1977 - EXPANSION PLAN

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COFFIN BUTTE
SANITARY LANDFILL
EXPANSION PLAN

FOR
VALLEY LANDFILLS, INC.
CORVALLIS, OREGON

October 1, 1977

CONSULTANTS:
H. Randy Sweet, Geologist/Hydrogeologist
Regional Consultants, Inc.

COFFIN BUTTE LANDFILL EXPANSION PLAN

FIGURES

TABLES

PLATES

APPENDICES

SUMMARY

The existing operational area at Coffin Butte Sanitary Landfill is nearly completed. In conjunction with the phased closeout of this area, a 22 acre expansion area is being developed. Closeout of the existing area and short-term projected expansion provides for over one million yards of refuse disposal or about four years operation at a projected annual disposal volume of about one-quarter million yards per year.

Site design is aimed at improved moisture routing. A clayey base, down-gradient moisture barrier and leachate collection system are included. Five production and/or monitoring wells have been installed to check the effectiveness of the bottom seal and collection system. Final disposal of leachate contaminated water is through irrigation.

INTRODUCTION

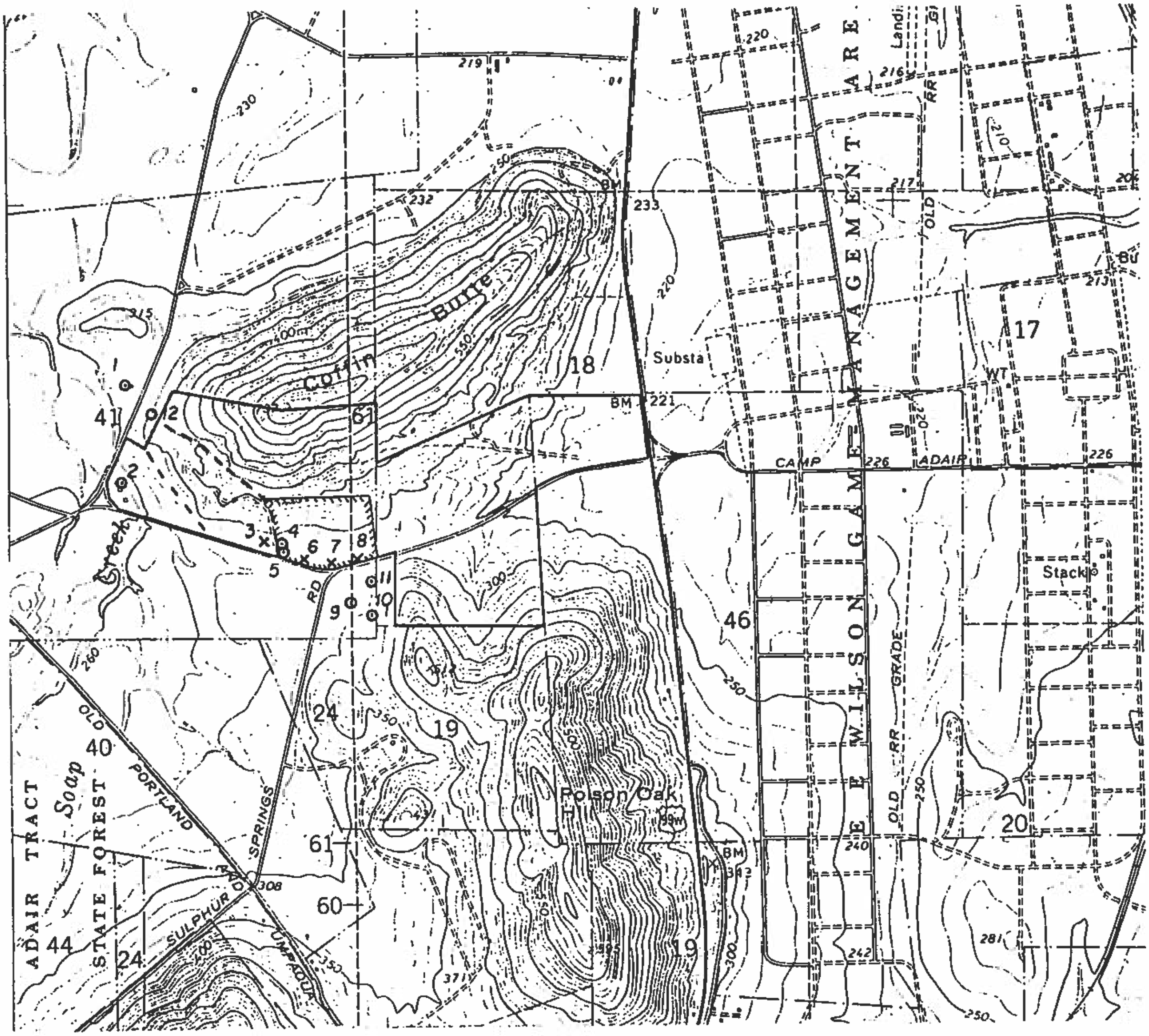
Location

Coffin Butte Sanitary Landfill is located on the southwest flank of Coffin Butte and the expansion area is to the west of the existing operation, see Figure 1. The site entrance is just under one mile west of Highway 99W. The existing area and part of the expansion area are in the NW¼, SE¼, Sec. 13, T 10 S, R 5 W, W.M. with additional expansion area in NW¼, SW¼, Sec. 18, T 10 S, R 4 W, W.M., all in Benton County.

Background

The Coffin Butte Landfill was originally sited in a quarry and operated as a burning dump for about 23 years. In 1971-72 upgrading of the operation at the site was initiated. Since that time, the site has added improved moisture routing systems including up-gradient cutoffs; better shaping and covering procedures on refuse lifts; and down-gradient collection, lagoon holding, and irrigation of leachate contaminated water.

In a letter from Valley Landfills to the Department of Environmental Quality, dated April 14, 1976, the "Proposed Closeout of Existing Coffin Butte Sanitary Landfill" was outlined. This phased closeout and the concomitant development of the expansion area is well underway. Development plans for the expansion area follow.



