND; gray; well sorted grades to coarser sand
60	Hydrostar pump intake					SILTY SAND; gray; fine; gray clay stringers
65	ATD					SILTY SAND; gray; fine
70						
75	sediment trap, Type 316 stainless steel threaded end plug heave 75.5 to 77 feet					with light brown silt lenses Total depth, 77 feet *Elevations relative to arbitrary 200 feet datum

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel
- Water Level (date measured)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties
- Water Level (ATD)

Logged by: JJS
Approved by: EWM

Figure No. A-4

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-4S	1 of 2

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing):
Surface Elevation: 207
Water Level Elev.:
Start Date: October 13, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 13, 1990
Drilling Method: Hollow Stem Auger

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
						Topsoil
						ADVANCE GLACIAL OUTWASH VERY GRAVELLY SILTY SAND; brown; well rounded gravel, pebble to small cobble size; dry; loose
				8		
				8		
5				11		
	cement grout backfill					cobbles
						SAND; dark brown; trace silt; medium to very coarse; minor granule size gravel; slightly moist
				7		
				11		
10				14		
						grades finer
				8		SAND; dark brown; medium; trace silt; minor granule size gravel; subrounded to subangular sand, 50% quartz; well sorted
				14		
15				15		
						increasing silt
				8		SILTY SAND; dark brown; fine to medium; moist
				17		
20				19		
				11		SILTY SAND; fine to medium; moist
				20		
25				26		
				13		increasing silt
				28		
30				34		
				15		increasing silt, increasing moisture
				31		
35				41		
				38		VERY SILTY GRAVELLY SAND; gray; cohesive; coarse to very coarse sand; gravel granule to small cobble size
				58		
				49		

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel
- Water Level (date measured)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties
- Water Level (ATD)

Logged by: EWM
Approved by: EWM

Figure No. A-5

Converse NW

Monitoring Well Geologic & Construction Log

Project Number	Well Number	Sheet
89-35228-10	LG-4S	2 of 2

Project: Lake Goodwin Landfill
Location: Snohomish County, Washington
Elevation (Top of Well Casing):
Surface Elevation: 207
Water Level Elev.:
Start Date: October 13, 1990
Drilling Contractor: Ponderosa Drilling
Finish Date: October 13, 1990
Drilling Method: Hollow Stem Auger

Depth feet	Well Construction	Lab Tests	ST	Blows/ 6"	OVM Reading	Description
						ADVANCE GLACIAL OUTWASH
				26 55 67		SILTY SANDY GRAVEL; dark grayish brown; gravel to small cobbles; well rounded; very dense
45						SILTY SAND; gray; fine to medium; well sorted; moist; very dense
				16 36 59		
50						
				17 42 60		grades slightly coarser
55						Total depth, 54.5 feet Boring backfilled with cement grout
60						
65						
70						
75						

ST - Sampler Type:
- 2" OD Split Spoon
- Bulk Grab Sample
- Drive Barrel
- Water Level (date measured)

Lab Tests:
- S - Soil Properties
- C - Chemical Properties
- Water Level (ATD)

Logged by: EWM
Approved by: EWM

Figure No. A-5

WATER WELL REPORTS WITHIN APPROXIMATE ONE-MILE RADIUS OF LANDFILL

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

(31)

Application No. ....

Permit No. ....

(1) OWNER: Name Don Paquette Address 4717-183 St NW. Stanwood WA

(2) LOCATION OF WELL: County .... — SW ¼ SE ¼ Sec 16 T 31 N., R 04 W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: [✓ Domestic] Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)....

[✓ New well] Method: Dug ☐ Bored ☐
Deepened ☐ [✓ Cable] Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 131 ft. Depth of completed well 131 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: ......" Diam. from ...... ft. to ...... ft.
Threaded ☐ ......" Diam. from ...... ft. to ...... ft.
[✓ Welded] ......" Diam. from ...... ft. to ...... ft.

Perforations: Yes ☐ [✓ No]
Type of perforator used..................
SIZE of perforations ...... in. by ...... in.
...... perforations from ...... ft. to ...... ft.
...... perforations from ...... ft. to ...... ft.
...... perforations from ...... ft. to ...... ft.

Screens: [✓ Yes] No ☐
Manufacturer's Name..................
Type S.S. Model No. ....
Diam. 6 Slot size 10 from 126 ft. to 131 ft.
Diam. ...... Slot size ...... from ...... ft. to ...... ft.

Gravel packed: Yes ☐ [✓ No] Size of gravel: ....
Gravel placed from ...... ft. to ...... ft.

Surface seal: [✓ Yes] No ☐ To what depth? ...... ft.
Material used in seal clay
Did any strata contain unusable water? Yes ☐ [✓ No]
Type of water?...... Depth of strata ......
Method of sealing strata off..................

(7) PUMP: Manufacturer's Name..................
Type: .... H.P. ......

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ...... ft.
Static level 55 ft. below top of well Date......
Artesian pressure ...... lbs. per square inch Date......
Artesian water is controlled by...... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?......
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test 5-21-82
Bailer test 15 gal./min. with ...... ft. drawdown after 1/2 hrs.
Artesian flow...... g.p.m. Date......
Temperature of water...... Was a chemical analysis made? Yes ☐ [✓ No]

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Top soil	0	1
Hard pan	1	4
clay	4	31
Gravel	31	32
Hard pan	32	55
clay	55	125
silty sand	125	131

Work started......, 19...... Completed......, 19......

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Hitt Well Drilling
(Person, firm, or corporation) (Type or print)

Address 23926-54 ave NW Stanwood

[Signed] Everett Hitt
(Well Driller)

License No. 187 Date 5-21, 1982

(USE ADDITIONAL SHEETS IF NECESSARY)

Y 050-1-20

3

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

2/14-16P Application No.

Permit No. 61-24211P

(1) OWNER: Name DUNEDIN INDUSTRIES LTD Address P.O. BOX 612 STANWOOD WA

(2) LOCATION OF WELL: County SNOHOMISH SE 1/4 SE 1/4 Sec 16 T 31 N., R [illegible] W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☑ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)....

New well ☑ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☑ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled [illegible] ft. Depth of completed well 160 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from [illegible] ft. to [illegible] ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☐ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☑
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☑ No ☐
Manufacturer's Name [illegible]
Type [illegible] Model No [illegible]
Diam. [illegible] Slot size [illegible] from 155 ft. to 160 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☑ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☑ No ☐ To what depth? [illegible] ft.
Material used in seal [illegible]
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ft.
Static level 127 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☑ No ☐ If yes, by whom?
Yield: 55 gal./min. with 6 ft. drawdown after hrs.
" " "
" " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test [illegible]
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	160

Ridgecrest water system

RECEIVED
FEB 1 1984
DEPARTMENT OF ECOLOGY
NORTHWEST REGION

Work started , 19 Completed , 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME [illegible]
(Person, firm, or corporation) (Type or print)

Address [illegible]

[Signed] [illegible]
(Well Driller)

License No. 247 Date , 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

(57)

Application No. 51107-16A

Permit No. ....

(1) **OWNER:** Name Mr. Ronnie Christenson Address 1905 52nd Ave NW. Stanwood.

(2) **LOCATION OF WELL:** County SNOHO SW¼ SE¼ Sec. 16 T. 31 N., R. 04E W.M.

Bearing and distance from section or subdivision corner

(3) **PROPOSED USE:** Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one) ....
New well ☑ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☑ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 6 inches.
Drilled 161 ft. Depth of completed well 161 ft.

(6) **CONSTRUCTION DETAILS:**

Casing installed: ....." Diam. from .... ft. to .... ft.
Threaded ☐ ....." Diam. from .... ft. to .... ft.
Welded ☑ 6" Diam. from .... ft. to 161 ft.

Perforations: Yes ☐ No ☑
Type of perforator used....
SIZE of perforations .... in. by .... in.
.... perforations from .... ft. to .... ft.
.... perforations from .... ft. to .... ft.
.... perforations from .... ft. to .... ft.

Screens: Yes ☐ No ☑
Manufacturer's Name....
Type.... Model No....
Diam. .... Slot size .... from .... ft. to .... ft.
Diam. .... Slot size .... from .... ft. to .... ft.

Gravel packed: Yes ☐ No ☑ Size of gravel: ....
Gravel placed from .... ft. to .... ft.

Surface seal: Yes ☑ No ☐ To what depth? 15+ ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? .... Depth of strata....
Method of sealing strata off....

(7) **PUMP:** Manufacturer's Name....
Type: .... H.P....

(8) **WATER LEVELS:** Land-surface elevation above mean sea level.... ....ft.
Static level ....ft. below top of well Date 3-31-97
Artesian pressure ....lbs. per square inch Date....
Artesian water is controlled by.... (Cap, valve, etc.)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☑ If yes, by whom?....
Yield: .... gal./min. with .... ft. drawdown after .... hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ....
Bailer test 25+ gal./min. with .... ft. drawdown after 1 hrs.
Artesian flow .... g.p.m. Date....
Temperature of water .... Was a chemical analysis made? Yes ☐ No ☑

(10) **WELL LOG:**

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Silty Sand & Gravel	0	16
Gray Till	16	90
Blue Silty Sand w/ Some Gravel	90	105
Sandy Silt & Gravel	105	135
Coarse Sand & Gravel	135	161

RECEIVED
APR 13 1997
DEPARTMENT OF ECOLOGY

Work started 3-25 19 97 Completed 3-30 19 97

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Arndal Drilling Co. (Person, firm, or corporation) (Type or print)

Address PO Box 662 Monroe WA 98272

[Signed] A R Arndal (Well Driller)

License No. 0007 Date 3-31, 19 97

(USE ADDITIONAL SHEETS IF NECESSARY)

3

e Original and First Copy with
partment of Ecology
econd Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. .....

Permit No. .....

(1) **OWNER:** Name A. Bustad Address 5406-130th Pl. NE Marysville, WA.

(2) **LOCATION OF WELL:** County Snohomish — SE ¼ NW ¼ Sec. 17 T. 31 N., R 4E W.M.

Bearing and distance from section or subdivision corner

(3) **PROPOSED USE:** Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one) ....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 6 inches.
Drilled 156 ft. Depth of completed well 156 ft.

(6) **CONSTRUCTION DETAILS:**

Casing installed: 6 " Diam. from +1 ft. to 151 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type Firewound Model No Stainless
Diam. 6 Slot size .030 from 151 ft. to 156 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal Puddling clay
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) **PUMP:** Manufacturer's Name
Type: H.P.

(8) **WATER LEVELS:** Land-surface elevation above mean sea level .... 400 ft.
Static level 134 ft. below top of well Date 8-17-88
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " "
" " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 10 gal./min. with 3 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water 50 Was a chemical analysis made? Yes ☐ No ☒

(10) **WELL LOG:**

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Soil, sandy	0	3
Hardpan	3	94
Clay, gray, sand layers	94	134
Gravel, wet, silty	134	145
Gravel, pea, sand	145	156

RECEIVED
AUG 2 [illegible]
DEPT. OF ECOLOGY

Work started 8-9 19 88 Completed 8-22 19 88

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Ace Drilling & Pump Service
(Person, firm, or corporation) (Type or print)

Address 14503-23rd Av NE Arlington, WA.

[Signed] Edward J Countryman
(Well Driller)

License No. 0697 Date 8-22 19 88

(USE ADDITIONAL SHEETS IF NECESSARY)

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

59

Application No.
Permit No.

(1) OWNER: Name WILLIAM A. MURRAY JR. Address 5129 New Castle Ave. Encino Ca. 913

(2) LOCATION OF WELL: County Snohomish — NW ¼ SW ¼ Sec. 10 T. 31 N., R. 4 E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ [✓ Municipal] Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) 8126
[✓ New well] Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 230 ft. Depth of completed well 230 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from +1 ft. to 220 ft.
Threaded ☐ " Diam. from ft. to ft.
[✓ Welded] " Diam. from ft. to ft.

Perforations: Yes ☐ [✓ No]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: [✓ Yes] No ☐
Manufacturer's Name Johnson
Type stainless wirewound Model No
Diam. 6 Slot size 12 from [illegible] ft. to [illegible] ft.
Diam. 6 Slot size 14 from 225 ft. to 230 ft.
6 blank 218 220

Gravel packed: Yes ☐ [✓ No] Size of gravel:
Gravel placed from ft. to ft.

Surface seal: [✓ Yes] No ☐ To what depth? 18 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes ☐ [✓ No]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level.... 150 ft.
Static level 116 ft. below top of well Date 6/5/81
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ [✓ No] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	*Water Level*	*Time*	*Water Level*	*Time*	*Water Level*

Date of test
Bailer test 10 gal./min. with 74 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Soil brown	0	3
Cemented gravel	3	120
Sandstone soft	120	150
Brown clay sandy	150	205
Claystone brown	205	210
Sandstone	210	218
Sand	218	230

Work started , 19 Completed 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME JANNSEN WELL DRILLING
(Person, firm, or corporation) (Type or print)

Address 430 West Ave Arlington, Wa. 98223

[Signed] Michael A. Jannsen
(Well Driller)

License No. 0749 Date 6/10/81, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 3

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. _____

Water Right Permit No. _____

(1) OWNER: Name E Earl Bivins Address 312-NW 178th St, Seattle 98177

(2) LOCATION OF WELL: County Snohomish NE ¼ SW ¼ Sec 18 T 31 N., R 4E W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) 198th & Marine View Drive

(3) PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ] DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____

Abandoned [ ] New well [X] Method: Dug [ ] Bored [ ] Deepened [ ] Cable [ ] Driven [ ] Reconditioned [ ] Rotary [X] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches. Drilled 495 feet. Depth of completed well 453 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from +1 ft. to 443 ft.

Welded [X] Liner installed [ ] Threaded [ ] " Diam. from _____ ft. to _____ ft.

Perforations: Yes [ ] No [X]

Type of perforator used _____

SIZE of perforations _____ in. by _____ in.

_____ perforations from _____ ft. to _____ ft.

_____ perforations from _____ ft. to _____ ft.

_____ perforations from _____ ft. to _____ ft.

Screens: Yes [X] No [ ]

Manufacturer's Name Johnson

Type Stainless steel 1 Model No _____

Diam. 5 Slot size .016 from 443 ft. to 453 ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____

Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.

Material used in seal bentonite

Did any strata contain unusable water? Yes [ ] No [X]

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

(7) PUMP: Manufacturer's Name N/A

Type _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 230 ft. below top of well Date 11/17/87

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (Cap, valve, etc.))

(9) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? Yes [X] No [ ] If yes, by whom? Wynn/Bayr

Yield: 6 gal./min. with _____ ft. drawdown after _____ hrs.

" " " " " " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test 6 gal./min. with 20 ft. drawdown after 1 hrs.

Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water 51 Was a chemical analysis made? Yes [X] No [ ]

Iron 5.0ppm

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Brown till & boulders	0	20
Blue gray till	20	105
Brown silty sand & gravel	105	115
Brown silty dry sand	115	Gray 216
Gray silty sand, some gravel	162	185
Blue /gray till	185	203
Damp brown sand	203	225
Gray silty clay	225	260
Gray silt-stone,	260	365
Gray siltstone & sands	365	370
Gray siltstone, clay, wet	370	420
Gray silty sand, water, silt	420	433
Gray siltstone, sand/water	433	440
Gray silty sand, water	440	495

RECEIVED JAN 22 1988 DEPARTMENT OF ECOLOGY NORTHWEST REGION

Work started 10/23 87 Completed 11/17 1987

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME OELKE DRILLING, INC (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address 4312 166th Ave E., Sumner 98390

(Signed) _____ (WELL DRILLER) License No. 0837

Contractor's Registration No. OELKEDI136OC Date 1/18 1988

(USE ADDITIONAL SHEETS IF NECESSARY)

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT (38)
STATE OF WASHINGTON

Application No. ....
Permit No. ....

(1) OWNER: Name H. Peterson Address 20001 - [illegible]

(2) LOCATION OF WELL: County Sno — SW ¼ NW ¼ Sec 18 T 31 N., R 4 E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☒

(4) TYPE OF WORK: Owner's number of well (if more than one) ....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 210 ft. Depth of completed well 210 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: ....." Diam. from ..... ft. to ..... ft.
Threaded ☐ ....." Diam. from ..... ft. to ..... ft.
Welded ☒ 6" Diam. from +2 ft. to 200 ft.

