METROPOLITAN SERVICE DISTRICT

PHASE I: SITING ISSUES - POTENTIAL SANITARY LANDFILLS

FEASIBILITY REPORT

FOR

DURHAM PITS

TASK 1. LEACHATE: IMPACT AND CONTROL

CH2M HILL NORTHWEST, INC. P12946.B0
25 October 1979

25 October 1979

P12946.B0

Metropolitan Service District
527 S.W. Hall Boulevard
Portland, Oregon 97201

Attention: Mr. Merle Irvine, Director
Solid Waste Division

Gentlemen:

One copy of Task 1, Leachate: Impact and Control is attached, pursuant to the terms of the contract between Metro and CH2M HILL NORTHWEST, INC., dated 12 July 1979, to conduct a feasibility study report on the possible use of the Durham Pits site as a sanitary landfill.

The report is the result of a thorough literature search, field investigation, and technical analysis. Existing conditions at the site are documented, the probable water quality impacts of landfill development are discussed, and potential engineering alternatives for leachate control are analyzed.

Our findings indicate that a combination of leachate control alternatives and solid waste operational techniques will reduce the potential for leachate contamination of ground water. The report discusses the range of risks associated with development of the Durham Pits for sanitary landfill. Any major construction project has associated levels of risk. The designer attempts to reduce those risks to an acceptable level through responsible design. The community served by the facility must then review the risks and evaluate the project.

Based on the findings of this study, we recommend that the Metropolitan Service District seek formal opinions concerning the acceptability of the Durham Pits site from the appropriate State and Federal regulatory agencies, particularly the State of Oregon Department of Environmental Quality, regarding the Federal Environmental Protection Agency Guidelines for new landfills. Our staff will be available to answer questions regarding the report or to provide supporting data gathered during the study.

We appreciate the opportunity to be of service to the Metropolitan Service District on this important project.

Sincerely,

Michael D. Kennedy, P.E.
Project Manager

Rhea Lydia Graham
Engineering Geologist

Jeffery H. Randall
Ground-Water Hydrologist

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Enclosure

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I. PREFACE

A. INTRODUCTION

1. PURPOSE OF STUDY

CH2M HILL NORTHWEST, INC., under contract to the Metropolitan Service District of Portland, Oregon, performed studies addressing the potential for leachate impact from proposed sanitary landfill operations at the Durham Pits site. The gravels exploited at the Durham Pits contain a ground-water aquifer, which many private wells in the area tap for drinking water use. The U.S. Environmental Protection Agency (EPA) (13 September 1979 Federal Register) requires that a new sanitary landfill facility or practice not endanger ground water currently used as a drinking water supply. Endangerment is defined as the introduction of a contaminant that would require additional treatment of current drinking water supplies or would otherwise make the water unfit for human consumption.

This report presents:

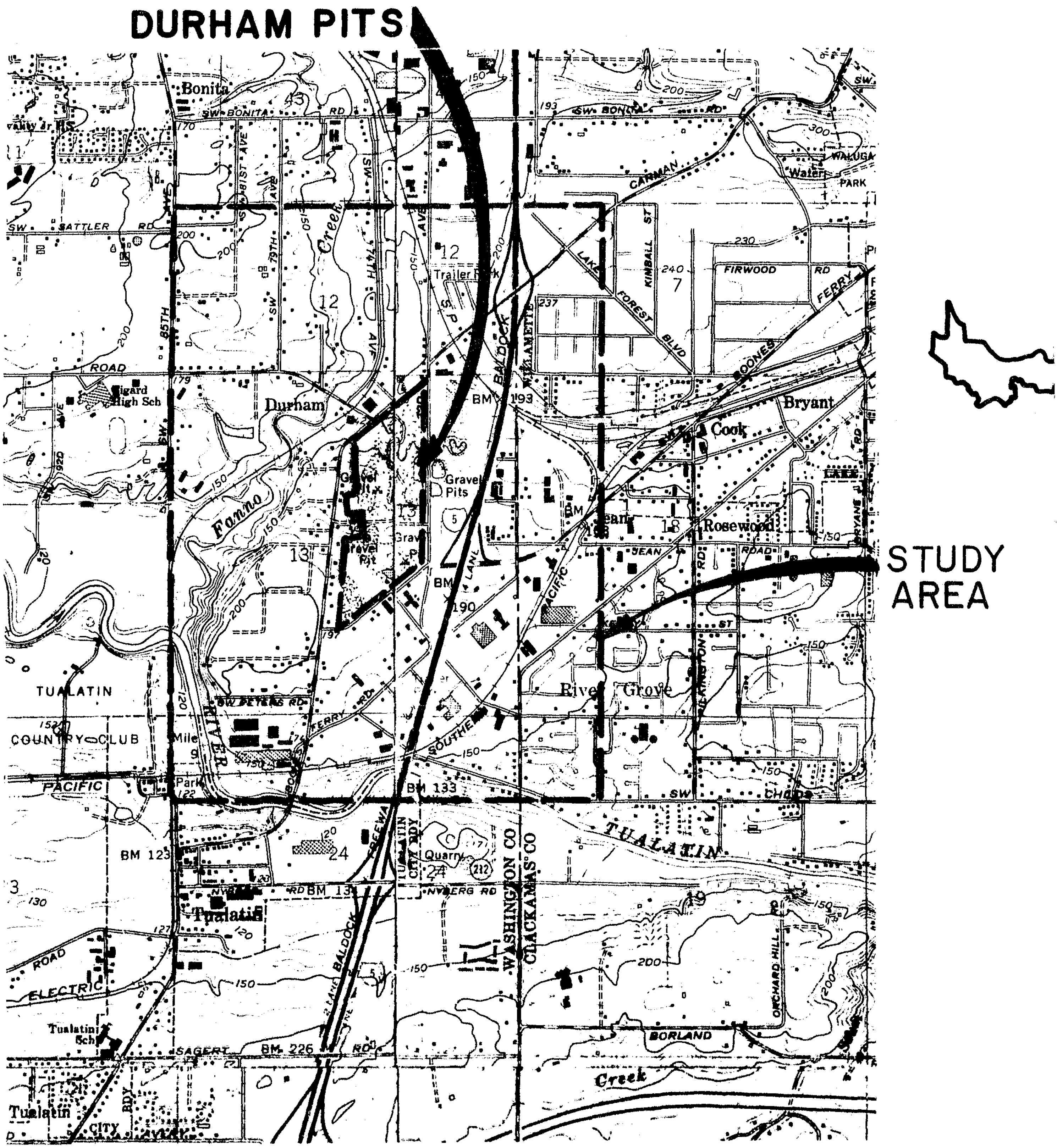
- Data sets gathered for the studies
- Conclusions drawn from analyses
- Recommendations for leachate control at the Durham site
- Appendices containing supporting data

All statements made in this report are based upon available data and information for the Durham site and the surrounding area (see Figure I-1). The recommendations are based solely on technical criteria.

2. SCOPE OF STUDY

Hydrological, geological, and geotechnical analyses were performed to determine:

- Existing character of the ground-water aquifer present in the Durham gravels



SITE MAP

1" = 2000' APPROX.

SOURCE:
U.S.G.S. QUADRANGLE MAP 19

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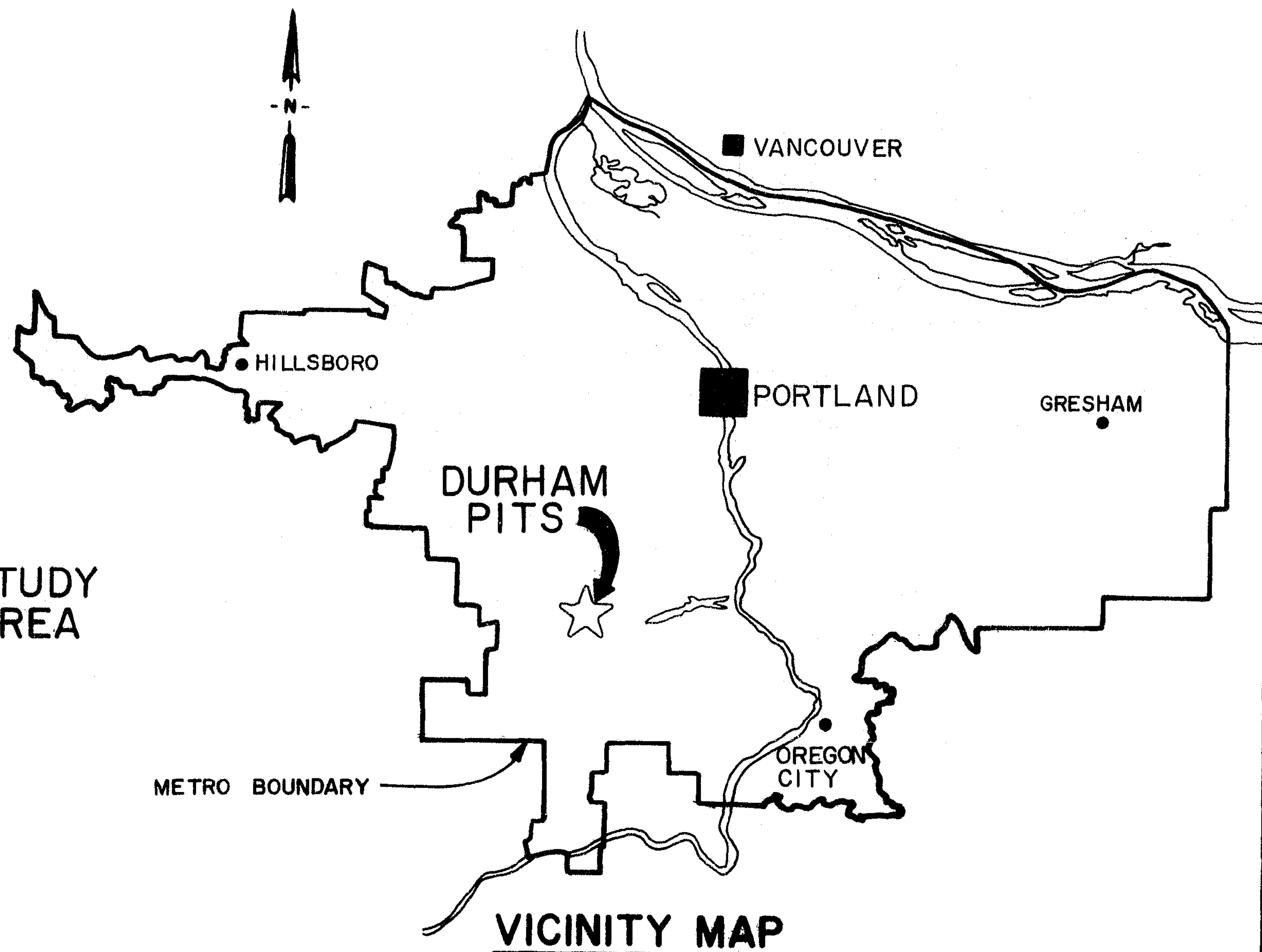

VICINITY MAP

LE MAP 19

FIGURE I-1

METROPOLITAN SERVICE DISTRICT
POTENTIAL SANITARY LANDFILL SITE
LEACHATE IMPACT AND CONTROL
FOR DURHAM SITE
WASHINGTON COUNTY, OREGON

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- Impact upon the aquifer water quality of leachate generated by sanitary landfilling operations

- Technical feasibility of leachate control at the Durham site

Appendix A-1 presents the detailed scope of services for this study.

II. EXISTING PHYSICAL CONDITIONS

A. SITE DESCRIPTION

1. PHYSICAL SITE

The Durham gravel pits are located in the eastern half of Section 13, Township 2 south, Range 1 west, Washington County, Oregon.

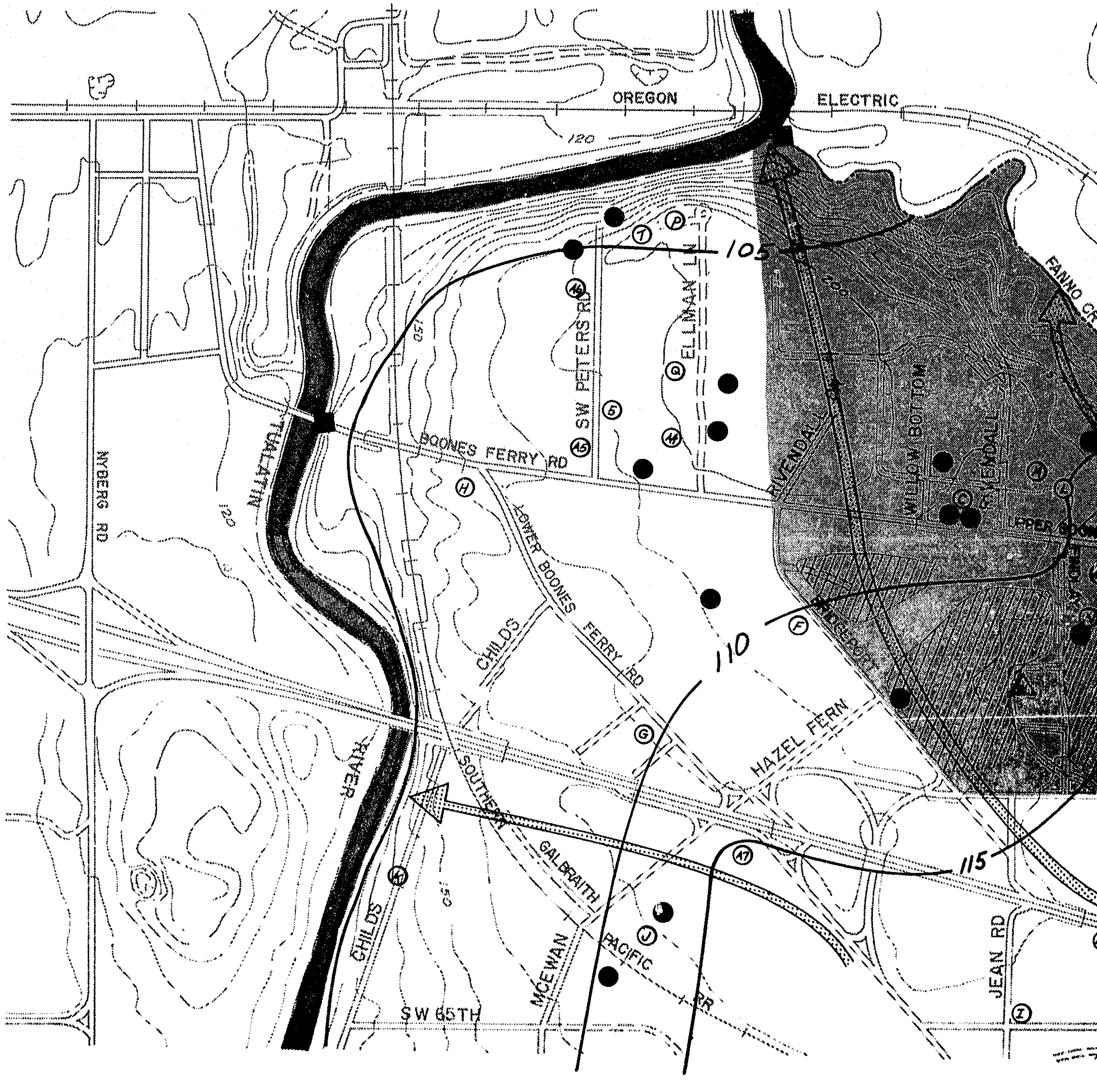
The site is located partly in the cities of Tualatin and Tigard, near the city of Durham, and close to Interstate 5 and the Washington/Clackamas County lines. Figure I-1 shows a site location map and vicinity map of the project area. The property, consisting of 69.97 acres (Washington County Department of Planning, Durham Gravel Pit Study, 1974) is bordered by S.W. 72nd Avenue on the east and by S.W. Boones Ferry Road on the west. (Figure II-1 shows the location in more detail.)

The site is operated as a gravel pit by the Washington County Public Works Department. It was previously operated by Tigard Sand and Gravel. The county uses a portable crusher to process gravel extracted from the site. Currently, the crusher is not located on the site. A pumphouse is located at a pond in the northeast center of the site. A plastic pipe waterline runs from the pond to the crusher location. An unimproved north-south dirt road runs through the site, with a spur to the pond with the pumphouse. A 6-acre parcel of privately owned property separates the southwest pit from the other excavated areas.

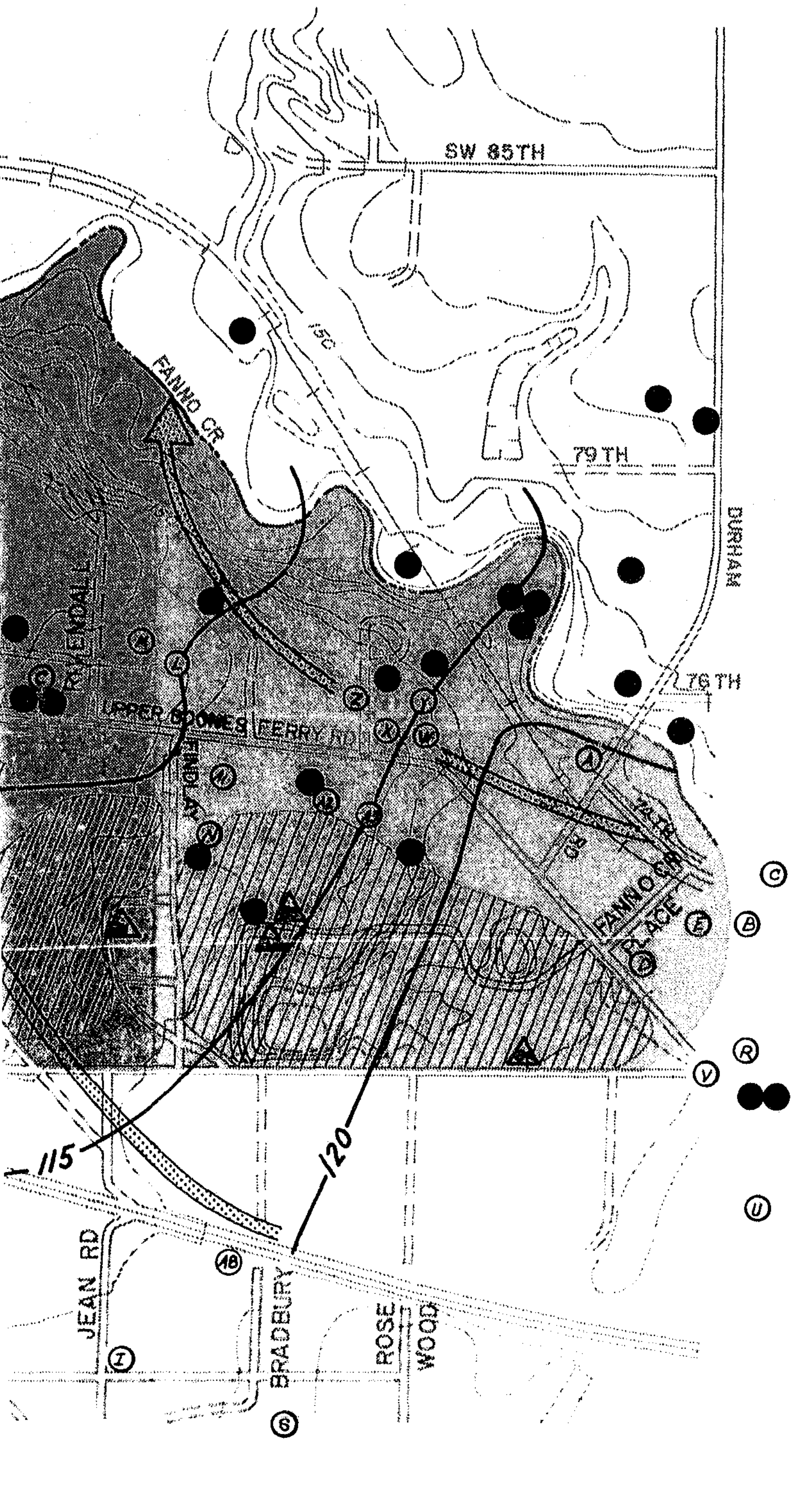
2. SURFACE DRAINAGE

The Durham gravel pits are located in the Tualatin Valley, where the Tualatin River and its tributaries are the major drainage system. Fanno Creek, draining the southwest slope of the Portland Hills, is the western boundary of the study area. The southeast-flowing Tualatin River forms the southern boundary of the study area (see Figure I-1 for the site map).

The Tualatin River and Fanno Creek gradients are very slight in the study area. Their drainage patterns are typical of those associated with mature streams. Fanno Creek joins the Tualatin River in the southwest corner of the study area.



DURHAM PITS STUDY AREA: WELL LOCATIONS



SYMBOLS AND LEGEND

AREA OF POTENTIAL LEACHATE IMPACT

DURHAM PITS

—150— LANDSURFACE ELEVATION (WASHINGTON CO. BASEMAP 1 IN.= 400 FT. SCALE)

—110— ELEVATION GROUND WATERTABLE. (FEET ABOVE MSL)

GENERALIZED DIRECTION OF GROUND-WATER FLOW.

Ⓐ WELLS USED IN WATER LEVEL SURVEY (SEE APPENDIX I FOR DETAILED INVENTORY)

● WELLS FOR WHICH DRILLING LOGS WERE OBTAINED FROM OREGON WATER RESOURCES DEPARTMENT. LOCATIONS ARE APPROXIMATE.

△ CH2M HILL TEST BORINGS WITH PIEZOMETERS FOR GROUND WATER MONITORING.

■ CH2M HILL SURFACE WATER SAMPLING SITES

NOTE: GROUND WATERTABLE ELEVATIONS WERE CALCULATED BY SUBTRACTING DEPTH TO WATER BELOW LAND SURFACE FROM SURFACE ELEVATIONS AS DETERMINED FROM THE CITY OF TIGARD AND THE CITY OF TUALATIN 1 IN.= 100 FT. SCALE TOPOGRAPHIC MAPS.

N

400 0 400 800

SCALE IN FEET

OCATIONS & GROUND-WATER TABLE ELEVATIONS

FIGURE II-1

METROPOLITAN SERVICE DISTRICT
POTENTIAL SANITARY LANDFILL SITE
LEACHATE IMPACT AND CONTROL
FOR DURHAM SITE
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3. UTILITIES

a. Gas Pipeline

The property is crossed by a 10-3/4-inch natural gas line, installed in 1956, that is owned and operated by Northwest Natural Gas Company. The line is located along S.W. Findley Road, which was vacated within the property boundary in 1972. The pipeline right-of-way has been retained by Northwest Natural Gas Company, so that the gravels underlying the pipeline remain intact and have not been exploited. The line runs east-west near the center of the property, thus dividing it into north and south regions.

b. Sewer Service

Currently, most of the residences and businesses in the area surrounding the Durham gravel pits are not served by a municipal sewage treatment facility. Exceptions to this are Kingsgate Development, directly west of the gravel pits, and the motels and restaurants to the southeast--all served by the Unified Sewerage Agency through its Durham wastewater treatment plant, located to the northwest on S.W. Durham Road.

c. Water Supply

The majority of homes in this area are supplied with water from their own wells, with only the Kingsgate Development and some of the homes along S.W. Upper Boones Ferry Road being supplied by the Lake Grove Water District.

B. CLIMATOLOGICAL CONDITIONS

The generation of leachate within refuse is partly a function of the quantity of water entering the refuse. Therefore, climatological data on storm intensity, annual precipitation, and evapotranspiration rates were collected. The appropriate climatological data have been used in analyses relating to surface water drainage and leachate generation.

C. GEOLOGY

1. GEOLOGIC UNITS

The bedrock underneath the Durham Pits consists of several lava flows known collectively as the Columbia River Basalt. The basalt is probably 1,000 feet thick and was extruded between 11 and 25 million years ago.

Undifferentiated fill (less than 1 million years old), commonly in thicknesses of 300 to 600 feet, overlies the Columbia River Basalt at Durham. It is probably entirely a freshwater deposit.

The gravels at Durham consist of cross-bedded, bouldery pebble and cobble gravel in a matrix of silt and medium to coarse sand. Boulders in the gravel are as much as 5 feet in diameter. The gravels are principally basalt with scattered granitic, metamorphic, and limonite clasts. Most of the basalt clasts have been derived from the Boring Lava and Columbia River Basalt in the Tualatin Mountains adjacent to Lake Oswego. Quartzite and granite cobbles are from gravel deposits of southeast Portland opposite the east end of Lake Oswego. Limonite cobbles probably have their source in an iron deposit at Lake Oswego.

2. GEOLOGIC HISTORY

Gravel deposits at Durham are considered to be of lacustrine origin and to have been deposited during torrential floods. Trimble (1963) mapped the deposits at Durham as an extension of widespread Pleistocene lacustrine deposits in the east Portland area.

Composition of the gravels and the structure of the deposit and its orientation give credence to the occurrence of a gigantic flood during the late Pleistocene. Flood waters poured through the gap, eroding out the present Lake Oswego, and washing gravels and blocks of basalt through the Tualatin Mountains to deposit them in the fan-shaped delta at Durham. The evidence and mechanism for such a flood are well documented in geological publications (Bretz, 1925, 1928; Allison, 1933).

Before these gravels were deposited, a structural change depressed the Columbia River Basalt, producing a basin between Cooper Mountain and the Tualatin Mountains.

3. GEOTECHNICAL INVESTIGATION

The major concerns in developing a leachate impact and control design recommendation for a solid waste disposal facility are the ground-water hydrology and the soil parameters present at the proposed site. In order to better understand the soil conditions, a two-part geotechnical investigation was made of the site.

a. Site Reconnaissance

The first part of the investigation was a geologic reconnaissance of existing exposures on the site. The gravel layers exploited there vary from fine-grained, cross-bedded sands to coarser beds of sandy gravels. All depositional patterns are of fluvial origin. The gravels are rarely clean; they usually contain silt and sand fines. The coarser gravels occur in lenses and do not show major lateral continuity. To the north, these beds diminish in extent and in coarseness of the gravels. Several feet of silt to clayey silt material with no gravel is present north of boring B-3. The silt is varved, indicating that quieter water conditions existed at the time of deposition.

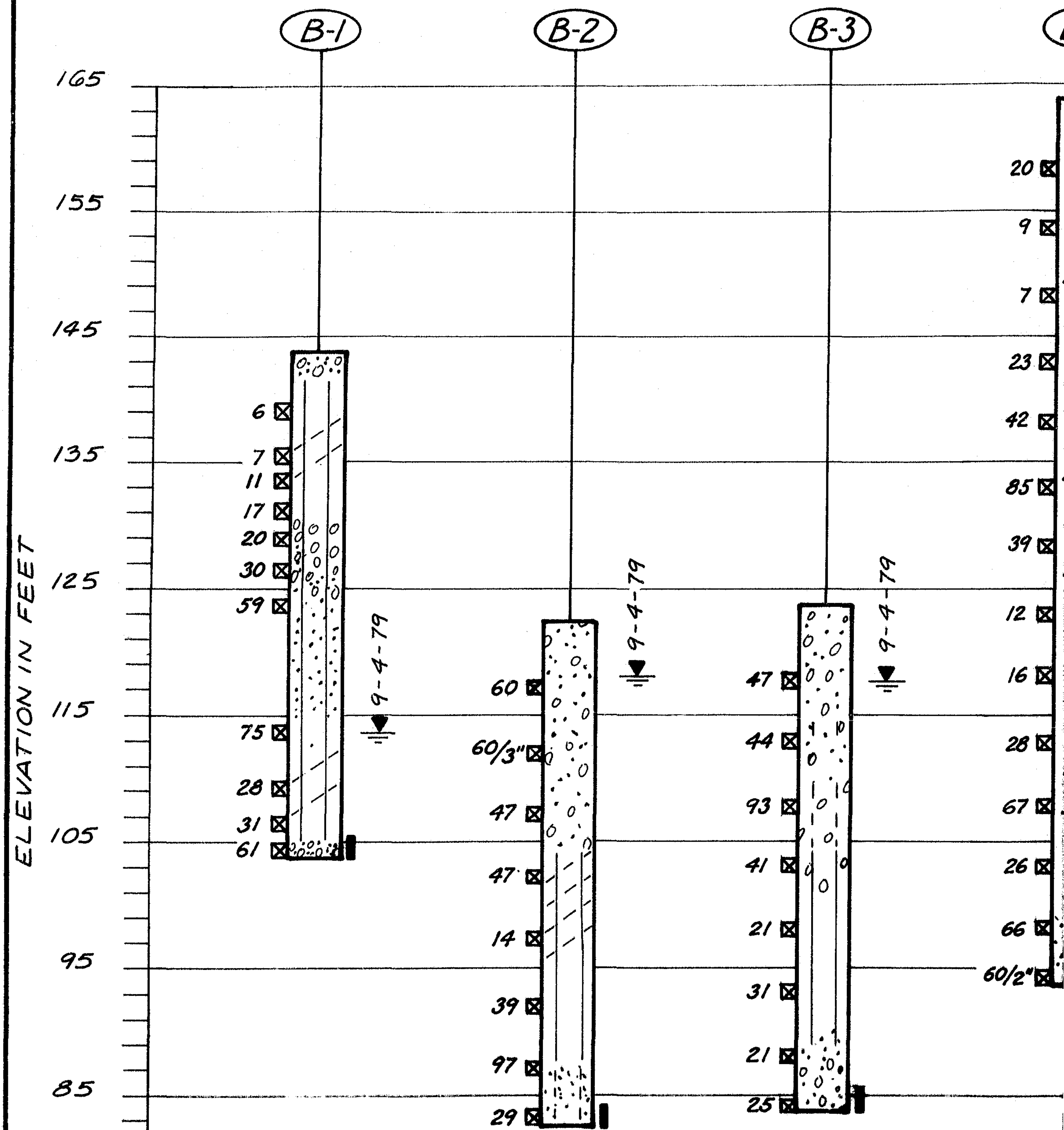
Because of the gravel exposures on the site, test pits were not warranted as part of the geotechnical exploration.

b. Site Borings

The second part of the investigation consisted of drilling four subsurface borings to determine the soil conditions below the surface. The borings were terminated below the existing water table so that permanent piezometers could be installed to monitor ground-water elevations and quality. The locations of the test borings are shown on Figure II-1. The criteria used for choosing the boring locations were: (a) surface elevations to be at the lowest accessible elevation on the site, since the existing cuts provided information from the higher elevations; and (b) the locations to be arranged such that the directional flow and quality variations of the ground water might be detected.

The borings were drilled from 16 to 22 August 1979 by Don Kenner of Sherwood, Oregon, a soils sampling contractor. The drilling rig was a CME-55 truck-mounted rotary unit specially equipped to retrieve samples at given intervals from the hole. The sample interval was usually 5 feet, unless changes in materials encountered warranted more frequent sampling. During the drilling process, material in the hole was continually washed up out of the hole as cuttings, which are small pieces of material. These cuttings and the samples retrieved from specific depths were examined by a CH2M HILL geologist on site at the time of drilling. No in-hole tests were performed in any of the borings.