LEGEND

⊙ – *Water well, see Appendix B*

× – *Monitoring well, see Fig. 4 and Appendix B*

——— *Property line*

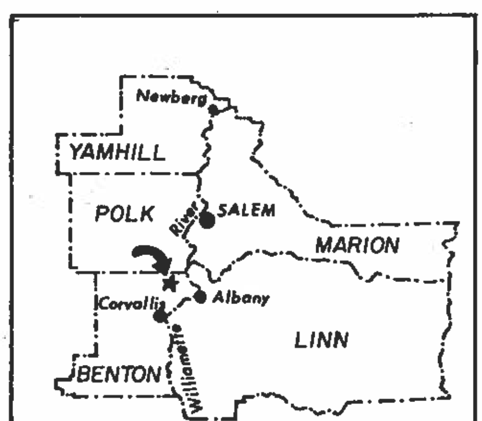
- - - - - *Existing operation*

Expansion area

0 ¼ ½ ¾ 1 Mile

0 1000 2000 3000 4000 5000 Feet

COFFIN BUTTE LOCATION



VICINITY MAP

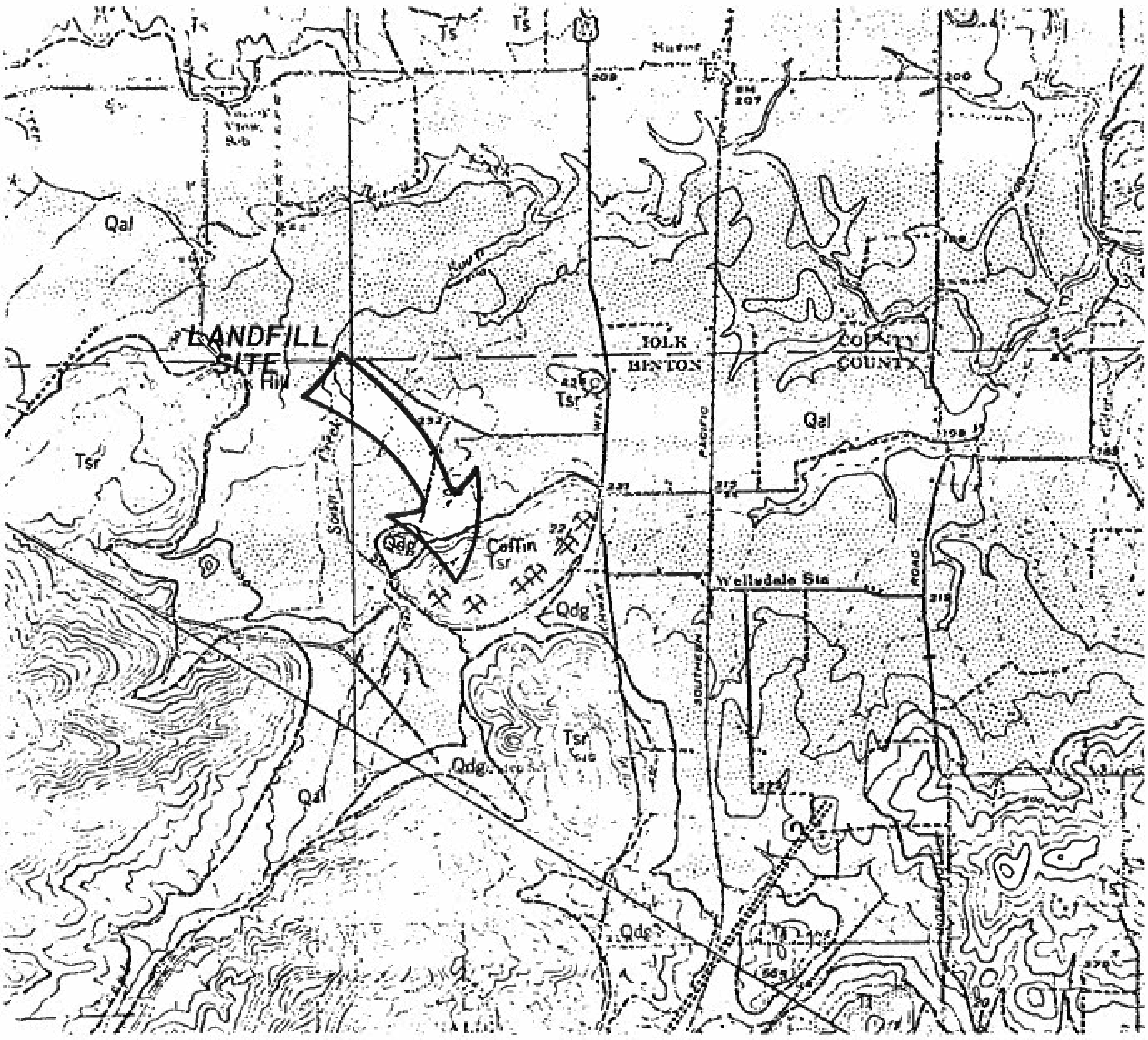
FIGURE 1

GEOLOGY

Coffin Butte has been mapped as part of the Siletz River volcanic series (Sr) by Vokes et. al. (1954), see Figure 2. This series reportedly includes the oldest rocks (lower Eocene) cropping out in the area and consists of "a thick sequence of zeolitic pillow lava, basaltic flows, flow breccia, minor amounts of interbedded tuffaceous siltstone and fine tuff, and an overlying sequence of thin-bedded tuffaceous siltstone and tuff that is somewhat shalely in places".