Perforations: Yes ☐ No ☒
Type of perforator used.....
SIZE of perforations ..... in. by ..... in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

Screens: Yes ☒ No ☐
Manufacturer's Name.....
Type..... Model No.....
Diam. 5¼ Slot size 15 from 200 ft. to 205 ft.
Diam. 5⅝ Slot size 012 from 205 ft. to 210 ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☐
Type of water?..... Depth of strata.....
Method of sealing strata off.....

(7) PUMP: Manufacturer's Name.....
Type: ..... H.P. .....

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ..... ft.
Static level 150 ft. below top of well Date 9-30-67
Artesian pressure ..... lbs. per square inch Date.....
Artesian water is controlled by..... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? CWD
Yield: 30 gal./min. with 192 ft. drawdown after 4 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test .....
Bailer test..... gal./min. with..... ft. drawdown after..... hrs.
Artesian flow..... g.p.m. Date.....
Temperature of water..... Was a chemical analysis made? Yes ☒ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand & Gravel	0	3
Tan Hard Pan	3	24
Blue Hard Pan	24	56
Tan Sand w/ Gravel	56	96
Blue Clay	96	113
Fine Sand w/ Blue Clay	113	120
Sand w/ Clay	120	144
Sand	144	157
Blue Clay	157	158
Sand	158	163
Blue Clay w/ Sand	163	176
Wood Sand Gravel	176	185
Wood Sand & Blue Clay	185	194
Sand Gravel w/	194	210
Water		

Work started 5-15 1967 Completed 5-21 1967

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Canano Well Drilling (Person, firm, or corporation) (Type or print)
Address 215 N. [illegible] Rd CI
[Signed] [illegible] (Well Driller)
License No. 611 Date 9-30, 1967

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT (41)

STATE OF WASHINGTON

Application No. .....

Permit No. .....

(1) OWNER: Name Brad L'Heureux Address 5131-183 51st Stanwood

(2) LOCATION OF WELL: County Island — SW¼ NE¼ Sec. 17 T. 31 N., R. 4E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) .....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled ..... ft. Depth of completed well 315 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from T 12 ft. to 310 ft.
Threaded ☐ ..." Diam. from ..... ft. to ..... ft.
Welded ☒ ..." Diam. from ..... ft. to ..... ft.

Perforations: Yes ☐ No ☒
Type of perforator used .....
SIZE of perforations ..... in. by ..... in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type ..... Model No. .....
Diam. 5 7/8 Slot size 12 from 310 ft. to 315 ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☐ No ☐ Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal Puddling Clay
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? ..... Depth of strata .....
Method of sealing strata off .....

(7) PUMP: Manufacturer's Name .....
Type: ..... H.P. .....

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 211 ft. below top of well Date Aug 21-79
Artesian pressure ..... lbs. per square inch Date .....
Artesian water is controlled by ..... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom? .....
Yield: ..... gal./min. with ..... ft. drawdown after ..... hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test .....
Bailer test 15 gal./min. with 14 ft. drawdown after 2 hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water 51 Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation

MATERIAL	FROM	TO
Yellowish Clay + gravel	0	12
Blue hard pan with Boulders	12	40
Clean gravel	40	46
Gray hard pan with gravel	46	80
Blue sandy Clay	80	96
Blue hard pan with gravel	96	111
Clean gravel	111	220
Tan sand with wood + little water	220	228
Blue Clay hard	228	241
Blue silt + sand, wood little water	241	268
Blue Clay sticky with wood	268	272
Blue silt + fine sand + wood	272	285
Blue hard Clay	285	296
Gravel + sand with wood + water	296	301
Tan sand + water	301	315

Work started Aug 16 19 79 Completed Aug 21 19 79

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Camano Well Drilling
(Person, firm, or corporation) (Type or print)

Address 2517 N. Goodrich Rd

[Signed] Joseph Younes
(Well Driller)

License No. 0611 Date Aug 22, 1979

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. .....

Permit No. ....

(1) OWNER: Name VERSEL NANCE Address 18316-82nd Dr. N.W.Stanwood, Wa. 982

(2) LOCATION OF WELL: County Snohomish SW ¼ NE ¼ Sec 19 T 31 N., R 4E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one).... 7913
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 329 ft. Depth of completed well 328 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 5/8 " Diam. from +1 ft. to 322 ft.
Threaded ☐ ..... " Diam. from ..... ft. to ..... ft.
Welded ☒ ..... " Diam. from ..... ft. to ..... ft.

Perforations: Yes ☐ No ☒
Type of perforator used .....
SIZE of perforations ..... in. by ..... in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type stainless Model No .....
Diam. 6" Slot size 10 from 322 ft. to 328 ft.
Diam. 6" Slot size blank from 321 ft. to 322 ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal Cement-bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ..... Depth of strata .....
Method of sealing strata off .....

(7) PUMP: Manufacturer's Name .....
Type: ..... H.P. .....

(8) WATER LEVELS: Land-surface elevation above mean sea level.... 240 ft.
Static level 220 ft. below top of well Date 9/16/79
Artesian pressure ..... lbs. per square inch Date .....
Artesian water is controlled by ..... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? .....
Yield: ..... gal./min. with ..... ft. drawdown after ..... hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test .....
Bailer test 10 gal./min. with 40 ft. drawdown after 2 hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water 52 Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Soil brown sandy	0	2
Clay brown sandy med boulders	0	7
Clay brown sandy	7	23
SSand and gravels	23	86
Clay gray sandy	86	126
Sand gravel/ clay streaks	126	139
Clay gray sandy	139	154
Sand med gray clay streaks	154	175
Clay gray sandy sand streaks	175	318
Sand med fine (water bearing	318	329

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DEPT. OF ECOLOGY
OLYMPIA, WA

Work started 9/10/79 19..... Completed 9/16/79 19.....

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME JANNSEN WELL DRILLING
(Person, firm, or corporation) (Type or print)

Address 430 West Ave. Arlington, Wa. 98223

[Signed] Rick Wallaert
(Well Driller)

License No. 1060 Date 9/18/79, 19.....

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy 31/4E/19/A

WATER WELL REPORT
STATE OF WASHINGTON

Application No. /
Permit No. ....

(1) OWNER: Name Nina Randle Address [illegible]

(2) LOCATION OF WELL: County [illegible] ¼ ¼ Sec. [illegible] T. [illegible] N., R. [illegible] W.M.
Bearing and distance from section or subdivision corner Birmingham [illegible]dront Estates

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)....
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well [illegible] inches.
Drilled [illegible] ft. Depth of completed well [illegible] ft.

(6) CONSTRUCTION DETAILS:
Casing installed: [illegible] " Diam. from [illegible] ft. to [illegible] ft.
Threaded ☐ [illegible] " Diam. from ft. to ft.
Welded ☐ [illegible] " Diam. from [illegible] ft. to [illegible] ft.

Perforations: Yes ☐ No ☐
Type of perforator used [illegible]
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☐
Manufacturer's Name [illegible]
Type [illegible] Model No. [illegible]
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☐ Size of gravel: [illegible]
Gravel placed from ft. to ft.

Surface seal: Yes ☐ No ☐ To what depth? ft.
Material used in seal [illegible]
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? [illegible] Depth of strata
Method of sealing strata off [illegible]

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ft.
Static level [illegible] ft. below top of well Date [illegible]
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test [illegible] gal./min. with [illegible] ft. drawdown after [illegible] hrs.
Artesian flow g.p.m. Date
Temperature of water [illegible] Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
[illegible] sandy	[illegible]	[illegible]
boulders, cobbles, cemented	3	10
gravel. coarse. cemented	10	71
sand, gravel, fine. dry. loose	71	101
sand. brown, fine thin clay layers	101	163
sand, blue. silty. wet	163	187
clay. silt. thin layers of fine sand, wet	187	211
clay. blue	211	280
clay, blue, thin layers of peat (some gas)	280	300
* peat, dark brown, thin sand layers. 16 lbs gas (~~[illegible]~~ methane)	300	307
clay, blue, silty	307	341
peat, silt. thin layers	341	343
of [illegible]	343	354
shale grey green, soft	354	406
Sandstone [illegible] water blue color		

Work started [illegible] 19[illegible] Completed [illegible] 19[illegible]

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME [illegible] Drilling & Pump Service
(Person, firm, or corporation) (Type or print)

Address [illegible] 1 Box 205 Arlington, [illegible]

[Signed] Robert E. Freeman
(Well Driller)

License No. [illegible] Date 1-[illegible], 1975

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. .....

Permit No. ....

(1) OWNER: Name Jim Grandon Address 18101-76th Av NW Stanwood, WA.

(2) LOCATION OF WELL: County Snohomish ¼ ¼ Sec. 20 T. 31 N., R. 4E W.M.

Bearing and distance from section or subdivision corner Lot 3-Div 1-Block 54-C.D. Hillmans Div. Birm. Add.

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) .....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

5) DIMENSIONS: Diameter of well 6 inches.
Drilled 315 ft. Depth of completed well 315 ft.

6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from +1 ft. to 310 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type Wirewound Model No Stainless
Diam. 6 Slot size .030 from 310 ft. to 315 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal Puddled clay
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Pioneer
Type: Sub H.P. 1 hp

(8) WATER LEVELS: Land-surface elevation above mean sea level .... 400 ft.
Static level 251 ft. below top of well Date 8-17-84
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 10 gal./min. with 20 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water 50 Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Soil	0	3
Hardpan	3	58
Gravel, sand, dry, clay layers	58	158
Clay, silty, gay	158	189
Clay, blue	189	193
Gravel, silty	193	196
Sand, silty	196	260
Clay, blue, silty	260	300
Gravel, sand, loose, wet	300	315

SEP 2 6 1984

Work started 8-1 19 84 Completed 8-17 19 84

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Ace Drilling & Pump Service
(Person, firm, or corporation) (Type or print)

Address 14503-23rd Av NE Arlington, WA.

[Signed] Robert E. Freeman
(Well Driller)

License No. 0137 Date 8-25, 19 84

(USE ADDITIONAL SHEETS IF NECESSARY)

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. .....

Permit No. ....

(1) OWNER: Name G.D. Fidler Address 18314 Fruitland Stanwood

(2) LOCATION OF WELL: County Island — ¼ ¼ Sec. 20 T. 31 N., R. 4 W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one).... .....
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☑ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 301 ft. Depth of completed well 301 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: ....." Diam. from ..... ft. to ..... ft.
Threaded ☐ ....." Diam. from ..... ft. to ..... ft.
Welded ☑ ....." Diam. from 0 ft. to 247 ft.

Perforations: Yes ☐ No ☑
Type of perforator used .....
SIZE of perforations ..... in. by ..... in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

Screens: Yes ☑ No ☐ Cook
Manufacturer's Name .....
Type ..... Model No .....
Diam. 6 Slot size 10-10 from 247 ft. to 301 ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☐ No ☑ Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes ☐ No ☐ To what depth? ..... ft.
Material used in seal Clay
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? ..... Depth of strata .....
Method of sealing strata off .....

(7) PUMP: Manufacturer's Name .....
Type: ..... H.P. .....

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ..... ft.
Static level 270 ft. below top of well Date .....
Artesian pressure ..... lbs. per square inch Date .....
Artesian water is controlled by ..... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☑ If yes, by whom? .....
Yield: ..... gal./min. with ..... ft. drawdown after ..... hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test .....
Bailer test 15 gal./min. with 3 ft. drawdown after 1½ hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water ..... Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top Soil	0	2
Hard pan	2	20
Blue sand	20	35
Sandy clay	35	100
Hard pan	100	120
Sandy clay	120	175
Clay	175	235
Sandy clay	235	250
Gravel	250	259
Very Sandy	259	264
Water Sand	264	301

Work started ..... 19..... Completed ..... 19.....

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Hartwell Drilling
(Person, firm, or corporation) (Type or print)

Address 12926-54th Ave Stanwood Wa

[Signed] Everett Hall
(Well Driller)

License No. 187 Date May 27, 1982

(USE ADDITIONAL SHEETS IF NECESSARY)

050-1-20

3

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

(50)

Application No. ....

Permit No. ....

(1) OWNER: Name Foeschel + Schultz Address 19203 Old Hwy 99

(2) LOCATION OF WELL: County Snohomish — SW ¼ SW ¼ Sec 21 T 31 N., R 4 W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: [✓ Domestic] Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ....

[✓ New well] Deepened ☐ Reconditioned ☐

Method: Dug ☐ Cable ☐ Rotary ☐ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.

Drilled 220 ft. Depth of completed well 220 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from 0 ft. to 220 ft.

Threaded ☐ ......" Diam. from ...... ft. to ...... ft.

[✓ Welded] ......" Diam. from ...... ft. to ...... ft.

Perforations: Yes ☐ [✓ No]

Type of perforator used ....

SIZE of perforations ...... in. by ...... in.

...... perforations from ...... ft. to ...... ft.

...... perforations from ...... ft. to ...... ft.

...... perforations from ...... ft. to ...... ft.

Screens: [✓ Yes] No ☐

Manufacturer's Name ....

Type .... Model No. ....

Diam. ...... Slot size ...... from ...... ft. to ...... ft.

Diam. ...... Slot size ...... from ...... ft. to ...... ft.

Gravel packed: Yes ☐ [✓ No] Size of gravel: ....

Gravel placed from ...... ft. to ...... ft.

Surface seal: [✓ Yes] No ☐ To what depth? 18 ft.

Material used in seal Natural Bentonite

Did any strata contain unusable water? Yes ☐ [✓ No]

Type of water? ...... Depth of strata ......

Method of sealing strata off ......

(7) PUMP: Manufacturer's Name —

Type: .... H.P. ......

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ...... ft.

Static level 180 ft. below top of well Date 8-5-77

Artesian pressure ...... lbs. per square inch Date ......

Artesian water is controlled by .... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? [✓ Yes] No ☐ If yes, by whom? The driller

Yield: ...... gal./min. with ...... ft. drawdown after ...... hrs.

" 30 " " "

" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ....

Bailer test 00 gal./min. with ...... ft. drawdown after ...... hrs.

Artesian flow — g.p.m. Date ......