Figure II-2 is a graphical presentation of the material types at each boring location. The boring locations are shown on Figure II-1. The materials penetrated were basically gravels, with silt and/or sand matrix overlying less permeable silts, which in turn overlie more gravels. The upper 25 feet



BORING LOGS

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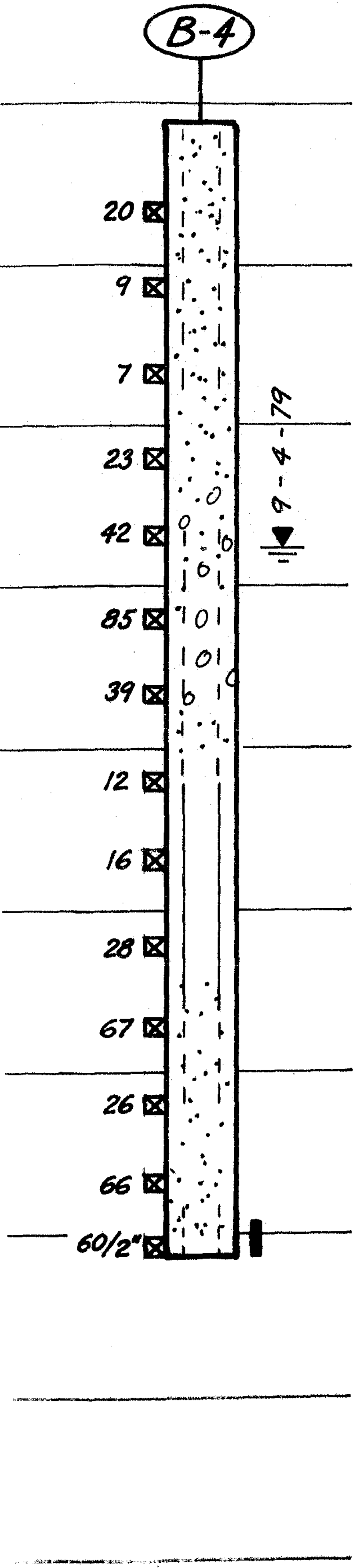
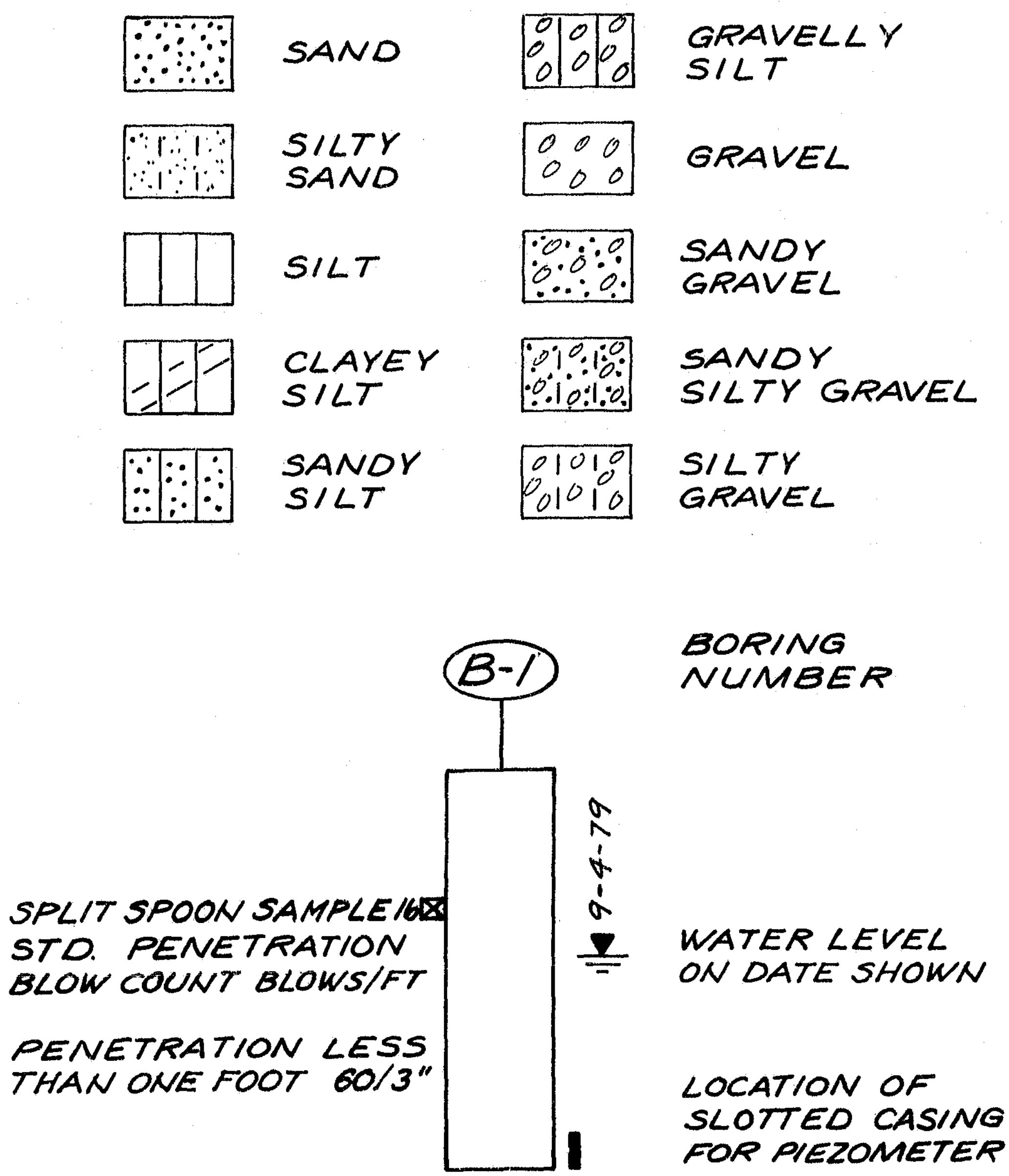


SYMBOLS AND LEGEND



NOTES:

1. BORINGS DRILLED 16-22 AUGUST, 1979 WITH TRUCK MOUNTED CME 55 5½" ROTARY RIG.
2. LOGS REPRESENT ONLY THE OPINION OF THE ENGINEER REGARDING THE TYPE OF MATERIALS ENCOUNTERED.

FIGURE II-2

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LEACHATE IMPACT AND CONTROL
FOR DURHAM SITE
WASHINGTON COUNTY, OREGON**

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of B-1 encountered bouldery fill pushed into the area and not natural ground conditions. Borings B-2 and B-3 were begun at the lowest surface elevations of the four borings. The material penetrated by these two borings probably has not been reworked by the gravel pit operations. Boring B-4, the northernmost boring, was drilled outside of the pit excavation; therefore, the subsurface materials have probably not been disturbed.

East of B-2, a permanent pond, representing the ground-water table, is present. A seasonal pond, perched on the varved silts mentioned earlier in the site reconnaissance, is present west of B-3. Little or no water stands in this pond during summer months.

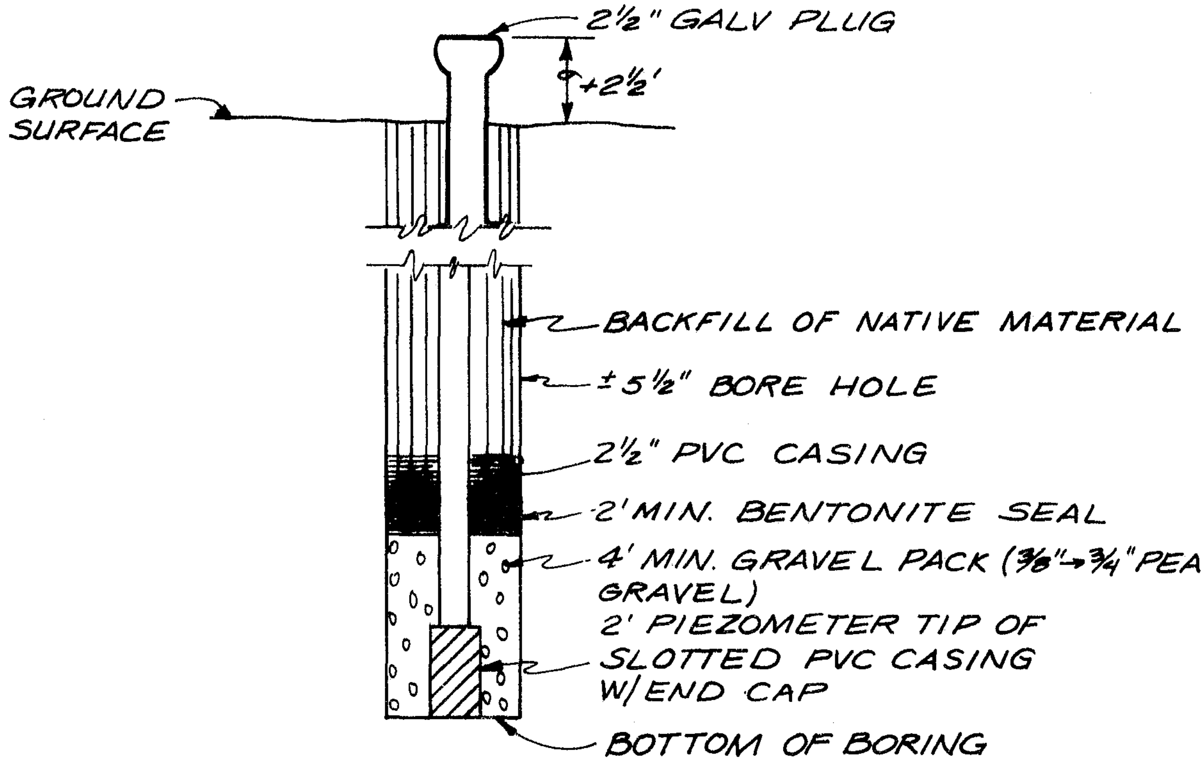
These boring logs do not directly show the hydraulic characteristics of these materials, such as permeability. Also, it is not possible to determine exactly the areal distribution of materials that underlie the entire site based on four sampling points.

Construction details of the piezometers installed in the boreholes are shown in Figure II-3. After each boring was drilled to total depth, the hole was washed out with water to remove all remaining cuttings. The 2-1/2-inch PVC pipe and piezometer tip assembly were lowered to the bottom of the hole. Pea gravel was then carefully poured into the annulus between the PVC pipe and borehole wall. The purpose of the gravel was to provide a highly conductive zone around the piezometer tip and keep fine material in the formation from plugging the piezometer slots. A seal was placed over the gravel pack to prevent entry of water from above. The seal consists of highly compressed clay pellets manufactured by Earl B. Hall, Inc. (EBHI). When the pellets become moist, they expand, thus forming a plug around the PVC pipe.

The remainder of the hole was then backfilled to the surface with native materials. The top of the PVC pipe was capped with a galvanized plug to keep the piezometer from being contaminated.

c. <u>Laboratory Analyses</u>

A determination of the coefficient of permeability of the soil materials present in the Durham Pits allows us to quantify the infiltration rate of fluids through these materials. Bag samples of three types of the materials present were classified and a sieve analysis performed on each. The samples were of the coarsest gravel, sample S-2; the finest sand without gravel, S-1; and the siltiest fraction, S-3. Results of sieve analyses are given in Appendix B.



PIEZOMETER INSTALLATION IN BORINGS
FOR GROUND WATER MONITORING

FIGURE II-3

METROPOLITAN SERVICE DISTRICT
POTENTIAL SANITARY LANDFILL SITE
LEACHATE IMPACT AND CONTROL
FOR DURHAM SITE
WASHINGTON COUNTY, OREGON

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The coefficient of permeability, K, was computed using the Hazen grain size method. The average K of the Durham gravels is 3×10^{-2} cm/sec (90 ft/day). This value is an approximation of the permeability and indicates that these soils have good drainage and moderate infiltration rates.

D. GROUND-WATER HYDROLOGY

1. HYDROGEOLOGY

The Durham gravels form the major aquifer or water-bearing unit in the study area. Many local residents obtain their domestic water from this formation. Review of driller's logs obtained from the Oregon Department of Water Resources (DWR) (Appendix C) indicates significant variations laterally and with depth of the aquifer's lithology. The gravels are a series of overlapping, truncated, discontinuous lenses of silt to clay, fine to medium cross-bedded sands, and cross-bedded bouldery cobble gravel in a silty sand matrix. Typically, the lateral extent of any lens may vary from a few hundred to a few thousand feet. No clay or clean gravel layers were exposed in the pitwalls or found in test borings.

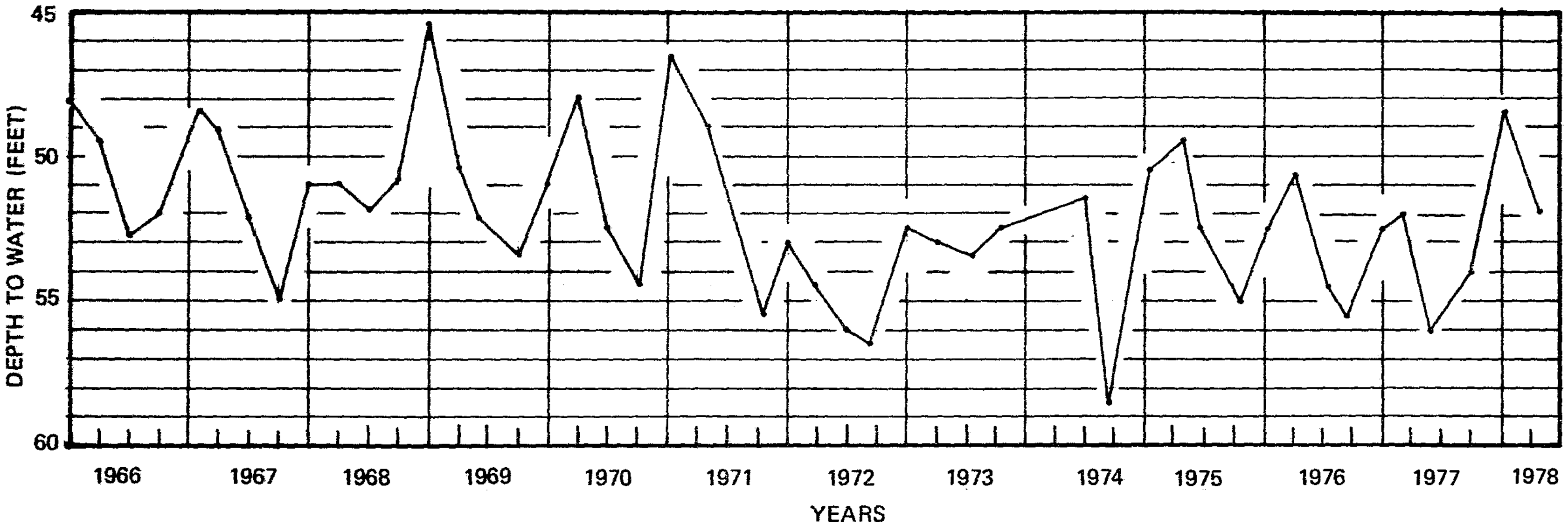
The average permeability of the Durham gravels was calculated as 90 feet per day, based primarily on the grain size analysis. This moderate value is controlled not by the gravel fraction, but by the silty sand matrix through which the water must flow.

Surface infiltration is generally good at the site because of the high permeability of the topsoil, which reduces runoff.

2. GROUND-WATER MOVEMENT

We conducted a water level survey of 31 wells in the vicinity of Durham Pits from 31 July to 1 August 1979 (see Appendix C). The purpose of the survey was to obtain water level information to aid in estimating the direction and rate of ground-water flow in the study area.

The water levels were plotted and contoured as shown in Figure II-1. The direction of ground-water flow is at right angles to the contours. In general, the ground water flows southwest, discharging to Fanno Creek and the Tualatin River. The water table elevation is about 130 feet in the



WATER TABLE FLUCTUATIONS AT THE PILKINGTON NURSERY WELL, DURHAM, OREGON

FIGURE II-4

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FOR DURHAM SITE
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northeast, sloping to 105 feet along the Tualatin River. The water level contours are based on one set of measurements obtained during the driest period of the year. Seasonal fluctuations in water-table elevation near Durham Pits have been measured by the Oregon DWR for many years. Figure II-4 is a plot of the Pilkington Nursery well, which shows a maximum fluctuation of 12 feet. This change probably reflects localized summer decline due to extended irrigation pumpage at the measured well. In general, the regional water-level fluctuation is estimated as 5 feet. We recommend continued monitoring of the test piezometers to establish seasonal fluctuations at the pits.

Water levels in most wells at the northern extremity of the study area are very near the surface. These shallow, hand dug wells probably tap a perched water table formed above a low-permeability clayey silt layer. The elevation difference between the perched and regional water table is about 15 feet.

The estimated quantity of flow beneath the Durham site through the upper saturated 50 feet is 154 gallons per minute. This quantity was calculated using Darcy's law (flow rate (Q) = permeability (K) x cross-sectional area (A) x gradient (I)), with the following values:

K = 90 feet per day

A = 2,200 feet wide x 50 feet thick

I = 0.003 (15 feet/5,200 feet)

3. WATER QUALITY

Available surface water quality data were collected from the Oregon Department of Environmental Quality and the Unified Sewerage Agency. To supplement the existing data, we collected water samples from Fanno Creek, the Tualatin River, and test boreholes B-2 and B-4. The water quality data are presented in Appendix D.

In general, the data show that the ground and surface water is of good quality, except for the high bacteria counts in the surface water. Comparison of ground- and surface-water qualities indicates that the Tualatin River and Fanno Creek are higher in nitrate, sulfate, chloride, sodium, and pH than the regional ground water. These chemical constituents are indicators of the sewage effluent discharges (including septic tanks) to these streams. The ground water was higher in iron and manganese as would be expected, based on the lower pH and the presence of limonite (hydrous iron oxides) coatings on some gravels.

Bacteria (total and fecal coliform) counts were not obtained from ground-water samples; however, it is highly unlikely that they exist in the water below the site. Fanno Creek and the Tualatin River have high levels of total and fecal coliforms, indicative of sewage effluent contamination or other animal-caused pollution.

The ground-water quality of test boring B-4 was anomalous. During installation of the piezometer, a large volume of "imported" water was used to flush out the hole. Some of this residual water near the well may not have been completely bailed out prior to sampling. This well has been resampled, but the analysis has not been completed.

III. LEACHATE

A. CHARACTERISTICS

1. PHYSICAL AND CHEMICAL

a. Leachate Generation

Leachate is an obnoxious mineralized liquid produced when decomposing refuse buried in a landfill comes in contact with water. The water can come from several sources, including precipitation on the site, offsite runoff onto the top of the site that percolates through the refuse, or ground water intrusion.

The decomposing refuse has the capacity to hold a certain amount of water before any liquid will be released. After the landfilled refuse has reached its maximum water-holding capacity (field capacity), any additional water entering the refuse will cause an equal amount of water (leachate) to leave the site. This leachate that leaves the landfilled refuse must be controlled to prevent damage to the environment.

b. Leachate Quality

Leachate is composed of many different chemical compounds, organic and inorganic. Its characteristics can vary dramatically from site to site, according to the specific types of refuse placed in the site and the length of contact time between the refuse and water. Table III-1 indicates the range of characteristic constituents found in leachate from municipal solid waste.

There is the possibility that this site will be used for disposal of boiler ash from the proposed Resource Recovery Facility in Oregon City. The boiler ash will be relatively inert with regard to organic compounds but could contain substantial inorganic chemical material. If the combustion of the refuse within the boiler is incomplete, there will be some degree of organic residue. This leachate will require collection and treatment prior to disposal. Table III-2 presents ash leachate characteristics from a specific test program.

2. GROUND-WATER INTERACTIONS

Concepts useful for describing surface-water pollution are generally not valid for ground water. The relatively slow velocity of ground water results in laminar flow, which

Table III-1

RANGE OF LEACHATE CHARACTERISTICS

Constituent	Value[a] mg/l Range[b]	Value[a] mg/l Typical
BOD^5 (5-day biochemical oxygen demand)	2,000-30,000	10,000
TOC (total organic carbon)	1,500-20,000	6,000
COD (chemical oxygen demand)	3,000-45,000	18,000
Total suspended solids	200- 1,000	500
Organic nitrogen	10- 600	200
Ammonia nitrogen	10- 800	200
Nitrate	5- 40	25
Total phosphorus	1- 70	30
Ortho phosphorus	1- 50	20
Alkalinity as $CaCO_3$	1,000-10,000	3,000
pH	5.3- 8.5	6
Total hardness as $CaCO_3$	300-10,000	3,500
Calcium	200- 3,000	1,000
Magnesium	50- 1,500	250
Potassium	200- 2,000	300
Sodium	200- 2,000	500
Chloride	100- 3,000	500
Sulfate	100- 1,500	300
Total iron	50- 600	60

[a]Except pH.

[b]Representative range of values. Higher maximum values have been reported in the literature for some of the constituents.

Source: Tchobanoglous, George, Hilary Theisen, and Rolf Eliassen, Solid Wastes: Engineering Principles and Management Issues. McGraw-Hill, Inc. 1977.

Note: Constituents will also include the total array of heavy metals in concentrations which will range from only trace amounts to several 100 mg/l dependent on the wastes deposited in the landfill.

Table III-2

ASH LEACHATE CHARACTERISTICS

Parameter	Leachate Analysis (mg/l)
Alkalinity	1,800
Aluminum	2.5
Arsenic	0.21
Barium	1.3
Biochemical Oxygen Demand	890
Cadmium	0.015
Calcium	540
Chloride	4,200
Chromium	<0.01
Chemical Oxygen Demand	1,100
Conductivity	20,000
Copper	2.8
Fluoride	3.0
Hydrocarbons	<1
Iron	<0.1
Lead	0.09
Magnesium	1.8
Manganese	<0.1
Mercury	<0.001
Nickel	0.2
Nitrate - N	0.28
Nitrite - N	0.13
pH	12.20
Phosphorous (Total)	0.41
Potassium	1,900
Selenium	0.46
Silicon	1.4
Silver	0.05
Sodium	2,000
Sulfate	140
Tin	2.0
Titanium	<0.1
Total Dissolved Solids	11,000
Zinc	0.05

Source: CH2M HILL, and Winzler and Kelly Water Laboratory, Humboldt County Solid Waste Resource Recovery Study, East Hamilton Solid Waste Reduction Unit, Hamilton, Ontario, Canada. June 1977.

Note: Biochemical oxygen demand value of 890 mg/l indicates incomplete combustion.

exhibits different mixing characteristics than does turbulent flow usually associated with surface streams. If water of different chemical composition enters the ground-water system, it does not mix with the entire ground-water body. Instead, it moves with and in the direction of the ground-water flow as a plume undergoing minimal mixing. Diversions in flow direction from induced changes in gradient (e.g., a pumping well) will also divert the leachate plume. The plume shape is determined by the physical characteristics of the soil. Hydraulic and geologic conditions and leachate density determine the vertical depth to which leachate will migrate into the aquifer. The thickness and width of the plume will probably increase with distance down gradient from the source.

The chemistry of leachate interaction with ground water and soil material is highly complex and variable. There are no hard and fast rules to predict quality changes when leachate mixes with ground water. The following discussion emphasizes major trends; however, all possible chemical conditions and resulting reactions may not be represented.

Attenuation is defined as a reduction in dissolved constituent concentration with distance in the direction of flow. Attenuation may result from chemical, physical, or biochemical reactions that remove the constituent from solution. Apparent attenuation occurs from dilution through mixing with water of better quality. Not all leachate constituents are attenuated to the same degree, and some are not attenuated at all.

In soils and sediments underlying landfills, the cation exchange capacity (CEC) will immobilize a certain amount of the leached cations. When the capacity has been reached, further percolation of cations will not be affected.

It should be noted that cation exchange is not a permanent fixation. Cations may be desorbed with changes in solution composition, pH, or oxidation-reduction (redox) potential.

Divalent and trivalent cations include most of the heavy metals. These are held more strongly than sodium, potassium, or ammonium on the cation exchange complex. Heavy metals will displace monovalent cations, which are adsorbed. Heavy metals are also prone to adsorption on hydrous oxide coatings in the soil. The hydrous oxides are frequently cited as so limiting metal solubility that agricultural deficiencies of copper, zinc, and cobalt occur. Attenuation of heavy metals present in leachate is desirable. In locations virtually free of clay minerals, these coatings may be present on sand grains, giving the sandy formation some ability to attenuate metallic ions.

In general, heavy metal anions containing chromium, arsenic, boron, and selenium are not attenuated to any degree in ground-water environments where pH <7 and Eh <0 (slightly acid and reducing conditions).

Chemical precipitation in the aquifer is possible if the natural ground-water composition includes ions that form insoluble compounds with leachate constituents. An example would be formation of insoluble hydroxyapatite with leachate phosphate and calcium in ground water. Iron, aluminum, and manganese can also form virtually insoluble precipitates with phosphate.

Carbonate can react with calcium, magnesium, and some heavy metals forming relatively insoluble compounds. Also, changes in redox potential, buffering reactions, or changes in lithology may produce other precipitation reactions.

The second means of attentuation in aquifers is by physical filtration. This mechanism removes only suspended matter, such as turbidity or microorganisms in the leachate, not dissolved constituents. The finer the grain size of the aquifer material, the more efficient the filtering will be. Usually ten feet are sufficient to remove most suspended solids.

The third means of attenuation is termed decay. Oxidation of organic compounds reduces them to carbon dioxide and water. Microorganisms carried into the aquifer zone are deprived of a good nutrient supply and are subjected to a cooler temperature than in the solid waste zone. This results in a lowering of biochemical activity, frequently to the point of cessation. The inactivation, coupled with natural die-off, tends to reduce bacterial and viral numbers rapidly.

Table III-3 summarizes the susceptibility of leachate components to major attenuation in ground-water systems.

B. CONTROL

1. DESIGN

The potential for environmental degradation from leachate produced in landfills is a serious problem and one that has been the subject of an increasing number of studies and Federal regulations. Most recently, the Environmental Protection Agency has promulgated solid waste disposal facility criteria under Section 4004 of the Resource Conservation and Recovery Act of 1976 (RCRA). Section 257.3-4 "Groundwater" of these regulations stipulates practices that

Table III-3

Susceptibility of Leachate Constituents to Major Attenuation

Constituent	Attenuation Mechanism
Chloride	O
Sulfate	O
Phosphate	A-C
Nitrate	O
Ammonium	A
Sodium	O
Potassium	A
Calcium	A
Magnesium	A
Heavy Metal Anions (Cr, Se, B, As)	O
Heavy Metal Cations (Pb, Cu, Ni, Zn, Cd, Fe, Mn, Hg, Cr)	A-C
COD	O
Volatile Acids	O
Phenols	O-A
MBAS	O-A
Bacteria and Virus	F-B

O = No Attenuation
A = Adsorption
B = Biological Degradation
C = Chemical Precipitation
F = Filtration

will be unacceptable in a solid waste disposal facility. The specific rule indicates that "a facility or practice shall not contaminate an underground drinking water source beyond the solid waste boundary or beyond an alternative boundary specified in accordance with Paragraph B of this section." The primary leachate control objective in designing a landfill in an active area of ground water use is to prohibit significant migration of leachate beyond the landfill boundary.

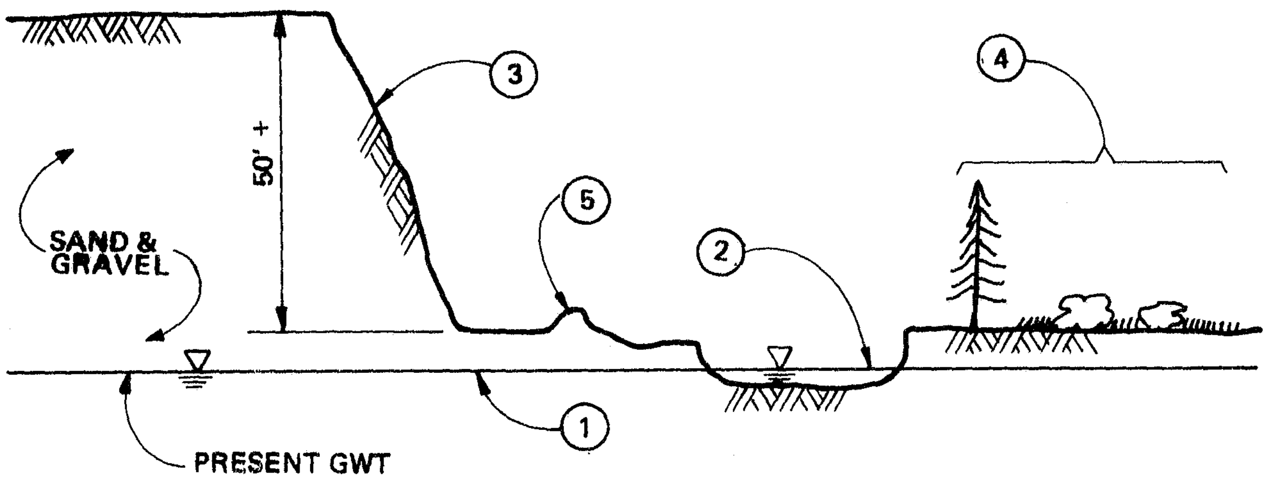
Geotechnical soils parameters furnish some of the information used to determine lining criteria for the prevention of leachate escape, as well as information about the potential for leachate migration through the surrounding soils. Some means to prevent leachate escape must be used at this site. The gravels, sands, and silts on the site are free-draining and permeable. In addition, ground-water aquifers are contained within these soils. The following discussion addresses design techniques for leachate control.

Because the site is located in relatively permeable soils, and because a number of shallow wells around the site are used for domestic water supply, a conservative approach should be used in designing a leachate control system. This is especially true because (a) the ground water could become contaminated, and (b) it would be extremely expensive to make repairs or corrections later in a landfill if the leachate is not controlled initially. Basically, a "belt and suspenders" approach should be used.

Such an approach consists of (a) minimizing the amount of water that can enter the landfill by using a relatively impermeable cover over the complete landfill, and (b) controlling the water that does enter the landfill by catching it on a bottom lining and removing it with a leachate collection system. The intercepted leachate can then be sent to a wastewater treatment facility or other disposal facility.

a. Proposed Leachate Control System

The existing conditions are illustrated in Figure III-1. The summer ground-water table is generally less than 10 feet below most of the pit floor. In some areas, excavation has been made below the summer ground-water table; consequently, ponds have been formed. The side slopes of the pit are very steep and have a rough surface; occasionally, large boulders and other material are in some danger of ravelling off this slope. The bottom of the pit has trees, brush, and grass, and the pit floor is generally rough and uneven. Accurate topographic mapping of the pits was unavailable during the preparation of this study.