The west end of Coffin Butte as well as that area between Coffin Butte and Poison Oak Hill to the south are reportedly underlain by decomposed gravels (Qdg), see Figure 2. This poorly consolidated sand and gravel with minor amounts of silt and clay is found in partly disected benches of lower Pleistocene age. The source material for the gravels is assumed to be the older Spencer Formation (Vokes et. al., 1954).

Geologic mapping and geophysical work, seismic survey, were carried out at the site in the Spring of 1975 in order to locate and inventory the quarry rock and overburden as well as more fully describe surface and subsurface moisture routing, see following section and Appendix C. Seismic probing was performed with a Bison 1570 B Signal Enhancement Seismograph. Locations of seismic probling sites are shown on Plate I and the profile information developed in the survey is included in the cross-sections on Plate II and in Appendix C.



(Vokes, et. al., 1954)

Qdg

Decomposed gravels

Partly consolidated sand and gravel, with minor amounts of silt and clay.

Tsrk
Tsr

Siletz River volcanic series

Pillow lavas, basalt flows, and breccia, with interbedded tuffaceous siltstone and sandstone; Kings Valley siltstone member, Tsrk, thin-bedded shaly tuffaceous and tuff.

COFFIN BUTTE GEOLOGY MAP

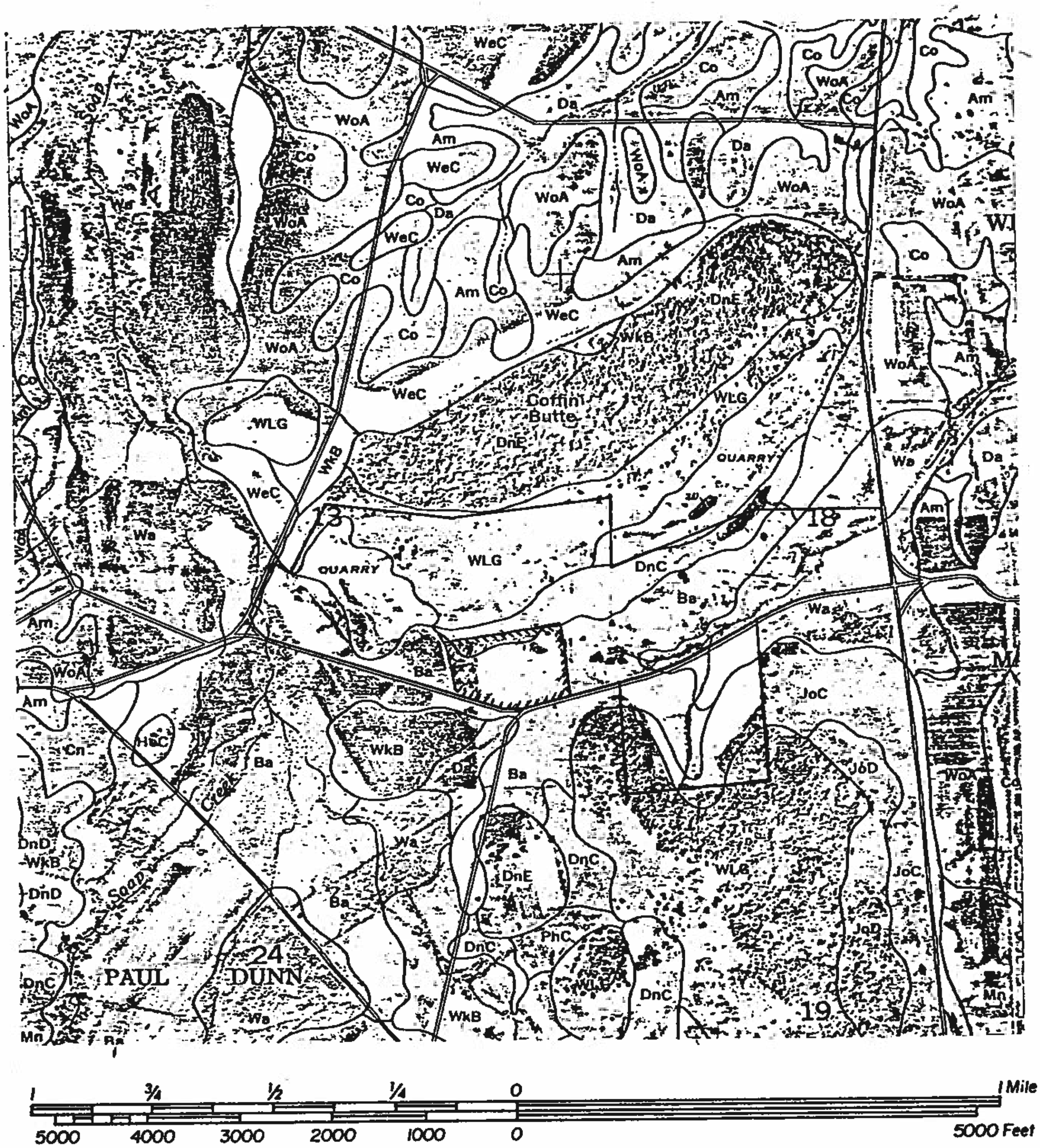
FIGURE 2

SOILS