Temperature of water ...... Was a chemical analysis made? Yes ☐ [✓ No]

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Gravel	0	41
Hardpan (gray)	42	50
Clay (gray)	51	109
Sandy clay (Brown)	110	188
Sand (water)	189	205
Coarse Sand + Gravel.		
Water	206	220

RECEIVED
AUG 2 1979
DEPT. OF ECOLOGY

Work started 7-31, 19...... Completed 8-6, 1979

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Anderson Drilling Co (Person, firm, or corporation) (Type or print)

Address 7412 - 204th NE

[Signed] [illegible] (Well Driller)

License No. 0771 Date Aug 8, 1979

(USE ADDITIONAL SHEETS IF NECESSARY)

Appendix B

APPENDIX B

AQUIFER TESTS

Hydraulic properties of the advance outwash were tested by performing short-term pump tests in wells LG-1, LG-3 and LG-4. A 2-inch-diameter submersible stainless steel Grundfos pump was used for pumping. Wells LG-1 and LG-4 were pumped for a period of approximately 120 minutes. Well LG-3 was pumped for approximately 80 minutes. Because of the similarity of the test results for the first three wells and the similar aquifer characteristics observed in all wells during drilling, well LG-2 was not tested. The average discharge rates and maximum drawdown values are given below:

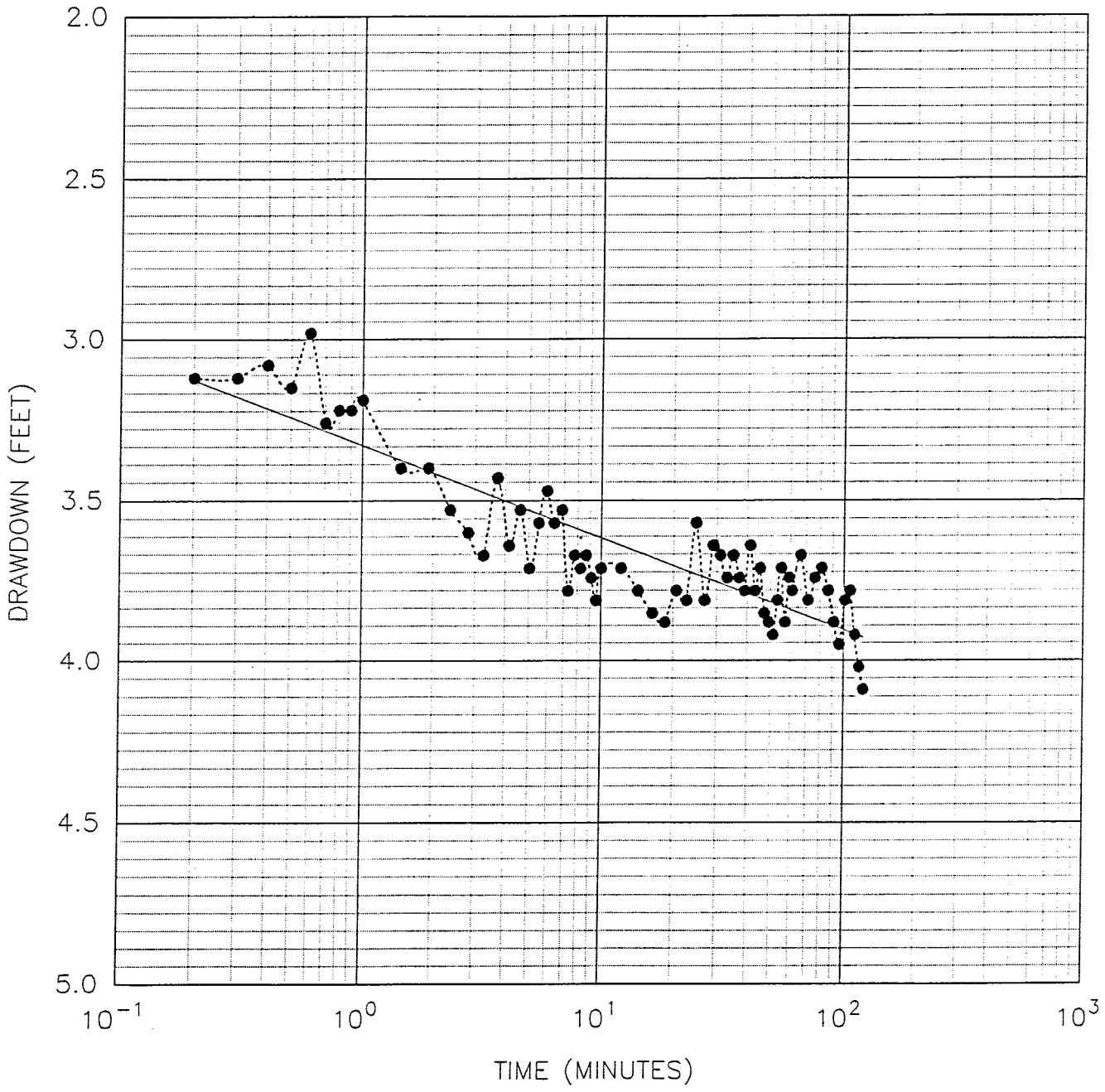
Well	Q (gpm)	Drawdown (feet)
LG-1	3.7	4.1
LG-3	4.3	3.2
LG-4	4.8	2.0

Water levels during the pump tests were monitored using a data logger and 15-psi transducer. Flow was measured with a totalizer and cross checked with periodic volumetric measurements. Semi-logarithmic plots of drawdown versus pumping time are presented in Figures B-1, B-2,and B-3.

The Cooper and Jacob (1946) solution was used to estimate aquifer properties. Cooper and Jacob devised a form of the Theis (1935) solution, which uses a semi-log plot of drawdown versus time rather than a log-log, curve-matching technique. Assumptions inherent in the two solutions are identical. The Cooper and Jacob method was chosen for two reasons: (1) the drawdown from each pump test was small, making the degree of curve-matching accuracy for the Theis solution low; and (2) discharge fluctuations made the curve-matching procedure difficult. The discharge fluctuations were simplified by doing a regression analysis on the linear drawdown on semi-log plots. The resulting slope of drawdown values was used to obtain parameters for the Cooper and Jacob solution.

Transmissivity calculations are shown on the drawdown plots. Hydraulic conductivity was determined from the saturated aquifer thickness above the aquitard in wells LG-1 and LG-3. For well LG-4, which was completed in a silty sand with silt and clay stringers, an aquifer thickness equal to the saturated screened interval was used.

Semilog Plot: Drawdown vs. Time



T = 264 (Q)/ΔS

T = 264 (3.72)/0.28

T = 3507 gpd/ft

T = 469 ft^2/day

ΔS = 0.28 ft

Q = 3.72 gpd

K = T/b

b = 4.5 ft

K = 104.2 ft/day

Approved for publication _____ by _____

LG-1 PUMP TEST DATA

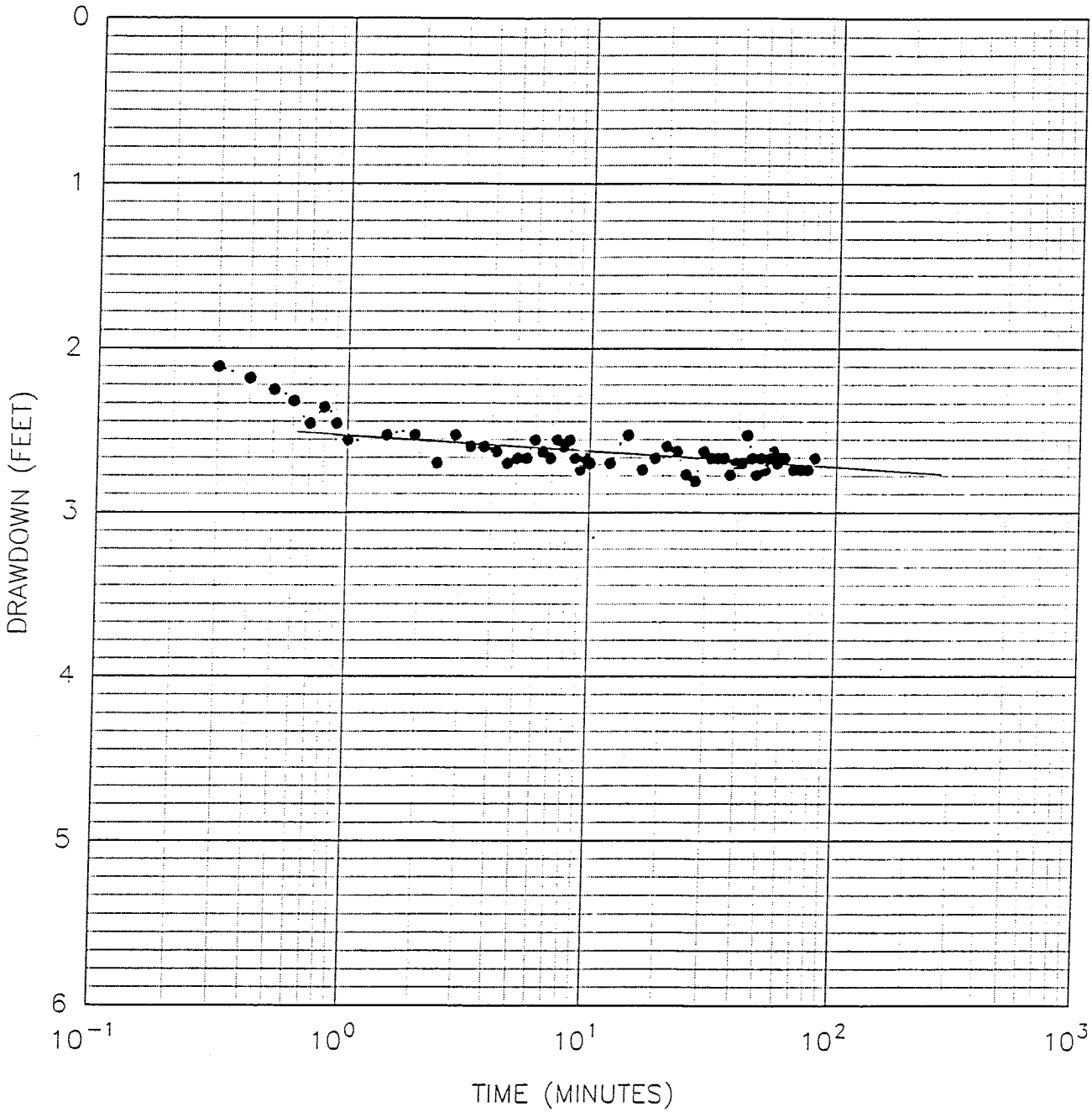
LAKE GOODWIN LANDFILL
Snohomish County, Washington
for Snohomish County Department of Public Works

Project No.
89-35228-10

Figure No.
B-1

Converse Consultants NW Geotechnical Engineering and Applied Earth Sciences

Semilog Plot: Drawdown vs. Time



$T = 264\ (Q)/\Delta S$

$T = 264\ (4.5\ gpm)/0.1$

$T = 11{,}880\ gpd/ft$

$T = 1588\ ft^2/day$

$\Delta S = 0.1\ ft$

$Q = 4.5\ gpm$

$K = T/b$

$b = 11\ ft$

$K = 144.36\ ft/day$

Approved for publication _____ by _____

LG-3 PUMP TEST DATA

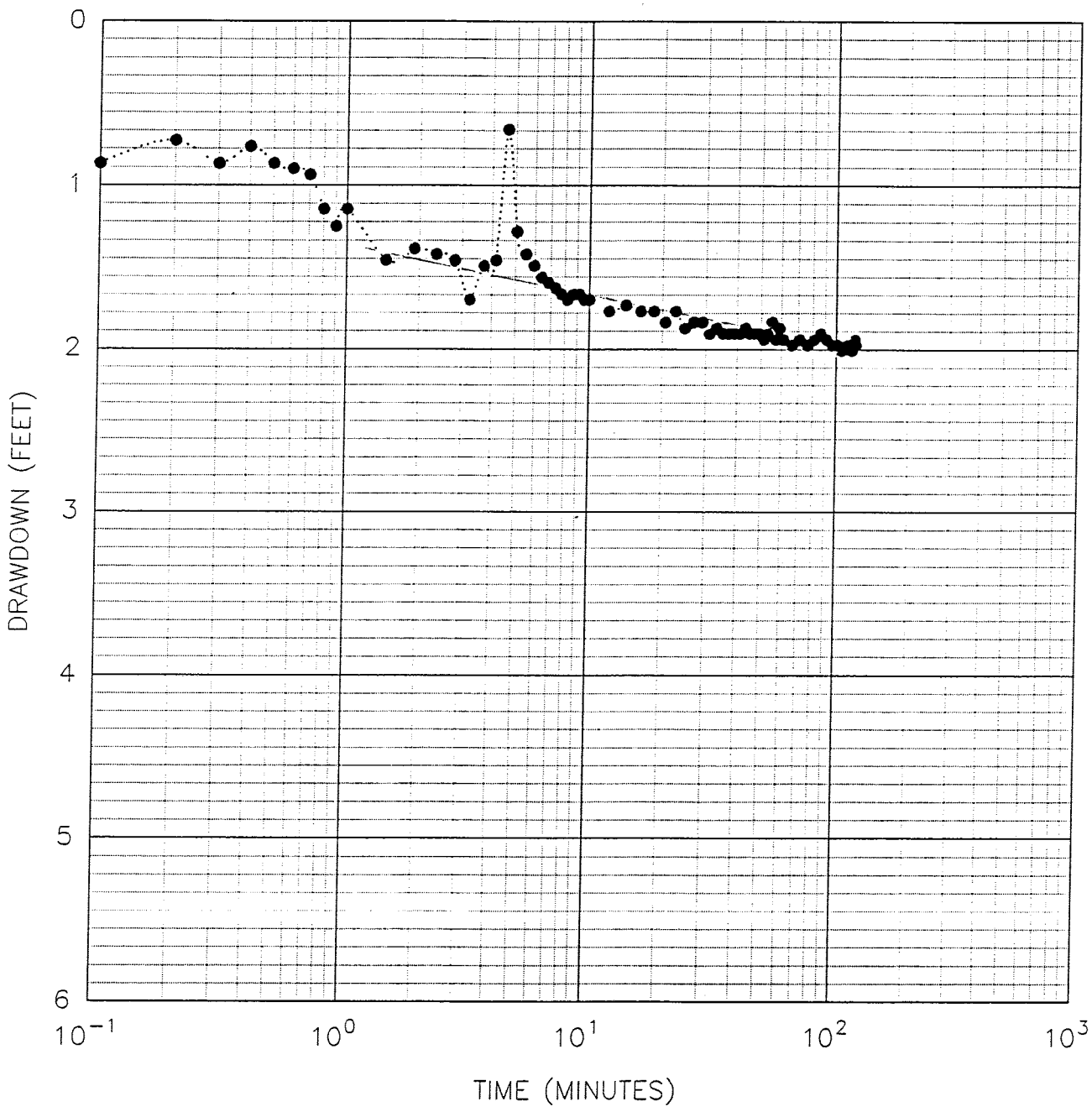
LAKE GOODWIN LANDFILL
Snohomish County, Washington
for Snohomish County Department of Public Works

Project No. 89-35228-10

Figure No. B-2

Converse Consultants NW Geotechnical Engineering and Applied Earth Sciences

Semilog Plot: Drawdown vs. Time



$T = 264\ (Q)/\Delta S$

$T = 264\ (4.9)/0.3$

$T = 4{,}312$ gpd/ft

$T = 576$ ft^2/day

$\Delta S = 0.3$ ft

$Q = 4.9$ gpm

$K = T/b$

$b = 15$ ft

Approved for publication _____ by _____

LG-4 PUMP TEST DATA

LAKE GOODWIN LANDFILL
Snohomish County, Washington
for Snohomish County Department of Public Works

Project No. 89-35228-10

Converse Consultants NW — Geotechnical Engineering and Applied Earth Sciences

Figure No. B-3

Appendix C

APPENDIX C

LABORATORY-REPORTED ANALYTICAL RESULTS

Laboratory analytical results are presented in this appendix. Three sets of analytical data are included in the following order:

- Groundwater quality (MFS parameters)
- Groundwater quality (priority pollutant compounds)
- Drill water (MFS parameters)
- Soils tests (MFS parameters plus total organic halides)

Sample designations for water quality samples refer to the monitoring well that the sample was obtained from. Soil sample numbers reference the boring number and the sequence depth. For example, sample LG-1-1 was obtained from boring LG-1 at a depth of 5 feet. Sample LG-1-17 refers to sample from boring LG-1 obtained at a depth of 85 feet.

One sample of the drill water was obtained and analyzed for MFS parameters. This sample is designated LG-F.

Laucks 82 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

CLIENT: Snohomish County Dept Pub Wrk
Cathcart Landfill
14528 Highway 9
Snohomish, WA 98290
ATTN : Dawn Shroy-Marshall

Certificate of Analysis
Work Order# : 90-12-281
DATE RECEIVED : 12/17/90
DATE OF REPORT: 01/16/91

Work ID : MFS
Taken By : Client
Transported by: Hand Delivered
Type : Water

SAMPLE IDENTIFICATION:

	Sample Description	Collection Date
01	110 LG-3	12/17/90 10:45
02	111 LG-1	12/17/90 11:40
03	112 LG-2	12/17/90 12:50
04	113 LG-4	12/17/90 14:00
05	Method Blank	N/A

COMMENTS ON TOTAL COLIFORM ANALYSIS:

A Total Coliform Count of under 2.2 MPN per 100 mls meets U.S.E.P.A. and Public Health criteria for drinking water. A Total Coliform Count above 2.2 MPN per 100 mls does not meet these criteria. If the symbol >/ appears in your report, it means that the total coliform concentration is greater than or equal to the number shown.

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Chemistry. Microbiology. and Technical Services

CLIENT : Snohomish County Dept Pub Wrk

Certificate of Analysis

Work Order# : 90-12-281

Aliquots for metals (Iron, Manganese, Zinc), and Soluble NO3NO2 are being reported as dissolved, samples were filtered and preserved upon receipt at the laboratory. All other metals are being reported as total metals.

The flag "U" indicates the analyte of interest was not detected, to the limit of detection shown.

Unless otherwise instructed all samples will be discarded on 03/02/91

Respectfully submitted,
Laucks Testing Laboratories, Inc.