1. PRESENT GROUND WATER TABLE USUALLY A FEW FEET BELOW MOST OF THE PIT FLOOR.
2. SOME AREAS OF DEEPER EXCAVATION, WITH WATER.
3. VERY STEEP SLOPES, ROUGH SURFACE, OCCASIONAL LARGE BOULDERS THAT MAY FALL.
4. SMALL TREES, BRUSH, & GRASS.
5. ROUGH, UNEVEN SURFACE OVER MUCH OF THE PIT FLOOR.

EXISTING CONDITIONS

FIGURE III-1

METROPOLITAN SERVICE DISTRICT
POTENTIAL SANITARY LANDFILL SITE
LEACHATE IMPACT AND CONTROL
FOR DURHAM SITE
WASHINGTON COUNTY, OREGON

CH2M HILL

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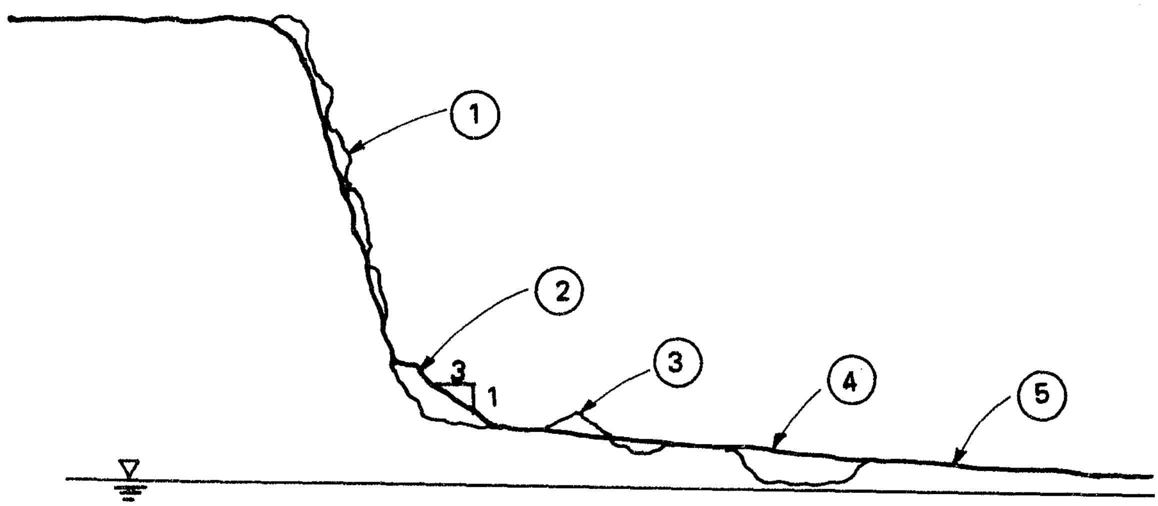
Figure III-2 illustrates some of the needed site preparation. It will be necessary to clear, grub, and strip all vegetative material from the pit floor as a first step. The side slopes should be smoothed to remove overhangs and to generally scale down any loose material that might fall during the operation of the landfill. A fillet or fill should be placed at the juncture of the pit floor and side walls, with a gentle slope of about three on one. This will form a good working surface for construction of the bottom lining. The bottom of the pit floor should be graded to a smooth shape and sloped to drain. The existing ponds should be filled in as part of the grading in the bottom.

Figure III-3 illustrates the proposed concept for leachate control. The top of the completed landfill will be covered by a 3- to 4-foot layer of topsoil capable of supporting vegetation. Under this 3- to 4-foot layer of soil, a "roof" lining, probably of synthetic material, would be placed. Bedding material would separate the top liner from the refuse. The side slopes of the pit would be covered by a plastic lining draped from the top of the banks to the bottom. The bottom of the pit would be covered with an impermeable lining, probably a synthetic liner. Just above the bottom lining would be a system of perforated pipes, laid in gravel to collect any leachate that forms.

Because of the steep side slopes, it will take special care during construction to make the side lining watertight. Therefore, a granular material should be placed between the refuse and the side lining. This granular material will function to intercept water moving laterally through the refuse or any water that may leak through the side lining from the outside, and will transport the water to the drain pipes in the bottom.

The heavy arrows on Figure III-3 indicate the direction of water flow; the wavy arrows schematically show the direction of landfill gas. The relative amount of water is shown by the width of the large arrows. Most of the precipitation falling on the top would be directed off the site by the roof lining to adjacent surface drainages. The 0 to 5 gallons per minute of water that may leak through the roof lining will go downward to the pervious top cover material and then laterally to the granular material placed against the side slopes. The water will then proceed downward to the pervious material on top of the bottom lining and through this material to the collection pipes.

The elevation of the edge of the bottom lining should be above the maximum anticipated ground-water level.



1 SMOOTH SIDE SLOPES, REMOVE OVERHANGS AND GENERALLY SCALE DOWN LOOSE, DANGEROUS MATERIAL

2 FILL HERE TO TOP ELEVATION= 3'± ABOVE FLOOR ELEVATION OR TO ABOVE MAXIMUM ESTIMATED GW ELEVATION

3 GRADE SMOOTH AND SLOPE TO DRAIN

4 FILL AREAS NOW WATER FILLED

5 CLEAR, GRUB, AND STRIP ALL VEGETATIVE MATTER

SITE PREPARATION

FIGURE III-2

METROPOLITAN SERVICE DISTRICT
POTENTIAL SANITARY LANDFILL SITE
LEACHATE IMPACT AND CONTROL
FOR DURHAM SITE
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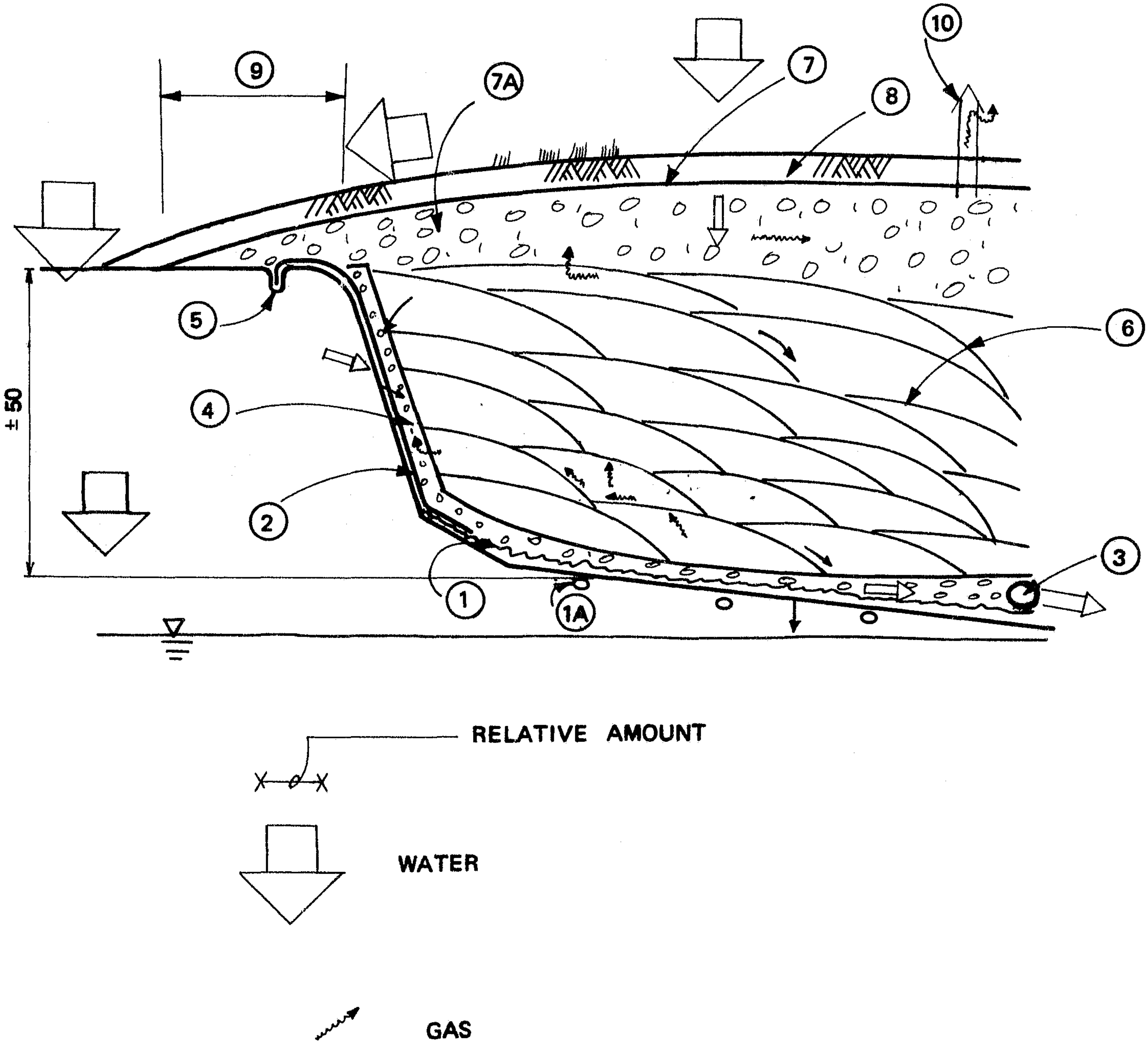

COMPLETED LANDFILL

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(1) IMPERMEABLE MEMBRANE LINER, PROVIDE SAND BELOW AND ABOVE, PROVIDE 18" PERVIOUS COVER FOR MECHANICAL PROTECTION AND TO LEAD LEACHATE TO DRAIN (3)

(1A) POSSIBLE VENT PIPES TO PREVENT AIR PRESSURE: WHICH MAY LIFT LINING (1) BEFORE WASTE IS IN PLACE AND TO MONITOR LEACHATE ESCAPE

(2) PLASTIC LINER DRAPED OVER SLOPES, SHEETS OVERLAPPED WITH NO FIELDSEAM, COVER WITH SUNSHADE IF NECESSARY, STAKE TO SLOPE OR COVER WITH WIRE NET TO PREVENT WIND DAMAGE UNTIL WASTE IS PLACED

(3) LEACHATE COLLECTION PIPE(S) AT LOW POINTS

(4) PERVIOUS, GRANULAR MATERIAL PLACED AS PIT IS FILLED

(5) ANCHOR TRENCH FOR SLOPE LINER

(6) PERVIOUS COVER ON CELLS SERVES TO CONDUCT WATER QUICKLY TO THE BOTTOM. ALSO GAS CAN. VENT UPWARDS

(7) PLASTIC LINER FOR ROOF, SLOPED TO DRAIN AWAY

(7A) PERVIOUS MATERIAL TO ALLOW GAS VENTING TO (10)

(8) SOIL COVER WITH TOPSOIL AND PLANTED

(9) EAVE OR OVERHANG ON "ROOF"

(10) GAS VENTS

FIGURE III-3

METROPOLITAN SERVICE DISTRICT
POTENTIAL SANITARY LANDFILL SITE
LEACHATE IMPACT AND CONTROL
FOR DURHAM SITE
WASHINGTON COUNTY, OREGON

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Figure III-4 illustrates the eave effect that can be realized by making the roof lining extend about 30 feet beyond the edge of the pit. This overlap will be coordinated with the detailed surface drainage plan to be developed during preliminary design.

b. Design Considerations

Some of the specific items that will have to be considered in the later detailed leachate control system design are discussed below.

Bottom Liner. The bottom liner must be of high quality construction. A watertight lining should be the goal. Mechanical protection, consisting of about 18 inches of soil, must be provided to prevent damaging the lining with equipment during solid waste placement operations. This lining material must also be selected to be resistant to attack by the leachate. Other sanitary landfill sites in the United States currently operate with a synthetic bottom liner. Examples of these sites are listed in Appendix E.

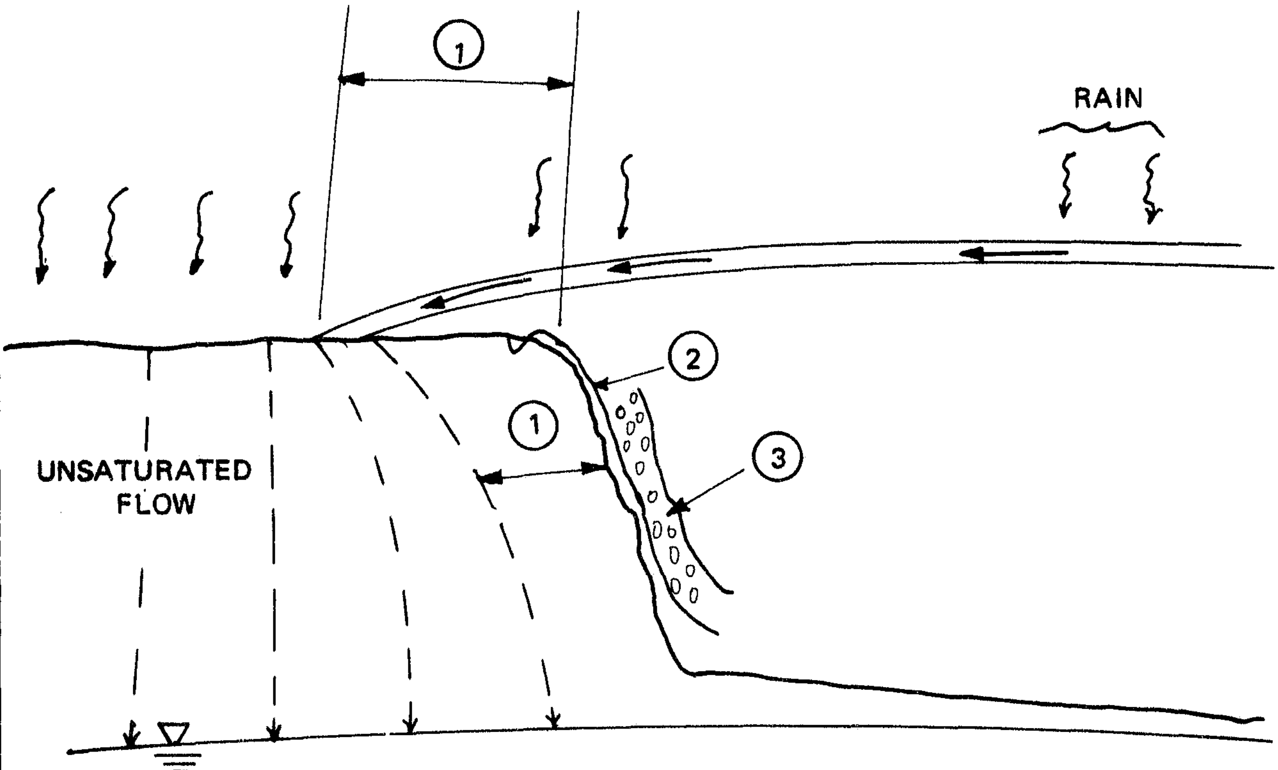
Side Liner. The side lining will be exposed to the elements for the period of time until the landfill is completed. This lining will be subject to sunlight and ozone, which deteriorates some lining materials. Therefore, either a lining material that will not deteriorate due to exposure to the elements should be selected, or a sunshade should be provided by using a second lining over the primary lining material. This sunshade material should be resistant to deterioration by sunlight.

In addition, wind may cause flutter and possible mechanical damage to the lining. This could be prevented by securing the side lining to the side slope at frequent intervals or by placing wire net over the lining. It may also be possible to install the side lining in phases as filling progresses, to minimize exposure to damage. The detailed timing of side lining installation would be determined in the operational plan.

Roof Liner. There are no other special requirements. This lining will be subject to mechanical damage during its construction, so care should be taken during placement. It should not be in contact with leachate.

c. Grading

A great deal of effort will be required to develop a suitable grading plan for the pit floor. The plan must consider the needs of the leachate collection system and drainage during



1. EAVE WILL MINIMIZE RAINWATER INFILTRATION ENTER REFUSE

2. SLOPE LINING MINIMIZES AMOUNT OF WATER THAT CAN ENTER LANDFILL

3. GRANULAR MATERIAL COLLECTS THAT WATER WHICH PENETRATES SLOPE LINING AND QUICKLY LEADS IT TO LEACHATE COLLECTION SYSTEM, THEREBY MINIMIZING CONTACT TIME WITH REFUSE

EAVE EFFECT

FIGURE III-4

METROPLITAN SERVICE DISTRICT
POTENTIAL SANITARY LANDFILL SITE
LEACHATE IMPACT AND CONTROL
FOR DURHAM SITE
WASHINGTON COUNTY, OREGON

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operation of the pit. The preparation will necessarily require careful construction and inspection to ensure a smooth base for the liner to prevent mechanical damage.

A grading plan will also be necessary for the top of the landfill when it is completed. Proper drainage of precipitation away from the pit will minimize the amount of seepage into the landfill. A minimum top slope of 3 percent will ensure adequate runoff to adjacent surface drainages.

d. Additional Data Required for Detailed Design

To establish the proper elevation for the edge of the bottom lining, it will be necessary to determine the maximum anticipated ground-water levels. This should be accomplished by taking periodic readings of the piezometers and the water levels of the ponds that now exist in the pits.

The bottom synthetic lining material must be resistant to attack from leachates. Manufacturers' data on existing landfills using synthetic liners should be reviewed, as well as specific product specifications. Data from leachate contact tests with synthetic lining materials should be reviewed.

2. SOLID WASTE OPERATIONAL TECHNIQUES

A detailed operations plan for complete filling and closure of the site will be developed in future work, if the site is acceptable from the technical standpoint. The operations techniques presented below address only the topic of control of leachate impacts.

Several solid waste operational techniques should be incorporated into a new sanitary landfill to decrease the potential of leachate escape from the site into surrounding soils and/or ground water. These methods include refuse shredding, amount and type of final cover material and final slope, and alternative methods of compacting and placing refuse to minimize leachate generation. These various techniques are discussed below.

a. Shredded Refuse Landfill Operation

Shredding is a size reduction process whereby raw solid waste is mechanically reduced, in a milling machine, to a homogeneous mass of relatively consistent small-particle-sized material. In the size reduction process that occurs in the milling machine, the refuse is violently torn and experiences an increase in temperature. The food and other organic particles present in raw refuse are dispersed and absorbed by the paper portion of refuse during the shredding process. In the shredding process, the incoming heterogeneous refuse is reduced to some consistent predetermined particle size. This particle size, being less than the average particle size of the incoming refuse, increases the total surface area of the milled waste, and allows accelerated chemical and biological decomposition reactions to occur. This increased reaction time is enhanced by the mixing action of the shredding process that distributes the water, chemicals, bacteria, and nutrients present in the incoming wastes evenly throughout the final processed mass. Rapid decomposition in the landfilled refuse allows settlement and stabilization to occur much more quickly than in an unprocessed refuse landfill. Studies have shown that significant settlement has occurred within the first 2 years after completion of a shredded refuse landfill.[1/]

There are several important differences in composition and production rates of leachate from milled refuse and unprocessed refuse. The general differences are:

- Initial leachate production rates are generally higher from shredded refuse, although this depends to a large degree on the amount and permeability of final cover.

- Organic matter is leached from shredded refuse at a higher concentration and more quickly than from unshredded refuse.

- Shredded refuse leachate is initially acidic and approaches neutrality with time. Unshredded refuse leachate becomes more acidic with time.

- Shredded refuse leachate characteristics are influenced less by seasonal variations in weather than is unshredded refuse leachate.

- Shredded refuse reaches a "mature" decomposed state much more quickly than unshredded refuse.

1/ Reinhardt and Ham, 1973, Final Report on a Milling Project at Madison, Wisconsin, between 1966 and 1972.

These conclusions support the beneficial aspects of landfilling shredded refuse when leachate is collected from the site and treated. Because the major portion of decomposition and leachate generation occurs evenly and quickly, shredded refuse landfills can be returned to productive uses sooner than nonshredded landfills.

Shredding increases the rate of physical-chemical leaching and biological decomposition by increasing the surface area of the refuse, thereby exposing more of the refuse to biological and leaching activity. Also, water flows more evenly through the entire volume of refuse rather than through channels, as in unprocessed refuse. The shredding process also breaks up large items and allows the refuse to decompose uniformly, so that the readily removable matter is quickly extracted from the refuse at an even rate, leaving a relatively inert mass behind.

The objective of lining the site is to prevent leachate escape, and the integrity of the liner is crucial. It is anticipated that the top liner will prevent any significant infiltration of precipitation and, hence, generation of leachate. The accelerated rate of decomposition of shredded refuse will result in less reliance being placed on the long-term durability of the liner. The sooner the refuse reaches a "mature" decomposed state, the lower the potential for ground-water impact from leachate.

In summary, shredding refuse appears to be a useful technique to accelerate the generation of leachate. With a leachate collection system in operation beneath the proposed landfill site, the likelihood for capture and removal of leachate is greatly enhanced if this leachate is produced rapidly. The impact of time-related failures of the underdrained system and/or the site liner can be minimized if leachate production occurs within the first several years after completion of the site.

b. Final Cover

The thickness of final cover and the top slope are both critical items to determine the quantity of infiltration that will percolate through the cover and into the refuse. In a well-designed site, this infiltration of precipitation falling directly on the site will be the primary source of leachate generation. An impermeable layer of synthetic material placed over the final lift of refuse will prohibit infiltration of most precipitation. Placement of a thick layer of soil over the synthetic cover will provide a base for future landscaping and will also allow moisture retention. Landscaping with a high consumptive water use will also aid in decreasing infiltration through the top cover.

Another operational technique for final cover is for an increase in the top slope of the site. This increased slope will result in a greater rate of runoff to adjacent surface water drainages. Top slopes of approximately 3 percent are adequate for most drainage and are aesthetically pleasing as well. Greater slopes of up to 10 to 15 percent could be designed to rapidly drain surface water into drainage swales lined with half-round culvert pipe. The drainage could then be conveyed away from the site.

c. Operational Techniques

Several techniques can be employed during filling of the landfill that will either minimize leachate generation or tend to minimize the total escape of leachate from the completed site.

One technique addresses daily cover. Studies and experience at operating landfills have indicated that daily cover is not necessary for shredded refuse. The cover is primarily for aesthetic reasons. For this site, if an impermeable daily cover were used, a small reduction in leachate generation could be expected.

It is important that the daily refuse cells be placed and compacted in layers sloping from the outer edges of the site toward the middle. This will tend to create horizontal layering within the site and direct the flow of any rainwater that may percolate through the site toward the middle. The water will move laterally to the center of the site, down through the refuse and may then be collected in the leachate collection system.

d. Leakage Through Liner

The design approach chosen for the Durham Pits site is to line the landfill with an impermeable synthetic membrane to contain all generated leachate. However, small holes may develop during construction and placement of the liner. The estimated seepage rate through a typical installed synthetic membrane is about 10^{-3} inches per day at 20 feet of head. This value is based on actual measured losses after 1 year of service.[1/] The calculated seepage rate at the Durham site is 0.1 gallons per minute, using site parameters of 70 acres surface area and 1.0 foot maximum depth of leachate. The 0.1 gallons per minute seepage is an average value. Maximum worst case values should not exceed 1 gallon per minute (10 times greater).

[1/] Kays, W. B., 1978, Construction of Linings for Reservoirs, Tanks, and Pollution Control Facilities, John Wiley & Sons, p. 213.

Upward leakage of ground water into the landfill may also occur where the bottom liner is below the maximum ground-water table elevation. However, this small volume of leakage (less than 1 gpm) can easily be controlled by the leachate collection/drainage system described earlier in this report.

C. GENERATION VOLUMES

1. WATER BALANCE

Leachate containing suspended and dissolved materials as a result of contact with the disposed solid waste is generated in all sanitary landfills. A reasonable estimate of leachate quantity is needed in order to evaluate collection, treatment, and discharge capacity.

To assist in determining infiltration and evapotranspiration quantities, a water balance was constructed for the Durham Pits site, incorporating:

- Average monthly precipitation
- Average monthly potential evapotranspiration
- Average monthly actual transpiration (assuming 3-inch water soil capacity)

A total site precipitation of approximately 42.1 inches per year is realized, of which approximately 14.4 inches per year are estimated to be lost to evapotranspiration. The water balance for the Portland area indicated that:

- On the average, excess potential evapotranspiration capacity exists (above that which can be drawn from soil moisture utilization) from approximately mid-May through mid-September.
- On the average, from mid-November through mid-May, a water surplus will exist and excess rainfall that does not become surface runoff or evapotranspirate will infiltrate and may produce leachate.

2. MAXIMUM LEACHATE QUANTITY

Several assumptions must be made in calculating the potential leachate quantity generated at the Durham site. The most conservative (worst case) assumptions yield the upper limit for leachate quantity.

The maximum potential volume of leachate generated by precipitation recharge at the Durham site was calculated by the water balance method to equal 53 million gallons per year, or about 100 gallons per minute. Table III-1 summarizes these calculations. The form of the water balance equation used is:

Leachate Volume = Precipitation - Evapotranspiration

Runoff was assumed to be negligible from the fill cover. A synthetic top cover was not included; hence, precipitation that does not evapotranspirate will infiltrate the refuse. Soil moisture-holding capacity was also taken to be negligible, assuming the fill will reach a quasi-steady state after operations begin. These assumptions are conservative in that they tend to yield leachate volumes that are maximums.

The maximum height that leachate will stand above the bottom of the pit is 7.7 feet. This "worst case" value assumes no leachate is collected during the year, and porosity (or void spaces) of the fill equals 30 percent.

3. EXPECTED LEACHATE QUANTITY

The conceptual leachate control system should prevent the generation of significant quantities of leachate within the site. The assumptions used to calculate the expected leachate quantity are:

- Runoff from the top cover to adjacent surface drainages is assumed to be 98 percent, due to the impermeable top cover.
- Soil moisture-holding capacity was assumed to equal 4 inches of water.
- Field capacity of the refuse was assumed to equal 50 percent.

Based on these assumptions, potential leachate volume due to recharge by precipitation is calculated to equal about 920,000 gallons per year or about 2 gallons per minute.

The site life will be determined in later tasks. If the site can be completed and the top cover placed before the refuse reaches field capacity, leachate generation from precipitation recharge may not occur. The specifics of site life and placing final cover should be investigated in more detail during preliminary design.

With the top cover and the leachate collection underdrain system, maximum height of leachate in the site should never exceed 1 foot.

D. GROUND-WATER IMPACT

Figure III-5 is a simplified diagrammatic representation showing how the small amount of leachate that may escape the landfill will move through the subsurface and ultimately discharge to the Tualatin River and Fanno Creek. The areal extent of potential impact is shown on Figure II-1.

The estimated volume of leachate leakage to ground water ranges from 1 to 0.1 gallon per minute. The leachate will probably mix with the upper 50 feet of ground-water flow beneath the site. The estimated flow in this zone is 154 gallons per minute, therefore yielding dilution ratios of 1:154 to 1:1,540. This means the diluted concentration of any leachate component in ground water will be 0.6 to 0.06 percent of its undiluted concentration.

In addition to pure dilution, many of the leachate constituents will be attenuated by various mechanisms. Table III-2 summarizes the susceptibility of leachate components to attenuation.

The magnitude of attenuation cannot be quantified for the Durham site without extensive laboratory column tests using site materials and leachate of the quality expected to be generated at the site.

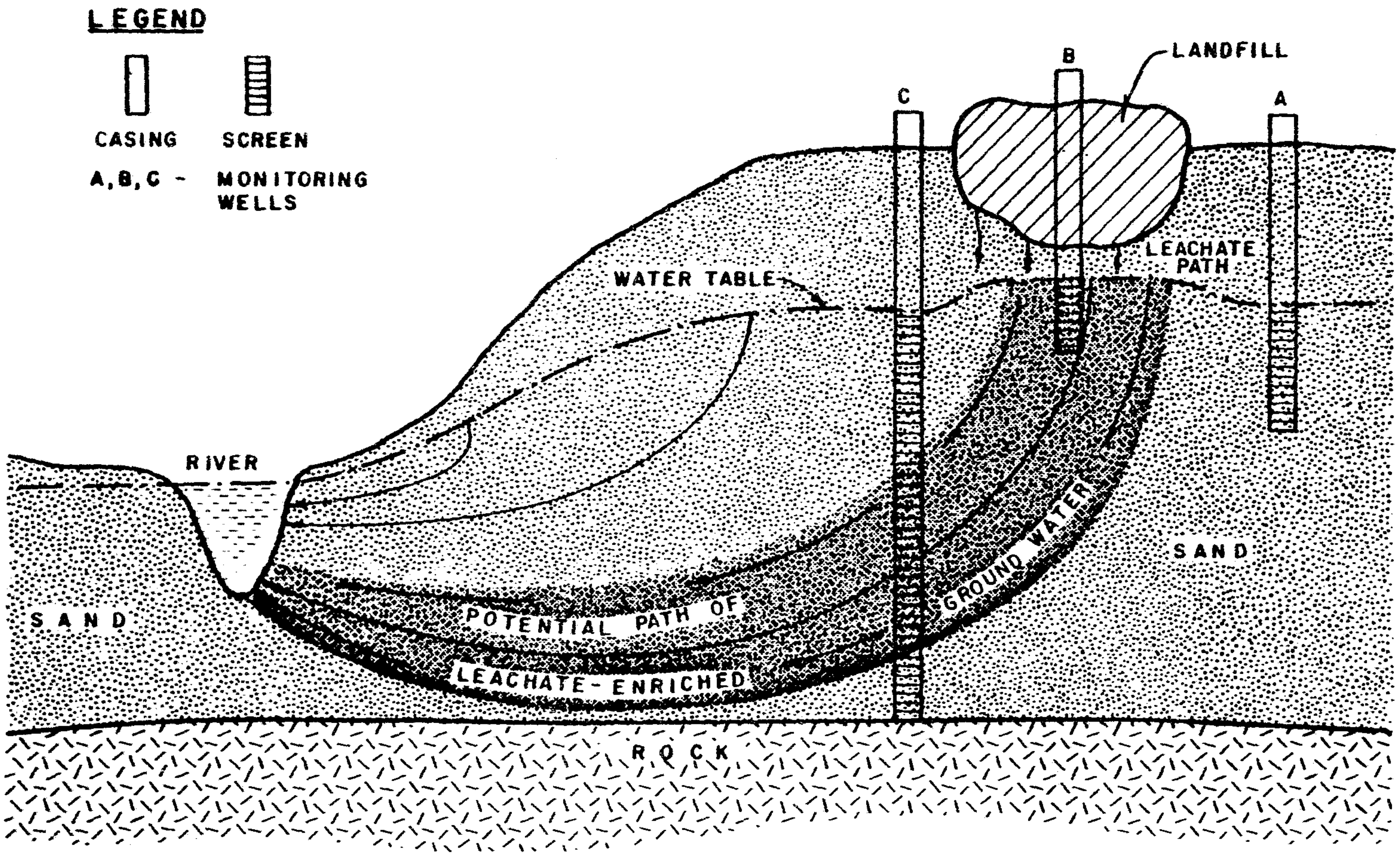

Figure III-5 Diagrammatic Cross-Section of Leachate Plume Beneath the Durham Site

IV. RECOMMENDATIONS AND RISKS

This report discussed the geotechnical, hydrogeological, and solid waste aspects of developing the Durham Pits site for sanitary landfill. The objective of this study was to determine if there is a technically feasibile method by which the Durham site can be used for sanitary landfill, taking into account leachate impact and control.