General soils mapping in the vicinity of Coffin Butte has been completed by the Soil Conservation Service and is published as the Soil Survey of Benton County Area, Oregon, see Figure 3. Soils mapped at the site include Witzel very cobbly loam (WLG) in the upper portions of the site; Dixonville silty clay loam (DnC) on the side hill; and Bashaw silty clay loam (Ba) in the southern lower area adjacent to the county road.

In 1973, CH_2M-Hill excavated and logged six backhoe test pits in the area east of the existing landfill operation, see Appendix A. In February, 1977, nine additional test pits were excavated and logged in the proposed expansion area, see Plate I and Appendix A.

The information from the soils investigations is employed in the development plan for the expansion area. The lower portion of the expansion area (Bashaw silty clay loam and Dixonville silty clay loam) has a heavy gray and very dark brown silty clay and clay at relatively shallow depths. These layers generally produce perched water tables during the winter months, due to their very slow permeability or hydraulic conductivity and high winter precipitation. The impervious nature of the clayey material was confirmed through laboratory analysis, see "Development Plan" section and Appendix A. The highly plastic clays have reported coefficients of permeability ranging from 10^{-6} to 10^{-8} cm/sec (10^{-2} to 10^{-4} gal/day/ft.^{2}; 10^{-3} to 10^{-5} ft/day). These clays were placed and compacted at slightly wet of optimum moisture content in the down-gradient berm. This generally results in a reduced permeability and the coefficient of permeability of the berm core has been conservatively estimated to be 10^{-6} cm/sec (10^{-2} gal/day/ft^2; 10^{-3} ft/day).