J. M. Owens

Laucks 82 YEARS
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

CLIENT : Snohomish County Dept Pub Wrk

Certificate of Analysis

Work Order # 90-12-281

TESTS PERFORMED AND RESULTS:

Analyte	Units	01	02	03	04
Ammonia as N	mg/L	0.01 U	0.01 U	0.01 U	0.01
Chemical Oxygen Demand	mg/L	10. U	10. U	10. U	10. U
Chloride (Method 300.0)	mg/L	51.	9.	7.	10.
Hardness as CaCO3	mg/L	360.	170.	76.	170.
Iron (Method 236.1)	mg/L	0.05 U	0.05 U	0.05 U	0.05 U
Manganese (Method 243.1)	mg/L	0.016	0.005	0.032	0.004
Nitrate as N	mg/L	9.7	1.2	0.5	1.6
Nitrite as N	mg/L	0.008	0.005 U	0.005 U	0.005 U
Specific Conductance	Micromhos/cm	1000.	240.	180.	350.
Sulfate as SO4	mg/L	110.	24.	10.	22.
Total Coliform Count	MPN per 100 ml	8.	17.	70.	7.
Total Organic Carbon	mg/L	6.7	3.1	2.7	1.8
Zinc (Method 289.1)	mg/L	0.006	0.007	0.010	0.011
pH	gl elec @25C	6.7	6.8	7.2	6.6

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Chemistry, Microbiology, and Technical Services

REPORT ON WORK ORDER 9012281 PREPARATION BLANKS

Test : Iron (Method 236.1)
Blank Name : B1219AA01 Preparation Date: 12/19/90
Conc Found : 0.050 _ Control Limit : 0.050
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Manganese (Method 243.1)
Blank Name : B1219AA01 Preparation Date: 12/19/90
Conc Found : 0.002 U Control Limit : 0.004
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Zinc (Method 289.1)
Blank Name : B1219AA01 Preparation Date: 12/19/90
Conc Found : 0.005 _ Control Limit : 0.010
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Nitrate as N
Blank Name : B1220ICW01 Preparation Date: 12/20/90
Conc Found : 0.200 U Control Limit : 0.400
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

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REPORT ON WORK ORDER 9012281 PREPARATION BLANKS

Test : Sulfate as SO4
Blank Name : B1220ICW01 Preparation Date: 12/20/90
Conc Found : 1.000 U Control Limit : 2.000
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Chemical Oxygen Demand
Blank Name : B1226CODW01 Preparation Date: 12/26/90
Conc Found : 10.000 U Control Limit : 20.000
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Hardness as CaCO3
Blank Name : B1228HARD01 Preparation Date: 12/28/90
Conc Found : 1.000 U Control Limit : 2.000
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Chloride (Method 300.0)
Blank Name : B1227ICW01 Preparation Date: 12/27/90
Conc Found : 1.000 U Control Limit : 2.000
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

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Chemistry, Microbiology, and Technical Services

REPORT ON WORK ORDER 9012281 PREPARATION BLANKS

Test : **Ammonia as N**
Blank Name : B0102NH3W01 Preparation Date: 01/02/91
Conc Found : 0.012 Control Limit : 0.020
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : **Total Organic Carbon**
Blank Name : B0102TOC_W01 Preparation Date: 01/02/90
Conc Found : 1.000 U Control Limit : 2.000
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : **Nitrite as N**
Blank Name : B1218NO2_W01 Preparation Date: 12/18/90
Conc Found : 0.005 U Control Limit : 0.010
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

* = outside control limits
U = analtye not detected

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82 years

940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry. Microbiology. and Technical Services

CLIENT: Snohomish County Dept Pub Wrk
Cathcart Landfill
14528 Highway 9
Snohomish, WA 98290
ATTN : Dawn Shroy-Marshall

Certificate of Analysis

Work Order# : 90-12-389
DATE RECEIVED : 12/27/90
DATE OF REPORT: 02/14/91

Work ID : Lk. Goodwin
Taken By : Client
Transported by: Hand Delivered
Type : Water

SAMPLE IDENTIFICATION:

	Sample Description	Collection Date
01	#110 LG-3	12/27/90 11:10
02	#111 LG-1	12/27/90 13:05
03	#112 LG-2	12/27/90 12:05
04	#113 LG-4	12/27/90 14:10
05	Method Blank	N/A
06	Quality Control	N/A
07	Quality Control	N/A

Aliquots for metals (Iron, Manganese, Zinc), and Soluble NO3NO2 are being reported as dissolved, samples were filtered and preserved upon receipt at the laboratory. All other metals are being reported as total metals.

Unless otherwise instructed all samples will be discarded on 03/12/91

Respectfully submitted,
Laucks Testing Laboratories, Inc.

J. M. Owens

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Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063
Chemistry, Microbiology, and Technical Services

USING OUR REPORTS

Laucks has installed an electronic Laboratory Information Management System which now produces both our reports and invoices. The following information and definitions will help you use the new formats; and we encourage you to call us if your questions are not answered here.

SAMPLE IDENTIFICATION - Sample IDs are recorded as they appear on your sample containers or chain-of-custody documents. One "sample" may have several "fractions" (different analytical tasks), so a sample's ID may appear more than once on the cover page. You may notice "extra" samples, not submitted by you. These were added by Laucks to allow our electronic system to accommodate quality control analyses, such as method blanks and matrix spikes.

TEST RESULTS - Analyses which result in a single data point are shown in alphabetical order in the body of the report. Tests which yield multiple results are generally reported on separate pages, on a sample-by-sample basis.

MEASUREMENT UNITS - The reporting units are shown to the right of the analyte name. In the event that a different unit was more appropriate to a specific sample, that exception is shown immediately beneath the test result. Units commonly employed are mg/kg (solids) or mg/L (liquids), comparable to parts per million; ug/kg (solids) or ug/L (liquids), comparable to parts per billion; and percent (%).

METHODS OF ANALYSIS - The EPA or Standard Methods method number is now shown in parentheses after the analyte name; or, for analyses which yield multiple data points, in the header information on the individual report page.

ABBREVIATIONS - Several abbreviations can appear in our reports. The most commonly employed abbreviations are:

U : The analyte of interest was not detected, to the limit of detection indicated.

B : The analyte of interest was detected in the method blank associated with the sample, as well as in the sample itself. The B flag is applied without regard to the relative concentrations detected in the blank and sample.

J : The analyte of interest was detected below the routine reporting limit. This value should be regarded as an estimate.

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Chemistry, Microbiology, and Technical Services

T : The flagged values represent the SUM of two co-eluting compounds. The SUM of these two values is shown as though it were a result for each of them, but in fact it represents the total and the two figures should not be further added together.

D : The value reported derives from analysis of a diluted sample or sample extract.

SDL : Sample Detection Limit. The SDL can vary from sample to sample, depending on sample size, matrix interferences, moisture content and other sample-specific conditions.

PQL : Practical Quantitation Limit. This limit is drawn from the test method and usually represents the SDL multiplied by a matrix-specific factor.

CRQL : Client Requested Quantitation Limit, usually the limit of detection specified at your request. Might also be referred to as Contract Required Quantitation Limit.

DB : Dry Basis. The value reported has been back-calculated to normalize for the moisture content of the sample.

AR : As-Received. The value has NOT been normalized for moisture.

Other abbreviations, used in special applications, are defined where they appear.

DISPOSAL DATE - Our reports now include the date on which we will dispose of your samples. (In limited instances, we may require that the samples be returned to your custody.) If you wish to have the samples back, or would like to have them stored for a longer period, please notify us before the disposal date.

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Chemistry, Microbiology, and Technical Services

CLIENT : Snohomish County Dept Pub Wrk

Certificate of Analysis

Work Order # 90-12-389

TESTS PERFORMED AND RESULTS:

Analyte	Units	01	02	03	04
Antimony (Method 7041)	ug/L	3. U	3. U	3. U	3. U
Arsenic (Method 206.3)	mg/L	0.005 U	0.005 U	0.005 U	0.005 U
Beryllium (Method 6010)	ug/L	1. U	1. U	1. U	1. U
Cadmium (Method 6010)	ug/L	1. U	1. U	1. U	1. U
Chromium (Method 6010)	ug/L	12.	15.	10.	6.6
Copper (Method 6010)	ug/L	7.	2.9	4.	1.5
Cyanide, Total (335.3)	mg/L	0.005 U	0.005 U	0.005 U	0.005 U
Lead (Method 6010)	ug/L	5. U	5. U	5. U	5. U
Mercury (Method 7470)	ug/L	1.0 U	1.0 U	1.0 U	1.0 U
Nickel (Method 6010)	ug/L	15.	7.2	3.6	4.4
Selenium (Method 7741)	ug/L	5. U	5. U	5. U	5. U
Silver (Method 6010)	ug/L	1. U	1. U	1. U	1. U
Thallium (Method 7841)	ug/L	2. U	2. U	2. U	2. U
Total Phenol	mg/L	0.005 U	0.005 U	0.005 U	0.005 U
Zinc (Method 6010)	ug/L	2.8	2.9	3.3	3.

Laucks 82 Years
Testing Laboratories, Inc.
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Chemistry, Microbiology, and Technical Services

REPORT ON SAMPLE: 9012389-01A
Client Sample ID: #110 LG-3

Date Received : 12/27/90
Date Extracted : N/A
Test Code : 8080

Collection Date : 12/27/90
Date Analyzed : 01/24/91
Test Method : SW 8080
Extraction Method : SW 3510

Report Units : ug/L

Compound	Result	SDL	Analysis Date	Confirmation Date
Alpha-BHC	0.05 U	0.05	01/24/91	01/24/91
Beta-BHC	0.05 U	0.05	01/24/91	01/24/91
Delta-BHC	0.05 U	0.05	01/24/91	01/24/91
Gamma-BHC	0.05 U	0.05	01/24/91	01/24/91
Heptachlor	0.05 U	0.05	01/24/91	01/24/91
Aldrin	0.05 U	0.05	01/24/91	01/24/91
Heptachlor Epoxide .	0.05 U	0.05	01/24/91	01/24/91
Endosulfan I	0.05 U	0.05	01/24/91	01/24/91
Dieldrin	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDE	0.1 U	0.1	01/24/91	01/24/91
Endrin	0.1 U	0.1	01/24/91	01/24/91
Endosulfan II	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDD	0.1 U	0.1	01/24/91	01/24/91
Endosulfan Sulfate .	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDT	0.1 U	0.1	01/24/91	01/24/91
Methoxychlor	0.5 U	0.5	01/24/91	01/24/91
Endrin Ketone	0.1 U	0.1	01/24/91	01/24/91
Alpha Chlordane	0.5 U	0.5	01/24/91	01/24/91
Gamma Chlordane	0.5 U	0.5	01/24/91	01/24/91
Toxaphene	1.0 U	1.0	01/24/91	01/24/91
Aroclor-1016	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1221	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1232	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1242	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1248	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1254	1.0 U	1.0	01/24/91	01/24/91
Aroclor-1260	1.0 U	1.0	01/24/91	01/24/91

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Surrogate recovery report for sample 9012389-01A

Surrogate	Percent Recovery	Limits: Min.	Max.
Dibutylchlorendate	97	43	152
Isodrin	95	32	96
Tetrachloro-m-xylene	69.	60	150
Decachlorobiphenyl	99.	60	150

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Chemistry, Microbiology, and Technical Services

REPORT ON SAMPLE: 9012389-02A
Client Sample ID: #111 LG-1

Date Received : 12/27/90
Date Extracted : N/A
Test Code : 8080

Collection Date : 12/27/90
Date Analyzed : 01/24/91
Test Method : SW 8080
Extraction Method : SW 3510

Report Units : ug/L

Compound	Result	SDL	Analysis Date	Confirmation Date
Alpha-BHC	0.05 U	0.05	01/24/91	01/24/91
Beta-BHC	0.05 U	0.05	01/24/91	01/24/91
Delta-BHC	0.05 U	0.05	01/24/91	01/24/91
Gamma-BHC	0.05 U	0.05	01/24/91	01/24/91
Heptachlor	0.05 U	0.05	01/24/91	01/24/91
Aldrin	0.05 U	0.05	01/24/91	01/24/91
Heptachlor Epoxide .	0.05 U	0.05	01/24/91	01/24/91
Endosulfan I	0.05 U	0.05	01/24/91	01/24/91
Dieldrin	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDE	0.1 U	0.1	01/24/91	01/24/91
Endrin	0.1 U	0.1	01/24/91	01/24/91
Endosulfan II	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDD	0.1 U	0.1	01/24/91	01/24/91
Endosulfan Sulfate .	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDT	0.1 U	0.1	01/24/91	01/24/91
Methoxychlor	0.5 U	0.5	01/24/91	01/24/91
Endrin Ketone	0.1 U	0.1	01/24/91	01/24/91
Alpha Chlordane	0.5 U	0.5	01/24/91	01/24/91
Gamma Chlordane	0.5 U	0.5	01/24/91	01/24/91
Toxaphene	1.0 U	1.0	01/24/91	01/24/91
Aroclor-1016	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1221	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1232	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1242	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1248	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1254	1.0 U	1.0	01/24/91	01/24/91
Aroclor-1260	1.0 U	1.0	01/24/91	01/24/91

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Chemistry, Microbiology, and Technical Services

Surrogate recovery report for sample 9012389-02A

Surrogate	Percent Recovery	Limits: Min.	Max.
Dibutylchlorendate	80	43	152
Isodrin	95	32	96
Tetrachloro-m-xylene	75.	60	150
Decachlorobiphenyl	85.	60	150

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Chemistry, Microbiology, and Technical Services

REPORT ON SAMPLE: 9012389-03A
Client Sample ID: #112 LG-2

Date Received : 12/27/90
Date Extracted : N/A
Test Code : 8080

Collection Date : 12/27/90
Date Analyzed : 01/24/91
Test Method : SW 8080
Extraction Method : SW 3510

Report Units : ug/L

Compound	Result	SDL	Analysis Date	Confirmation Date
Alpha-BHC	0.05 U	0.05	01/24/91	01/24/91
Beta-BHC	0.05 U	0.05	01/24/91	01/24/91
Delta-BHC	0.05 U	0.05	01/24/91	01/24/91
Gamma-BHC	0.05 U	0.05	01/24/91	01/24/91
Heptachlor	0.05 U	0.05	01/24/91	01/24/91
Aldrin	0.05 U	0.05	01/24/91	01/24/91
Heptachlor Epoxide .	0.05 U	0.05	01/24/91	01/24/91
Endosulfan I	0.05 U	0.05	01/24/91	01/24/91
Dieldrin	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDE	0.1 U	0.1	01/24/91	01/24/91
Endrin	0.1 U	0.1	01/24/91	01/24/91
Endosulfan II	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDD	0.1 U	0.1	01/24/91	01/24/91
Endosulfan Sulfate .	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDT	0.1 U	0.1	01/24/91	01/24/91
Methoxychlor	0.5 U	0.5	01/24/91	01/24/91
Endrin Ketone	0.1 U	0.1	01/24/91	01/24/91
Alpha Chlordane	0.5 U	0.5	01/24/91	01/24/91
Gamma Chlordane	0.5 U	0.5	01/24/91	01/24/91
Toxaphene	1.0 U	1.0	01/24/91	01/24/91
Aroclor-1016	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1221	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1232	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1242	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1248	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1254	1.0 U	1.0	01/24/91	01/24/91
Aroclor-1260	1.0 U	1.0	01/24/91	01/24/91

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Surrogate recovery report for sample 9012389-03A

Surrogate	Percent Recovery	Limits: Min.	Max.
Dibutylchlorendate	76	43	152
Isodrin	90	32	96
Tetrachloro-m-xylene	69.	60	150
Decachlorobiphenyl	77.	60	150

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Chemistry, Microbiology, and Technical Services

REPORT ON SAMPLE: 9012389-04A
Client Sample ID: #113 LG-4

Date Received : 12/27/90
Date Extracted : N/A
Test Code : 8080

Collection Date : 12/27/90
Date Analyzed : 01/24/91
Test Method : SW 8080
Extraction Method : SW 3510