The determination of acceptability of any given site will have to be based upon relative risks and benefits. No major construction project is free of risk. The same is true with construction of a new sanitary landfill. The best technical solutions and construction methods are subject to risk.

The Durham site is technically feasible for sanitary landfill use, within certain levels of risk. The final determination of acceptability should be made by decision makers sensitive to the social and political concerns of the community, in full awareness of the technical solutions and resultant risks.

The recommendations outlined in this section present a technically feasible solution to use of the Durham Pits for sanitary landfill. The associated risks are also presented for decision making.

A. RECOMMENDATIONS

The following actions, if implemented at the Durham site, will reduce the risks of contamination of ground water by leachate to the levels indicated at the end of this section.

1. All refuse delivered to the Durham site should be shredded off-site prior to landfilling. Unprocessed refuse should be prohibited from disposal at the site.

2. The site design should include a bottom liner. The bottom liner should be composed of an impermeable membrane such as polyvinyl chloride (PVC), Hypalon, chlorinated polyethylene (CPE), or butyl rubber. These types of materials have an elongation of over 100 percent. They provide a flexible liner that can be more easily installed. The membrane will need to be covered with an appropriate thickness of fine-textured earth cover, as well as placed over a suitably prepared smooth surface, so that heavy equipment can operate in the landfill without a high risk of tearing the liner.

Membrane liner thicknesses of 20 mil are usually used in landfills, but 30 mil thicknesses are sometimes used where heat generation could be a problem. Reinforced materials may be necessary in critical areas, such as areas of bottom leachate collection.

3. The site design should include a side liner. The side liner should also be constructed of an impermeable membrane such as PVC, Hypalon, CPE, or butyl rubber and other. Side slopes of 3:1 or flatter, where possible, will minimize stretching in unreinforced sheets of PVC of a length of 25 feet. Otherwise, a reinforced liner must be used to obtain strength. The sides can be lined in sections as cells of fill are constructed.

4. The site design should include a top cover. The top cover should also be of an impermeable membrane, which can then be covered with earth so that the ground can be planted. This membrane will adjust to differential settlement that may occur. The cover should be crowned to a minimum slope of 3 percent so that the water runs off and is not impounded on the membrane.

5. The site design should include a bottom leachate collection system. The bottom leachate collection drain system should be installed in a manner to minimize ponding of leachate directly over the liner. A method for achieving this goal includes the use of perforated pipe to collect leachate, sloped to transmit the leachate to a sump. A pump would then periodically discharge the leachate to a disposal area. The perforated pipe should be covered with a gravel blanket to increase its effectiveness. The bottom must be sloped to direct leachate flow towards the collection drain system and sump.

6. The possibility of the Lake Grove Water District providing domestic water service to all residences and businesses now using well water in the Durham pits study area, should be investigated. This would further minimize the risks of ground water contamination to drinking water.

7. Piezometers should be installed around the perimeter of the landfill operation to monitor ground-water quality at the landfill boundaries.

B. RISKS

The recommendations presented here outline a technically feasible solution to use the Durham Pits for sanitary landfill. This solution requires the use of impermeable membranes to contain leachate. Membranes have been used in landfill construction since 1970; however, their long-term field durability (greater than 10 years) has not been determined.

Liners of natural or synthetic material are the best alternative solution for areas where the site's natural soil or hydrogeology is less than desirable. The technique depends on near total containment, followed by collection and treatment of the leachate. The containment must last in perpetuity to have zero risk. However, there can be no absolute guarantee that the membranes will not leak some leachate to ground water.

The existing conditions, potential leachate composition, and expected liner performance have been evaluated. The estimated volume of leachate leakage ranges from 0.1 to 1.0 gallons per minute. The estimated qualitative impacts of leachate contamination of ground water are summarized below.

1. Dilution due to mixing with native ground water ranges from 1:86 to 1:860.

2. Dissolved species such as sodium, potassium, chloride, sulfate, calcium, nitrate, and the heavy metal anions such as chromate, selenium, borate, and arsenic will increase in concentration in the ground water.

3. Heavy metal cations in the leachate such as lead, copper, zinc, cadmium, and iron will be attenuated to some degree by various chemical mechanisms in the aquifer.

4. Bacteria and viruses will be removed from the leachate-enriched ground water after passing through less than 100 feet of material.

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8. Tchobanoglous, George, Hilary Theisen, and Rolf Eliassen, 1977, Solid Wstes: Engineering Principles and Management Issues, McGraw-Hill, Inc.

9. Trimble, D.E., 1963, Geology of Portland, Oregon, and adjacent areas: U.S. Geol. Survey Bull. 1119.

APPENDIX A

SCOPE OF SERVICES

APPENDIX A

SCOPE OF SERVICES

FOR THE

METROPOLITAN SERVICE DISTRICT'S

FEASIBILITY REPORTS FOR POTENTIAL SANITARY LANDFILLS

DURHAM SITE

PHASE I - SITING ISSUES

TASK 1. LEACHATE: IMPACT AND CONTROL

Work on this task will include:

Analyze existing geologic, hydrologic, and topographic data.

Analyze existing recent subsurface investigations, including soils, ground water, and geology, for other sites in the vicinity of the Durham site.

Analyze existing climatological data as to wind characteristics and rainfall, including intensity-duration characteristics for 5-, 10-, 25-, and 100-year storms.

Analyze drainage characteristics.

Analyze ground and surface water pollution potential, using existing water quality data and projected leachate quality and quantity, including leachate from boiler ash.

This information, combined with the geotechnical information obtained from the subsurface exploration discussed below, will be used to determine depth to aquifers, direction of flow, local users, and possible impacts of contamination by leachate. The analyses and conclusions will be detailed in a short technical memorandum.

A surface drainage plan will be prepared indicating natural drainages, proposed drainages during filling operations, and final surface drainage system.

A comprehensive geotechnical investigation of the Durham site will be completed. A three-phase field investigation will be undertaken, as follows:

1. Review of available soils and geologic data for the Durham area and a cursory field inspection by a geotechnical engineer.

2. Backhoe test pits to identify bottom conditions in the pit areas.

3. Drilling and sampling to determine subsurface hydrogeologic conditions.

Following these investigations, a laboratory testing program would be completed to determine material parameters such as strength, permeability, consolidation, and compaction. The laboratory data and field investigations will be summarized in a geotechnical design memorandum, including settlement, seepage rates, and material balance. Selected soils boring will be installed to allow ground water sampling.

An analysis of possible leachate control alternatives wil be completed and include specific features of site design and operation that act in concert to control total leachate escape from the site. These considerations will include:

- Shredding of refuse

- Type of final cover material and slope

- Leachage collection underdrains

- Ground water barrier system under site to prohibit ground water intrusion

- Type of site liner, including synthetic materials, admix liners, or a combination of these

- Alternative methods of compacting and placing of refuse during wet and dry periods to minimize leachate generation

All these methods will be evaluated for effectiveness by considering the impact on the local site ground and surface water hydrology. The analyses and recommendations will be detailed in a technical memorandum. A recommendation will be made regarding the suitability of the Durham site for sanitary landfill operations considering potential leachate impact.

APPENDIX B

CH2M HILL GEOTECHNICAL LABORATORY TEST DATA

SHEET ___ OF ___

COPIED

CH2M HILL

PROJECT NUMBER P12946.B0

PARTICLE-SIZE ANALYSIS

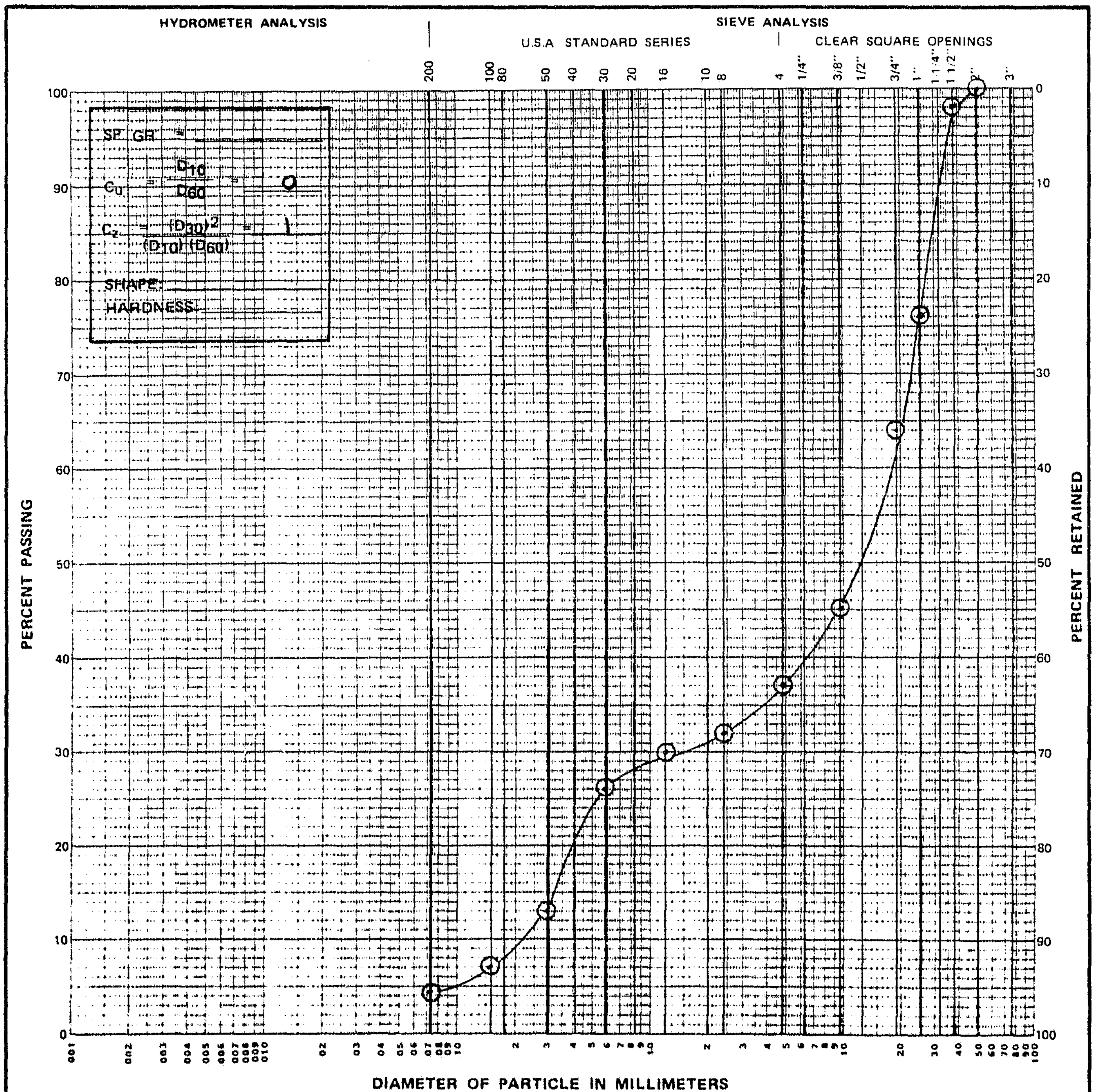
ASTM D422

PROJECT DESCRIPTION: METRO DURHAM

MATERIALS LABORATORY: CH2M HILL INC.

SAMPLE LOCATION: ________ SAMPLE NO. S-1

TYPE OF SAMPLE: LT. BROWN SANDY GRAVEL GP



COL-LOIDS	CLAY SIZE	SILT SIZE	SAND			GRAVEL	COBBLES
			FINE	MEDIUM	COARSE		

SAMPLE CLASSIFICATION ________

TESTED BY:	DATE:	COMPUTED BY:	DATE:	CHECKED BY:	DATE:
J. RAMONDON	22 OCTOBER 1979	J. RAMONDON	22 OCTOBER 1979		

LAB FORM 422 2/78

PROJECT: METRO DURHAM JOB NO: P12946.B0

T.H. NO: SAMPLE NO: S-1

DEPTH:

TYPE OF MATERIAL: LT. BROWN SANDY GRAVEL

CORNELL, HOWLAND, HAYES & MERRYFIELD
CLAIR A. HILL & ASSOCIATES
ENGINEERS PLANNERS ECONOMISTS

CH2M HILL

SIEVE ANALYSIS

GROSS WT. SAMPLE: 12.24 lbs. TARE WT.: ON SCALE NET WT. SAMPLE: 12.24 lbs.

U.S. STANDARD SIEVE	GROSS WEIGHT	TARE WEIGHT	NET WEIGHT RETAINED		PERCENT RETAINED		ACCUMULATIVE PERCENT PASSING
			INDIVIDUAL	ACCUMULATIVE	INDIVIDUAL	ACCUMULATIVE	
2"		ON SCALE		0.00 lbs.		0	100
1½				0.25		2	98
1				2.90		24	76
3/4				4.40		36	64
3/8				6.67		55	45
No. 4				7.73		63	37
8				8.32		68	32
16				8.59		70	30
30				9.03		74	26
50				10.68		87	13
100				11.41		93	7
200				11.71		95.7	4.3
PAN				12.20			

REMARKS:

Prepared by: REE Date: 10-19-79 | Tested by: LBD Date: 10-22-79 | Checked: Date:

SHEET ___ OF ___

CH2M HILL

PROJECT NUMBER P12946.30

PARTICLE-SIZE ANALYSIS

ASTM D422

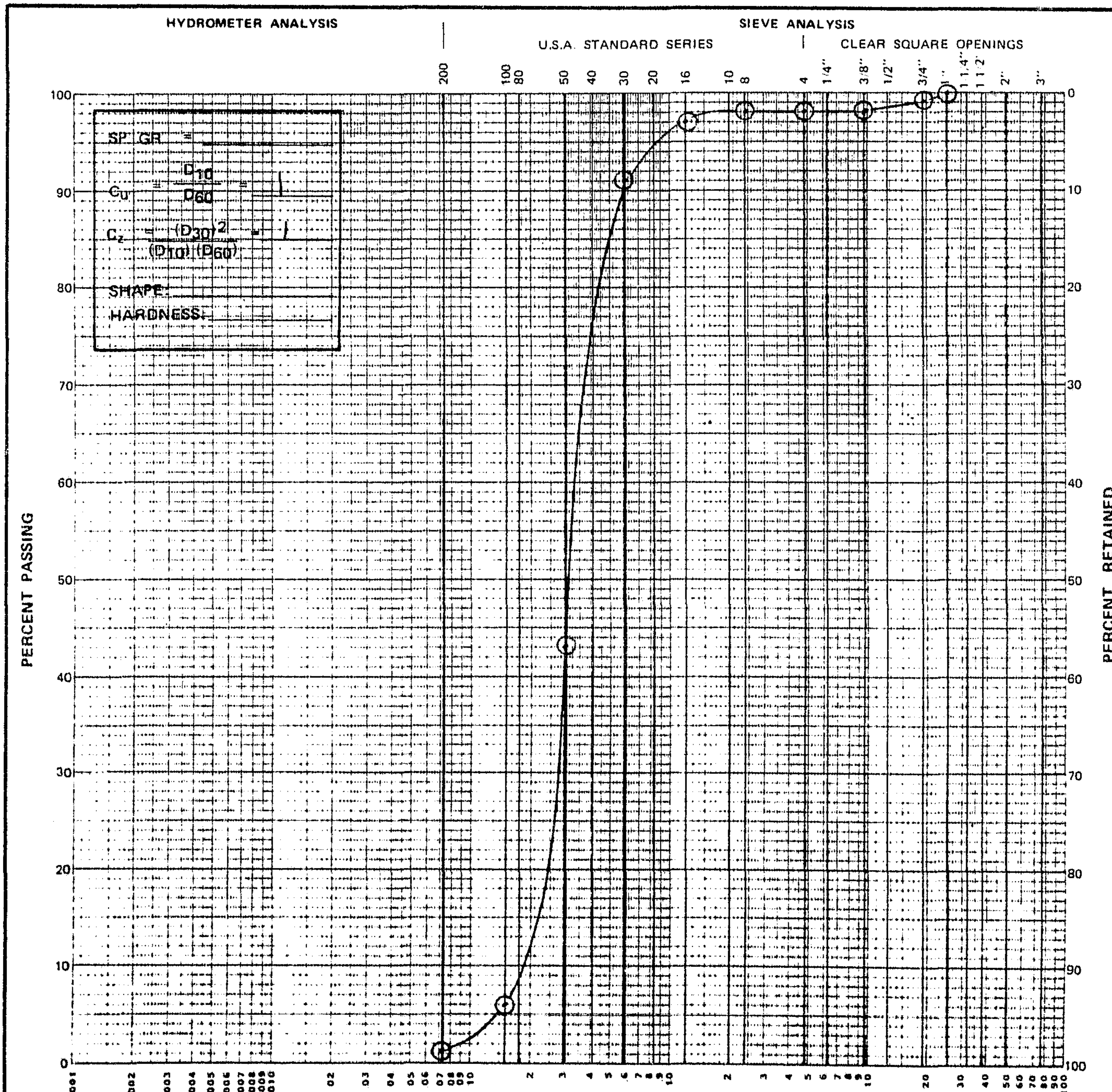
COPIED

PROJECT DESCRIPTION: METRO DURHAM

MATERIALS LABORATORY: CH2M HILL INC.

SAMPLE LOCATION: ______ SAMPLE NO. S-2

TYPE OF SAMPLE: LT. BROWN MED.-F SAND SP



COL. LOIDS	CLAY SIZE	SILT SIZE	SAND			GRAVEL	COBBLES
			FINE	MEDIUM	COARSE		

SAMPLE CLASSIFICATION ______

TESTED BY:	DATE:	COMPUTED BY:	DATE:	CHECKED BY:	DATE:
J. PLAMONDON	22 OCTOBER 1979	J. PLAMONDON	22 OCTOBER 1979		

LAB FORM 422 2/78

PROJECT: METRO DURHAM JOB NO: P12946.30

T.H. NO: SAMPLE NO: S-2

DEPTH:

TYPE OF MATERIAL: LT. BROWN MED-F SAND

CORNELL, HOWLAND, HAYES & MERRYFIELD
CLAIR A. HILL & ASSOCIATES
ENGINEERS PLANNERS ECONOMISTS

CH2M HILL

SIEVE ANALYSIS

GROSS WT. SAMPLE: 1058.9 g TARE WT.: 130.4 R-12 NET WT. SAMPLE: 928.5

U.S. STANDARD SIEVE	GROSS WEIGHT	TARE WEIGHT	NET WEIGHT RETAINED		PERCENT RETAINED		ACCUMULATIVE PERCENT PASSING
			INDIVIDUAL	ACCUMULATIVE	INDIVIDUAL	ACCUMULATIVE	
1"		ON SCALE		0.0 g		0	100
3/4"				12.5		1	99
3/8"				18.4		2	98
No. 4				20.9		2	98
8				21.8		2	98
16				26.8		3	97
30				84.6		9	91
50				525.7		57	43
100				877.9		94	6
200				916.5		98.7	1.3
PAN				929.8			

REMARKS:

Prepared by: REE Date: 10-19-79 | Tested by: J. [illegible] Date: 10-22-79 | Checked: Date:

SHEET___ OF ___

CH2M HILL

PROJECT NUMBER P12946.80

PARTICLE-SIZE ANALYSIS

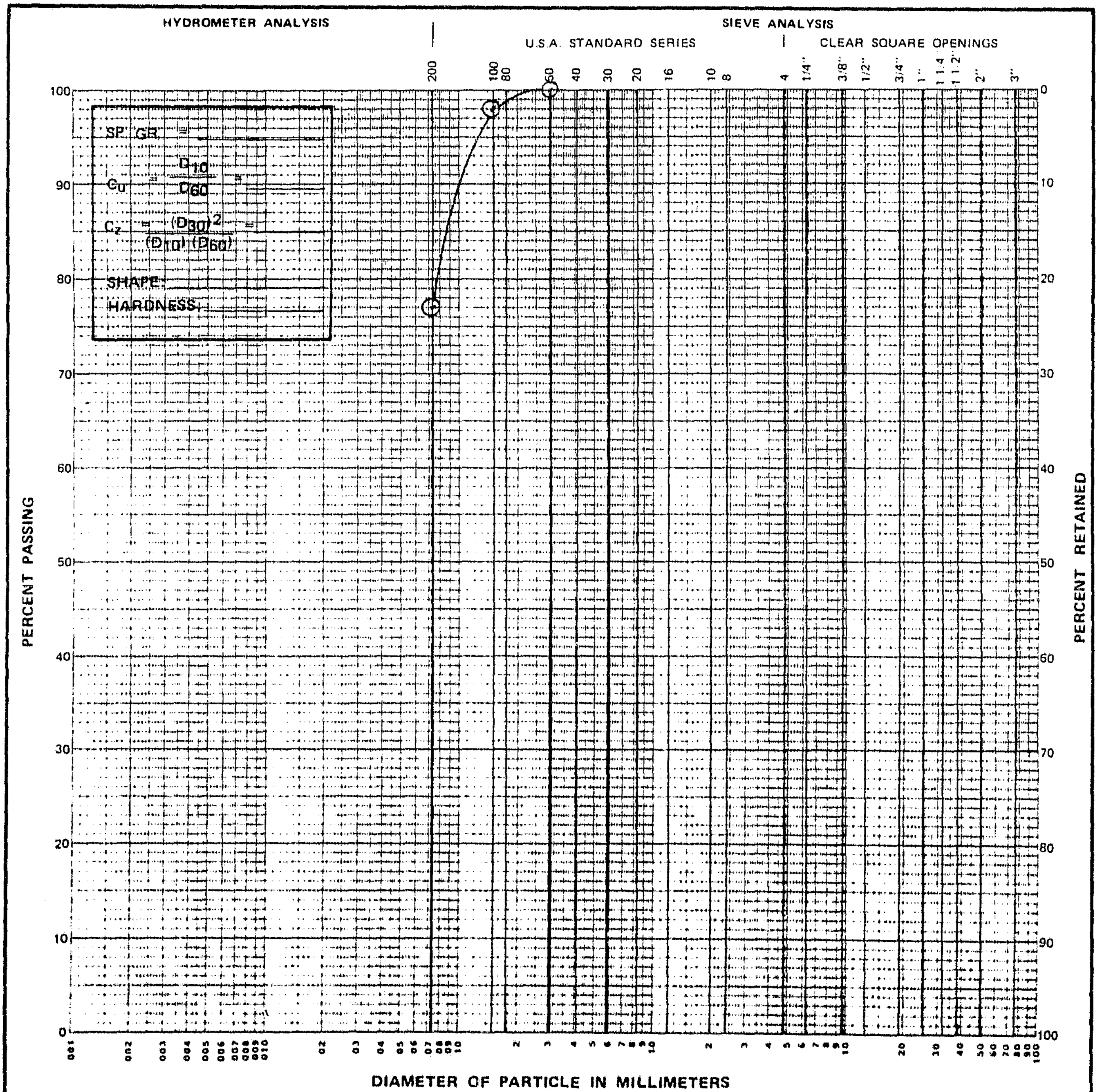
ASTM D422

PROJECT DESCRIPTION: METRO DURHAM

MATERIALS LABORATORY: CH2M HILL INC.

SAMPLE LOCATION: ______ SAMPLE NO. S-3

TYPE OF SAMPLE: LT. BROWN F SANDY SILT



COL-LOIDS	CLAY SIZE	SILT SIZE	SAND			GRAVEL	COBBLES
			FINE	MEDIUM	COARSE		

SAMPLE CLASSIFICATION ______

TESTED BY:	DATE:	COMPUTED BY:	DATE:	CHECKED BY:	DATE:
J. PLAMONDON	22 OCTOBER 1979	J. PLAMONDON	22 OCTOBER 1979		

LAB FORM 422 2/78

PROJECT: Metro Durham JOB NO: P12946.B0

T.H. NO: SAMPLE NO: S-3

DEPTH:

TYPE OF MATERIAL: Lt. Brown F. Sandy Silt

CORNELL, HOWLAND, HAYES & MERRYFIELD
CLAIR A. HILL & ASSOCIATES
ENGINEERS PLANNERS ECONOMISTS

CH2M HILL

SIEVE ANALYSIS

GROSS WT. SAMPLE: 601.3 g TARE WT.: 128.9 g R-3 NET WT. SAMPLE: 472.4 g

U.S. STANDARD SIEVE	GROSS WEIGHT	TARE WEIGHT	NET WEIGHT RETAINED		PERCENT RETAINED		ACCUMULATIVE PERCENT PASSING
			INDIVIDUAL	ACCUMULATIVE	INDIVIDUAL	ACCUMULATIVE	
No. 30	128.9	128.9	0.0	0.0		0	100
50	128.9	128.9	0.0	0.0		0	100
100	138.4	128.9	9.5	9.5		2	98
200	180.7	128.9	51.8	61.3		13.0	77.0
PAN	194.0	128.9	65.1	126.4			

REMARKS:

Prepared by: REE Date: 10-19-79	Tested by: L. Plamondon Date: 10-22-79	Checked: Date:

APPENDIX C

WELL INVENTORY

AND

OREGON DEPARTMENT OF WATER RESOURCES

WATER WELL REPORTS

WELL INVENTORY

INVENTORY OF WELLS USED IN WATER LEVEL SURVEY

OWNER/TENANT ADDRESS	INVENTORY NUMBER	DATE MEASURED	DEPTH TO WATER (ft)	LAND SURFACE ELEVATION (ft) [a]	WATER TABLE ELEVATION (ft. above MSL)
Resident 7420 S.W. Durham Road Tigard, Oregon 97223	A	7/31/79	9	132	123.0
Resident 15930 S.W. 74th Tigard, Oregon 97223	B	7/31/79	10.0	143	133.5
John Bowles 15575 S.W. 74th Tigard, Oregon 97223	C	7/31/79	30.5 (pumping)	146	115.5 (pumping)
Resident 7325 S.W. Fanno Creek Tigard, Oregon 97223	D	7/31/79	4.5	145	140.5
The Beebe Company 16075 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	E	7/31/79	at surface	142.5	142.5
Leane Eastas Tank Lines 7380 S.W. Bridgeport Road Tigard, Oregon 97223	F	7/31/79	85.5	195	109.5
Le Rose Mobile Park 18040 S.W. Lower Boones Ferry Road Tigard, Oregon 97223	G	7/31/79	69	178	109.0
Resident 18230 S.W. Boones Ferry Road Tigard, Oregon 97223	H	7/31/79	56	165	109.0
Mr. Schogren 6625 S.W. Jean Tigard, Oregon 97223	I	7/31/79	61.5	178.5	117.0
Resident 7055 S.W. McEvan Tigard, Oregon 97223	J	7/31/79	59	170.5	111.5
Mrs. Nelson 6956 S.W. Childs Tigard, Oregon 97223	K	7/31/79	21.5	130	108.5
Resident 16935 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	L	7/31/79	74	184	110
No Measurement	M	7/31/79			
Mr. Ed Huebotter 16870 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	N	7/31/79	70	182.5	112.5
Resident 17015 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	O	7/31/79	>75 (no water)	191.5	<116.5
No Measurement	P				
Henry Russell 7920 S.W. Ellman Tigard, Oregon 97223	Q	7/31/79	95	198	103.0
Jack E. Smith 15895 S.W. 72nd Tigard, Oregon 97223	R	7/31/79	5.5	149	143.5
E. F. Hale 17650 S.W. Meridian Tigard, Oregon 97223	S	7/31/79	22	164	±142
Mr. Lauterbach 8300 S.W. Peters Tigard, Oregon 97223	T	7/31/79	96.5	200	103.5

OWNER/TENANT ADDRESS	INVENTORY NUMBER	DATE MEASURED	DEPTH TO WATER (ft)	LAND SURFACE ELEVATION (ft) [a]	WATER TABLE ELEVATION (ft. above MSL)
Resident 15835 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	U	8/1/79	7	±156	±149
Connie's Market S.W. 72nd and Boones Ferry Road Tigard, Oregon 97223	V	8/1/79	16.5	154	137.5
No Measurement	W	8/1/79			
Mr. Haines 16515 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	X	8/1/79	55	167.5	112.5
Mr. Lows 16555 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	Y	8/1/79	26	140	114
Mrs. Bowles 16605 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	Z	8/1/79	61	167.5	106.5
Mr. Martinesi 16790 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	A1	8/1/79	70.5	180.5	110
W. Dale 16650 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	A2	8/1/79	55	168.5	113.5
Mr. Sittel 16520 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	A3	8/1/79	62.5 (pumping)	167	104.5 (pumping)
Resident 7760 S.W. Ellman Tigard, Oregon 97223	A4	8/1/79	85	194	109
Mr. Lawson 17995 S.W. Upper Boones Ferry Road Tigard, Oregon 97223	A5	8/1/79	75.5	185	109.5
B. Stark 8100 S.W. Peters Road Tigard, Oregon 97223	A6	8/1/79	81.5	190.5	109
Hancock Lumber Company 17990 S.W. McEwan Tigard, Oregon 97223	A7	8/1/79	62.5	178.5	116
Joe Barker 6727 S.W. Bridgeport Road Tigard, Oregon 97223	A8	8/1/79	103 (pumping)	178	75 (pumping)
CH2M HILL Test Borings	B1	9/4/79	32.5	146.27[b]	113.8
	B2	9/4/79	6.7	124.89[b]	118.2
	B3	9/4/79	8.4	126.16[b]	117.8
	B4	9/4/79	29.0	166.31[b]	137.3

[a] Land Surface Elevation estimated from City of Tigard 1 inch to 100 feet topographic maps.

[b] Top of casing as surveyed by CH2M HILL.

OREGON DEPARTMENT OF WATER RESOURCES

WATER WELL REPORTS

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON 97310, within 30 days from the date of well completion.

RECEIVED NOV 2 - 1971 STATE ENGINEER SALEM, OREGON

#1

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

State Well No. 2S/1W-13

State Permit No.

(1) OWNER:
Name Charles Dean
Address 10985 S.W. Hazelbrook Rd., Tigard, Ore.