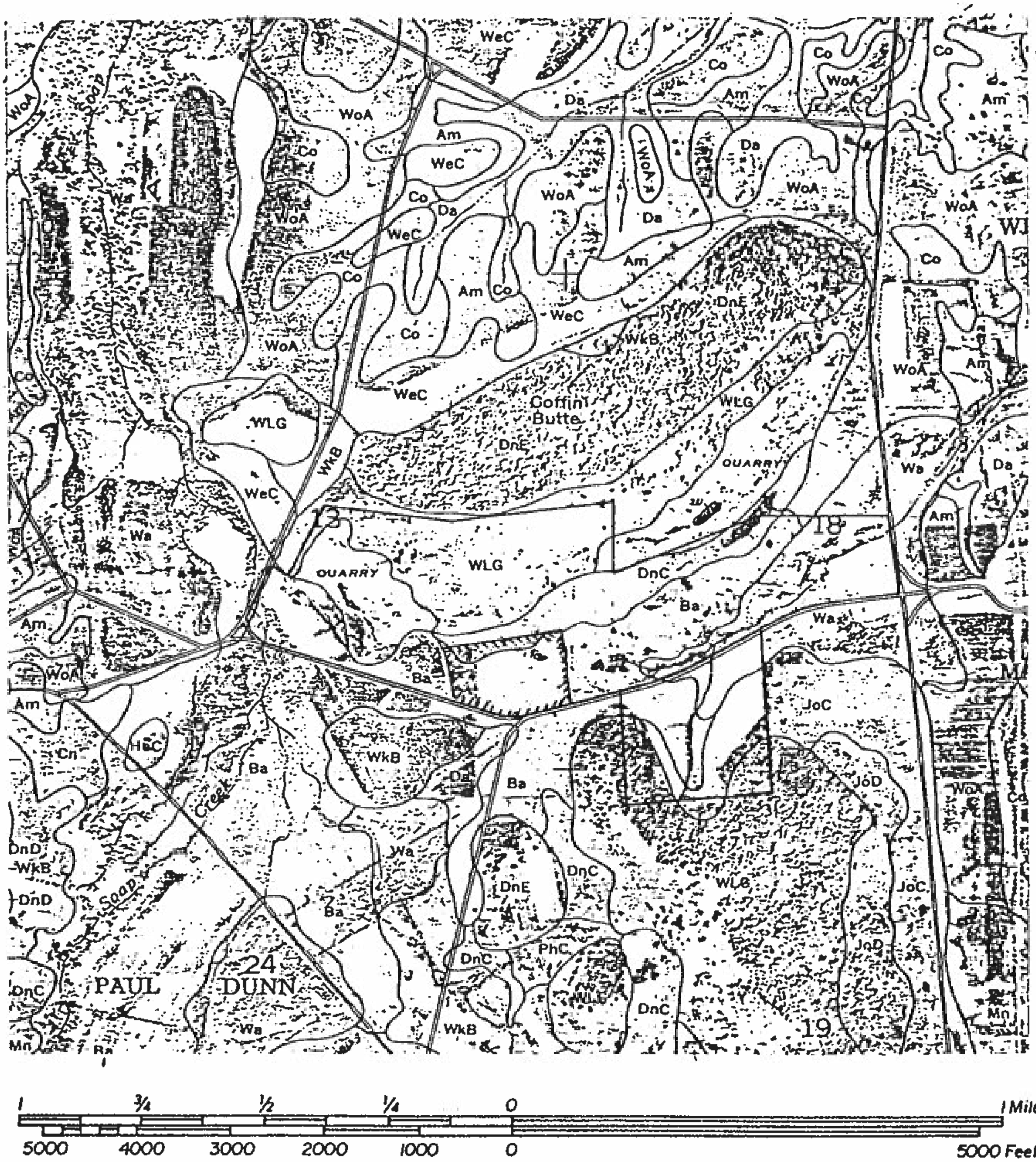


LEGEND

———	Property line
┬┬┬┬┬	Expansion area
WLG	Witzel very cobbly loam
DnC	Dixonville clay loam
Ba	Bashaw silty clay loam

COFFIN BUTTE SOILS MAP

FIGURE 3



LEGEND

———	Property line
┬┬┬┬┬┬	Expansion area
WLG	Witzel very cobbly loam
DnC	Dixonville clay loam
Ba	Bashaw silty clay loam

COFFIN BUTTE SOILS MAP

FIGURE 3

HYDROLOGY

Climate

Corvallis receives over 37 inches per year of incident precipitation. Johnsgard (1963) has reported that 26.8 inches per year of pan evaporation have been measured for the area. Prevailing winds in the vicinity of Coffin Butte are reportedly southerly and south-westerly from September to May with northerly-northwesterly winds during the remainder of the year. The hilly area in the site vicinity breaks up the prevailing wind patterns and results in more complex local pattern at the site.