Report Units : ug/L

Compound	Result	SDL	Analysis Date	Confirmation Date
Alpha-BHC	0.05 U	0.05	01/24/91	01/24/91
Beta-BHC	0.05 U	0.05	01/24/91	01/24/91
Delta-BHC	0.05 U	0.05	01/24/91	01/24/91
Gamma-BHC	0.05 U	0.05	01/24/91	01/24/91
Heptachlor	0.05 U	0.05	01/24/91	01/24/91
Aldrin	0.05 U	0.05	01/24/91	01/24/91
Heptachlor Epoxide .	0.05 U	0.05	01/24/91	01/24/91
Endosulfan I	0.05 U	0.05	01/24/91	01/24/91
Dieldrin	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDE	0.1 U	0.1	01/24/91	01/24/91
Endrin	0.1 U	0.1	01/24/91	01/24/91
Endosulfan II	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDD	0.1 U	0.1	01/24/91	01/24/91
Endosulfan Sulfate .	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDT	0.1 U	0.1	01/24/91	01/24/91
Methoxychlor	0.5 U	0.5	01/24/91	01/24/91
Endrin Ketone	0.1 U	0.1	01/24/91	01/24/91
Alpha Chlordane	0.5 U	0.5	01/24/91	01/24/91
Gamma Chlordane	0.5 U	0.5	01/24/91	01/24/91
Toxaphene	1.0 U	1.0	01/24/91	01/24/91
Aroclor-1016	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1221	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1232	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1242	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1248	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1254	1.0 U	1.0	01/24/91	01/24/91
Aroclor-1260	1.0 U	1.0	01/24/91	01/24/91

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Chemistry, Microbiology, and Technical Services

Surrogate recovery report for sample 9012389-04A

Surrogate	Percent Recovery	Limits: Min.	Max.
Dibutylchlorendate	86	43	152
Isodrin	96	32	96
Tetrachloro-m-xylene	61.	60	150
Decachlorobiphenyl	86.	60	150

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Chemistry Microbiology and Technical Services

REPORT ON SAMPLE: 9012389-05A
Client Sample ID: Method Blank

Date Received : 12/27/90
Date Extracted : N/A
Test Code : 8080

Collection Date : N/A
Date Analyzed : 01/24/91
Test Method : SW 8080
Extraction Method : SW 3510

Report Units : ug/L

Compound	Result	SDL	Analysis Date	Confirmation Date
Alpha-BHC	0.05 U	0.05	01/24/91	01/24/91
Beta-BHC	0.05 U	0.05	01/24/91	01/24/91
Delta-BHC	0.05 U	0.05	01/24/91	01/24/91
Gamma-BHC	0.05 U	0.05	01/24/91	01/24/91
Heptachlor	0.05 U	0.05	01/24/91	01/24/91
Aldrin	0.05 U	0.05	01/24/91	01/24/91
Heptachlor Epoxide .	0.05 U	0.05	01/24/91	01/24/91
Endosulfan I	0.05 U	0.05	01/24/91	01/24/91
Dieldrin	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDE	0.1 U	0.1	01/24/91	01/24/91
Endrin	0.1 U	0.1	01/24/91	01/24/91
Endosulfan II	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDD	0.1 U	0.1	01/24/91	01/24/91
Endosulfan Sulfate .	0.1 U	0.1	01/24/91	01/24/91
4,4'-DDT	0.1 U	0.1	01/24/91	01/24/91
Methoxychlor	0.5 U	0.5	01/24/91	01/24/91
Endrin Ketone	0.1 U	0.1	01/24/91	01/24/91
Alpha Chlordane	0.5 U	0.5	01/24/91	01/24/91
Gamma Chlordane	0.5 U	0.5	01/24/91	01/24/91
Toxaphene	1.0 U	1.0	01/24/91	01/24/91
Aroclor-1016	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1221	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1232	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1242	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1248	0.5 U	0.5	01/24/91	01/24/91
Aroclor-1254	1.0 U	1.0	01/24/91	01/24/91
Aroclor-1260	1.0 U	1.0	01/24/91	01/24/91

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Chemistry, Microbiology, and Technical Services

Surrogate recovery report for sample 9012389-05A

Surrogate	Percent Recovery	Limits: Min.	Max.
Dibutylchlorendate	96	43	152
Isodrin	97	32	96
Tetrachloro-m-xylene	77.	60	150
Decachlorobiphenyl	96.	60	150

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Chemistry. Microbiology. and Technical Services

REPORT ON SAMPLE: 9012389-01A
Client Sample ID: #110 LG-3

Date Received : 12/27/90
Date Extracted : 01/02/91
Test Code : LXTCSW

Collection Date : 12/27/90
Date Analyzed : 01/23/91
Test Method : SW8270
Extraction Method : SW3510

Compound	Result (ug/L)		SDL (ug/L)	Compound	Result (ug/L)		SDL (ug/L)
Phenol	1	U	1	3-Nitroaniline	5	U	5
Aniline	5	U	5	Acenaphthene	1	U	1
Bis(2-chloroethyl)ether	1	U	1	2,4-Dinitrophenol	10	U	10
2-Chlorophenol	1	U	1	4-Nitrophenol	10	U	10
1,3-Dichlorobenzene	1	U	1	Dibenzofuran	1	U	1
1,4-Dichlorobenzene	1	U	1	2,4-Dinitrotoluene	2	U	2
Benzyl alcohol	1	U	1	Diethyl phthalate	1	U	1
1,2-Dichlorobenzene	1	U	1	4-Chlorophenyl phenylether	1	U	1
2-Methylphenol	1	U	1	Fluorene	1	U	1
Bis(2-chloroisopropyl)ether	1	U	1	4-Nitroaniline	2	U	2
4-Methylphenol	1	U	1	4,6-Dinitro-2-methylphenol	10	U	10
N-Nitroso-di-n-propylamine	1	U	1	N-Nitrosodiphenylamine	1	U	1
Hexachloroethane	2	U	2	1,2-Diphenylhydrazine	2	U	2
Nitrobenzene	1	U	1	4-Bromophenyl phenylether	2	U	2
Isophorone	1	U	1	Hexachlorobenzene	2	U	2
2-Nitrophenol	2	U	2	Pentachlorophenol	10	U	10
2,4-Dimethylphenol	1	U	1	Phenanthrene	1	U	1
Benzoic acid	25	U	25	Anthracene	1	U	1
Bis(2-chloroethoxy)methane	1	U	1	Di-n-butyl phthalate	1		1
2,4-Dichlorophenol	2	U	2	Fluoranthene	1	U	1
1,2,4-Trichlorobenzene	1	U	1	Pyrene	1	U	1
Naphthalene	1	U	1	Benzidine	25	U	25
4-Chloroaniline	1	U	1	Butylbenzylphthalate	1	U	1
Hexachlorobutadiene	1	U	1	3,3'-Dichlorobenzidine	10	U	10
4-Chloro-3-methylphenol	2	U	2	Benzo(a)anthracene	1	U	1
2-Methylnaphthalene	1	U	1	Chrysene	1	U	1
Hexachlorocyclopentadiene	2	U	2	Bis(2-ethylhexyl)phthalate	1	U	1
2,4,6-Trichlorophenol	2	U	2	Di-n-octyl phthalate	1	U	1
2,4,5-Trichlorophenol	2	U	2	Benzo(b)fluoranthene	1	U	1
2-Chloronaphthalene	1	U	1	Benzo(k)fluoranthene	1	U	1
2-Nitroaniline	2	U	2	Benzo(a)pyrene	1	U	1
Dimethyl phthalate	1	U	1	Indeno(1,2,3-cd)pyrene	1	U	1
Acenaphthylene	1	U	1	Dibenzo(a,h)anthracene	1	U	1
2,6-Dinitrotoluene	2	U	2	Benzo(g,h,i)perylene	1	U	1

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Chemistry, Microbiology, and Technical Services

GC/MS ABN surrogate recovery report for sample 9012389-01A

Surrogate	Percent Recovery	Limits: Min.	Max.
Nitrobenzene d5.....	82	37	104
2-Fluorobiphenyl.....	82	37	105
Terphenyl d14.....	106	20	126
Phenol d6.....	41	10	69
2-Fluorophenol.....	53	20	86
2,4,6-Tribromophenol.	109	24	124
D10-Azobenzene.....	91	35	114
2-Bromophenol.....	72	27	97

* = Surrogate recovery is outside of control limits.

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Chemistry, Microbiology, and Technical Services

REPORT ON SAMPLE: 9012389-02A
Client Sample ID: #111 LG-1

Date Received : 12/27/90
Date Extracted : 01/02/91
Test Code : LXTCSW

Collection Date : 12/27/90
Date Analyzed : 01/23/91
Test Method : SW8270
Extraction Method : SW3510

Compound	Result (ug/L)		SDL (ug/L)	Compound	Result (ug/L)		SDL (ug/L)
Phenol	1	U	1	3-Nitroaniline	5	U	5
Aniline	5	U	5	Acenaphthene	1	U	1
Bis(2-chloroethyl)ether	1	U	1	2,4-Dinitrophenol	10	U	10
2-Chlorophenol	1	U	1	4-Nitrophenol	10	U	10
1,3-Dichlorobenzene	1	U	1	Dibenzofuran	1	U	1
1,4-Dichlorobenzene	1	U	1	2,4-Dinitrotoluene	2	U	2
Benzyl alcohol	1	U	1	Diethyl phthalate	1	U	1
1,2-Dichlorobenzene	1	U	1	4-Chlorophenyl phenylether	1	U	1
2-Methylphenol	1	U	1	Fluorene	1	U	1
Bis(2-chloroisopropyl)ether	1	U	1	4-Nitroaniline	2	U	2
4-Methylphenol	1	U	1	4,6-Dinitro-2-methylphenol	10	U	10
N-Nitroso-di-n-propylamine	1	U	1	N-Nitrosodiphenylamine	1	U	1
Hexachloroethane	2	U	2	1,2-Diphenylhydrazine	2	U	2
Nitrobenzene	1	U	1	4-Bromophenyl phenylether	2	U	2
Isophorone	1	U	1	Hexachlorobenzene	2	U	2
2-Nitrophenol	2	U	2	Pentachlorophenol	10	U	10
2,4-Dimethylphenol	1	U	1	Phenanthrene	1	U	1
Benzoic acid	25	U	25	Anthracene	1	U	1
Bis(2-chloroethoxy)methane	1	U	1	Di-n-butyl phthalate	1		1
2,4-Dichlorophenol	2	U	2	Fluoranthene	1	U	1
1,2,4-Trichlorobenzene	1	U	1	Pyrene	1	U	1
Naphthalene	1	U	1	Benzidine	25	U	25
4-Chloroaniline	1	U	1	Butylbenzylphthalate	1	U	1
Hexachlorobutadiene	1	U	1	3,3'-Dichlorobenzidine	10	U	10
4-Chloro-3-methylphenol	2	U	2	Benzo(a)anthracene	1	U	1
2-Methylnaphthalene	1	U	1	Chrysene	1	U	1
Hexachlorocyclopentadiene	2	U	2	Bis(2-ethylhexyl)phthalate	1	U	1
2,4,6-Trichlorophenol	2	U	2	Di-n-octyl phthalate	1	U	1
2,4,5-Trichlorophenol	2	U	2	Benzo(b)fluoranthene	1	U	1
2-Chloronaphthalene	1	U	1	Benzo(k)fluoranthene	1	U	1
2-Nitroaniline	2	U	2	Benzo(a)pyrene	1	U	1
Dimethyl phthalate	1	U	1	Indeno(1,2,3-cd)pyrene	1	U	1
Acenaphthylene	1	U	1	Dibenzo(a,h)anthracene	1	U	1
2,6-Dinitrotoluene	2	U	2	Benzo(g,h,i)perylene	1	U	1

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Chemistry, Microbiology, and Technical Services

GC/MS ABN surrogate recovery report for sample 9012389-02A

Surrogate	Percent Recovery	Limits: Min.	Max.
Nitrobenzene d5.....	89	37	104
2-Fluorobiphenyl.....	89	37	105
Terphenyl d14.....	113	20	126
Phenol d6.....	45	10	69
2-Fluorophenol.....	57	20	86
2,4,6-Tribromophenol.	119	24	124
D10-Azobenzene.....	101	35	114
2-Bromophenol.....	79	27	97

* = Surrogate recovery is outside of control limits.

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Chemistry, Microbiology, and Technical Services

REPORT ON SAMPLE: 9012389-03A
Client Sample ID: #112 LG-2

Date Received : 12/27/90
Date Extracted : 01/02/91
Test Code : LXTCSW

Collection Date : 12/27/90
Date Analyzed : 01/23/91
Test Method : SW8270
Extraction Method : SW3510

Compound	Result (ug/L)		SDL (ug/L)	Compound	Result (ug/L)		SDL (ug/L)
Phenol	1	U	1	3-Nitroaniline	5	U	5
Aniline	5	U	5	Acenaphthene	1	U	1
Bis(2-chloroethyl)ether	1	U	1	2,4-Dinitrophenol	10	U	10
2-Chlorophenol	1	U	1	4-Nitrophenol	10	U	10
1,3-Dichlorobenzene	1	U	1	Dibenzofuran	1	U	1
1,4-Dichlorobenzene	1	U	1	2,4-Dinitrotoluene	2	U	2
Benzyl alcohol	1	U	1	Diethyl phthalate	1	U	1
1,2-Dichlorobenzene	1	U	1	4-Chlorophenyl phenylether	1	U	1
2-Methylphenol	1	U	1	Fluorene	1	U	1
Bis(2-chloroisopropyl)ether	1	U	1	4-Nitroaniline	2	U	2
4-Methylphenol	1	U	1	4,6-Dinitro-2-methylphenol	10	U	10
N-Nitroso-di-n-propylamine	1	U	1	N-Nitrosodiphenylamine	1	U	1
Hexachloroethane	2	U	2	1,2-Diphenylhydrazine	2	U	2
Nitrobenzene	1	U	1	4-Bromophenyl phenylether	2	U	2
Isophorone	1	U	1	Hexachlorobenzene	2	U	2
2-Nitrophenol	2	U	2	Pentachlorophenol	10	U	10
2,4-Dimethylphenol	1	U	1	Phenanthrene	1	U	1
Benzoic acid	25	U	25	Anthracene	1	U	1
Bis(2-chloroethoxy)methane	1	U	1	Di-n-butyl phthalate	1	U	1
2,4-Dichlorophenol	2	U	2	Fluoranthene	1	U	1
1,2,4-Trichlorobenzene	1	U	1	Pyrene	1	U	1
Naphthalene	1	U	1	Benzidine	25	U	25
4-Chloroaniline	1	U	1	Butylbenzylphthalate	1	U	1
Hexachlorobutadiene	1	U	1	3,3'-Dichlorobenzidine	10	U	10
4-Chloro-3-methylphenol	2	U	2	Benzo(a)anthracene	1	U	1
2-Methylnaphthalene	1	U	1	Chrysene	1	U	1
Hexachlorocyclopentadiene	2	U	2	Bis(2-ethylhexyl)phthalate	1	U	1
2,4,6-Trichlorophenol	2	U	2	Di-n-octyl phthalate	1	U	1
2,4,5-Trichlorophenol	2	U	2	Benzo(b)fluoranthene	1	U	1
2-Chloronaphthalene	1	U	1	Benzo(k)fluoranthene	1	U	1
2-Nitroaniline	2	U	2	Benzo(a)pyrene	1	U	1
Dimethyl phthalate	1	U	1	Indeno(1,2,3-cd)pyrene	1	U	1
Acenaphthylene	1	U	1	Dibenzo(a,h)anthracene	1	U	1
2,6-Dinitrotoluene	2	U	2	Benzo(g,h,i)perylene	1	U	1

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GC/MS ABN surrogate recovery report for sample 9012389-03A

Surrogate	Percent Recovery	Limits: Min.	Max.
Nitrobenzene d5.....	93	37	104
2-Fluorobiphenyl.....	83	37	105
Terphenyl d14.....	107	20	126
Phenol d6.....	42	10	69
2-Fluorophenol.....	55	20	86
2,4,6-Tribromophenol.	112	24	124
D10-Azobenzene.....	93	35	114
2-Bromophenol.....	77	27	97

* = Surrogate recovery is outside of control limits.

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Chemistry, Microbiology, and Technical Services

GC/MS ABN surrogate recovery report for sample 9012389-04A

Surrogate	Percent Recovery	Limits: Min.	Max.
Nitrobenzene d5.....	92	37	104
2-Fluorobiphenyl.....	83	37	105
Terphenyl d14.....	104	20	126
Phenol d6.....	49	10	69
2-Fluorophenol.....	62	20	86
2,4,6-Tribromophenol.	110	24	124
D10-Azobenzene.....	91	35	114
2-Bromophenol.....	77	27	97

* = Surrogate recovery is outside of control limits.