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

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

(5) CASING INSTALLED:
Threaded ☐ Welded ☒
6 " Diam. from 0 ft. to 70 ft. Gage .250
59/16 " Diam. from 0 ft. to 600 ft. Gage 10
" Diam. from ft. to ft. Gage

(6) PERFORATIONS:
Perforated? ☒ Yes ☐ No.
Type of perforator used Cutting torch
Size of perforations 1/4 in. by 12 in.
36 perforations from 580 ft. to 600 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) 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.
rotary	30	Total	2
" "	15	100	2

Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Bentonite-cement grout
Well sealed from land surface to 70 ft.
Diameter of well bore to bottom of seal 9 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 3 sacks
Number of sacks of bentonite used in well seal 2 sacks
Brand name of bentonite National
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☐ Yes ☒ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Washington Driller's well number
¼ ¼ Section 13 T. 2S R. 1W W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 25 ft.
Static level 5 ft. below land surface. Date 10-15-71
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6"
Depth drilled 600 ft. Depth of completed well 600 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
Topsoil-Brown	0	3	
Clay-Brown	3	25	
Clay-Br-Sandy-Water seep	25	60	25
Clay-Blue	60	87	
Clay-Brown	87	90	
Clay-Gray	90	105	
Clay-Brown	105	150	
Clay-Gray	150	195	
Clay-Blue	195	300	
Clay-Tan	300	360	
Clay-Gray	360	390	
Clay-Brown	390	495	
Clay-Blue-Rock seams-Blk	495	510	
Clay-Br-Rock seams-Blk-Water Trace	510	582	
Rock-Blk-Water	582	600	5

Work started 10-11 1971 Completed 10-13 1971
Date well drilling machine moved off of well 10-14 1971

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] (signature) (Drilling Machine Operator) Date 10-27, 1971
Drilling Machine Operator's License No. 277

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name S & M Drilling & Supply
(Person, firm or corporation) (Type or print)
Address Rt. 1 Box 31, Canby, Ore. 97013
[Signed] (signature) (Water Well Contractor)
Contractor's License No. 520 Date 10-27, 1971

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED
OCT 26 1970
STATE ENGINEER
SALEM, OREGON

#2

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

State Well No. 2S/1W 13
State Permit No.

OWNER:
Name Raymond D. Thurdrue
Address 17365 Upper Boones Ferry Road Tigard, ore.

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

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

(5) CASING INSTALLED: Threaded ☐ Welded ☒
6 " Diam. from 0 ft. to 91 ft. Gage 1/4 wall
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(6) PERFORATIONS: Perforated? ☒ Yes ☐ No.
Type of perforator used torch
Size of perforations 1/8 in. by 6 in.
22 perforations from 85 ft. to 105 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) 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.
" " " "
" " " "
Bailer test 10 gal./min. with 15 ft. drawdown after 1 hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

CONSTRUCTION:
Well seal—Material used Bentonite
Well sealed from land surface to 60 ft.
Diameter of well bore to bottom of seal 9 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal xxx sacks
Number of sacks of bentonite used in well seal 3 sacks
Brand name of bentonite National
Number of pounds of bentonite per 100 gallons of water 50 lbs./100 gals.
Was a drive shoe used? ☐ Yes ☒ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Washington Driller's well number
¼ ¼ Section 13 T. 2-S R. 1-W W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 90 ft.
Static level 70 ft. below land surface. Date 10-7-70
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing 6
Depth drilled 105 ft. Depth of completed well 105 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
Top soil	0	2	
Brown clay	2	6	
Sand and gravel	6	91	
Pea gravel and course blue sand	91	105	

Work started 10-7-70 19 Completed 10-7-70 19
Date well drilling machine moved off of well 10-7-70 19

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Ralph Turner (Drilling Machine Operator) Date 10-17, 1970
Drilling Machine Operator's License No. 254

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name Ralph Turner Drilling Co. (Person, firm or corporation) (Type or print)
Address Rte 1 Box 141 Hillsboro, ore.
[Signed] Ralph Turner (Water Well Contractor)
Contractor's License No. 247 Date 10-17, 1970

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

#3

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM 10, OREGON within 30 days from the date of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

State Well No. 2/1W-13

State Permit No.

(1) OWNER:
Name C. A. White
Address [illegible] & Commercial Ave
Portland, Ore

(2) LOCATION OF WELL:
County Washington / Driller's well number
¼ ¼ Section 13 T. 2S R. 1W W.M.
Bearing and distance from section or subdivision corner
Lot 90 [illegible]

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒
6" Diam. from 0 ft. to 95 ft. Gage 17
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Well seal—Material used in seal Bentonite
Depth of seal 20 ft. Was a packer used? no
Diameter of well bore to bottom of seal 12 in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 56 ft. below land surface Date 6/8/66
Artesian pressure lbs. per square inch Date

(11) 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.
" " " "
" " " "
Bailer test 10 gal./min. with 0 ft. drawdown after 2 hrs.
Artesian flow g.p.m. Date
Temperature of water 52 Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG: Diameter of well below casing 6
Depth drilled 98 ft. Depth of completed well 98 ft.
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
Dirt & Boulders	0	25
Brown Cemented sand	25	65
Black Cemented sand	65	85
Black sand & River Rock	85	98

Work started 6/6 19 66 Completed 6/8 19 66
Date well drilling machine moved off of well 6/8 19 66

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

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
NAME RALPH TURNER
(Person, firm or corporation) (Type or print)
Address Rt Box 141 Hillsboro
Drilling Machine Operator's License No. 311
[Signed] Ralph Turner
(Water Well Contractor)
Contractor's License No. 247 Date 6/8, 19 66

(USE ADDITIONAL SHEETS IF NECESSARY)

DUPLICATE
File Original, and Duplicate with the STATE ENGINEER, SALEM, OREGON

WATER WELL REPORT

STATE OF OREGON

Fill In State Permit No. 2S/1W 13

#24

(1) OWNER:
Name J.E.Reid
Address Rt 1 Bx 290, Tigard, Oregon

(2) LOCATION OF WELL:
County WASH. Owner's number, if any— None
R. F. D. or Street No. Rt 1, Box 290 TIGARD, ORE.
Bearing and distance from section or subdivision corner Approx. 400 East of the SW corner of the NE¼ of NW¼ of Section 13, Township 2 South, Range 1 West

(3) TYPE OF WORK (check):
New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

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

(5) EQUIPMENT:
Rotary ☐
Cable ☒
Dug Well ☐

(6) CASING INSTALLED:
Threaded ☐ Welded ☒

FROM	ft. to	ft.	Diam.	Gage or Wall
0	65		6	.280

If gravel packed

Diameter of Bore	from ft.	to ft.
no		

Type and size of shoe or well ring Steel
Size of gravel:
ribe joint

(7) PERFORATIONS:
Type of perforator used
SIZE of perforations 1 in., length, by 3/16 in.

FROM	ft. to	ft.	perf per foot	No. of rows
32	34		8	1
33	36		8	1

SCREENS:
Give Manufacturer's Name, Model No. and Size
none

(8) CONSTRUCTION:
Was a surface sanitary seal provided? ☒ Yes ☐ No To what depth 22 ft.
Were any strata sealed against pollution? ☒ Yes XXX
If yes, note depth of strata
FROM ft. to Surface Water

METHOD OF SEALING

(9) WATER LEVELS:
Depth at which water was first found 25 ft.
Standing level before perforating XXXX ft.
Standing level after perforating 23 ft.

Log Accepted by:
[Signed] J. E. Reid (Owner) Dated 12/4, 1955

(10) WELL TESTS:
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. draw down after hrs

Artesian flow g.p.m.
Shut-in pressure lbs. per square inch.
Bailer test 18 g.p.m. with Total ft. drawdown
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No
Was electric log made of well? ☐ Yes ☒ No

(11) WELL LOG:
Diameter of well, inches.
Total depth 155 ft. Depth of completed well 100 ft.
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.*

ft. to	ft.	
0	10	Dirt & Clay
10	16	Dirty Gravel
16	28	Brown Silt & Sand
28	34	Gravel--Water
34	39	Coarse Sand & Gravel-Water
39	80	Blue Clay
80	85	Sandy Clay Rotten Wood &
		About 1 G.P.M. but N.G.
85	155	Blue Clay no water.

Ground elevation at well site ?? 200 feet above mean sea level.
Work started Nov 1955 Completed Nov 1955

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 Steinman Bros.
(Person, firm, or corporation) (Typed or printed)
Address 8332, S.E. 16th. Ave. Portland. Ore.
Driller's well number 4355
[Signed] Ed Steinman
(Well Driller)
License No. 1 Dated 12/4, 1955

#4

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM 10, OREGON within 30 days from the date of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

State Well No. 2/1w-13
State Permit No.

(1) OWNER:
Name Hilding A. Pearson
Address 8150 S.W. Peters Rd., Tigard 23, Ore.

(2) LOCATION OF WELL:
County Wash Driller's well number
S.W. ¼ ¼ Section 13 T. 2S R. 1W W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☐
6" Diam. from 0 ft. to 110 ft. Gage 17 lb
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Well seal—Material used in seal Cement
Depth of seal 20 ft. Was a packer used? no
Diameter of well bore to bottom of seal 10 in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 95 ft. below land surface Date
Artesian pressure lbs. per square inch Date

(11) 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.
" " " "
" " " "
Bailer test 15 gal./min. with 3 ft. drawdown after 2 hrs.
Artesian flow g.p.m. Date
Temperature of water 52° Was a chemical analysis made? ☐ Yes ☐ No

(12) WELL LOG: Diameter of well below casing 6"
Depth drilled 117 ft. Depth of completed well 117 ft.

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifiers 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
Boulders	2	25
Sand & Gravel	25	88
Brown Sand	88	100
Gray Sand & Gravel	100	117

Work started Sept 25 1963 Completed Nov 11 1963
Date well drilling machine moved off of well Nov 11 1963

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

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME RALPH TURNER WELL DRILLING
(Person, firm or corporation) (Type or print)
Address R1 BOX 141 HILLSBORO
Drilling Machine Operator's License No. 311
[Signed] Ralph Turner
(Water Well Contractor)
Contractor's License No. 247 Date 19

(USE ADDITIONAL SHEETS IF NECESSARY)

#5

File Original and First Copy with the STATE ENGINEER, SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON

State Well No. 2/1W-13

State Permit No.

OWNER:

Name Mr. Henry F. Hears

Address 2382 NW Pettygrv

Portland Ore.

(2) LOCATION OF WELL:

County Wash. Owner's number, if any—

¼ ¼ Section 13 T. 2S R. 1W W.M.

Bearing and distance from section or subdivision corner

Rockwood Lots Lot 16 SW Peters Rd.

Tualitan

(3) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(5) TYPE OF WELL:

Rotary ☐ Driven ☐ Cable ☒ Jetted ☐ Dug ☐ Bored ☐

~~Star shoe~~

(6) CASING INSTALLED: Threaded ☐ Welded ☒

5/800" Diam. from 0 ft. to 86 ft. Gage 17.02#

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

~~Seald At 16 ft Cemmnt And Bentenite~~

(7) PERFORATIONS: Perforated? ☐ 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.

perforations from ft. to ft.

perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☒ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Was well gravel packed? ☐ Yes ☒ No Size of gravel:

Gravel placed from ft. to ft.

Was a surface seal provided? ☐ Yes ☐ No To what depth? ft.

Material used in seal—

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? Depth of strata

Method of sealing strata off

(10) WATER LEVELS:

Static level 80 ft. below land surface Date

Artesian pressure lbs. per square inch Date

Log Accepted by:

[Signed] Date , 19
(Owner)

(11) 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.

" " " "

" " " "

Bailer test 10 gal./min. with 2 ft. drawdown after 3 hrs.

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

(12) WELL LOG: Diameter of well 6 inches.

Depth drilled 89 ft. Depth of completed well 86 ft.

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
Clay	0	4
Large blue gravel	4	24
Fine gravel and sand	24	31
Blue gravel	31	37
Small gravel and clay	37	44
Med. blue gravel	44	87
blue clay	87	89

Work started Oct. 26 19 62 Completed Nov. 1-62 19

(13) PUMP:

Manufacturer's Name

Type: H.P.

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 MEEKER WELLDRILLING
(Person, firm, or corporation) (Type or print)

Address 2902 Hoover BLVD Newberg ORE.

Driller's well number

[Signed] John H. Meeker
(Well Driller)

License No. 111 Date Nov. 1-62 , 19

(USE ADDITIONAL SHEETS IF NECESSARY)

N.C. #6

File Original and First Copy with the STATE ENGINEER, SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON

State Well No. 2/1w-13
State Permit No.

(1) OWNER:
Name W. Herman Taylor
Address 16515 S.W. Upper Boones Ferry Rd
Tigard, Oregon

(2) LOCATION OF WELL:
County Washington Owner's number, if any—
¼ ¼ Section 13 T. 2 S R. 1 W W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒
6 " Diam. from 0 ft. to 181 ft. Gage .025
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Was a surface seal provided? ☒ Yes ☐ No To what depth? 35 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

(10) WATER LEVELS:
Static level 40 ft. below land surface Date Nov 5-62
Artesian pressure lbs. per square inch Date

Log Accepted by:
[Signed] Date , 19
(Owner)

(11) 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.
" " " "
" " " "
Bailer test 15 gal./min. with 110 ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☒ Yes ☐ No

(12) WELL LOG: Diameter of well 6 inches.
Depth drilled 199 ft. Depth of completed well 199 ft.
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
Brown sand	0	2
Red Clay	2	7
Coarse Gravel	7	33
Clay - medium brown sand	33	55
Clay " sand gray	55	63
Coarse Brown sand	63	72
Gray Clay	72	84
Sand - fine black	84	94
Clay gray	94	95
Blue clay	95	184
Sand - fine black	184	199

Work started July 26 1962 Completed Nov 5 1962

(13) PUMP:
Manufacturer's Name Fairbanks-Morse
Type Submersible H.P. 1/2

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 Skyles Drilling & Supply
(Person, firm, or corporation) (Type or print)
Address Gladstone Oregon
Driller's well number 222
[Signed] George H. Skyles
(Well Driller)
License No. 45 Date Nov 15, 1962

(USE ADDITIONAL SHEETS IF NECESSARY)

#7

File Original and First Copy with the STATE ENGINEER, SALEM OREGON

WATER WELL REPORT
STATE OF OREGON

State Well No. 2/1w-13
State Permit No.

OWNER:
Name John & Katherine Werth
Address c/o Shell Oil Co., 1220 S. W. Morrison, Portland, Ore.

(2) LOCATION OF WELL:
County Washington Owner's number, if any—
¼ ¼ Section T. R. W.M.
Bearing and distance from section or subdivision corner
13 2S 1 W

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒
6 " Diam. from 0 ft. to 95 ft. Gage Std.
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Was a surface seal provided? ☒ Yes ☐ No To what depth? ft.
Material used in seal— Driving casing
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 58½ ft. below land surface Date 4/7/61
Artesian pressure lbs. per square inch Date

Log Accepted by:
[Signed] .... (Owner) Date ...., 19....

(11) 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.
" " " "
" " " "
Bailer test 22 gal./min. with 7 ft. drawdown after 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG: Diameter of well 6 inches.
Depth drilled 96 ft. Depth of completed well 96 ft.

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
Fill	0	1
Topsoil	1	2
Sand, gravel, cobble & boulders	2	80
Quick sand & coarse sand, no water	80	85
Blue clay	85	90
Brown sand & gravel	90	96

Work started 3/27 1961 Completed 4/8 1961

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

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 A. M. JANNSEN DRILLING CO. (Person, firm, or corporation) (Type or print)
Address 21075 S. W. Tualatin Valley Hwy., Aloha, Ore.
Driller's well number -
[Signed] [signature] (Well Driller)
License No. 79 Date 4/18, 1961

(USE ADDITIONAL SHEETS IF NECESSARY)

ORIGINAL
File Original and Duplicate with the STATE ENGINEER, SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON

#21

State Well No.
State Permit No. 2S/1W13B3 (ab)

(1) OWNER:
Name J.C. Phillips 15900 S.W. 76th
Address Tigard, Oregon

(2) LOCATION OF WELL:
County Washington   Owner's number, if any—
NE ¼ NW ¼ Section 13 T. 2S R. 1W W.M.
Bearing and distance from section or subdivision corner
NW of NE WSD

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED:
Threaded ☐ Welded ☒
6" Diam. from 0 ft. to 141'11" ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS:
Well screen installed ☐ Yes ☐ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Was well gravel packed? ☒ Yes ☐ No Size of gravel: ½" minus
Gravel placed from 140 ft. to 146 ft.
Was a surface seal provided? ☒ Yes ☐ No To what depth? 23 ft.
Material used in seal— Drill cuttings
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 14 ft. below land surface Date July 27
Artesian pressure lbs. per square inch Date

Log Accepted by:
[Signed] J. C. Phillips (Owner) Date , 19

(11) 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.
" " " "
" " " "
Bailer test 5 gal./min. with total ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water 57 Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG:
Diameter of well 6 inches.
Depth drilled 146 ft. Depth of completed well 142 ft.

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
Yellow sandy clay	0	16
~~16~~ Cement Gravel	16	23
Heaving sand and fine gravel	23	28
Sand	28	32
Blue and grey sandy clay	32	53
Brown sandy clay	53	60
Blue clay	60	83
Blue mucky clay	83	120
Packed grey sand	120	128
Brown packed sand	128	129
Blue sandy clay	129	137
Brown packed sand	137	138
Blue and grey sandy clay	138	142
Fine gravel—water	142	143
~~143~~ Blue clay	143	146

Work started July 1957 Completed July 1957

(13) PUMP:
Manufacturer's Name Myers
Type: Jet H.P.

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 Steinman Bros. (Person, firm or corporation) (Type or print)
Address 15112 S.E. McLoughlin Milwaukie 22, Oregon
Driller's well number 20-57
[Signed] Bob McConnell (Well Driller)
License No. I Date Aug. 8, 1957.

(USE ADDITIONAL SHEETS IF NECESSARY)

File Original and First Copy with the STATE ENGINEER, SALEM, OREGON

Data from USGS

#18

WATER WELL REPORT
STATE OF OREGON

State Well No. 2/1W-13B(1) (ab)
State Permit No. ......

OWNER:
Name Pilkington Nursery
Address

(2) LOCATION OF WELL:
County WASH Owner's number, if any—
NW ¼ NE ¼ Section 13 T. 2S R. 1W W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
New Well ☐ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☐
......" Diam. from 0 ft. to 640 ft. Gage ......
......" Diam. from ...... ft. to ...... ft. Gage ......
......" Diam. from ...... ft. to ...... ft. Gage ......

(7) PERFORATIONS: Perforated? ☐ 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.
...... perforations from ...... ft. to ...... ft.
...... perforations from ...... ft. to ...... ft.

(8) SCREENS: Well screen installed ☐ Yes ☐ No
Manufacturer's Name ......
Type ...... Model No. ......
Diam. ...... Slot size ...... Set from ...... ft. to ...... ft.
Diam. ...... Slot size ...... Set from ...... ft. to ...... ft.

(9) CONSTRUCTION:
Was well gravel packed? ☐ Yes ☐ No Size of gravel: ......
Gravel placed from ...... ft. to ...... ft.
Was a surface seal provided? ☐ Yes ☐ No To what depth? ...... ft.
Material used in seal—
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? Depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 2 ft. below land surface Date 1929
Artesian pressure lbs. per square inch Date

Log Accepted by:
[Signed] ...... Date ...... 19......
(Owner)

(11) 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.
" " " "
" " " "
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

(12) WELL LOG: Diameter of well ...... inches.
Depth drilled 640 ft. Depth of completed well ft.
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 and boulders	0	50
Black Clay	50	640
Sand seam at 630		
Well abandoned because of high Chloride Content		

Work started 19 Completed 19

(13) PUMP:
Manufacturer's Name None
Type: ...... H.P.

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 ......
(Person, firm, or corporation) (Type or print)
Address ......
Driller's well number ......
[Signed] ......
(Well Driller)
License No. ...... Date ......, 19......

(USE ADDITIONAL SHEETS IF NECESSARY)

ATE ENGINEER
Salem, Oregon

Well Record #18

STATE WELL NO. 2S/1W 13B(1)
COUNTY Washington
APPLICATION NO. (ab)

OWNER: Pilkington Nursery
MAILING ADDRESS:

LOCATION OF WELL: Owner's No.
CITY AND STATE:

¼ ¼ Sec. T. N./S., R. E./W., W.M.

Bearing and distance from section or subdivision corner

Altitude at well 160 ft.

Section

TYPE OF WELL: drilled Date Constructed

Depth drilled 640 ft. Depth cased 640 ft.

CASING RECORD: 8-6 XX inch.

FINISH:

AQUIFERS: Sand from 630 to 632 ft.

WATER LEVEL: 2 ft. below land surface.

PUMPING EQUIPMENT: Type H.P.
Capacity G.P.M.

WELL TESTS:
Drawdown ft. after hours G.P.M.
Drawdown ft. after hours G.P.M.

USE OF WATER Temp. °F. , 19
SOURCE OF INFORMATION USGS
DRILLER or DIGGER
ADDITIONAL DATA:
Log Water Level Measurements Chemical Analysis X Aquifer Test

REMARKS: Penetrated gravel and boulders from 0 to 80 ft., black clay from 80 to 640 ft. with sand seam at 630 ft.; well had small yield; abandoned because of high chloride content; see table 4 for chemical analysis; well No.71 of WSP 890.

STATE ENGINEER
Salem, Oregon

#18

State Well No. 2/1W-13B1 (ab)

County Washington

Application No. ....

Chemical Analysis

OWNER Pilkington Nursery OWNER'S NO. ....

ANALYST unknown Address ....

Date of Collection ....

Point of Collection ....

	P.P.M.	E.P.M.
Silica (SiO_2)	13	
Iron (Fe) Total		
Manganese (Mn)		
Calcium (Ca)		
Magnesium (Mg)		
Sodium (Na)		
Potassium (K)		
Bicarbonate (HCO_3)	120	
Carbonate (CO_3)		
Sulfate (SO_4)		
Chloride (Cl)	350	
Fluoride (F)		
Nitrate (NO_3)		
Boron (B)		
Dissolved Solids	780	
Hardness as $CaCO_3$	240	
Specific Conductance (Micromhos at 25°C)		
pH		
Percent Sodium		
Sodium Absorption Ratio (S.A.R.)		
CLASS		

#26

7 1961

File Original and First Copy with the STATE ENGINEER, SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON

State Well No. 3/1W-13C
State Permit No. (no)

(1) OWNER:
Name D. A. Wilkinson
Address 16500 S. W. 85th Ave.
Tigard, Oregon

(2) LOCATION OF WELL:
County Washington Owner's number, if any—
NE ¼ NW ¼ Section 13 T. 2S R. 1W W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒
6" Diam. from 0 ft. to ~~559~~ 577 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Was a surface seal provided? ☐ Yes ☐ No To what depth? ft.
Material used in seal—
Did any strata contain unusable water? ☒ Yes ☐ No
Type of water? Iron Depth of strata 459 to 461
Method of sealing strata off 6 inch casing

(10) WATER LEVELS:
Static level 20 ft. below land surface Date 11/15/61
Artesian pressure lbs. per square inch Date

Log Accepted by:
[Signed] D. A. Wilkinson (Owner) Date 12-5-1961

(11) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? R. M. Wade
Yield: 20 gal./min. with 330 ft. drawdown after 5 hrs.
" " " "
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 58 Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG: Diameter of well 6 inches.
Depth drilled 613 ft. Depth of completed well 610 ft.
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
Brown silt and sand	0	23
Brown sand	23	53
Blue silt	53	60
Blue clay	60	124
Grey clay	124	229
Brown clay	229	313
Grey clay	313	380
Brown clay	380	414
Blue clay	414	459
Black sand (5 gpm)	459	461
Blue clay	461	493
Brown sandy clay	493	508
Blue clay	508	558
Brown clay	558	565
Grey brittle shale	565	578
Grey clay	578	~~610~~ 600
Brown and green shale sand and gravel (water)	600	610
Brown clay	610	613

Work started 10/12/61 19 Completed 11/15/61 19

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

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 Steinman Bros. (Person, firm, or corporation) (Type or print)
Address 15112 S. E. McLoughlin, Milwaukie, Ore.
Driller's well number 65-61
[Signed] Steinman Bros. (Well Driller)
License No. I Date 12/4/61, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

#26

.TER WELL CONTRACTOR
iginal and first copy
his report are to be filed with the
GINEER, SALEM 10, OREGON
hin 30 days from the date of well completion.

SEP 18 1962

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

State Well No. 2/1W-13C

State Permit No. (ba)

(1) OWNER:

Jerry Wilkinson

dress 16500 S. W. 85th

Tigard, Oregon

(2) LOCATION OF WELL:

County Washington Driller's well number 65-61

NE ¼ NW ¼ Section 13 T. 2S R. 1W W.M.

Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):

w Well ☐ Deepening ☒ Reconditioning ☐ Abandon ☐

bandonment, describe material and procedure in Item 12.

(4) PROPOSED USE (check):

Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒

6" Diam. from 0 ft. to 657'-8" ft. Gage .250

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☐ 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.

perforations from ft. to ft.

perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☒ No

Manufacturer's Name

e Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Well seal—Material used in seal

Depth of seal ft. Was a packer used?

Diameter of well bore to bottom of seal in.

Were any loose strata cemented off? ☐ Yes ☐ No Depth

Was a drive shoe used? ☐ Yes ☐ No

Was well gravel packed? ☐ Yes ☐ No Size of gravel:

Gravel placed from ft. to ft.

any strata contain unusable water? ☐ Yes ☐ No

e of water? Depth of strata

Method of sealing strata off

(10) WATER LEVELS:

Static level 15 ft. below land surface Date 9/5/62

Artesian pressure lbs. per square inch Date

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

Was a pump test made? ☒ Yes ☐ No If yes, by whom? Steinman Br

Yield: 35 gal./min. with 200 ft. drawdown after 8 hrs.

" " " "

" " " "

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

Artesian flow g.p.m. Date

Temperature of water 56 Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG: Diameter of well below casing 6

Depth drilled 770 ft. Depth of completed well 770 ft.

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
Brown clay	613	659
Green conglomerate	659	692
Brown conglomerate (hard and soft)	692	750
Grey broken rock (water)	750	770

Work started 8/14/62 19 Completed 9/5/14 19

Date well drilling machine moved off of well 9/6/62 19

(13) PUMP:

Manufacturer's Name Sumo

Type: S Submersible H.P. 5

Water Well Contractor's Certification:

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

NAME Steinman Bros.
(Person, firm or corporation) (Type or print)

Address 15112 S. E. McLoughlin, Milwaukie Ore.

Drilling Machine Operator's License No. 67

[Signed] Steinman Bros.
(Water Well Contractor)

Contractor's License No. I Date 9/15/62, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

File Original and First Copy with the STATE ENGINEER, SALEM, OREGON

#23

WATER WELL REPORT
STATE OF OREGON

State Well No. 2/1W-13BC
State Permit No. (ba)

(1) OWNER:
Name Melville Eastham
Address 17015 S.W. Upper Boones Ferry Rd.
Tigard Oreg.

(2) LOCATION OF WELL:
County Washington Owner's number, if any—
N. E.¼ N. W.¼ Section 13 T. 2 S. R. 1 W. W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒
6" Diam. from 0 ft. to 166'-11" ft. Gage .280
5" Diam. from 162 ft. to 200 ft. Gage .187
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☒ Yes ☐ No
Type of perforator used Cutting Torch
SIZE of perforations 1/8 in. by 12 in.
40 perforations from 170 ft. to 200 ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Was a surface seal provided? ☐ Yes ☐ No To what depth? ft.
Material used in seal—
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 57 ft. below land surface Date 7/10/59
Artesian pressure lbs. per square inch Date

Log Accepted by:
[Signed] Melville Eastham Date , 19
(Owner)
By Henry V. Means Agt

(11) 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.
" " " "
" " " "
Bailer test 35 gal./min. with 16 ft. drawdown after 2 hrs.
Artesian flow g.p.m. Date
Temperature of water 52 Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG: Diameter of well 6 inches.
Depth drilled 200 ft. Depth of completed well 200 ft.

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	13
Loose Gravel & Boulders	13	27
Dirty Sand	27	31
Sand & Gravel	31	38
Sandy Clay	38	40
Gravel	40	75
Grey Clay	75	85
Brown Sand & Pea Gravel	85	86
Grey Sand	86	90
Brown Sand & Pea Gravel	90	92
Brown Clay	92	97
Grey Clay	97	134
Grey Sand	134	155
Grey Clay	155	171
Grey Sand (water)	171	176
Brown Clay	176	178
Grey Clay	178	187
Brown Clay & Sand	187	191
Grey Sand (Coarse)(water)	191	200

Work started 6/29/59 19 Completed 7/10/59 19

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

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 Steinman Bros.
(Person, firm, or corporation) (Type or print)
Address 15112 S.E.McLoughlin Milwaukie 22, Ore
Driller's well number 2259
[Signed] Steinman Bros
(Well Driller)
License No. 1 Date 8/8/59, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

A2 #20

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM 10, OREGON within 30 days from the date of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

State Well No. 2/1W-13C

State Permit No. (ba)

(1) OWNER:
Name Wallace Dale
Address 13?70 S. W. Upper Boones Ferry Rd. Tigard, Ore.

(2) LOCATION OF WELL:
County Washington Driller's well number 1-63
NE ¼ N ? ¼ Section 13 T.2 S R.1 W W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒
6" Diam. from 0 ft. to 64 ft. Gage .280
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Well seal—Material used in seal drillcuttings & clay
Depth of seal 20 ft. Was a packer used? fine crushed rock
Diameter of well bore to bottom of seal 12 in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 53 ft. below land surface Date 1/26/63
Artesian pressure lbs. per square inch Date

(11) 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.
" " " "
" " " "
Bailer test 20 gal./min. with 1 ft. drawdown after 2 hrs.
Artesian flow g.p.m. Date
Temperature of water 52 Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 70 ft. Depth of completed well 66 ft.

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, top	0	1
Conglomerate, brown clay & boulders	1	20
Gravel, loose dry	20	49
Conglomerate, brown clay & gravel	49	62
Sand & gravel, loose	62	67
Clay, grey	67	70

Work started 1/22/63 19 Completed 1/28/63 19
Date well drilling machine moved off of well 1/28/63 19

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

Water Well Contractor's Certification:

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

NAME Steinman Bros.
(Person, firm or corporation) (Type or print)
Address 15112 S.E. McLoughlin Milwaukie 22, O.

Drilling Machine Operator's License No. 69

[Signed] Steinman Bros
(Water Well Contractor)

Contractor's License No. 1 Date 1/28/63, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

STATE ENGINEER
Salem, Oregon

Well Record #8

(bb)
STATE WELL NO. 2S/1W 13D(1)
COUNTY Washington
APPLICATION NO. 0

OWNER: Durham School
MAILING ADDRESS:

LOCATION OF WELL: Owner's No. ....
CITY AND STATE:

..........¼ ....¼ Sec. .... T. .... N./S., R. .... E./W., W.M.