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Chemistry, Microbiology, and Technical Services

REPORT ON SAMPLE: 9012389-05A
Client Sample ID: Method Blank

Date Received : 12/27/90
Date Extracted : 01/02/91
Test Code : LXTCSW

Collection Date : N/A
Date Analyzed : 01/23/91
Test Method : SW8270
Extraction Method : SW3510

Compound	Result (ug/L)		SDL (ug/L)	Compound	Result (ug\L)		SDL (ug/L)
Phenol	1	U	1	3-Nitroaniline	5	U	5
Aniline	5	U	5	Acenaphthene	1	U	1
Bis(2-chloroethyl)ether	1	U	1	2,4-Dinitrophenol	10	U	10
2-Chlorophenol	1	U	1	4-Nitrophenol	10	U	10
1,3-Dichlorobenzene	1	U	1	Dibenzofuran	1	U	1
1,4-Dichlorobenzene	1	U	1	2,4-Dinitrotoluene	2	U	2
Benzyl alcohol	1	U	1	Diethyl phthalate	1	U	1
1,2-Dichlorobenzene	1	U	1	4-Chlorophenyl phenylether	1	U	1
2-Methylphenol	1	U	1	Fluorene	1	U	1
Bis(2-chloroisopropyl)ether	1	U	1	4-Nitroaniline	2	U	2
4-Methylphenol	1	U	1	4,6-Dinitro-2-methylphenol	10	U	10
N-Nitroso-di-n-propylamine	1	U	1	N-Nitrosodiphenylamine	1	U	1
Hexachloroethane	2	U	2	1,2-Diphenylhydrazine	2	U	2
Nitrobenzene	1	U	1	4-Bromophenyl phenylether	2	U	2
Isophorone	1	U	1	Hexachlorobenzene	2	U	2
2-Nitrophenol	2	U	2	Pentachlorophenol	10	U	10
2,4-Dimethylphenol	1	U	1	Phenanthrene	1	U	1
Benzoic acid	25	U	25	Anthracene	1	U	1
Bis(2-chloroethoxy)methane	1	U	1	Di-n-butyl phthalate	1	U	1
2,4-Dichlorophenol	2	U	2	Fluoranthene	1	U	1
1,2,4-Trichlorobenzene	1	U	1	Pyrene	1	U	1
Naphthalene	1	U	1	Benzidine	25	U	25
4-Chloroaniline	1	U	1	Butylbenzylphthalate	1	U	1
Hexachlorobutadiene	1	U	1	3,3'-Dichlorobenzidine	10	U	10
4-Chloro-3-methylphenol	2	U	2	Benzo(a)anthracene	1	U	1
2-Methylnaphthalene	1	U	1	Chrysene	1	U	1
Hexachlorocyclopentadiene	2	U	2	Bis(2-ethylhexyl)phthalate	1	U	1
2,4,6-Trichlorophenol	2	U	2	Di-n-octyl phthalate	1	U	1
2,4,5-Trichlorophenol	2	U	2	Benzo(b)fluoranthene	1	U	1
2-Chloronaphthalene	1	U	1	Benzo(k)fluoranthene	1	U	1
2-Nitroaniline	2	U	2	Benzo(a)pyrene	1	U	1
Dimethyl phthalate	1	U	1	Indeno(1,2,3-cd)pyrene	1	U	1
Acenaphthylene	1	U	1	Dibenzo(a,h)anthracene	1	U	1
2,6-Dinitrotoluene	2	U	2	Benzo(g,h,i)perylene	1	U	1

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GC/MS ABN surrogate recovery report for sample 9012389-05A

Surrogate	Percent Recovery	Limits: Min.	Max.
Nitrobenzene d5.....	87	37	104
2-Fluorobiphenyl.....	83	37	105
Terphenyl d14.....	101	20	126
Phenol d6.....	42	10	69
2-Fluorophenol.....	55	20	86
2,4,6-Tribromophenol.	103	24	124
D10-Azobenzene.....	87	35	114
2-Bromophenol.....	71	27	97

* = Surrogate recovery is outside of control limits.

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Chemistry, Microbiology, and Technical Services

REPORT ON SAMPLE: 9012389-01A
Client Sample ID: #110 LG-3

Date Received : 12/27/90
Date Extracted : N/A
Test Code : LXTCVW

Collection Date : 12/27/90
Date Analyzed : 12/28/90
Test Method : SW 8240

Compound	Result (ug/L)	SDL (ug/L)	Compound	Result (ug/L)	SDL (ug/L)
Chloromethane	1 U	1	Bromodichloromethane	1 U	1
Bromomethane	1 U	1	1,2-Dichloropropane	1 U	1
Vinyl chloride	1 U	1	Trichloroethene	1 U	1
Chloroethane	3 U	3	Benzene	1 U	1
Methylene chloride	1 U	1	Dibromochloromethane	3 U	3
Acetone	13	5	1,1,2-Trichloroethane	1 U	1
Carbon disulfide	1 U	1	Bromoform	1 U	1
1,1-Dichloroethene	1 U	1	4-Methyl-2-pentanone	3 U	3
1,1-Dichloroethane	1 U	1	2-Hexanone	3 U	3
trans-1,2-Dichloroethene	1 U	1	1,1,2,2-Tetrachloroethane	3 U	3
cis-1,2-Dichloroethene	1 U	1	Tetrachloroethene	1 U	1
Total 1,2-Dichloroethene	1 U	1	Toluene	1 U	1
Chloroform	1 U	1	Chlorobenzene	3 U	3
2-Butanone	3 U	3	trans-1,3-Dichloropropene	3 U	3
1,2-Dichloroethane	1 U	1	Ethylbenzene	1 U	1
1,1,1-Trichloroethane	1 U	1	cis-1,3-Dichloropropene	3 U	3
Carbon tetrachloride	1 U	1	Styrene	1 U	1
Vinyl acetate	1 U	1	Total Xylene	1 U	1

Surrogate Recovery Report

Surrogate Compound	Percent Recovery	Limits: Min.	Max.
1,2-Dichloroethane d4	99	78	118
Toluene d8	98	83	117
p-Bromofluorobenzene	96	81	115

* Surrogate recovery is outside of control limits. See comments.

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Chemistry, Microbiology, and Technical Services

REPORT ON SAMPLE: 9012389-04A
Client Sample ID: #113 LG-4

Date Received : 12/27/90
Date Extracted : N/A
Test Code : LXTCVW

Collection Date : 12/27/90
Date Analyzed : 12/28/90
Test Method : SW 8240

Compound	Result (ug/L)	SDL (ug/L)	Compound	Result (ug/L)	SDL (ug/L)
Chloromethane	1 U	1	Bromodichloromethane	1 U	1
Bromomethane	1 U	1	1,2-Dichloropropane	1 U	1
Vinyl chloride	1 U	1	Trichloroethene	1 U	1
Chloroethane	3 U	3	Benzene	1 U	1
Methylene chloride	1 U	1	Dibromochloromethane	3 U	3
Acetone	59	5	1,1,2-Trichloroethane	1 U	1
Carbon disulfide	1 U	1	Bromoform	1 U	1
1,1-Dichloroethene	1 U	1	4-Methyl-2-pentanone	3 U	3
1,1-Dichloroethane	1 U	1	2-Hexanone	3 U	3
trans-1,2-Dichloroethene	1 U	1	1,1,2,2-Tetrachloroethane	3 U	3
cis-1,2-Dichloroethene	1 U	1	Tetrachloroethene	1 U	1
Total 1,2-Dichloroethene	1 U	1	Toluene	1 U	1
Chloroform	1 U	1	Chlorobenzene	3 U	3
2-Butanone	3 U	3	trans-1,3-Dichloropropene	3 U	3
1,2-Dichloroethane	1 U	1	Ethylbenzene	1 U	1
1,1,1-Trichloroethane	1 U	1	cis-1,3-Dichloropropene	3 U	3
Carbon tetrachloride	1 U	1	Styrene	1 U	1
Vinyl acetate	1 U	1	Total Xylene	1 U	1

Surrogate Recovery Report

Surrogate Compound	Percent Recovery	Limits: Min.	Max.
1,2-Dichloroethane d4	104	78	118
Toluene d8	100	83	117
p-Bromofluorobenzene	99	81	115

* Surrogate recovery is outside of control limits. See comments.

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Chemistry, Microbiology, and Technical Services

REPORT ON SAMPLE: 9012389-05A
Client Sample ID: Method Blank

Date Received : 12/27/90
Date Extracted : N/A
Test Code : LXTCVW

Collection Date :
Date Analyzed : 12/28/90
Test Method : SW 8240

Compound	Result (ug/L)	SDL (ug/L)	Compound	Result (ug/L)	SDL (ug/L)
Chloromethane	1 U	1	Bromodichloromethane	1 U	1
Bromomethane	1 U	1	1,2-Dichloropropane	1 U	1
Vinyl chloride	1 U	1	Trichloroethene	1 U	1
Chloroethane	3 U	3	Benzene	1 U	1
Methylene chloride	1 U	1	Dibromochloromethane	3 U	3
Acetone	11	5	1,1,2-Trichloroethane	1 U	1
Carbon disulfide	1 U	1	Bromoform	1 U	1
1,1-Dichloroethene	1 U	1	4-Methyl-2-pentanone	3 U	3
1,1-Dichloroethane	1 U	1	2-Hexanone	3 U	3
trans-1,2-Dichloroethene	1 U	1	1,1,2,2-Tetrachloroethane	3 U	3
cis-1,2-Dichloroethene	1 U	1	Tetrachloroethene	1 U	1
Total 1,2-Dichloroethene	1 U	1	Toluene	1 U	1
Chloroform	1 U	1	Chlorobenzene	3 U	3
2-Butanone	3 U	3	trans-1,3-Dichloropropene	3 U	3
1,2-Dichloroethane	1 U	1	Ethylbenzene	1 U	1
1,1,1-Trichloroethane	1 U	1	cis-1,3-Dichloropropene	3 U	3
Carbon tetrachloride	1 U	1	Styrene	1 U	1
Vinyl acetate	1 U	1	Total Xylene	1 U	1

Surrogate Recovery Report

Surrogate Compound	Percent Recovery	Limits: Min.	Max.
1,2-Dichloroethane d4	100	78	118
Toluene d8	96	83	117
p-Bromofluorobenzene	97	81	115

* Surrogate recovery is outside of control limits. See comments.

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Chemistry, Microbiology, and Technical Services

REPORT ON WORK ORDER 9012389 PREPARATION BLANKS

Test : Arsenic (Method 206.3)
Blank Name : B1231HY02 Preparation Date: 12/31/90
Conc Found : 0.005 U Control Limit : 0.010
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Selenium (Method 7741)
Blank Name : B1231HY05 Preparation Date: 12/31/90
Conc Found : 5.000 U Control Limit : 10.000
Units : ug/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Cyanide, Total (335.3)
Blank Name : B1228CN_W01 Preparation Date: 12/28/90
Conc Found : 0.005 U Control Limit : 0.010
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Silver (Method 6010)
Blank Name : B0102ICP_W01 Preparation Date: 01/02/91
Conc Found : 1.000 U Control Limit : 2.000
Units : ug/L

This blank and comments, if any, apply to the following sample(s):
1-4

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REPORT ON WORK ORDER 9012389 PREPARATION BLANKS

Test : Nickel (Method 6010)
Blank Name : B0102ICP_W01 Preparation Date: 01/02/91
Conc Found : 2.000 U Control Limit : 4.000
Units : ug/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Lead (Method 6010)
Blank Name : B0102ICP_W01 Preparation Date: 01/02/91
Conc Found : 5.000 U Control Limit : 10.000
Units : ug/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Zinc (Method 6010)
Blank Name : B0102ICP_W01 Preparation Date: 01/02/91
Conc Found : 1.000 U Control Limit : 5.000
Units : ug/L

This blank and comments, if any, apply to the following sample(s):
1-4

Test : Mercury (Method 7470)
Blank Name : B0104HGW01 Preparation Date: 01/04/91
Conc Found : 1.000 U Control Limit : 2.000
Units : ug/L

This blank and comments, if any, apply to the following sample(s):
1-4

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REPORT ON WORK ORDER 9012389 PREPARATION BLANKS

Test : Total Phenol
Blank Name : B0102PNL_W01 Control Limit : 0.010
Conc Found : 0.005 U
Units : mg/L Preparation Date: 01/02/91

This blank applies to the following samples:
1-4

Test : Antimony (Method 7041)
Blank Name : B0102GFW01 Preparation Date: 01/02/91
Conc Found : 3.000 U Control Limit : 6.000
Units : ug/L

This blank applies to the following samples:
1-4

* = outside control limits
U = analtye not detected

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REPORT ON WORK ORDER 9012389 PREPARATION BLANKS

Test : Thallium (Method 7841)
Blank Name : B0102GFW01 Preparation Date: 01/02/91
Conc Found : 2.000 U Control Limit : 4.000
Units : ug/L

This blank and comments, if any, apply to the following sample(s):
1-4

* = outside control limits
U = analtye not detected

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Chemistry, Microbiology, and Technical Services

REPORT ON WORK ORDER 9012389 MATRIX SPIKE/MATRIX SPIKE DUPLICATES

Test	: Arsenic (Method 206.3)		
Matrix Spike Recovery	: 90%		
Matrix Spike Duplicate Recovery	: 95%	Control Limits	
Relative percent difference	: 5	Recovery	RPD
Control limits	:	74 - 136	17

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

Test	: Selenium (Method 270.3)		
Matrix Spike Recovery	: 90%		
Matrix Spike Duplicate Recovery	: 95%	Control Limits	
Relative percent difference	: 5	Recovery	RPD
Control limits	:	55 - 147	19

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

Test	: Cyanide, Total (335.3)		
Matrix Spike Recovery	: 73%		
Matrix Spike Duplicate Recovery	: 72%	Control Limits	
Relative percent difference	: 2	Recovery	RPD
Control limits	:	69 - 133	30

This MS/MSD and comments, if any, apply to the following sample(s):
9012389-01-04

U = not detected
* = outside control limits

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Chemistry, Microbiology, and Technical Services

REPORT ON WORK ORDER 9012389 MATRIX SPIKE/MATRIX SPIKE DUPLICATES

Test	: Silver (Method 6010)		
Matrix Spike Recovery	: 87%		
Matrix Spike Duplicate Recovery	: 81%	Control Limits	
Relative percent difference	: 7	Recovery	RPD
Control limits	:	57 - 119	25

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

Test	: Beryllium (Method 6010)		
Matrix Spike Recovery	: 95%		
Matrix Spike Duplicate Recovery	: 108%	Control Limits	
Relative percent difference	: 12	Recovery	RPD
Control limits	:	69 - 129	16

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

Test	: Cadmium (Method 6010)		
Matrix Spike Recovery	: 92%		
Matrix Spike Duplicate Recovery	: 90%	Control Limits	
Relative percent difference	: 2	Recovery	RPD
Control limits	:	62 - 118	17

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

U = not detected
* = outside control limits

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Chemistry, Microbiology, and Technical Services

REPORT ON WORK ORDER 9012389 MATRIX SPIKE/MATRIX SPIKE DUPLICATES

Test	: Chromium (Method 6010)		
Matrix Spike Recovery	: 94%		
Matrix Spike Duplicate Recovery	: 92%	Control Limits	
Relative percent difference	: 3	Recovery	RPD
Control limits	:	55 - 124	23

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

Test	: Copper (Method 6010)		
Matrix Spike Recovery	: 93%		
Matrix Spike Duplicate Recovery	: 93%	Control Limits	
Relative percent difference	: 0	Recovery	RPD
Control limits	:	62 - 119	28

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

Test	: Nickel (Method 6010)		
Matrix Spike Recovery	: 91%		
Matrix Spike Duplicate Recovery	: 88%	Control Limits	
Relative percent difference	: 3	Recovery	RPD
Control limits	:	62 - 117	13

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

U = not detected
* = outside control limits

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Chemistry, Microbiology, and Technical Services

REPORT ON WORK ORDER 9012389 MATRIX SPIKE/MATRIX SPIKE DUPLICATES

Test	: Lead (Method 6010)		
Matrix Spike Recovery	: 99%		
Matrix Spike Duplicate Recovery	: 88%	Control Limits	
Relative percent difference	: 12	Recovery	RPD
Control limits	:	65 - 118	14

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

Test	: Zinc (Method 6010)		
Matrix Spike Recovery	: 95%		
Matrix Spike Duplicate Recovery	: 89%	Control Limits	
Relative percent difference	: 7	Recovery	RPD
Control limits	:	50 - 123	24

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

Test	: Mercury (Method 7470)		
Matrix Spike Recovery	: 104%		
Matrix Spike Duplicate Recovery	: 104%	Control Limits	
Relative percent difference	: 0	Recovery	RPD
Control limits	:	75 - 122	30

This MS/MSD and comments, if any, apply to the following sample(s):
9012389 1-4

U = not detected
* = outside control limits

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Chemistry, Microbiology, and Technical Services

REPORT ON WORK ORDER 9012389 MATRIX SPIKE/MATRIX SPIKE DUPLICATES

Test	: Total Phenol		
Matrix Spike Recovery	: 112%		
Matrix Spike Duplicate Recovery	: 109%	Control Limits	
Relative percent difference	: 3	Recovery	RPD
Control limits	:	69 - 126	14

This MS/MSD and comments, if any, apply to the following sample(s):
9012389 1-4

Test	: Thallium (Method 7841)		
Matrix Spike Recovery	: 76%		
Matrix Spike Duplicate Recovery	: 76%	Control Limits	
Relative percent difference	: 1	Recovery	RPD
Control limits	:	50 - 150	30

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

Test	: Antimony (Method 7041)		
Matrix Spike Recovery	: 80%		
Matrix Spike Duplicate Recovery	: 80%	Control Limits	
Relative percent difference	: 1	Recovery	RPD
Control limits	:	50 - 150	30

This MS/MSD and comments, if any, apply to the following sample(s):
1-4

U = not detected
* = outside control limits

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Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063
Chemistry, Microbiology, and Technical Services

CLIENT: Snohomish County Dept Pub Wrk
Cathcart Landfill
14528 Highway 9
Snohomish, WA 98290
ATTN : Dawn Shroy-Marshall

Certificate of Analysis
Work Order# : 90-10-269
DATE RECEIVED : 10/15/90
DATE OF REPORT: 10/24/90

Work ID : Lk Goodwin
Taken By : Client
Transported by: Hand Delivered
Type : Water

SAMPLE IDENTIFICATION:

	Sample Description	Collection Date
01	90 LG-F	10/15/90 09:50
02	Method Blank	N/A

A Total Coliform Count of under 2.2 MPN per 100 mls meets U.S.E.P.A. and Public Health criteria for drinking water. A Total Coliform Count above 2.2 MPN per 100 mls does not meet these criteria. If the symbol >/ appears in your report, it means that the total coliform concentration is greater than or equal to the number shown.

Aliquots for metals (Iron, Manganese, Zinc), and Soluble NO3NO2 are being reported as dissolved, samples were filtered and preserved upon receipt at the laboratory.

The flag "U" indicates the analyte of interest was not detected, to the limit of detection shown.

The flag "B" indicates the analyte of interest was detected in the method blank associated with the sample, as well as in the sample itself.

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Chemistry. Microbiology. and Technical Services

CLIENT : Snohomish County Dept Pub Wrk

Certificate of Analysis

Work Order# : 90-10-269

Unless otherwise instructed all samples will be discarded on 12/09/90

Respectfully submitted,
Laucks Testing Laboratories, Inc.

J. M. Owens

J. M. Owens

Laucks 82 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063
Chemistry, Microbiology, and Technical Services

CLIENT : Snohomish County Dept Pub Wrk

Certificate of Analysis

Work Order # 90-10-269

TESTS PERFORMED AND RESULTS:

Analyte	Units	01
Ammonia as N	mg/L	0.01 U
Chemical Oxygen Demand	mg/L	10. U
Chloride (Method 300.0)	mg/L	5.
Hardness as CaCO3	mg/L	74.
Iron (Method 236.1)	mg/L	0.08
Manganese (Method 243.1)	mg/L	0.013
Nitrate + Nitrite as N	mg/L	1.4
Nitrate as N	mg/L	1.4
Specific Conductance	Micromhos/cm	160.
Sulfate as SO4	mg/L	6.
Total Coliform Count	MPN per 100 ml	2.2 U
Total Organic Carbon	mg/L	1.3
Zinc (Method 289.1)	mg/L	0.005 B
pH	gl elec @25C	8.6

Laucks 82 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

REPORT ON WORK ORDER 9010269 PREPARATION BLANKS

Test : Chemical Oxygen Demand
Blank Name : B1016CODW01 Preparation Date: 10/16/90
Conc Found : 10.000 U Control Limit : 20.000
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1

Test : Nitrate + Nitrite as N
Blank Name : B1016NNW01 Preparation Date: 10/16/90
Conc Found : 0.010 U Control Limit : 0.020
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1

Test : Chloride (Method 300.0)
Blank Name : B1016ICW01 Preparation Date: 10/16/90
Conc Found : 1.000 U Control Limit : 2.000
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1

Test : Nitrate as N
Blank Name : B1016ICW01 Preparation Date: 10/16/90
Conc Found : 0.200 U Control Limit : 0.400
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1

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Chemistry, Microbiology, and Technical Services

REPORT ON WORK ORDER 9010269 PREPARATION BLANKS

Test : Sulfate as SO4
Blank Name : B1016ICW01 Preparation Date: 10/16/90
Conc Found : 1.000 U Control Limit : 2.000
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1

Test : Ammonia as N
Blank Name : B1017NH3W01 Preparation Date: 10/17/90
Conc Found : 0.010 U Control Limit : 0.020
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1

Test : Iron (Method 236.1)
Blank Name : B1016AA01 Preparation Date: 10/16/90
Conc Found : 0.050 U Control Limit : 0.250
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1

Test : Manganese (Method 243.1)
Blank Name : B1016AA01 Preparation Date: 10/16/90
Conc Found : 0.002 U Control Limit : 0.004
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1

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940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

REPORT ON WORK ORDER 9010269 PREPARATION BLANKS

Test : Zinc (Method 289.1)
Blank Name : B1016AA01 Preparation Date: 10/16/90
Conc Found : 0.002 Control Limit : 0.004
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1

Test : Total Organic Carbon
Blank Name : B1018TOC_WO1 Preparation Date: 10/18/90
Conc Found : 1.000 U Control Limit : 2.000
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1

Test : Hardness as CaCO3
Blank Name : B1024HARW01 Preparation Date: 10/24/90
Conc Found : 1.000 U Control Limit : 2.000
Units : mg/L

This blank and comments, if any, apply to the following sample(s):
1

* = outside control limits
U = analtye not detected

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

CLIENT: Solid Waste Division
c/o Cathcart Landfill
14528 Highway 9
Snohomish, WA 98290
ATTN: Dawn Shroy-Marshall

LABORATORY NO. 9010289

DATE: Dec. 18, 1990

REPORT ON: SOIL

SAMPLE IDENTIFICATION: Submitted 10/16/90 and identified as shown below:

1) LG-1-1 10/13/90 Lake Goodwin Landfill
2) LG-1-17 10/14/90 Lake Goodwin Landfill
3) LG-1-18 10/14/90 Lake Goodwin Landfill

TESTS PERFORMED AND RESULTS:

	1	2	3
Total Coliform Count, MPN/per gram	<2.	5.	<2.
Total Solids, %	97.0	65.6	75.4
Conductivity, umhos/cm	11.	12.	28.
Total Organic Carbon, %	0.6	0.2	0.4
pH, glass electrode at 25°C	5.8	6.8	7.2
	parts per million (mg/kg), dry basis		
Halogenated Hydrocarbons	<40.	<40.	<40.
Chemical Oxygen Demand	5700.	2400.	2500.
Chloride	<15.	18.	<15.
Nitrate as N	<2.1	3.6	2.8
Nitrite as N	<0.20	<0.20	<0.20
Ammonia	<0.10	<0.10	<0.10
Sulfate as SO4	21.	20.	12.
Iron	14000.	34000.	21000.
Zinc	24.	120.	47.
Manganese	210.	570.	330.

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

Solid Waste Division

LABORATORY NO. 9010289

Key

< indicates "less than"

Respectfully submitted,

LAUCKS TESTING LABORATORIES, INC.

J. M. Owens

JMO:bv

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063
Chemistry, Microbiology, and Technical Services

APPENDIX

Copy of Chain-of-Custody Attached

4010209

CHAIN OF CUSTODY RECORD

DATE 10.16.90 PAGE ____ OF ____

Laucks Testing Laboratories, Inc.
940 South Harney St Seattle Washington 98108 (206)767 5060

THIS INFORMATION WILL BE USED FOR REPORTING

NAME SNOHOMISH COUNTY SOLID WASTE MGMT.

ADDRESS 14528 Hwy 9
SNOHOMISH, WA 98290

ATTENTION: DAWN SHROY MARSHALL

PROJECT NAME Lake Goodwin Landfill

JOB/P.O. NO.

SAMPLER (SIGNATURE) (PRINTED NAME) ERICK MILLER

LAB NO.	LAB SA #	SAMPLE NO.	DATE	TIME	LOCATION	pH, Temperature	Specific Conductance	COD	TOC	TOX H.H.	Total Coliform	Chloride	Nitrate	Nitrite	Ammonia	Sulfate	Iron Zinc	Manganese	NO. OF CONTAINERS
		LG-1-1	10.15.90		LK GOODWIN L.F.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓✓	✓	2
		LG-1-17	10.16.90		↓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓✓	✓	2
		LG-1-18	10.16.90			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓✓	✓	2

OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS

RUN M/FS PARAMETERS ON SOIL SAMPLES

LG-1-1 4'
LG-1-17 85'
LG-1-18 90'

RELINQUISHED BY
SIGNATURE Erick W. Miller
PRINTED NAME ERICK MILLER
COMPANY CONVERSE
DATE 10-16-90
TIME 12:55

RECEIVED BY
SIGNATURE
PRINTED NAME
COMPANY
DATE
TIME

RELINQUISHED BY
SIGNATURE
PRINTED NAME
COMPANY
DATE
TIME

RECEIVED BY
SIGNATURE R. Valdez
PRINTED NAME R. Valdez
COMPANY LAUCKS TESTING LABS
DATE 10/16/90
TIME 1253

TOTAL NUMBER OF CONTAINERS: 6

SHIPMENT METHOD:

SPECIAL SHIPMENT, HANDLING OR STORAGE REQUIREMENTS

INSTRUCTIONS:
1. Shaded areas for lab use only.
2. Complete in ballpoint pen. Draw one line through errors and initial.
3. Be specific in test requests.
4. Check off tests to be performed for each sample.
5. Retain final copy after signing.
6. Provide name and telephone of your contact person.

NAME
TELEPHONE

BILLING INFORMATION, IF DIFFERENT

NAME
ADDRESS
ATTN:

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

CLIENT: Solid Waste Division
c/o Cathcart Landfill
14528 Highway 9
Snohomish, WA 98290
ATTN: Dawn Shroy-Marshall

LABORATORY NO. 9010548

DATE: Dec. 18, 1990

REPORT ON: SOIL

SAMPLE IDENTIFICATION: Submitted 10/30/90 and identified as shown below:

1) LG-2-1 10/27/90
2) LG-2-23 10/27/90
3) LG-2-24 10/27/90

TESTS PERFORMED AND RESULTS:

	1	2	3
Total Coliform Count, MPN/per gram	1700.	<2.	2.
Total Solids, %	93.0	92.5	82.1
Conductivity, umhos/cm	14.	14.	26.
Total Organic Carbon, %	0.5	0.2	0.2
pH, glass electrode at 25°C	7.0	6.9	7.2
	parts per million (mg/kg), dry basis		
Halogenated Hydrocarbons	<18.	<18.	<18.
Chemical Oxygen Demand	1800.	1100.	2800.
Chloride	<12.	<12.	<12.
Nitrate as N	<2.4	<2.4	<2.4
Nitrite as N	<0.2	<0.2	<0.2
Ammonia	<0.11	<0.11	<0.11
Sulfate as SO4	10.	13.	13.
Iron	13000.	20000.	17000.
Zinc	25.	39.	37.
Manganese	230.	430.	260.

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063
Chemistry Microbiology and Technical Services

Solid Waste Division

LABORATORY NO. 9010548

Key

< indicates "less than"

Respectfully submitted,

LAUCKS TESTING LABORATORIES, INC.

J. M. Owens

JMO:bv

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

APPENDIX

Copy of Chain-of-Custody Attached

am test inc.

CHAIN OF CUSTODY RECORD

4U0048

PROJ. NO.	PROJECT NAME
89-35228-10	Lake Goodwin land fill

SAMPLERS: (Signature) Erick Miller / John Strunk
Erick Miller

Client Name Snohomish Co. Solid Waste Management Division Cathcart Landfill
Client Phone 14528 Rt. 9 Snohomish, WA 98290
CONTACT PERSON Dawn Shroy Marshall 668-3193

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	pH, Temp, Spec. Cond	COD, TOX, TOC	Total Coliform	Chloride, Nitrate, NH3-N	Ammonia, Silfide	Iron, Zinc, Manganese	REMARKS
LG-2-1	10-27-90			X	Monitoring Well Boring LG-2	2	X	X	X	X	X	X	Run IMFS Parameters on Soils
LG-2-23	↓			X	↓	2	X	X	X	X	X	X	5 ft
LG-2-24	↓			X	↓	2	X	X	X	X	X	X	115 ft
													120 ft

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Erick Miller	10/29/90 1:40	Christopher A. Scott			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Christopher A. Scott		R. Valdez			
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	

LaWS

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

am test inc.
14603 N.E. 87th St.
REDMOND, WA 98052
(206) 885-1664

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

CLIENT: Solid Waste Division
c/o Cathcart Landfill
14528 Highway 9
Snohomish, WA 98290
ATTN: Dawn Shroy-Marshall

LABORATORY NO. 9010515

DATE: Dec. 18, 1990

REPORT ON: SOIL

SAMPLE IDENTIFICATION: Submitted 10/26/90 and identified as shown below:

1) LG-3-1 10/23/90
2) LG-3-17 10/23/90
3) LG-3-18 10/23/90

TESTS PERFORMED AND RESULTS:

	1	2	3
Total Coliform Count, MPN/per gram	280,000.	5.	110.
Total Solids, %	73.4	81.5	82.9
Conductivity, umhos/cm	620.	44.	38.
Total Organic Carbon, %	2.0	0.6	0.2
pH, glass electrode at 25°C	6.1	7.9	7.9

	parts per million (mg/kg), dry basis		
Halogenated Hydrocarbons	<35.	<35.	<35.
Chemical Oxygen Demand	100,000.	2,400.	2,600.
Chloride	<13.	<13.	<13.
Nitrate as N	4.9	3.2	<2.
Nitrite as N	<0.3	<0.3	<0.3
Ammonia	2.7	3.0	<0.12
Sulfate as SO4	1600.	14.	15.
Iron	29,000.	16,000.	16,000.
Zinc	220.	32.	34.
Manganese	470.	250.	240.

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

Solid Waste Division

LABORATORY NO. 9010515

Key

< indicates "less than"

Respectfully submitted,

LAUCKS TESTING LABORATORIES, INC.

J. M. Owens

JMO:bv

-90,515

CHAIN OF CUSTODY RECORD

DATE _____ PAGE ____ OF ____

LAUCKS
Testing Laboratories, Inc
940 South Harney St. Seattle, Washington 98108 (206)767-5060

THIS INFORMATION WILL BE USED FOR REPORTING

NAME: Snohomish County Solid Waste Management Division

ADDRESS: Cathcart Landfill
14528 Rt. 9, Snohomish, WA 98290

ATTENTION: Dawn Shroy Marshall

PROJECT NAME: Lake Goodwin Monitoring Wells

JOB/P.O. NO.