Bearing and distance from section or subdivision corner ....

Altitude at well 170 ft.

TYPE OF WELL: drilled Date Constructed ....

Depth drilled 150 ft. Depth cased 142 ft.

Section ....

CASING RECORD: 6 inch

FINISH:

AQUIFERS: Gravel from 135 to 148 ft

WATER LEVEL: —

PUMPING EQUIPMENT: Type jet .... H.P. ....
Capacity .... G.P.M.

WELL TESTS:
Drawdown .... ft. after .... hours .... G.P.M.
Drawdown .... ft. after .... hours .... G.P.M.

USE OF WATER public supply Temp. .... °F. ...., 19......
SOURCE OF INFORMATION U.S.G.S.
DRILLER or DIGGER ....
ADDITIONAL DATA:
Log X Water Level Measurements .... Chemical Analysis .... Aquifer Test ....

REMARKS: Reported water-bearing sand from 65 to 135 ft. and clay from 148 to 150 ft.; see table 2 for log.

#8

(bb)

STATE ENGINEER
Salem, Oregon

State Well No. 2S/1W 13D(1)
County Washington
Application No.

Well Log

Owner: Durham School Owner's No.

Driller: Frank Zell Date Drilled 1951

CHARACTER OF MATERIAL	(Feet below land surface) From	To	Thickness (feet)
Valley fill:			
Sand		45	45
Clay		65	20
Sand		135	70
Gravel		148	13
Clay		150	2

ORIGINAL
File Original, and Duplicate with the STATE ENGINEER, SALEM, OREGON

WATER WELL DRILLERS REPORT
STATE OF OREGON

Do Not Fill In — State Well No. #17 2/1W-13 D (bb)
State Permit No. GR-2764 app. GR-2615 cert.

(1) OWNER:
Washington Co. School Dist #82
8040 SW Durham Road
Tigard #23, Orc.

(2) LOCATION OF WELL:
County Washington Owner's number, if any—
R. F. D. or Street No.
Bearing and distance from section or subdivision corner
N 45°E 100' feet to SW corner Lot 4.
Durham Acres, NW¼ NW¼
1000' E & 300' S from NW cor. Sec. 13

(3) TYPE OF WORK (check): Reg. Statement
New well ☐ Deepening ☐ Reconditioning ☐ Abandon ☐
abandonment, describe material and procedure in Item 11.

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

(5) EQUIPMENT:
Rotary ☐
Cable ☑
Dug Well ☐

(6) CASING INSTALLED:
Threaded ☐ Welded ☐

FROM	ft. to	ft.	Diam.	Gage or Wall
0	150		6	

If gravel packed

Diameter of Bore	from ft.	to ft.

Type and size of shoe or well ring
Size of gravel:
Describe joint

(7) PERFORATIONS:
Type of perforator used unk
SIZE of perforations in., length, by in.

FROM	ft. to	ft.	perf per foot	No. of rows
110	147	?		

SCREENS:
Give Manufacturer's Name, Model No. and Size

(8) CONSTRUCTION:
Was a surface sanitary seal provided? ☐ Yes ☐ No To what depth ft.
Were any strata sealed against pollution? ☐ Yes ☐ No
If yes, note depth of strata
FROM ft. to ft.
METHOD OF SEALING

(9) WATER LEVELS:
…th at which water was first found ft.
…ding level before perforating ft.
…ding level after perforating ft.

Log Accepted by:
[Signed] .... Dated ...., 19......
Owner

(10) WELL TESTS:
Was a pump test made? ☐ Yes ☐ No If yes, by whom?
Yield: 17 gal./min. with ft. draw down after hrs.
Artesian flow .... g.p.m.
Shut-in pressure .... lbs. per square inch.
~~Boiler~~ test .... g.p.m. with .... ft. drawdown
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No
Was electric log made of well? ☐ Yes ☐ No

(11) WELL LOG:
Diameter of well, 6 inches.
Total depth 200 ft. Depth of completed well 150 ft.

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.*

ft. to	ft.	
0	8	Brown Silt
8	64	" Sand
64	74	Clay blue, very sticky
74	95	Silt, brown & blue
95	105	Clay, blue sticky
105	120	Silt, brown & blue
120	125	Silt, brown
135	140	Silt, blue - sand & water bearing - Mica.
140	150	Shale, blue
150	200	Shale, blue, clay, sandy layers

Ground elevation at well site .... feet above mean sea level.
Work started July 1951. Completed Aug 1951

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 unk.
(Person, firm, or corporation) (Typed or printed)
Address
Driller's well number
[Signed] ....
(Well Driller)
License No. .... Dated ...., 19......

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED AUG 6 1969 STATE ENGINEER SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

#22

State Well No. 2/1W-13Cc E

State Permit No.

OWNER:
Name William C. Winthers
Address 16775 S. W. Upper Boones Ferry
Tigard, Or. 97223

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

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

CASING INSTALLED: Threaded ☐ Welded ☒
6 " Diam. from 0 ft. to 183 ft. Gage 0.250
5-9/16 O.D. Liner 181 ft. to 191 ft. Gage 10
" Diam. from ft. to ft. Gage

(6) PERFORATIONS: Perforated? ☒ Yes ☐ No.
Type of perforator used Torch
Size of perforations 1/8 in. by 12 in.
18 perforations from 182 ft. to 190 ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WATER LEVEL: Completed well.
Static level 75 ft. below land surface Date 7-29-69
Artesian pressure lbs. per square inch Date

(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.
" " "
" " "
Bailer test 20 gal./min. with 90 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water 54° Was a chemical analysis made? ☐ Yes ☒ No

(10) CONSTRUCTION:
Well seal—Material used Bentonite
Depth of seal 0000 34 ft.
Diameter of well bore to bottom of seal 10 in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(11) LOCATION OF WELL:
County Washington Driller's well number 44-69
SW ¼ NW ¼ Section 13 T. 2S R. 1W W.M.
Bearing and distance from section or subdivision corner

(12) WELL LOG: Diameter of well below casing ---
Depth drilled 191 ft. Depth of completed well 191 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level as drilling proceeds. Note drilling rates.

MATERIAL	From	To	SWL
Clay, sandy, brown	0	3	
Cemented gravel	3	56	
Clay, brown	56	61	
Sand, grey	61	89	
Sand, brown	89	98	
Clay, grey	98	127	
Clay, blue	127	136	
Clay, grey	136	165	
Sand, grey	165	169	
Clay, grey	169	181	
Sand, grey, coarse	181	187	75
Clay, grey	187	191	

Work started July 16 1969 Completed July 29 1969
Date well drilling machine moved off of well July 31 1969

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Robert E. McConnell (Drilling Machine Operator) Date Aug. 5, 1969
Drilling Machine Operator's License No. 398

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
NAME Steinman Bros.
(Person, firm or corporation) (Type or print)
Address 15112 S.E.McLoughlin, Milwaukie, Or. 97222
[Signed] Robert E. McConnell (Water Well Contractor)
Contractor's License No. I Date Aug. 5, 1969

(USE ADDITIONAL SHEETS IF NECESSARY)

N & #10

Original and First Copy with the STATE ENGINEER, SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON

State Well No. 2/1W-13G (wc)

State Permit No.

OWNER:

Name Mr. E. D. Huebotter

Address 16870 Boones Ferry Rd
Tigard, Oregon

(2) LOCATION OF WELL:

County WASH Owner's number, if any—

¼ ¼ Section 13 T. R. 1 W.M.

Bearing and distance from section or subdivision corner

Tract 25 Lots 1-2-3

(3) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☒ Industrial ☐ Municipal ☐

Irrigation ☐ Test Well ☐ Other ☐

(5) TYPE OF WELL:

Rotary ☐ Driven ☐

Cable ☒ Jetted ☐

Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒

Star shoe

6 t/300 " Diam. from 0 ft. to 80'-3" ft. Gage 17.02#

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☐ 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.

perforations from ft. to ft.

perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☒ No

Manufacturer's Name

Type Model No.

Diam Slot size Set from ft. to ft.

Diam Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Was well gravel packed? ☐ Yes ☒ No Size of gravel:

Gravel placed from ft. to ft.

Was a surface seal provided? ☐ Yes ☐ No To what depth? ft.

Material used in seal—

Did any strata contain unusable water? ☐ Yes ☐ No

Type of water? Depth of strata

Method of sealing strata off

(10) WATER LEVELS:

Static level 66 ft. below land surface Date Jan 16-61

Artesian pressure lbs. per square inch Date

Log Accepted by:

[Signed] Edwin R Huebotter (Owner) Date 1-20-61, 19

(11) 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.

" " " "

" " " "

Bailer test 18 gal./min. with 5 ft. drawdown after 1 hrs.

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

(12) WELL LOG: Diameter of well 6 inches

Depth drilled 80 ft. Depth of completed well 80 ft.

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
Clay	0	4
Small boulders	4	5
Graveland clay	5	11
small boulders and gravel	11	14
clay and gravel	14	17
small boulders and gravel	17	19
Clay and gravel	19	27
gravel	27	34
gravel	34	39
clay and gravel	45	51
gravel and some clay	51	62
clay and small gravel	62	65
heavy free gravel	68	80

Work started Jan 5 19 61 Completed Jan 16 19 61

(13) PUMP:

Manufacturer's Name 1/2 HP Jacuzzi

Type: H.P.

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 MEEKER WELL DRILLING (Person, firm, or corporation) (Type or print)

Address 2902 Hoover Blvd., Newberg, Oregon

Driller's well number

[Signed] [signature] Meeker (Well Driller)

License No. 111 Date Jan 16, 19 61

(USE ADDITIONAL SHEETS IF NECESSARY)

MAY 29 1961
STATE ENGINEER
SALEM, OREGON

N 4 # 10

e Original and
st Copy with the
ATE ENGINEER,
LEM, OREGON

WATER WELL REPORT
STATE OF OREGON

State Well No. 2/1W-13G(c)

State Permit No.

OWNER:
Name Mr. E.D. Huebotter
Address 16870 Boones Ferry Rd.
Tigard Ore.

(2) LOCATION OF WELL:
County Wash Owner's number, if any—
¼ ¼ Section T. R. W.M.
Bearing and distance from section or subdivision corner
SSee other Log

(3) TYPE OF WORK (check):
New Well ☐ Deepening ☒ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒
6 5/8 OD Diam. from 80 ft. to 146-4 ft. Gage 17.02#
24 ft. of 5½ od Diam. from 24ft ft. to ft. Gage
" Diam. from 146 ft. to 165 ft. Gage

(7) PERFORATIONS: Perforated? ☒ Yes ☐ No
Type of perforator used
SIZE of perforations in. by in.
5½ perforations from 146 ft. to 165 ft.
4 Rows perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Was a surface seal provided? ☐ Yes ☐ No To what depth? ft.
Material used in seal—
Did any strata contain unusable water? ☒ Yes ☐ No
Type of water? Brown Depth of strata 65-90
Method of sealing strata off Drove caseing past it

(10) WATER LEVELS:
Static level 70 ft. below land surface Date
Artesian pressure lbs. per square inch Date

Log Accepted by:
[Signed] Katherine Huebotter (Owner) Date , 19

(11) 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.
" " " "
" " at bottom " "
Bailer test 15 gal./min. with ft. drawdown after ½ hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

(12) WELL LOG: Diameter of well 6 inches.
Depth drilled 85 ft. Depth of completed well 165 ft.

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	80	89
blue clay	89	96
Brown clay	96	114
Blue silt With a little sand	114	125
Blue sand silt	125	155
" " " "	11 155	165
Blue clay	165	
Water was hard to clear		

Work started # 3/7/61 19 Completed 3/20/61 19

(13) PUMP:
Manufacturer's Name Jacuzzi
Type: 2 Stage Jet H.P. 1

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 MEEKER WELL DRILLING (Person, firm, or corporation) (Type or print)
Address 2902 Hoover Blvd. Newberg Ore.
Driller's well number
[Signed] John H. Meeker (Well Driller)
License No. 111 Date 3/20/61, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

OBSERVATION WELL #11

STATE ENGINEER
Salem, Oregon

Well Record

STATE WELL NO. 2/1W-13K(2)
COUNTY Washington
APPLICATION NO. ....

OWNER: Truck Parts Distributors (Old Elliott)
MAILING ADDRESS: Tualatin

LOCATION OF WELL: Owner's No. ....
CITY AND STATE: ....

NW ¼ SE ¼ Sec. 13 T. 2 ~~N.~~ S., R. 1 ~~E.~~ W., W.M.

Bearing and distance from section or subdivision corner ....

Altitude at well ....

Section 13

TYPE OF WELL: Dug Date Constructed ....

Depth drilled 92' Depth cased 92'

CASING RECORD:
36 inch

FINISH:

AQUIFERS:
Gravel

WATER LEVEL:
81.08 (3-30-62)

PUMPING EQUIPMENT: Type .... H.P. ....
Capacity .... G.P.M.

WELL TESTS:
Drawdown .... ft. after .... hours .... G.P.M.
Drawdown .... ft. after .... hours .... G.P.M.

USE OF WATER Domestic Temp. .... °F. ...., 19......
SOURCE OF INFORMATION Field Insp.
DRILLER or DIGGER ....
ADDITIONAL DATA:
Log NA Water Level Measurements ✓ Chemical Analysis .... Aquifer Test ....

REMARKS:

State Printing 80316

This well may have been abandon / see D-12

O #12 (Cd)

File Original and First Copy with the STATE ENGINEER, SALEM, OREGON

Copy from GR 2259

WATER WELL REPORT
STATE OF OREGON

State Well No. 2/1W-13L(1)

State Permit No. GR 2156

(1) OWNER:

Name Melville Eastham

Address 17015 SW. Upper Boone Ferry Rd Tigard

(2) LOCATION OF WELL: Henry Meyers, Agt.

County Wash Owner's number, if any—

NE ¼ SW ¼ Section 13 T. 2 S R. 1 W W.M.

Bearing and distance from section or subdivision corner

N 49° 40' E - 3476 feet to the Center of Section 13

(3) TYPE OF WORK (check):

New Well ☐ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐

Irrigation ☒ Test Well ☐ Other ☐

(5) TYPE OF WELL:

Rotary ☐ Driven ☐

Cable ☐ Jetted ☐

Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☐

6" Diam. from 0 ft. to 120 ft. Gage

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☒ Yes ☐ No

Type of perforator used Unknown

SIZE of perforations in. by in.

perforations from 32 ft. to 104 ft.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes ☐ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Was well gravel packed? ☐ Yes ☐ No Size of gravel:

Gravel placed from ft. to ft.

Was a surface seal provided? ☐ Yes ☐ No To what depth? ft.

Material used in seal—

Did any strata contain unusable water? ☐ Yes ☐ No

Type of water? Depth of strata

Method of sealing strata off

(10) WATER LEVELS:

Static level 60 ft. below land surface Date June 1941

Artesian pressure lbs. per square inch Date

Log Accepted by:

[Signed] Date 19
(Owner)

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

Was a pump test made? ☐ Yes ☐ No If yes, by whom?

Yield: 250 gal./min. with 6 ft. drawdown after hrs.

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

(12) WELL LOG: Diameter of well 7 inches.

Depth drilled 120 ft. Depth of completed well 120 ft.

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	5
Boulders & Clay	5	20
Loose gravel, sand and clay	20	36
Gravel, clay and boulders	36	80
Loose gravel	80	105
Gravel and clay	105	120

Work started 19 Completed 1941

(13) PUMP:

Manufacturer's Name Pomona

Type: H.P. 3

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 Steinman Bros
(Person, firm, or corporation) (Type or print)

Address

Driller's well number

[Signed]
(Well Driller)

License No. Date 19

(USE ADDITIONAL SHEETS IF NECESSARY)

STATE ENGINEER
Salem, Oregon

Well Record

O + #13

STATE WELL NO. 2/1W-13L (Ca)
COUNTY WASHINGTON
APPLICATION NO. GR 2259, GR 215

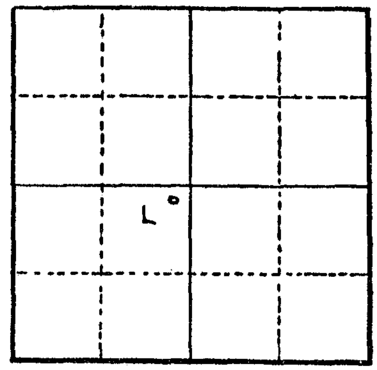
OWNER: Henry S. Mears
MAILING ADDRESS: 17015 SW Upper Boone Ferry R

LOCATION OF WELL: Owner's No. ....
CITY AND STATE: Tigard

NE ¼ SW ¼ Sec. 13 T. 2 ~~N.~~ S., R. 1 ~~E.~~ W., W.M.

Bearing and distance from section or subdivision corner N49° 40' E. 347.6' to the Center of Section 13 from the well

Altitude at well ....



Section 13

TYPE OF WELL: Drilled Date Constructed 1941
Depth drilled 120 Depth cased 120

CASING RECORD:

8-inch

FINISH:

Casing perforated

AQUIFERS:

Loose gravel from 80 to 105 feet.

WATER LEVEL:

80 feet below land surface.

PUMPING EQUIPMENT: Type Pomona H.P. 3
Capacity 30 G.P.M.

WELL TESTS:
Drawdown 6 ft. after .... hours Pumping 250 G.P.M.
Drawdown .... ft. after .... hours .... G.P.M.

USE OF WATER Irrigation Temp. .... °F. ...., 19......
SOURCE OF INFORMATION GR 2259
DRILLER or DIGGER Steinman Bros.
ADDITIONAL DATA:
Log ✓ Water Level Measurements .... Chemical Analysis .... Aquifer Test ....

REMARKS:

O & #13

STATE ENGINEER
Salem, Oregon

State Well No. 2/1W-13L (5a)
County WASHINGTON
Application No. GR 2259, GR 2156

Well Log

Owner: Henry S. Mears Owner's No.

Driller: Steinman Bros. Date Drilled 1941

CHARACTER OF MATERIAL	(Feet below land surface) From	To	Thickness (feet)
Soil	0	5	5
Boulders and clay	5	20	15
Loose cemented gravel, sand & clay	20	36	16
Gravel, clay and boulders	36	80	44
Loose gravel	80	105	25
Gravel and clay	105	120	15

RECEIVED
SEP 24 1959
STATE ENGINEER
SALEM, OREGON

#15

File Original and First Copy with the STATE ENGINEER, SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON

State Well No. 2/1W-13F

State Permit No.

OWNER:
Name R.E. HANSEN
Address TUALATIN, ORE.

(2) LOCATION OF WELL:
County WASHINGTON Owner's number, if any—
¼ ¼ Section T. R. W.M.
Bearing and distance from section or subdivision corner
1 BLOCK WEST OF HWY 217 ON S.W. PETERS ROAD - ON NORTH SIDE OF ROAD - 75 FT FROM STREET 20 FT FROM WEST PROPERTY LINE

(3) TYPE OF WORK (check):
New Well [X] Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):
Domestic [X] Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable [X] Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded [X]
6" Diam. from 0 ft. to 89 ft. Gage
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☐ Yes [X] 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.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed ☐ Yes [X] No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Was well gravel packed? ☐ Yes [X] No Size of gravel:
Gravel placed from ft. to ft.
Was a surface seal provided? ☐ Yes ☐ No To what depth? ft.
Material used in seal—
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? Depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 75 ft. below land surface Date 5/2/59
Artesian pressure lbs. per square inch Date

Log Accepted by:
[Signed] Date , 19
(Owner)

(11) 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.
" " " "
" " " "
Bailer test 8 gal./min. with 0 ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

(12) WELL LOG: Diameter of well inches
Depth drilled ft. Depth of completed well ft.
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	5
BOULDERS + GRAVEL	5	88
SAND	88	90
WATER	88	89

Work started 4/28 1959 Completed 5/2 1959

(13) PUMP:
Manufacturer's Name DORWARD PUMP CO.
Type: JET H.P. 3/4

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 PAUL E. ROSS
(Person, firm, or corporation) (Type or print)
Address 2040 SW 122 ALOHA ORE
Driller's well number
[Signed] Paul E Ross
(Well Driller)
License No. 94 Date 5/2, 1959

(USE ADDITIONAL SHEETS IF NECESSARY)

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON
within 30 days from the date of well completion.

RECEIVED
MAR 3 1970
STATE ENGINEER
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

#P

State Well No. 2/1W-13cd P

State Permit No.

(1) OWNER:
Name Wm. J. Nerris
Address 8280 SW Peters Rd Tigard Ore.

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☒
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

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

(5) CASING INSTALLED:
Threaded ☐ Welded ☐
" Diam. from ft. to ft. Gage
" Diam. from ABANDON ft. Gage
" Diam. from ft. to None ft. Gage

(6) PERFORATIONS:
Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WATER LEVEL: Completed well.
Static level ft. below land surface Date
Artesian pressure lbs. per square inch Date

(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.
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) CONSTRUCTION:
Well seal—Material used ABandon
Depth of seal ft.
Diameter of well bore to bottom of seal in.
Were any loose strata cemented off? ☐ Yes ☐ No Depth
Was a drive shoe used? ☐ Yes ☐ No
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☐ No Size of gravel:
Gravel placed from ft. to ft.

(11) LOCATION OF WELL:
County Wash Driller's well number 160
SE ¼ SW ¼ Section 13 T. 2S R. 1W W.M.
Bearing and distance from section or subdivision corner

(12) WELL LOG:
Diameter of well below casing 0
Depth drilled 35 ft. Depth of completed well 0 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level as drilling proceeds. Note drilling rates.

MATERIAL	From	To	SWL
Brown soil	0	3	
Brown clay & CoBBles	3	28	
Medium Gray Gravel	28	35	
Casing Pulled			
Hole Filled			
with Cement Grout			

Work started 2-19 1970 Completed 2-20 1970
Date well drilling machine moved off of well 2-20 1970

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Raymond A. Borders (Drilling Machine Operator) Date 2-20, 1970
Drilling Machine Operator's License No. 305

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
NAME B&S Drilling Co. (Person, firm or corporation) (Type or print)
Address Rt 3, Box 271A Sherwood
[Signed] Raymond A. Borders (Water Well Contractor)
Contractor's License No. 404 Date 2-20, 1970

(USE ADDITIONAL SHEETS IF NECESSARY)

STATE ENGINEER
Salem, Oregon

Well Record #16

STATE WELL NO. 2/1W-13[illegible]
COUNTY Washington
~~APPLICATION NO.~~ GR-3010

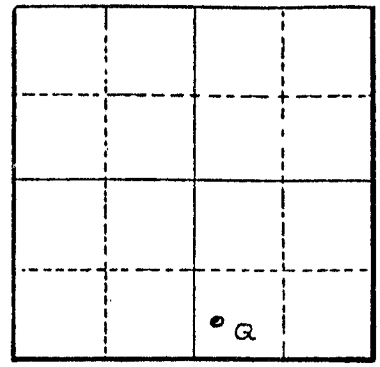
OWNER: Ben Brehm
MAILING ADDRESS: 13069 Lower Boones Ferrey Rd
CITY AND STATE: Washington

LOCATION OF WELL: Owner's No. ......

SW ¼ SE ¼ Sec. 13 T. 2 S., R. 1 W., W.M.

Bearing and distance from section or subdivision corner 2230' S & 400' E from cor of sec 13

Altitude at well ......



Section 13

TYPE OF WELL: Drilled Date Constructed 1948

Depth drilled 91' Depth cased 91'

CASING RECORD:
6-inch

FINISH:

AQUIFERS:

WATER LEVEL:
56'

PUMPING EQUIPMENT: Type Montgomery Ward - Jet H.P. 1
Capacity 12? G.P.M.

WELL TESTS:
Drawdown 5 ft. after ...... hours 15 1/3 G.P.M.
Drawdown ...... ft. after ...... hours ...... G.P.M.

USE OF WATER Irrigation Temp. ...... °F. ......, 19......
SOURCE OF INFORMATION GR-3945
DRILLER or DIGGER Sam Munson
ADDITIONAL DATA:
Log NA Water Level Measurements ...... Chemical Analysis ...... Aquifer Test ......

REMARKS:

State Printing 80316

#25

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
TE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

State Well No. 2/1W-13R
State Permit No.

OWNER:
Name J. C. Pilkington
Address 16515 S. W. Upper Boones Ferry Rd.
Tigard, Oregon.

(2) LOCATION OF WELL:
County Washington Driller's well number 11-62
SE ¼ SE ¼ Section 13 T. 2S R. 1W W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

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

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED: Threaded ☐ Welded ☒
6" Diam. from 0 ft. to 62 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☐ 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.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Well seal—Material used in seal Bentonite
Depth of seal 31 ft. Was a packer used? fine crushed rock
Diameter of well bore to bottom of seal 10 in.
Were any loose strata cemented off? ☐ Yes ☒ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 50 ft. below land surface Date 4/13/64
Artesian pressure lbs. per square inch Date

(11) 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.
" " " "
" " " "
Bailer test 30 gal./min. with no ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water 52 Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG: Diameter of well below casing 6"
Depth drilled 85 ft. Depth of completed well 64 ft.
Formation: *Describe by color, character, size of material and structure, and show thickness of aquifiers 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
Yellow sandy clay	0	5
Cement gravel and boulders	5	31
Cement gravel	31	56
Loosely cemented gravel(water)	56	61
Blue silty clay	61	80
Brown sandy clay	80	85

Work started Apr. 6 1964 Completed Apr. 13 1964
Date well drilling machine moved off of well Apr. 14 1964

(13) PUMP:
Manufacturer's Name Myer
Type: Submersible H.P. ½

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Steinman Bros.
(Person, firm or corporation) (Type or print)
Address 15112 S.E.McLoughlin, Milwaukie, Ore. 97222
Drilling Machine Operator's License No. 68
[Signed] Steinman Bros.
(Water Well Contractor)
Contractor's License No. 1 Date Apr. 13, 1964

(USE ADDITIONAL SHEETS IF NECESSARY)

APPENDIX D

WATER QUALITY DATA

CH2M HILL

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

UNIFIED SEWERAGE AGENCY

CH2M HILL
WATER QUALITY DATA
NEAR
DURHAM, OREGON

CH2M HILL
engineers
planners
economists
scientists

Environmental Laboratory

Date: 20 September 1979

Project No.: P12946.B0

Subject: Analysis of water samples for MSD--Durham Landfill. The samples were received 5 September 1979 and assigned reference numbers 7476-7483.

Parameter	Boring #2		Boring #4		Fanno Creek at Tualatin River		Tualatin R. at Boones Ferry Road Bridge	
as mg/l	B-2-A	B-2-B	B-4-A	B-4-B	FC-A	FC-B	TR-A	TR-B
Calcium, Ca	15.7	17.9	1.87	1.88	15.0	15.0	10.9	10.9
Magnesium, Mg	5.55	6.20	0.79	0.76	5.55	5.55	3.82	3.90
Potassium, K	2.60	2.85	0.87	0.47	2.77	2.79	2.11	2.15
Sodium, Na	6.10	6.85	3.28	3.07	7.84	7.83	10.90	11.40
Alkalinity, as $CaCO_3$								
Carbonate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	45.2	45.2	10.7	10.7	47.2	46.6	40.6	40.2
Chloride, Cl	2.85	1.55	2.95	2.33	10.4	10.4	9.69	9.84
Nitrate, N	0.03	0.04	0.02	0.03	0.91	0.91	2.56	3.55
Phosphate, P	0.11	0.17	0.10	0.05	0.17	0.17	0.11	0.14
Sulfate, SO_4	5.5	9.8	6.8	7.5	17.0	19.1	14.8	14.8
Hardness, $CaCO_3$	63.7	73.5	9.21	9.21	57.4	57.8	43.7	44.5
pH	5.60	5.58	5.38	5.95	6.15	6.20	6.20	6.12
Conductivity, µmhos/cm	118	129	32	28	132	132	121	122
Turbidity, NTU	90	115	33	12	47	47	8.3	7.5
Color	180	280	7.5	7.5	140	140	50	50
Odor	None	Detected	None	Detected	None	Detected	None	Detected
Total Dissolved Solids	144	168	42	39	148	147	119	129

Corvallis Office
1600 S.W. Western Blvd. P.O. Box 428 Corvallis, Oregon 97330 503/752-4271 Cable CH2M CVO

Date: 20 September 1979

Parameter as mg/l	Boring #2 B-2-A	Boring #2 B-2-B	Boring #4 B-4-A	Boring #4 B-4-B	Fanno Creek at Tualatin River FC-A	Fanno Creek at Tualatin River FC-B	Tualatin R. at Boones Ferry Road Bridge TR-A	Tualatin R. at Boones Ferry Road Bridge TR-B
Arsenic, As	0.003	0.004	<0.001	<0.001	0.003	0.002	0.001	0.001
Barium, Ba	0.16	0.17	0.09	0.06	0.11	0.10	0.05	0.08
Boron, B	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Cadmium, Cd	<0.010	0.016	0.016	<0.010	0.033	0.020	<0.010	<0.010
Chromium, Total Cr	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper, Cu	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cyanide, CN	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoride, F	0.19	0.20	0.09	0.09	0.16	0.16	0.19	0.19
Iron, Fe	3.72	7.55	0.22	0.48	2.93	2.38	0.30	0.72
Lead, Pb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Manganese, Mn	1.12	1.28	0.11	0.11	0.29	0.28	0.14	0.23
Mercury, Hg	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Selenium, Se	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver, Ag	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc, Zn	0.20	0.20	0.96	0.94	0.070	0.061	0.022	0.035

< Indicates "less than."

All tests are performed in accordance with current Environmental Protection Agency guidelines as published in the Federal Register.

The information shown on this sheet is test data only and no analysis or interpretation is intended or implied.

Samples will be retained 30 days unless otherwise requested.