SAMPLER (SIGNATURE): Erick Miller (PRINTED NAME): Erick Miller

LAB NO.	LAB SA #	SAMPLE NO.	DATE	TIME	LOCATION	TESTING PARAMETERS	NO. OF CONTAINERS	OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS
		LG-3-1	10-23-90		Lake Goodwin	pH, Temp. / Specific Conduct. / COD / TOX / TOC / Total Coliform / Chloride / Nitrate / Nitrite / Ammonia / Sulfate / Iron / Zinc / Manganese	2	@ 5 ft
		LG-3-17	↓		↓		2	85 ft
		LG-3-18	↓		↓		2	90 ft
								Run 14FS parameters on soil samples

RELINQUISHED BY: Erick W. Miller
SIGNATURE
Erick U. Miller
PRINTED NAME
Converse
COMPANY
DATE: 10-25-90
TIME: 2:00

RECEIVED BY: Christopher A. Scott
SIGNATURE
Christopher A. Scott
PRINTED NAME
Converse
COMPANY
DATE:
TIME:

RELINQUISHED BY
SIGNATURE
PRINTED NAME
COMPANY
DATE:
TIME:

RECEIVED BY: R. Valdez
SIGNATURE
R. Valdez
PRINTED NAME
LAUCKS TESTING LABS
COMPANY
DATE: 10/26/90
TIME: 300

TOTAL NUMBER OF CONTAINERS:

INSTRUCTIONS:
1. Shaded areas for lab use only.
2. Complete in ballpoint pen. Draw one line through errors and initial.
3. Be specific in test requests.
4. Check off tests to be performed for each sample.
5. Retain final copy after signing.
6. Provide name and telephone of your contact person.

NAME _____
TELEPHONE _____

SHIPMENT METHOD:

SPECIAL SHIPMENT, HANDLING OR STORAGE REQUIREMENTS:

BILLING INFORMATION, IF DIFFERENT
NAME _____
ADDRESS _____
ATTN: _____

90515

CHAIN OF CUSTODY RECORD

DATE _____ PAGE ____ OF ____

Laucks Testing Laboratories, Inc.
940 South Harney St. Seattle, Washington 98108 (206)767-5060

THIS INFORMATION WILL BE USED FOR REPORTING

NAME: Snohomish County Solid Waste Management Division

ADDRESS: Cathcart Landfill
14528 Rt. 9, Snohomish, WA 98290

ATTENTION: Dawn Shroy Marshall

PROJECT NAME: Lake Goodwin Monitoring Wells

JOB/P.O. NO.

SAMPLER (SIGNATURE): Erick Miller (PRINTED NAME): Erick Miller

LAB NO.	LAB SA #	SAMPLE NO.	DATE	TIME	LOCATION	TESTING PARAMETERS: pH, Temp. / Specific Conduct. / COD / TOX / TOC / Total Coliform / Chloride / Nitrate / Nitrite / Ammonia / Sulfate / Iron / Zinc / Manganese	NO. OF CONTAINERS	OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS
		LG-3-1	10-23-90		Lake Goodwin	X X X X X X X X X X X X X X	2	@ 5 ft
		LG-3-17	↓		↓	X X X X X X X X X X X X X X	2	85 ft
		LG-3-18	↓		↓	X X X X X X X X X X X X X X	2	90 ft
								Run 14FS parameters on soil samples

RELINQUISHED BY: Erick W. Miller
SIGNATURE: Erick U. Miller
PRINTED NAME: Erick U. Miller
COMPANY: Converse
DATE: 10-25-90
TIME: 2:00

RECEIVED BY: Christopher A. Scott
SIGNATURE: Christopher A. Scott
PRINTED NAME: Christopher A. Scott
COMPANY: Converse
DATE:
TIME:

RELINQUISHED BY
SIGNATURE
PRINTED NAME
COMPANY
DATE
TIME

RECEIVED BY: R. Valdez
SIGNATURE: R. Valdez
PRINTED NAME: R. Valdez
COMPANY: LAUCKS TESTING LABS
DATE: 10/26/90
TIME: 300

TOTAL NUMBER OF CONTAINERS:

INSTRUCTIONS:
1. Shaded areas for lab use only.
2. Complete in ballpoint pen. Draw one line through errors and initial.
3. Be specific in test requests.
4. Check off tests to be performed for each sample.
5. Retain final copy after signing.
6. Provide name and telephone of your contact person.

NAME _____
TELEPHONE _____

SHIPMENT METHOD:

SPECIAL SHIPMENT, HANDLING OR STORAGE REQUIREMENTS:

BILLING INFORMATION, IF DIFFERENT
NAME _____
ADDRESS _____
ATTN: _____

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063
Chemistry, Microbiology, and Technical Services

CLIENT: Solid Waste Division
c/o Cathcart Landfill
14528 Highway 9
Snohomish, WA 98290
ATTN: Dawn Shroy-Marshall

LABORATORY NO. 9010557

DATE: Dec. 20, 1990

REPORT ON: SOIL

SAMPLE IDENTIFICATION: Submitted 10/31/90 and identified as shown below:

1) LG-4-1 10/29/90
2) LG-4-11 10/30/90
3) LG-4-12 10/30/90

TESTS PERFORMED AND RESULTS:

	1	2	3
Total Coliform Count, MPN/per gram	5.	2.	<2.2
Total Solids, %	95.7	80.1	76.3
Conductivity, umhos/cm	7.	17.	21.
Total Organic Carbon, %	0.5	0.2	<0.1
pH, glass electrode at 25°C	6.6	7.6	7.7
	parts per million (mg/kg), dry basis		
Halogenated Hydrocarbons	<20.	<20.	<20.
Chemical Oxygen Demand	14,000.	2,600.	2,800.
Chloride	<10.	<11.	9.2
Nitrate as N	<2.	<2.	<1.
Nitrite as N	<0.3	<0.3	<0.3
Ammonia	<0.10	<0.12	<0.13
Sulfate as SO4	17.	<11.	7.3
Iron	19,000.	15,000.	19,000.
Zinc	38.	30.	43.
Manganese	310.	230.	440.

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063
Chemistry Microbiology and Technical Services

Solid Waste Division

LABORATORY NO. 9010557

Key

< indicates "less than"

Respectfully submitted,

LAUCKS TESTING LABORATORIES, INC.

J. M. Owens

JMO:bv

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry. Microbiology. and Technical Services

APPENDIX

Copy of Chain-of-Custody Attached

401055+

CHAIN OF CUSTODY RECORD

DATE 10·31·90 PAGE ____ OF ____

Laucks Testing Laboratories, Inc.
940 South Harney St Seattle Washington 98108 (206)767 5060

THIS INFORMATION WILL BE USED FOR REPORTING

NAME SNOHOMISH COUNTY SOLID WASTE MANAGEMENT DIVISION

ADDRESS CATHCART LANDFILL
14528 RT. 9 SNOHOMISH WA
98290

ATTENTION: DAWN SHROY MARSHALL

PROJECT NAME LAKE GOODWIN LF MONITORING WELLS

JOB/P.O. NO.

SAMPLER (SIGNATURE) John Strunk (PRINTED NAME) JOHN STRUNK

TESTING PARAMETERS

LAB NO.	LAB SA #	SAMPLE NO.	DATE	TIME	LOCATION	PH, TEMPERATURE	SPECIFIC CONDUCTANCE	COD	TOX	TOC	TOTAL COLIFORM	CHLORIDE	NITRATE	NITRITE	AMMONIA	SULFATE	IRON ZINC	MANGANESE	NO. OF CONTAINERS	OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS
		LG-4-1	10·29·90		LAKE GOODWIN	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	2	RUN MFS PARAMETERS
		LG-4-11	10.30.90		↓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	2	ON SOIL SAMPLES
		LG-4 12	↓		↓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	2	

LG-4-1 5'
LG-4-11 55'
LG-4-12 60

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE: John Strunk	10·31·90	SIGNATURE:	
PRINTED NAME: JOHN STRUNK	TIME: 11:28	PRINTED NAME:	TIME:
COMPANY: CONVERSE		COMPANY:	
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE:		SIGNATURE: R. Valdez	10/31/90
PRINTED NAME:	TIME:	PRINTED NAME: R. Valdez	TIME: 1121
COMPANY:		COMPANY: LAUCKS TESTING LABS	

TOTAL NUMBER OF CONTAINERS: 6

INSTRUCTIONS:
1. Shaded areas for lab use only.
2. Complete in ballpoint pen. Draw one line through errors and initial.
3. Be specific in test requests.
4. Check off tests to be performed for each sample.
5. Retain final copy after signing.
6. Provide name and telephone of your contact person.

NAME DAWN SHROY MARSHALL

TELEPHONE 668-6133

SHIPMENT METHOD:

SPECIAL SHIPMENT, HANDLING OR STORAGE REQUIREMENTS

BILLING INFORMATION, IF DIFFERENT

NAME

ADDRESS

ATTN:

Appendix D

APPENDIX D

WATER-VEL

Water-Vel program by In-Situ, Inc. is designed to predict groundwater direction and flow rate based on potentiometric (head) measurements and hydraulic conductivity. The hydraulic gradient is computed by the program with a least squares fit to the static water level elevations, and the groundwater velocity is obtained using generalized Darcy's Law, shown below. The program is capable of developing solutions for varying horizontal and vertical hydraulic conductivities.

$$\upsilon = \frac{KI}{\eta_e}$$

Where:
υ = Groundwater Velocity (L/t)
K = Hydraulic Conductivity (L/t)
I = Hydraulic Gradient (L/L)
η_e = Effective Porosity (Dimensionless)

Water-Vel calculations were done assuming an isotropic aquifer (vertical hydraulic conductivity = horizontal hydraulic conductivity). A sensitivity analysis was performed where the vertical hydraulic conductivity was given a value 5 orders of magnitude less than the horizontal. Results indicated only minor variation from the isotropic case.

The groundwater velocity estimated from Water-Vel program for the advance outwash aquifer is 1.24 ft/day, which is 0.42 ft/day less than the velocity estimated from the modified Darcy equation (1.66 ft/day). Water-Vel results suggest that either the gradient used in the Darcy equation is too high or the computer estimates are low. A gradient of 0.003 used in the Darcy equation results in a groundwater velocity estimate of 1.25 ft/day, which is much closer to the Water-Vel estimate. These results suggest that Water-Vel least squares fit agrees reasonably well with hand-calculated groundwater velocities at the site. An output listing of the Water-vel run is included at the end of this Appendix (Table D-1). Input parameters for Water-Vel, including coordinates for all well locations, are listed on the output.

Lake Goodwin LF
Snohomish, CO
Solid Waste

Snohomish County Public Works

Gerald E. Weed, P.E. Director

Wall Street Building
2930 Wetmore Avenue
Everett, Washington 98201
Willis D. Tucker, County Executive

April 23, 1991

Ms. Sally Saffioles
Department of Ecology
Northwest Regional Office
4350 - 150th N.E.
Redmond, WA 98052

Re: Lake Goodwin Landfill - Ecology Grant No. TAX 89064

Dear Sally:

Attached is the draft Hydrogeologic Study of the Lake Goodwin Landfill by Converse Consultants N.W. I have also sent a copy to Iloba Odum. I would like to meet with you and the Snohomish Health District in a couple of weeks to receive your comments and perhaps a quick field trip to locate a fifth groundwater monitoring well location. I will give you a call soon to set up that meeting.

Sincerely,

Kenneth B. Miller

KENNETH B. MILLER, PROJECT MANAGER
Solid Waste Management Division

KBM/sc
c: Jeff Defenbach, SHD
Dave Schonhard, SWMD
s:dsk1miller/lk goodwin grant

CHRISTINE O. GREGOIRE
Director

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
4350-150th Ave. N.E. • Redmond, Washington 98052-5301 • (206) 867-7000

August 24, 1990

TO: Iloba Odum

FROM: Sally Safioles

SUBJECT: Preconstruction Meeting for Lake Goodwin Landfill, Grant No. Tax 89064

On August 21, 1990 the following persons attended the preconstruction meeting and field trip to Lake Goodwin:

Ken Miller	Snohomish County Solid Waste Division
Erick Miller	Converse Consultants
John Strunk	Converse Consultants
Dawn Shroy-Marshall	Snohomish County Solid Waste Division
Thomas Fuhrhap	John Mathias & Associates Inc.
Mike Young	Snohomish Health District
Sally Safioles	Ecology-NWRO

FIELD INSPECTION

Prior to the preconstruction meeting, the above attendees and Jeff Defenbach of the Snohomish Health District met at Lake Goodwin Landfill to field inspect and flag the well locations. It was agreed upon that five wells would be installed: 3 deep and 2 shallow. Well LG-1 will be the upgradient well for the deep aquifer located on the east side of the landfill. Wells LG-2 and LG-3 are downgradient for the deep aquifer located on the west side on the landfill. It is anticipated, based on the drilling of LG-2, that a shallow perched zone will allow the placement of one of the shallow well as a cluster with LG-2 and will be designated as LG-2S. The second shallow will be placed on the Northeast side of the landfill.

PRECONSTRUCTION MEETING

At the preconstruction meeting the initial discussion focused on Lake Goodwin Landfill as a WAC 173-301 closed landfill and its status on the state's contaminated site list and the implications of the Model Toxic Control Act (MTCA). Lake Goodwin is currently a C2 on the state's contaminated sites list. This C2 status implies that there is no documentation to-date (such as ground or surface water data) of contamination. A C1 indicates that contamination has been documented. Once the wells are installed and depending on the water quality results, the status of this site may change. At that point Snohomish County Solid Waste Division has been advised to talk with Mike Gallagher, the Supervisor for

Ecology's NWRO Cleanup Section, to discuss further action on the site.

In order to provide the Cleanup Program with the appropriate water quality information, the wells will be sampled twice a year for the full priority pollutant scan (metals will be total), plus the MFS parameters. On a quarterly basis the wells will be sampled for the MFS parameters.

The following minutes are based on responses to review comments dated July 17, 1990 from Ecology to Ken Miller on the preliminary preconstruction bid package and hydrogeologic assessment of the site:

Well Construction Details: The well screen will be 10 feet in all wells for a more discrete sample. The joints will be flushed tread with no use of glues. No water is anticipated to be used downhole. If water is to be used, the closest source is the Seven Lakes Water District. It would first be checked for chlorination. The placement of the sand pack and other materials will be "sounded" with a Lufkin Tape which is weighted with a steel rod and depths indicated on the tape. Water levels will be measured with well probes. The final design for the well seal will be a thick bentonite slurry that will be tremied into the annular space. The wells will be protected with 2 or 3 Ecology blocks or concrete post. The driller does have a Washington State License and the 40 hour safety course.

Decontamination: The drill rig will be steam cleaned between each well site. All objects that go downhole and in contact with the soil will have a four wash decon. consisting of an Aquinox plus tap water rinse, tap rinse, methanol rinse, then distilled water rinse. This four wash decon. is used also for ground water sampling devices.

Logging the Well/Reporting Well Log: Converse Consultants will log the well from five-foot grab samples. The well logs will be included in the final report including details on surface seal and well protection. The well driller will submit the well logs to Ecology.

Sampling Devices: The deep wells will have dedicated Hydrostar pumps; the shallow wells will have dedicated Hydrostar pumps if greater than 30 feet, if less than 30 feet teflon tubing will be installed for use with a peristaltic pump. The Snohomish Solid Waste Division will collect the ground water samples.

Soil Samples: Soil samples will be collected every five feet for sieve analysis and for soil descriptions. Three soil samples in each well will be collected for chemical testing--one near surface sample (five foot depth) and one above and below the water table and tested for the MFS parameters.

Aquifer Testing/Groundwater Flow Velocity and Direction: A rising head aquifer test will be conducted in each well with a stainless steel slug bar. Wells will be surveyed in by Snohomish County personnel. Groundwater flow velocity and directions will then be determined.

Completion Dates: The estimated completion dates on the grant have passed (July 1990). Ken Miller will update those dates. Drilling is planned in September 1990. Ecology will be notified when the drilling is to begin.

Final Report: The final report should include, but is not limited to, site history, regional and site specific geology/hydrogeology, geologic cross-sections, well logs, ground water contour maps, well development methods, soils analyses, water quality data, aquifer testing methods and data, decontamination procedure, QA/QC sampling, suggestions and recommendations, and other information to fully document field activities.

cc: Ken Miller/Dawn Shroy-Marshall, Snohomish County SWMD
Erick Miller/John Strunk, Converse Consultant
Mike Young, Snohomish Health District
Cullen Stephenson, SW Unit Supervisor
Mike Gallagher, Toxic Cleanup Section, Supervisor