Reported by: Mary E Player

Mary E. Player

dmk

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

SURFACE WATER QUALITY

AND

SEWAGE TREATMENT PLANT EFFLUENT QUALITY

NEAR

DURHAM, OREGON

SUMMARY OF OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
SURFACE WATER QUALITY DATA NEAR
DURHAM, OREGON

STATION	DATE	pH	COLOR	TURB	TOTAL SOLIDS	SUSP SOLIDS	ALK	HARD	SO_4	NH_3-N	NO_3-N	PO_4	CL	TEMP.	D.O.	% O_2 SAT.	BOD	MPN/100 ml TOTAL	MPN/100 ml FECAL
Fanno	3-31-69									6.74	1.4	8.90		12.5	7.1	66	6.1	2300	
Creek	7-8-69									41.2	0.10	13.2		19.0	3.1	33	10.8	600	
at Durham	8-12-69	7.4	2.5	10	286	24	156	90.5	14.1	12.5	0.16	23.8	45.0	19.0	0.9/ 2.9		17.4/ 20.4	6200	450
	9-16-69									4.20	0.56			14.0	0.7	16	<66	70000	
	11-10-69													12.0	3.4	31	3.2	600	
	4-20-76	6.5												12.0	1.8		4.6	7000	620
Fanno Creek at Hwy. 217	8-12-69	6.9												2.0	1.6/ 2.9		9.4/ 19.8	<450	<450
Tualatin	3-31-69										0.68	0.33		9.5	10.3	89	1.25	6200	
River	7-8-69										0.50	0.62		20.5	9.2	102	4.6	450	
Hwy. 212	8-28-69													20.0	8.4	91	4.1		
Bridge	9-16-69													16.5	4.7	48	4.5	1300	
	11-10-69										0.90	0.43		10.0	8.3	75	1.25	2400	
	4-20-76	6.7												11.0	7.7		2.7	2400	620
Tualatin River at Hwy. 217 Bridge	4-20-76	6.6												11.0	6.8		3.0	2100	230
Tualatin	3-31-69									0.41				10.0	9.7	86	1.4	24,000	
River at	7-8-69									0.53				20.0	7.5	82	3.8	2300	
Boones Ferry	9-16-69													16.5	4.7	48	4.5	1300	
Rd.	11-10-69									0.43				10.0	7.8	70	1.4	600	

SUMMARY OF OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
SEWAGE TREATMENT PLANT EFFLUENT QUALITY NEAR
DURHAM, OREGON

STATION	DATE	FLOW MGD	COLOR	TURB	TOTAL SOLIDS	SUSP SOLIDS	ALK	HARD	pH	NH_3-N	NO_3-N	PO_4	CL	TEMP.	D.O.	% O_2 SAT.	BOD	MPN/100 ml TOTAL	MPN/100 ml FECAL
Fanno Creek STP	7-22-69		6	4.5			2.0												
	8-12-69												1.4					2300	<450
	8-6-70	2.0				10										17			
	5-15-72	3.5											1.3	16				2400	< 45
	5-13-74																	2600	< 10
	9-10-74																	<100	<100
	3-2-76			135/2.									2.4					1600	< 10
	4-9-76			102/2									1.0					<100	< 10
	6-8-76			98/2.5									2.0					600	< 10
Tualatin STP	5-15-72	0.47											1.0					1300	1300
	5-13-74																	<100	<100
	9-10-74																	5000	<100
	1-6-76			27/0									2.0					110	<2
	2-5-76			81/0.5									1.5					< 10	<2
	4-7-76			388/1									2.5					<100	<10
	6-8-76			290/2.5									0					$6x10^6$	$6x10^5$
	7-7-76			77/2.5									3.0					$4x10^5$	23,000
	8-3-76			36/2									7.5					<100	< 10
Ramada Inn STP	11-22-66	0.009				38			6.2				1.5	3.9		12			
	5-15-72	0.02											0					>7000	<7000
	5-13-74																	<1000	<1000
	9-10-74																	18,000	<100
	1-6-76			172/2.5									2.0					110	< 10
	2-5-76			86/2.5									1.5					<100	< 10
	3-1-76			53/3									2.0					2700	160
	4-7-76			06/3									3.0					<100	< 10
	5-5-76			102/3									0.1					27,000	1800
	6-8-76			110/3+									0					730,000	52,000
	7-7-76			126/3									3.0					2500	< 10
	8-3-76			298/3									0					110,000	1500
	10-5-76			54/3+									0					200,000	280,000
Durham STP	7-7-76			290/1.5									3.5					<100	< 10
	8-3-76			130/2									2.0					<100	< 10
	10-5-76			75/1.5									3.5					<100	< 10
Peerless Truck STP	5-15-72	0.015											<0.1					$7x10^5$	$7x10^5$

UNIFIED SEWERAGE AGENCY

WATER QUALITY DATA

NEAR

DURHAM, OREGON

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN79 TO 20JUL79
TUALATIN R-ELSNER RD BR

20-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	3	0	7.00	18.00	13.33	5.69
76	TURB	NTU	3	0	8.00	180.00	66.67	98.17
95	COND-LAB	UMHO	3	0	82.00	195.00	126.33	60.30
299	DO	MG/L	3	0	5.90	11.00	8.30	2.56
310	BOD(5)	MG/L	3	0	0.85	1.38	1.14	0.27
340	T-COD	MG/L	1	0	6.00	6.00	6.00	0.00
403	PH-GRAB	PH	3	0	7.07	7.25	7.15	0.09
410	OH-CACO3	MG/L	1	0	47.00	47.00	47.00	0.00
440	HCO3-ION	MG/L	1	0	60.38	60.38	60.38	0.00
500	TR	MG/L	3	0	98.00	127.00	114.33	14.84
515	TFR(TDS)	MG/L	3	0	83.00	109.00	99.00	14.00
530	TNFR(SS)	MG/L	3	0	9.40	21.80	15.20	6.24
610	NH3-N	MG/L	3	0	0.22	0.38	0.32	0.09
625	TKN-N	MG/L	3	0	1.02	1.35	1.13	0.19
630	NO2NO3-N	MG/L	3	0	0.86	2.24	1.39	0.75
665	TPO4-P	MG/L	3	0	0.16	0.23	0.20	0.04
680	TOC	MG/L	1	0	3.50	3.50	3.50	0.00
720	TCYANIDE	MG/L	1	1	0.00	0.00	0.00	0.00
745	T-S COMP	MG/L	1	0	0.35	0.35	0.35	0.00
940	CHLORIDE	MG/L	1	0	6.75	6.75	6.75	0.00
951	T-F(-)	MG/L	3	1	0.12	0.55	0.34	0.30
1002	T-AS	MG/L	3	0	0.00	0.00	0.00	0.00
1007	T-BA	MG/L	1	1	0.00	0.00	0.00	0.00
1022	T-B	MG/L	3	0	0.12	0.14	0.13	0.01

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN79 TO 20JUL79
TUALATIN R-ELSNER RD BR

PARAMETER	UNITS	NUM	ZEROS	RANGE MIN	MAX	MEAN	STANDARD DEVIATION
1027 T-CD	MG/L	3	2	0.00	0.00	0.00	0.00
1034 T-CR	MG/L	1	1	0.00	0.00	0.00	0.00
1042 T-CU	MG/L	3	0	0.01	0.03	0.02	0.01
1045 T-FE	MG/L	1	0	0.87	0.87	0.87	0.00
1051 T-PB	MG/L	3	2	0.02	0.02	0.02	0.00
1055 T-MN	MG/L	3	0	0.07	0.17	0.11	0.06
1067 T-NI	MG/L	1	1	0.00	0.00	0.00	0.00
1092 T-ZN	MG/L	3	0	0.01	0.01	0.01	0.00
31400 ATP	UG/L	3	0	0.11	0.60	0.28	0.28
31503 TOT-COLI	/100	3	0	75.00	200.00	131.67	63.31
31616 FEC-COLI	/100	3	0	30.00	220.00	94.00	109.12
32230 CHLPYL A	UG/L	3	0	2.14	15.60	7.15	7.36
32231 CHLPHL B	UG/L	3	0	0.70	2.45	1.29	1.00
32232 CHLPYL C	UG/L	3	0	0.89	2.06	1.37	0.61
32234 T-CHLPYL	UG/L	3	0	3.73	20.10	9.81	8.96
71900 T-HG	UG/L	3	3	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN79 TO 20JUL79
TUALATIN R-TUALATIN PARK

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	3	0	5.50	18.00	12.67	6.45
76	TURB	NTU	3	0	8.60	220.00	80.20	121.08
95	COND-LAB	UMHO	3	0	90.00	195.00	131.67	55.75
299	DO	MG/L	3	0	8.30	11.20	9.33	1.62
310	BOD(5)	MG/L	3	0	1.00	4.00	2.10	1.65
340	T-COD	MG/L	1	0	17.00	17.00	17.00	0.00
403	PH-GRAB	PH	3	0	7.11	7.21	7.15	0.06
410	OH-CACO3	MG/L	1	0	52.20	52.20	52.20	0.00
440	HCO3-ION	MG/L	1	0	65.31	65.31	65.31	0.00
500	TR	MG/L	3	0	104.00	148.00	129.33	22.74
515	TFR(TDS)	MG/L	3	0	93.00	130.00	110.00	18.68
530	TNFR(SS)	MG/L	3	0	10.90	28.80	19.37	8.99
610	NH3-N	MG/L	3	0	0.28	1.67	0.82	0.75
625	TKN-N	MG/L	3	0	1.02	1.80	1.49	0.41
630	NO2NO3-N	MG/L	3	0	0.88	2.24	1.43	0.72
665	TPO4-P	MG/L	3	0	0.15	0.27	0.22	0.06
680	TOC	MG/L	1	0	3.20	3.20	3.20	0.00
720	TCYANIDE	MG/L	1	1	0.00	0.00	0.00	0.00
745	T-S COMP	MG/L	1	0	0.35	0.35	0.35	0.00
940	CHLORIDE	MG/L	1	0	11.30	11.30	11.30	0.00
951	T-F(-)	MG/L	3	1	0.13	0.58	0.35	0.32
1002	T-AS	MG/L	3	0	0.00	0.00	0.00	0.00
1007	T-BA	MG/L	1	1	0.00	0.00	0.00	0.00
1022	T-B	MG/L	3	0	0.12	0.15	0.14	0.01

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN79 TO 20JUL79
TUALATIN R-TUALATIN PARK

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
1027	T-CD	MG/L	3	2	0.00	0.00	0.00	0.00
1034	T-CR	MG/L	1	1	0.00	0.00	0.00	0.00
1042	T-CU	MG/L	3	0	0.01	0.03	0.02	0.01
1045	T-FE	MG/L	1	0	0.87	0.87	0.87	0.00
1051	T-PB	MG/L	3	2	0.02	0.02	0.02	0.00
1055	T-MN	MG/L	3	0	0.08	0.17	0.11	0.05
1067	T-NI	MG/L	1	1	0.00	0.00	0.00	0.00
1092	T-ZN	MG/L	3	0	0.01	0.02	0.02	0.00
31400	ATP	UG/L	3	0	0.05	2.25	0.81	1.25
31503	TOT-COLI	/100	3	0	160.00	350.00	240.00	98.49
31616	FEC-COLI	/100	3	0	48.00	160.00	85.67	64.38
32230	CHLPYL A	UG/L	2	0	2.36	5.68	4.02	2.35
32231	CHLPHL B	UG/L	2	0	0.54	1.31	0.93	0.54
32232	CHLPYL C	UG/L	2	0	0.61	4.10	2.36	2.46
32234	T-CHLPYL	UG/L	2	0	3.51	11.10	7.31	5.37
71900	T-HG	UG/L	3	3	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN79 TO 20JUL79
TUALATIN R-HWY 212 BR

PARAMETER	UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10 TEMP-C	DEG	3	0	6.00	20.00	13.67	7.09
76 TURB	NTU	3	0	5.60	230.00	82.53	127.75
95 COND-LAB	UMHO	3	0	95.00	180.00	128.33	45.37
299 DO	MG/L	3	0	8.30	11.20	9.77	1.45
310 BOD(5)	MG/L	3	0	2.10	6.90	3.77	2.72
340 T-COD	MG/L	1	0	17.20	17.20	17.20	0.00
403 PH-GRAB	PH	3	0	7.11	7.80	7.37	0.38
410 OH-CACO3	MG/L	1	0	51.20	51.20	51.20	0.00
440 HCO3-ION	MG/L	1	0	59.15	59.15	59.15	0.00
500 TR	MG/L	3	0	106.00	143.00	128.33	19.66
515 TFR(TDS)	MG/L	3	0	94.00	132.00	110.00	19.70
530 TNFR(SS)	MG/L	3	0	11.50	31.60	19.07	10.93
610 NH3-N	MG/L	3	0	0.24	0.48	0.34	0.13
625 TKN-N	MG/L	3	0	0.90	1.68	1.33	0.40
630 NO2NO3-N	MG/L	3	0	0.98	2.32	1.60	0.67
665 TPO4-P	MG/L	3	0	0.16	0.31	0.23	0.08
680 TOC	MG/L	1	0	5.80	5.80	5.80	0.00
720 TCYANIDE	MG/L	1	1	0.00	0.00	0.00	0.00
745 T-S COMP	MG/L	1	0	0.30	0.30	0.30	0.00
940 CHLORIDE	MG/L	1	0	11.40	11.40	11.40	0.00
951 T-F(-)	MG/L	3	1	0.15	0.58	0.37	0.30
1002 T-AS	MG/L	3	0	0.00	0.00	0.00	0.00
1007 T-BA	MG/L	1	1	0.00	0.00	0.00	0.00
1022 T-B	MG/L	3	0	0.13	0.15	0.14	0.01

PARAMETER	UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
1027 T-CD	MG/L	3	2	0.00	0.00	0.00	0.00
1034 T-CR	MG/L	1	1	0.00	0.00	0.00	0.00
1042 T-CU	MG/L	3	0	0.01	0.03	0.02	0.01
1045 T-FE	MG/L	1	0	0.35	0.35	0.35	0.00
1051 T-PB	MG/L	3	2	0.01	0.01	0.01	0.00
1055 T-MN	MG/L	3	0	0.08	0.12	0.10	0.02
1067 T-NI	MG/L	1	1	0.00	0.00	0.00	0.00
1092 T-ZN	MG/L	3	0	0.01	0.02	0.02	0.00
31400 ATP	UG/L	3	0	0.11	2.60	0.96	1.42
31503 TOT-COLI	/100	3	0	20.00	230.00	126.67	105.04
31616 FEC-COLI	/100	3	0	3.40	190.00	67.13	106.43
32230 CHLPYL A	UG/L	2	0	2.75	7.55	5.15	3.39
32231 CHLPHL B	UG/L	2	0	0.89	1.00	0.94	0.08
32232 CHLPYL C	UG/L	2	0	0.67	1.45	1.06	0.55
32234 T-CHLPYL	UG/L	2	0	5.09	9.22	7.15	2.92
71900 T-HG	UG/L	3	3	0.00	0.00	0.00	0.00

ER

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN78 TO 31DEC78
FANNO CREEK

20-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	2	0	17.00	18.00	17.50	0.71
76	TURB	NTU	2	0	7.20	9.60	8.40	1.70
80	TRUCOLOR	UNIT	2	0	25.00	25.00	25.00	0.00
81	APPCOLOR	UNIT	2	0	35.00	45.00	40.00	7.07
95	COND-LAB	UMHO	2	0	220.00	270.00	245.00	35.36
299	DO	MG/L	2	0	5.50	7.30	6.40	1.27
310	BOD(5)	MG/L	2	0	1.40	2.60	2.00	0.85
340	T-COD	MG/L	2	0	18.00	24.00	21.00	4.24
403	PH-GRAB	PH	2	0	7.43	7.65	7.54	0.16
410	OH-CACO3	MG/L	2	0	100.20	110.00	105.10	6.93
440	HCO3-ION	MG/L	2	0	123.20	133.10	128.15	7.00
500	TR	MG/L	2	0	198.60	221.00	209.80	15.84
515	TFR(TDS)	MG/L	2	0	187.50	210.00	198.75	15.91
530	TNFR(SS)	MG/L	2	0	10.80	11.10	10.95	0.21
610	NH3-N	MG/L	2	0	0.15	0.21	0.18	0.04
625	TKN-N	MG/L	2	0	1.29	1.47	1.38	0.13
630	NO2NO3-N	MG/L	2	0	0.65	0.80	0.72	0.10
665	TPO4-P	MG/L	2	0	0.45	0.60	0.53	0.11
680	TOC	MG/L	2	0	5.80	11.20	8.50	3.82
720	TCYANIDE	MG/L	2	1	0.02	0.02	0.02	0.00
745	T-S COMP	MG/L	2	0	0.30	0.45	0.37	0.11
940	CHLORIDE	MG/L	2	0	13.44	15.70	14.57	1.60
951	T-F(-)	MG/L	2	0	0.19	0.27	0.23	0.06
1002	T-AS	MG/L	2	2	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN78 TO 31DEC78
FANNO CREEK

20-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
1007	T-BA	MG/L	2	2	0.00	0.00	0.00	0.00
1027	T-CD	MG/L	2	2	0.00	0.00	0.00	0.00
1034	T-CR	MG/L	2	2	0.00	0.00	0.00	0.00
1042	T-CU	MG/L	2	0	0.00	0.05	0.02	0.03
1045	T-FE	MG/L	2	0	0.49	0.94	0.72	0.32
1051	T-PB	MG/L	2	1	0.01	0.01	0.01	0.00
1055	T-MN	MG/L	2	0	0.31	0.34	0.33	0.02
1067	T-NI	MG/L	2	2	0.00	0.00	0.00	0.00
1092	T-ZN	MG/L	2	0	0.02	0.03	0.03	0.00
31503	TOT-COLI	/100	2	0	460.00	3100.00	1780.00	1866.76
31616	FEC-COLI	/100	2	0	280.00	500.00	390.00	155.56
32230	CHLPYL A	UG/L	1	0	28.27	28.27	28.27	0.00
32231	CHLPHL B	UG/L	1	0	5.33	5.33	5.33	0.00
32232	CHLPYL C	UG/L	1	0	4.74	4.74	4.74	0.00
32234	T-CHLPYL	UG/L	2	0	38.34	53.30	45.82	10.58
32730	PHENOL	MG/L	2	2	0.00	0.00	0.00	0.00
50060	CL(2)RES	MG/L	2	2	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN78 TO 31DEC78
TUALATIN R-ELSNER RD BR

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	5	0	8.00	22.00	16.30	5.12
76	TURB	NTU	5	0	5.70	38.00	13.82	13.70
80	TRUCOLOR	UNIT	3	0	15.00	25.00	18.33	5.77
81	APPCOLOR	UNIT	4	0	20.00	35.00	27.50	6.45
95	COND-LAB	UMHO	5	0	98.00	145.00	121.60	18.85
299	DO	MG/L	5	0	4.90	9.80	6.94	1.97
310	BOD(5)	MG/L	5	0	1.50	1.90	1.74	0.19
340	T-COD	MG/L	5	0	8.70	15.00	10.44	2.61
403	PH-GRAB	PH	5	0	6.85	7.40	7.15	0.21
410	OH-CACO3	MG/L	5	0	40.00	52.40	49.32	5.30
440	HCO3-ION	MG/L	5	0	49.29	59.64	54.80	4.54
500	TR	MG/L	5	0	102.00	128.40	118.78	11.10
515	TFR(TDS)	MG/L	5	0	92.10	115.30	107.78	9.34
530	TNFR(SS)	MG/L	5	0	6.80	16.40	10.92	3.56
610	NH3-N	MG/L	5	1	0.21	0.40	0.34	0.09
625	TKN-N	MG/L	5	0	1.23	2.31	1.65	0.41
630	NO2NO3-N	MG/L	5	0	0.76	1.44	0.98	0.31
665	TPO4-P	MG/L	5	0	0.27	0.71	0.42	0.17
680	TOC	MG/L	5	0	3.10	5.80	4.44	1.25
720	TCYANIDE	MG/L	5	3	0.01	0.02	0.02	0.00
745	T-S COMP	MG/L	5	0	0.10	0.70	0.29	0.24
940	CHLORIDE	MG/L	5	0	4.89	8.29	6.53	1.34
951	T-F(-)	MG/L	5	0	0.08	0.15	0.12	0.04
1002	T-AS	MG/L	4	3	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN78 TO 31DEC78
TUALATIN R-ELSNER RD BR

20-JUL-79

PARAMETER	UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
1007 T-BA	MG/L	5	5	0.00	0.00	0.00	0.00
1027 T-CD	MG/L	5	4	0.00	0.00	0.00	0.00
1034 T-CR	MG/L	5	4	0.01	0.01	0.01	0.00
1042 T-CU	MG/L	5	0	0.00	0.04	0.02	0.01
1045 T-FE	MG/L	5	0	0.44	1.24	0.73	0.31
1051 T-PB	MG/L	5	3	0.02	0.02	0.02	0.00
1055 T-MN	MG/L	5	0	0.09	0.17	0.12	0.03
1067 T-NI	MG/L	5	4	0.02	0.02	0.02	0.00
1092 T-ZN	MG/L	5	0	0.03	0.06	0.04	0.02
31400 ATP	UG/L	3	0	0.04	0.46	0.28	0.21
31503 TOT-COLI	/100	5	0	110.00	330.00	200.00	91.92
31616 FEC-COLI	/100	5	0	16.00	52.00	30.00	14.27
32230 CHLPYL A	UG/L	3	0	7.80	31.80	16.24	13.49
32231 CHLPHL B	UG/L	3	0	2.16	5.60	3.66	1.76
32232 CHLPYL C	UG/L	3	0	4.88	9.10	7.57	2.33
32234 T-CHLPYL	UG/L	5	0	14.80	46.50	22.52	13.66
32730 PHENOL	MG/L	5	5	0.00	0.00	0.00	0.00
50060 CL(2)RES	MG/L	5	5	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN78 TO 31DEC78
TUALATIN R-TUALATIN PARK

20-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	4	0	17.00	22.50	19.00	2.48
76	TURB	NTU	4	0	4.80	54.00	18.75	23.56
80	TRUCOLOR	UNIT	2	0	10.00	15.00	12.50	3.54
81	APPCOLOR	UNIT	3	0	25.00	30.00	26.67	2.89
95	COND-LAB	UMHO	4	0	140.00	175.00	155.00	14.72
299	DO	MG/L	4	0	5.30	9.70	7.33	1.97
310	BOD(5)	MG/L	4	0	1.83	2.20	2.06	0.18
340	T-COD	MG/L	4	0	8.70	14.20	11.65	2.41
403	PH-GRAB	PH	4	0	6.85	7.48	7.17	0.28
410	OH-CACO3	MG/L	4	0	50.90	58.00	53.86	3.45
440	HCO3-ION	MG/L	4	0	59.14	64.07	61.92	2.54
500	TR	MG/L	4	0	130.00	140.70	134.30	4.99
515	TFR(TDS)	MG/L	4	0	119.80	130.80	123.15	5.20
530	TNFR(SS)	MG/L	4	0	7.90	15.80	11.13	3.36
610	NH3-N	MG/L	4	0	0.35	1.65	0.92	0.55
625	TKN-N	MG/L	4	0	1.32	2.70	2.21	0.61
630	NO2NO3-N	MG/L	4	0	0.79	1.28	0.94	0.23
665	TPO4-P	MG/L	4	0	0.25	0.51	0.36	0.11
680	TOC	MG/L	4	0	3.40	7.60	5.00	1.95
720	TCYANIDE	MG/L	4	2	0.01	0.01	0.01	0.00
745	T-S COMP	MG/L	4	0	0.10	0.80	0.39	0.30
940	CHLORIDE	MG/L	4	0	7.98	10.80	9.35	1.28
951	T-F(-)	MG/L	4	0	0.10	0.19	0.14	0.04
1002	T-AS	MG/L	3	2	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN78 TO 31DEC78
TUALATIN R-TUALATIN PARK

PARAMETER	UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
1007 T-BA	MG/L	4	4	0.00	0.00	0.00	0.00
1027 T-CD	MG/L	4	4	0.00	0.00	0.00	0.00
1034 T-CR	MG/L	4	3	0.01	0.01	0.01	0.00
1042 T-CU	MG/L	4	0	0.01	0.02	0.01	0.00
1045 T-FE	MG/L	4	0	0.35	1.06	0.61	0.32
1051 T-PB	MG/L	4	3	0.03	0.03	0.03	0.00
1055 T-MN	MG/L	4	0	0.08	0.21	0.13	0.06
1067 T-NI	MG/L	4	4	0.00	0.00	0.00	0.00
1092 T-ZN	MG/L	4	0	0.03	0.05	0.04	0.01
31400 ATP	UG/L	2	0	0.06	0.45	0.25	0.28
31503 TOT-COLI	/100	4	0	160.00	1100.00	545.00	397.45
31616 FEC-COLI	/100	4	0	2.00	480.00	144.25	225.75
32230 CHLPYL A	UG/L	3	0	12.50	23.29	16.73	5.76
32231 CHLPHL B	UG/L	3	0	1.89	3.96	3.05	1.06
32232 CHLPYL C	UG/L	3	0	0.57	9.25	6.07	4.78
32234 T-CHLPYL	UG/L	4	0	25.00	26.10	25.64	0.46
32730 PHENOL	MG/L	4	4	0.00	0.00	0.00	0.00
50060 CL(2)RES	MG/L	4	4	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN78 TO 31DEC78
TUALATINR-HWY 212 BR

20-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	6	0	8.50	23.50	15.92	5.94
59	FLOW	FEET	1	0	2.25	2.25	2.25	0.00
76	TURB	NTU	6	0	3.50	33.00	13.37	12.15
80	TRUCOLOR	UNIT	4	0	15.00	20.00	16.25	2.50
81	APPCOLOR	UNIT	5	0	15.00	60.00	36.00	17.46
95	COND-LAB	UMHO	6	0	120.00	195.00	150.50	30.68
299	DO	MG/L	6	0	5.60	11.40	8.28	2.07
310	BOD(5)	MG/L	6	0	1.20	4.43	2.71	1.05
340	T-COD	MG/L	6	0	8.40	64.80	21.80	21.34
403	PH-GRAB	PH	6	0	6.70	7.30	7.07	0.23
410	OH-CACO3	MG/L	6	0	37.89	55.38	48.86	7.68
440	HCO3-ION	MG/L	6	0	44.36	64.07	55.23	6.54
500	TR	MG/L	6	0	126.20	150.00	138.63	10.02
515	TFR(TDS)	MG/L	6	0	116.40	144.80	129.27	11.07
530	TNFR(SS)	MG/L	6	0	3.20	14.20	9.40	4.18
610	NH3-N	MG/L	6	0	0.44	1.03	0.64	0.22
625	TKN-N	MG/L	6	0	1.56	2.55	1.99	0.37
630	NO2NO3-N	MG/L	6	0	0.83	1.82	1.34	0.40
665	TPO4-P	MG/L	6	0	0.27	0.55	0.35	0.11
680	TOC	MG/L	6	0	2.00	8.40	5.48	2.50
720	TCYANIDE	MG/L	6	4	0.02	0.02	0.02	0.00
745	T-S COMP	MG/L	6	0	0.12	0.80	0.38	0.26
940	CHLORIDE	MG/L	6	0	5.78	13.00	9.58	2.64
951	T-F(-)	MG/L	6	0	0.09	0.20	0.13	0.05

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN78 TO 31DEC78
TUALATINR-HWY 212 BR

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	MAX	MEAN	STANDARD DEVIATION
1002	T-AS	MG/L	4	3	0.00	0.00	0.00	0.00
1007	T-BA	MG/L	6	6	0.00	0.00	0.00	0.00
1027	T-CD	MG/L	6	5	0.00	0.00	0.00	0.00
1034	T-CR	MG/L	6	5	0.01	0.01	0.01	0.00
1042	T-CU	MG/L	6	1	0.01	0.02	0.02	0.01
1045	T-FE	MG/L	6	0	0.17	1.26	0.63	0.42
1051	T-PB	MG/L	6	4	0.03	0.03	0.03	0.00
1055	T-MN	MG/L	6	0	0.08	0.19	0.12	0.05
1067	T-NI	MG/L	6	4	0.01	0.01	0.01	0.00
1092	T-ZN	MG/L	6	0	0.02	0.05	0.04	0.01
31400	ATP	UG/L	4	0	0.15	0.93	0.41	0.35
31503	TOT-COLI	/100	6	0	130.00	1000.00	416.67	307.81
31616	FEC-COLI	/100	6	0	22.00	160.00	60.67	56.06
32230	CHLPYL A	UG/L	4	0	4.90	21.73	15.41	7.68
32231	CHLPHL B	UG/L	4	0	2.70	5.64	4.05	1.30
32232	CHLPYL C	UG/L	4	0	1.88	17.68	8.32	6.73
32234	T-CHLPYL	UG/L	6	0	19.00	33.10	26.70	5.06
32730	PHENOL	MG/L	6	6	0.00	0.00	0.00	0.00
50060	CL(2)RES	MG/L	6	5	0.25	0.25	0.25	0.00
71900	T-HG	UG/L	1	1	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN77 TO 31DEC77
TUALATIN R-ELSNER RD BR

OK

20-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	4	0	15.00	20.00	18.43	2.31
76	TURB	NTU	4	0	3.50	5.50	4.53	1.13
80	TRUCOLOR	UNIT	2	0	10.00	10.00	10.00	0.00
81	APPCOLOR	UNIT	2	0	20.00	50.00	35.00	21.21
95	COND-LAB	UMHO	4	0	112.00	145.00	128.50	13.77
299	DO	MG/L	4	0	7.80	9.20	8.43	0.68
310	BOD(5)	MG/L	4	0	0.92	3.45	1.99	1.06
340	T-COD	MG/L	3	0	9.80	16.80	12.27	3.93
401	PH-GRAB	PH	4	0	6.79	7.38	7.09	0.25
410	OH-CACO3	MG/L	4	0	46.50	56.00	49.63	4.39
440	HCO3-ION	MG/L	1	0	48.68	48.68	48.68	0.00
500	TR	MG/L	3	0	111.60	122.20	117.27	5.34
515	TFR(TDS)	MG/L	4	0	104.00	113.90	109.63	4.34
530	TNFR(SS)	MG/L	4	0	3.00	14.00	9.32	4.83
610	NH3-N	MG/L	4	0	0.05	0.37	0.17	0.14
625	TKN-N	MG/L	4	0	1.50	2.67	2.14	0.59
630	NO2NO3-N	MG/L	4	0	0.72	1.30	1.07	0.25
665	TPO4-P	MG/L	4	0	0.36	1.22	0.75	0.38
680	TOC	MG/L	3	0	3.70	7.00	5.57	1.69
720	TCYANIDE	MG/L	3	0	0.02	0.03	0.02	0.01
745	T-S COMP	MG/L	2	1	0.08	0.08	0.08	0.00
940	CHLORIDE	MG/L	4	0	6.56	11.12	8.73	1.89
951	T-F(-)	MG/L	2	0	0.06	0.08	0.07	0.02
1002	T-AS	MG/L	4	4	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN77 TO 31DEC77
TUALATIN R-ELSNER RD BR

20-JUL-79

PARAMETER	UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
1007 T-BA	MG/L	3	3	0.00	0.00	0.00	0.00
1022 T-B	MG/L	1	0	0.18	0.18	0.18	0.00
1027 T-CD	MG/L	4	4	0.00	0.00	0.00	0.00
1034 T-CR	MG/L	4	3	1.93	1.93	1.93	0.00
1042 T-CU	MG/L	4	3	0.04	0.04	0.04	0.00
1045 T-FE	MG/L	4	0	0.32	12.60	3.51	6.06
1051 T-PB	MG/L	4	4	0.00	0.00	0.00	0.00
1055 T-MN	MG/L	4	0	0.15	0.23	0.19	0.03
1092 T-ZN	MG/L	4	2	0.02	0.15	0.09	0.09
1102 T-SN	MG/L	1	1	0.00	0.00	0.00	0.00
31400 ATP	UG/L	3	0	0.70	15.00	5.78	8.00
31503 TOT-COLI	/100	4	0	55.00	900.00	361.50	390.97
31616 FEC-COLI	/100	4	0	10.00	17.00	12.25	3.30
50060 CL(2)RES	MG/L	4	4	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN77 TO 31DEC77
TUALATINR-HWY 212 BR

20-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	4	0	19.00	23.50	20.53	2.03
59	FLOW	FEET	1	0	2.20	2.20	2.20	0.00
76	TURB	NTU	4	0	3.60	5.00	4.37	0.68
80	TRUCOLOR	UNIT	2	0	10.00	15.00	12.50	3.54
81	APPCOLOR	UNIT	2	0	30.00	45.00	37.50	10.61
95	COND-LAB	UMHO	4	0	140.00	190.00	165.00	20.82
299	DO	MG/L	4	0	7.40	10.20	8.75	1.14
310	BOD(5)	MG/L	4	0	3.67	5.26	4.40	0.68
340	T-COD	MG/L	3	0	12.40	28.50	18.30	8.87
401	PH-GRAB	PH	4	0	6.70	7.50	7.03	0.34
410	OH-CACO3	MG/L	4	0	50.00	67.00	55.88	7.60
440	HCO3-ION	MG/L	1	0	56.00	56.00	56.00	0.00
500	TR	MG/L	3	0	135.00	172.60	150.67	19.57
515	TFR(TDS)	MG/L	3	0	125.00	164.80	141.93	20.55
530	TNFR(SS)	MG/L	4	0	8.00	11.40	9.45	1.56
610	NH3-N	MG/L	4	0	0.37	0.82	0.54	0.20
625	TKN-N	MG/L	4	0	2.43	3.45	2.84	0.46
630	NO2NO3-N	MG/L	4	0	1.37	2.20	1.82	0.34
665	TPO4-P	MG/L	4	0	0.30	1.45	0.79	0.56
680	TOC	MG/L	4	0	3.00	16.00	7.65	5.83
720	TCYANIDE	MG/L	3	0	0.02	0.03	0.02	0.01
745	T-S COMP	MG/L	2	1	0.04	0.04	0.04	0.00
940	CHLORIDE	MG/L	4	0	10.30	14.64	12.32	1.78
951	T-F(-)	MG/L	2	0	0.07	0.12	0.10	0.04

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN77 TO 31DEC77
TUALATINR-HWY 212 BR

20-JUL-79

PARAMETER	UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
1002 T-AS	MG/L	4	2	0.00	0.02	0.01	0.01
1007 T-BA	MG/L	3	3	0.00	0.00	0.00	0.00
1022 T-B	MG/L	1	0	0.27	0.27	0.27	0.00
1027 T-CD	MG/L	4	4	0.00	0.00	0.00	0.00
1034 T-CR	MG/L	4	4	0.00	0.00	0.00	0.00
1042 T-CU	MG/L	4	4	0.00	0.00	0.00	0.00
1045 T-FE	MG/L	4	0	0.19	0.47	0.31	0.12
1051 T-PB	MG/L	4	4	0.00	0.00	0.00	0.00
1055 T-MN	MG/L	4	0	0.10	0.19	0.14	0.04
1092 T-ZN	MG/L	4	2	0.02	0.03	0.03	0.01
1102 T-SN	MG/L	1	1	0.00	0.00	0.00	0.00
31400 ATP	UG/L	3	0	1.83	4.10	2.65	1.26
31503 TOT-COLI	/100	4	0	400.00	700.00	550.00	173.21
31616 FEC-COLI	/100	4	0	20.00	70.00	39.75	21.30
50060 CL(2)RES	MG/L	3	3	0.00	0.00	0.00	0.00

?ERR 5 INPUT CONVERSION ERROR
IN ROUTINE ".MAIN." LINE 37

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UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN77 TO 31DEC77
FANNO CREEK

23-JUL-79

PARAMETER	UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10 TEMP-C	DEG	1	0	17.00	17.00	17.00	0.00
76 TURB	NTU	1	0	4.80	4.80	4.80	0.00
84 TRUCOLOR	UNIT	1	0	15.00	15.00	15.00	0.00
85 APPCOLOR	UNIT	1	0	25.00	25.00	25.00	0.00
95 COND/CM	UMHO	1	0	260.00	260.00	260.00	0.00
299 DO	MG/L	1	0	5.50	5.50	5.50	0.00
310 BOD(5)	MG/L	1	0	2.14	2.14	2.14	0.00
340 T-COD-HI	MG/L	1	0	13.60	13.60	13.60	0.00
401 PH-GRAB	PH	1	0	7.30	7.30	7.30	0.00
410 OH-CACO3	MG/L	1	0	114.00	114.00	114.00	0.00
500 TR	MG/L	1	0	215.00	215.00	215.00	0.00
515 TFR	MG/L	1	0	209.00	209.00	209.00	0.00
530 TNFR	MG/L	1	0	5.00	5.00	5.00	0.00
610 NH3-N	MG/L	1	0	0.24	0.24	0.24	0.00
625 TKN-N	MG/L	1	0	1.68	1.68	1.68	0.00
630 NO2NO3-N	MG/L	1	0	1.02	1.02	1.02	0.00
665 TPO4-P	MG/L	1	0	0.82	0.82	0.82	0.00
680 TOC	MG/L	1	0	4.00	4.00	4.00	0.00
720 TCYANIDE	MG/L	1	0	0.02	0.02	0.02	0.00
940 CHLORIDE	MG/L	1	0	15.50	15.50	15.50	0.00
1002 T-AS	MG/L	1	1	0.00	0.00	0.00	0.00
1007 T-BARIUM	MG/L	1	1	0.00	0.00	0.00	0.00
1027 T-CD	MG/L	1	1	0.00	0.00	0.00	0.00
1034 T-CR	MG/L	1	1	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN77 TO 31DEC77
FANNO CREEK

23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
1045	T-FE	MG/L	1	0	0.70	0.70	0.70	0.00
1051	T-PB	MG/L	1	1	0.00	0.00	0.00	0.00
1055	T-MN	MG/L	1	0	0.27	0.27	0.27	0.00
1092	T-ZN	MG/L	1	1	0.00	0.00	0.00	0.00
31503	TOT-COLI	/100	1	0	1600.00	1600.00	1600.00	0.00
31616	FEC-COLI	/100	1	0	430.00	430.00	430.00	0.00
50060	CL(2)	MG/L	1	1	0.00	0.00	0.00	0.00

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN76 TO 31DEC76
TUALATIN R-HWY 99W BR

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	2	0	10.50	17.50	14.00	4.95
76	TURB	NTU	2	0	4.25	6.70	5.47	1.73
95	COND/CM	UMHO	2	0	100.00	101.00	100.50	0.71
299	DO	MG/L	2	0	6.60	6.80	6.70	0.14
310	BOD(5)	MG/L	2	0	1.13	1.26	1.20	0.09
401	PH-GRAB	PH	2	0	6.94	7.20	7.07	0.18
410	OH-CACO3	MG/L	2	0	42.44	48.00	45.22	3.93
500	TR	MG/L	2	0	110.80	117.00	113.90	4.38
530	TNFR	MG/L	2	0	7.40	14.60	11.00	5.09
610	NH3-N	MG/L	2	0	0.08	0.26	0.17	0.12
620	NO3-N	MG/L	2	0	0.80	0.95	0.88	0.11
665	TPO4-P	MG/L	1	0	0.12	0.12	0.12	0.00
929	T-NA	MG/L	2	0	3.00	4.45	3.72	1.03
937	T-K	MG/L	2	0	2.90	2.99	2.95	0.06
940	CHLORIDE	MG/L	2	0	7.16	9.62	8.39	1.74
945	SO4	MG/L	2	0	4.43	4.48	4.45	0.04
31503	TOT-COLI	/100	2	0	330.00	1200.00	765.00	615.18
31616	FEC-COLI	/100	2	0	22.00	68.00	45.00	32.53
50060	CL(2)	MG/L	2	1	0.20	0.20	0.20	0.00
70507	OPO4-P	MG/L	2	0	0.10	0.39	0.24	0.20

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN76 TO 31DEC76
TUALATIN R-HWY 212 BR

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	2	0	11.50	18.00	14.75	4.60
76	TURB	NTU	2	0	6.00	7.50	6.75	1.06
95	COND/CM	UMHO	2	0	118.00	128.00	123.00	7.07
299	DO	MG/L	2	0	7.80	11.60	9.70	2.69
310	BOD(5)	MG/L	2	0	2.15	2.36	2.26	0.15
401	PH-GRAB	PH	1	0	7.19	7.19	7.19	0.00
410	OH-CACO3	MG/L	1	0	45.54	45.54	45.54	0.00
500	TR	MG/L	2	0	127.00	132.20	129.60	3.68
530	TNFR	MG/L	2	0	5.70	9.30	7.50	2.55
610	NH3-N	MG/L	2	0	0.29	0.61	0.45	0.23
620	NO3-N	MG/L	2	0	1.45	1.94	1.70	0.35
665	TPO4-P	MG/L	1	0	0.23	0.23	0.23	0.00
929	T-NA	MG/L	2	0	3.25	5.40	4.33	1.52
937	T-K	MG/L	2	0	3.40	3.67	3.54	0.19
940	CHLORIDE	MG/L	2	0	10.10	11.65	10.88	1.10
945	SO4	MG/L	1	0	5.22	5.22	5.22	0.00
31503	TOT-COLI	/100	2	0	2400.00	5700.00	4050.00	2333.45
31616	FEC-COLI	/100	2	0	40.00	180.00	110.00	98.99
50060	CL(2)	MG/L	2	2	0.00	0.00	0.00	0.00
70507	OPO4-P	MG/L	2	0	0.22	0.60	0.41	0.27

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN75 TO 31DEC75
TUALATIN R-HWY 212 BR

OK

24-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	5	0	16.50	21.00	19.30	1.72
60	FLOW	MGD	5	0	87.19	212.00	141.32	46.63
299	DO	MG/L	5	0	7.20	10.20	8.62	1.15
310	BOD(5)	MG/L	4	0	2.05	4.95	2.94	1.35
340	T-COD-HI	MG/L	5	0	7.56	17.50	10.79	3.97
401	PH-GRAB	PH	5	0	6.95	7.40	7.13	0.18
410	OH-CACO3	MG/L	5	0	36.40	46.00	41.52	3.41
530	TNFR	MG/L	5	0	7.80	11.50	10.12	1.60
605	ORG-N	MG/L	5	0	0.59	0.79	0.69	0.08
610	NH3-N	MG/L	5	4	0.58	0.58	0.58	0.00
615	NO2-N	MG/L	5	1	0.02	0.05	0.03	0.01
620	NO3-N	MG/L	5	1	0.67	6.20	2.10	2.74
665	TPO4-P	MG/L	5	0	0.40	0.56	0.46	0.07
740	SO3	MG/L	5	0	1.00	1.50	1.10	0.22
745	T-S(-2)	MG/L	5	1	0.04	0.16	0.11	0.05
940	CHLORIDE	MG/L	5	0	7.07	9.98	8.21	1.13
945	SO4	MG/L	5	0	4.74	8.20	6.06	1.39
31503	TOT-COLI	/100	2	0	5900.00	6800.00	6350.00	636.40
31616	FEC-COLI	/100	2	0	30.00	60.00	45.00	21.21
70509	H+/CACO3	MG/L	5	0	2.60	8.57	5.06	2.27

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN75 TO 31DEC75
FANNO CREEK

23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	4	0	17.00	19.00	18.00	0.82
60	FLOW	MGD	3	0	5.36	7.30	6.01	1.12
299	DO	MG/L	4	0	2.80	3.90	3.44	0.46
310	BOD(5)	MG/L	3	0	4.55	6.40	5.72	1.02
340	T-COD-HI	MG/L	4	0	25.18	44.44	32.92	8.33
401	PH-GRAB	PH	4	0	7.01	7.16	7.10	0.06
410	OH-CACO3	MG/L	4	0	87.80	113.60	104.13	11.85
530	TNFR	MG/L	4	0	3.54	26.30	11.43	10.14
605	ORG-N	MG/L	4	0	10.92	14.41	12.32	1.60
610	NH3-N	MG/L	4	0	0.41	14.00	8.36	5.78
615	NO2-N	MG/L	4	0	0.26	0.33	0.29	0.03
620	NO3-N	MG/L	4	4	0.00	0.00	0.00	0.00
665	TPO4-P	MG/L	4	0	2.65	7.85	5.53	2.19
740	SO3	MG/L	4	1	0.90	1.50	1.30	0.35
745	T-S(-2)	MG/L	4	1	0.08	0.16	0.12	0.04
940	CHLORIDE	MG/L	4	0	21.50	34.40	30.72	6.19
945	SO4	MG/L	4	0	16.30	25.50	19.73	4.00
31503	TOT-COLI	/100	1	0	910000.00	910000.00	910000.00	0.00
31616	FEC-COLI	/100	1	0	7100.00	7100.00	7100.00	0.00
70509	H+/CACO3	MG/L	4	0	15.40	21.00	17.68	2.68

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN74 TO 31DEC74
TUALATIN R-ELSNER RD BR

23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	2	0	19.00	19.00	19.00	0.00
299	DO	MG/L	2	0	7.80	10.00	8.90	1.56
310	BOD(5)	MG/L	2	0	4.18	7.89	6.03	2.62
340	T-COD-HI	MG/L	2	0	12.56	25.02	18.79	8.81
401	PH-GRAB	PH	2	0	7.70	7.70	7.70	0.00
410	OH-CACO3	MG/L	2	0	44.00	51.00	47.50	4.95
530	TNFR	MG/L	2	0	12.85	14.70	13.78	1.31
605	ORG-N	MG/L	2	0	0.43	0.76	0.60	0.23
610	NH3-N	MG/L	2	2	0.00	0.00	0.00	0.00
615	NO2-N	MG/L	2	1	0.04	0.04	0.04	0.00
620	NO3-N	MG/L	1	1	0.00	0.00	0.00	0.00
665	TPO4-P	MG/L	2	1	0.40	0.40	0.40	0.00
740	SO3	MG/L	2	0	1.00	1.00	1.00	0.00
745	T-S(-2)	MG/L	1	0	0.12	0.12	0.12	0.00
945	SO4	MG/L	2	0	10.50	10.50	10.50	0.00
31503	TOT-COLI	/100	1	0	6000.00	6000.00	6000.00	0.00
31679	FEC-STRP	/100	1	0	20.00	20.00	20.00	0.00
70509	H+/CACO3	MG/L	2	0	2.50	3.00	2.75	0.35

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN74 TO 31DEC74
TUALATIN R-ELSNER RD BR

23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	2	0	19.00	19.00	19.00	0.00
299	DO	MG/L	2	0	7.80	10.00	8.90	1.56
310	BOD(5)	MG/L	2	0	4.18	7.89	6.03	2.62
340	T-COD-HI	MG/L	2	0	12.56	25.02	18.79	8.81
401	PH-GRAB	PH	2	0	7.70	7.70	7.70	0.00
410	OH-CACO3	MG/L	2	0	44.00	51.00	47.50	4.95
530	TNFR	MG/L	2	0	12.85	14.70	13.78	1.31
605	ORG-N	MG/L	2	0	0.43	0.76	0.60	0.23
610	NH3-N	MG/L	2	2	0.00	0.00	0.00	0.00
615	NO2-N	MG/L	2	1	0.04	0.04	0.04	0.00
620	NO3-N	MG/L	1	1	0.00	0.00	0.00	0.00
665	TPO4-P	MG/L	2	1	0.40	0.40	0.40	0.00
740	SO3	MG/L	2	0	1.00	1.00	1.00	0.00
745	T-S(-2)	MG/L	1	0	0.12	0.12	0.12	0.00
945	SO4	MG/L	2	0	10.50	10.50	10.50	0.00
31503	TOT-COLI	/100	1	0	6000.00	6000.00	6000.00	0.00
31679	FEC-STRP	/100	1	0	20.00	20.00	20.00	0.00
70509	H+/CACO3	MG/L	2	0	2.50	3.00	2.75	0.35

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN74 TO 31DEC74
TUALATIN R-ELSNER RD BR

23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	2	0	19.00	19.00	19.00	0.00
299	DO	MG/L	2	0	7.80	10.00	8.90	1.56
310	BOD(5)	MG/L	2	0	4.18	7.89	6.03	2.62
340	T-COD-HI	MG/L	2	0	12.56	25.02	18.79	8.81
401	PH-GRAB	PH	2	0	7.70	7.70	7.70	0.00
410	OH-CACO3	MG/L	2	0	44.00	51.00	47.50	4.95
530	TNFR	MG/L	2	0	12.85	14.70	13.78	1.31
605	ORG-N	MG/L	2	0	0.43	0.76	0.60	0.23
610	NH3-N	MG/L	2	2	0.00	0.00	0.00	0.00
615	NO2-N	MG/L	2	1	0.04	0.04	0.04	0.00
620	NO3-N	MG/L	1	1	0.00	0.00	0.00	0.00
665	TPO4-P	MG/L	2	1	0.40	0.40	0.40	0.00
740	SO3	MG/L	2	0	1.00	1.00	1.00	0.00
745	T-S(-2)	MG/L	1	0	0.12	0.12	0.12	0.00
945	SO4	MG/L	2	0	10.50	10.50	10.50	0.00
31503	TOT-COLI	/100	1	0	6000.00	6000.00	6000.00	0.00
31679	FEC-STRP	/100	1	0	20.00	20.00	20.00	0.00
70509	H+/CACO3	MG/L	2	0	2.50	3.00	2.75	0.35

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN74 TO 31DEC74
TUALATIN R-ELSNER RD BR

23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	2	0	19.00	19.00	19.00	0.00
299	DO	MG/L	2	0	7.80	10.00	8.90	1.56
310	BOD(5)	MG/L	2	0	4.18	7.89	6.03	2.62
340	T-COD-HI	MG/L	2	0	12.56	25.02	18.79	8.81
401	PH-GRAB	PH	2	0	7.70	7.70	7.70	0.00
410	OH-CACO3	MG/L	2	0	44.00	51.00	47.50	4.95
530	TNFR	MG/L	2	0	12.85	14.70	13.78	1.31
605	ORG-N	MG/L	2	0	0.43	0.76	0.60	0.23
610	NH3-N	MG/L	2	2	0.00	0.00	0.00	0.00
615	NO2-N	MG/L	2	1	0.04	0.04	0.04	0.00
620	NO3-N	MG/L	1	1	0.00	0.00	0.00	0.00
665	TPO4-P	MG/L	2	1	0.40	0.40	0.40	0.00
740	SO3	MG/L	2	0	1.00	1.00	1.00	0.00
745	T-S(-2)	MG/L	1	0	0.12	0.12	0.12	0.00
945	SO4	MG/L	2	0	10.50	10.50	10.50	0.00
31503	TOT-COLI	/100	1	0	6000.00	6000.00	6000.00	0.00
31679	FEC-STRP	/100	1	0	20.00	20.00	20.00	0.00
70509	H+/CACO3	MG/L	2	0	2.50	3.00	2.75	0.35

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN74 TO 31DEC74
TUALATIN R-ELSNER RD BR

23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	2	0	19.00	19.00	19.00	0.00
299	DO	MG/L	2	0	7.80	10.00	8.90	1.56
310	BOD(5)	MG/L	2	0	4.18	7.89	6.03	2.62
340	T-COD-HI	MG/L	2	0	12.56	25.02	18.79	8.81
401	PH-GRAB	PH	2	0	7.70	7.70	7.70	0.00
410	OH-CACO3	MG/L	2	0	44.00	51.00	47.50	4.95
530	TNFR	MG/L	2	0	12.85	14.70	13.78	1.31
605	ORG-N	MG/L	2	0	0.43	0.76	0.60	0.23
610	NH3-N	MG/L	2	2	0.00	0.00	0.00	0.00
615	NO2-N	MG/L	2	1	0.04	0.04	0.04	0.00
620	NO3-N	MG/L	1	1	0.00	0.00	0.00	0.00
665	TPO4-P	MG/L	2	1	0.40	0.40	0.40	0.00
740	SO3	MG/L	2	0	1.00	1.00	1.00	0.00
745	T-S(-2)	MG/L	1	0	0.12	0.12	0.12	0.00
945	SO4	MG/L	2	0	10.50	10.50	10.50	0.00
31503	TOT-COLI	/100	1	0	6000.00	6000.00	6000.00	0.00
31679	FEC-STRP	/100	1	0	20.00	20.00	20.00	0.00
70509	H+/CACO3	MG/L	2	0	2.50	3.00	2.75	0.35

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN74 TO 31DEC74
TUALATIN R-ELSNER RD BR

23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	2	0	19.00	19.00	19.00	0.00
299	DO	MG/L	2	0	7.80	10.00	8.90	1.56
310	BOD(5)	MG/L	2	0	4.18	7.89	6.03	2.62
340	T-COD-HI	MG/L	2	0	12.56	25.02	18.79	8.81
401	PH-GRAB	PH	2	0	7.70	7.70	7.70	0.00
410	OH-CACO3	MG/L	2	0	44.00	51.00	47.50	4.95
530	TNFR	MG/L	2	0	12.85	14.70	13.78	1.31
605	ORG-N	MG/L	2	0	0.43	0.76	0.60	0.23
610	NH3-N	MG/L	2	2	0.00	0.00	0.00	0.00
615	NO2-N	MG/L	2	1	0.04	0.04	0.04	0.00
620	NO3-N	MG/L	1	1	0.00	0.00	0.00	0.00
665	TPO4-P	MG/L	2	1	0.40	0.40	0.40	0.00
740	SO3	MG/L	2	0	1.00	1.00	1.00	0.00
745	T-S(-2)	MG/L	1	0	0.12	0.12	0.12	0.00
945	SO4	MG/L	2	0	10.50	10.50	10.50	0.00
31503	TOT-COLI	/100	1	0	6000.00	6000.00	6000.00	0.00
31679	FEC-STRP	/100	1	0	20.00	20.00	20.00	0.00
70509	H+/CACO3	MG/L	2	0	2.50	3.00	2.75	0.35

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN74 TO 31DEC74
TUALATIN R-ELSNER RD BR

23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	2	0	19.00	19.00	19.00	0.00
299	DO	MG/L	2	0	7.80	10.00	8.90	1.56
310	BOD(5)	MG/L	2	0	4.18	7.89	6.03	2.62
340	T-COD-HI	MG/L	2	0	12.56	25.02	18.79	8.81
401	PH-GRAB	PH	2	0	7.70	7.70	7.70	0.00
410	OH-CACO3	MG/L	2	0	44.00	51.00	47.50	4.95
530	TNFR	MG/L	2	0	12.85	14.70	13.78	1.31
605	ORG-N	MG/L	2	0	0.43	0.76	0.60	0.23
610	NH3-N	MG/L	2	2	0.00	0.00	0.00	0.00
615	NO2-N	MG/L	2	1	0.04	0.04	0.04	0.00
620	NO3-N	MG/L	1	1	0.00	0.00	0.00	0.00
665	TPO4-P	MG/L	2	1	0.40	0.40	0.40	0.00
740	SO3	MG/L	2	0	1.00	1.00	1.00	0.00
745	T-S(-2)	MG/L	1	0	0.12	0.12	0.12	0.00
945	SO4	MG/L	2	0	10.50	10.50	10.50	0.00
31503	TOT-COLI	/100	1	0	6000.00	6000.00	6000.00	0.00
31679	FEC-STRP	/100	1	0	20.00	20.00	20.00	0.00
70509	H+/CACO3	MG/L	2	0	2.50	3.00	2.75	0.35

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN74 TO 31DEC74
TUALATIN R-ELSNER RD BR

23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	2	0	19.00	19.00	19.00	0.00
299	DO	MG/L	2	0	7.80	10.00	8.90	1.56
310	BOD(5)	MG/L	2	0	4.18	7.89	6.03	2.62
340	T-COD-HI	MG/L	2	0	12.56	25.02	18.79	8.81
401	PH-GRAB	PH	2	0	7.70	7.70	7.70	0.00
410	OH-CACO3	MG/L	2	0	44.00	51.00	47.50	4.95
530	TNFR	MG/L	2	0	12.85	14.70	13.78	1.31
605	ORG-N	MG/L	2	0	0.43	0.76	0.60	0.23
610	NH3-N	MG/L	2	2	0.00	0.00	0.00	0.00
615	NO2-N	MG/L	2	1	0.04	0.04	0.04	0.00
620	NO3-N	MG/L	1	1	0.00	0.00	0.00	0.00
665	TPO4-P	MG/L	2	1	0.40	0.40	0.40	0.00
740	SO3	MG/L	2	0	1.00	1.00	1.00	0.00
745	T-S(-2)	MG/L	1	0	0.12	0.12	0.12	0.00
945	SO4	MG/L	2	0	10.50	10.50	10.50	0.00
31503	TOT-COLI	/100	1	0	6000.00	6000.00	6000.00	0.00
31679	FEC-STRP	/100	1	0	20.00	20.00	20.00	0.00
70509	H+/CACO3	MG/L	2	0	2.50	3.00	2.75	0.35

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN73 TO 31DEC73
TUALATIN R-ELSNER RD BR

23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	4	0	17.00	19.00	18.13	1.03
299	DO	MG/L	4	0	4.85	10.20	8.49	2.47
310	BOD(5)	MG/L	4	0	1.90	23.80	10.29	9.58
340	T-COD-HI	MG/L	4	0	11.45	30.90	23.10	9.51
401	PH-GRAB	PH	4	0	6.80	7.60	7.28	0.36
410	OH-CACO3	MG/L	2	0	54.00	74.20	64.10	14.28
530	TNFR	MG/L	4	0	7.90	77.30	27.35	33.36
605	ORG-N	MG/L	4	0	0.14	1.78	1.13	0.70
610	NH3-N	MG/L	4	1	0.25	0.63	0.45	0.19
615	NO2-N	MG/L	2	0	0.72	1.10	0.91	0.27
620	NO3-N	MG/L	2	1	0.11	0.11	0.11	0.00
740	SO3	MG/L	2	0	2.00	6.60	4.30	3.25
745	T-S(-2)	MG/L	2	2	0.00	0.00	0.00	0.00
945	SO4	MG/L	4	0	9.00	17.50	14.25	3.80
1034	T-CR	MG/L	1	1	0.00	0.00	0.00	0.00
31503	TOT-COLI	/100	4	0	10000.00	530000.00	164500.00	246717.80
31616	FEC-COLI	/100	1	0	10.00	10.00	10.00	0.00
31679	FEC-STRP	/100	3	0	6.00	340.00	125.33	186.29
50060	CL(2)	MG/L	2	2	0.00	0.00	0.00	0.00
70509	H+/CACO3	MG/L	2	0	2.00	4.00	3.00	1.41

UNIFIED SEWERAGE AGENCY
WATER QUALITY LABORATORY
DATA STATISTICS 1JAN73 TO 31DEC73
TUALATIN R-TUALATIN PARK

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23-JUL-79

PARAMETER		UNITS	NUM	ZEROS	RANGE MIN	RANGE MAX	MEAN	STANDARD DEVIATION
10	TEMP-C	DEG	3	0	18.00	19.00	18.67	0.58
299	DO	MG/L	3	0	5.90	10.70	7.53	2.74
310	BOD(5)	MG/L	3	0	5.70	5.85	5.75	0.09
340	T-COD-HI	MG/L	3	0	17.30	26.96	21.19	5.10
401	PH-GRAB	PH	3	0	7.20	7.40	7.27	0.12
410	OH-CACO3	MG/L	2	0	64.00	83.60	73.80	13.86
530	TNFR	MG/L	3	0	7.10	18.30	11.63	5.90
605	ORG-N	MG/L	3	0	1.35	1.51	1.41	0.09
610	NH3-N	MG/L	3	0	0.23	4.06	1.80	2.00
615	NO2-N	MG/L	2	1	1.10	1.10	1.10	0.00
620	NO3-N	MG/L	2	0	0.34	0.37	0.36	0.02
740	SO3	MG/L	2	0	1.50	6.60	4.05	3.61
745	T-S(-2)	MG/L	2	1	0.08	0.08	0.08	0.00
945	SO4	MG/L	3	0	9.50	20.50	14.33	5.62
31503	TOT-COLI	/100	3	0	10400.00	33000.00	23800.00	11870.98
31616	FEC-COLI	/100	1	0	16.00	16.00	16.00	0.00
31679	FEC-STRP	/100	2	0	130.00	200.00	165.00	49.50
50060	CL(2)	MG/L	2	1	0.20	0.20	0.20	0.00
70509	H+/CACO3	MG/L	2	0	4.00	6.00	5.00	1.41

APPENDIX E

PARTIAL LIST OF SANITARY LANDFILL INSTALLATIONS USING MEMBRANE LINERS

APPENDIX E

PARTIAL LIST OF SANITARY LANDFILL INSTALLATIONS USING MEMBRANE LINERS

Year	Company	Location	Membrane Thickness in mils
1971	Predmore Development Co.	Romeo MI	20 PVC
1972	Environmental Protection Agency, Cincinnati, OH	Kentucky	30 CPE
1972	Town of Brookhaven	Patchogue NY	20 PVC
1972	Stauffer Chemical Co.	St. Gabriel LA	20 PVC
1973	Town of Merrimack	Merrimack NH	15 PVC
1973	Town of North Hempstead	Roslyn NY	20 PVC
1973	Town of Milford	Milford CT	20 PVC
1973	Palisades, Inc.	Waterbury VT	20 PVC
1974	U.S. Army	West Point NY	30 PVC
1975	Allied Chemical	Jamesville NY	20 PVC
1975	Volusia County	Deland FL	20 PVC
1976	Allied Chemical	Hopewell VA	20 PVC
1976	Metropolitan District of Hong Kong	The New Territories, Hong Kong	20 PVC
1976	Warren County Solid Waste Authority Grunderville Landfill	Pleasantownship PA	20 PVC
1976	Niagra Recycling	Niagra Falls NY	20 PVC
1976	Gulf Coast Landfill	Ft. Myers FL	20 PVC
1976	Kramer Sanitary Landfill	Clarksboro NJ	20 PVC
1976	Bureau of Sanitation	Clarkton MD	20 PVC
1977	Mount Holly Landfill	Mount Holly NJ	20 PVC
1977	City of Ormond Beach	Ormond Beach FL	20 PVC
1977	Modern Trash Removal of York, Inc.	York PA	20 PVC
1977	Union Carbide	Rifle CO	20 PVC
1977	Kent County Dept. of Public works	Grand Rapids MI	20 PVC
1977	Toms River Chemical Corp.	Toms River NJ	20 PVC
1977	Kinsley Landfill, Inc.	Scotch Plains NJ	20 PVC
1978	Dept. of Public Works Clallam County	Port Angeles WA	20 PVC