Surface Water

The Coffin Butte area receives about 40 inches per year of precipitation. Much of the incident precipitation flows downslope from the upper portions of Coffin Butte as sheet runoff as well as via a number of poorly developed swales, see Plate I. In the lower portions of the site, natural drainage channels are better developed but remain intermittent in nature. Much of the natural surface drainage has been disrupted by previous quarrying activities at the site as well as the cutoff and diversion drains which have been installed to date, see Plate I.

Ground Water

Some surface water at Coffin Butte infiltrates into the soil and weathered bedrock. In the upper portion of the site, much of the infiltrating water percolates downward to the interface between the denser basaltic bedrock and overlying weathered surface materials. The perched ground water then moves down-gradient along this interface. Much of this perched ground water is discharged to the surface again in the quarry walls, road cuts, and in springs and seeps in other areas, where the surface of the denser bedrock is exposed or near the surface.

In the lower portion of the site, ground water is perched on the heavy gray clayey material described under soils. This perched water drains to swales and ditches and during the wetter winter months saturates the shallow soil profile.

The saturated zone (areal water table) has been developed in the lower portions of the site. Eleven water wells in the vicinity of the site are shown on Figure 1 and available well logs are included in Appendix B. Reported well depths range from 28 to about 50 feet having discharges ranging from 1.5 to 40 gal/min. Although the discharge/drawdown relationships are only reported for short term bailer tests, a specific capacity of less than 1 gpm/ft. is calculated and a correspondingly very low hydraulic conductivity in the fractured bedrock is indicated for the on-site wells.

Moisture Routing

Leachate production is a direct result of saturation of the refuse. Infiltrating precipitation and runoff are the primary sources of water at this site. Moisture routing at the landfill is aimed at diverting or re-routing surface as well as perched ground water away from the refuse prior to the contamination of the water by leachate.

The surface water is diverted via a system of ditches located throughout the site, see Plate I. Diversion of selected major swale drainage is shown on the plan. Some of this work has been carried out in conjunction with drainage improvements and the phased closeout at the existing operational area.

Perched ground water is generally intercepted and re-routed via deeper ditch systems. The previously mentioned geophysical investigation of the site indicated that relatively deep, 10 to 20 feet, cutoff ditches are required in the upper portion of the site, where the perched ground water moves along the bedrock surface. An existing haul road and quarry cut has been employed to develop this deeper cutoff, see Plate I. Shallower ground-water cutoff ditches are developed in the clayey material located in the lower portion of the expansion area.

On-site road ditches as well as the county road drainage system are employed to carry surface runoff as well as intercepted ground water away from the site.

DEVELOPMENT PLAN

Phased Closeout

Movement of large volumes of final cover from the proposed expansion area to the existing disposal area; the development of an integrated drainage network; utilizing available fill areas to their maximum potential; as well as taking advantage of the relatively short construction seasons at Coffin Butte has necessitated that the closeout of the existing site and construction of the expansion area be coordinated and phased, i.e. spread over a period of years.

The phased closeout of the existing operation at Coffin Butte, as outlined in our letter dated April 14, 1976, has been progressing as planned. Most of the surface area of the existing disposal area has now received final grading and cover and will be seeded with grass and clover this Fall, see Plate I. The final two refuse lifts will be placed in the upper portion of the existing site during the winters of 1977-78 and 1978-79; followed by grading, cover, and seeding, as outlined in Table 3.

During the development of the above work elements (also see Table 3) much of the construction in the proposed expansion area has been at least partially completed.

Expansion Area

The geology, soils, and hydrology of the proposed expansion area have been previously described and the topography and layout are shown on Plates I and II. The area covers about 22 acres. A series of refuse lifts with a maximum compacted waste materials depth of about 60 feet are to be deposited at the site.

TABLE 1

COFFIN BUTTE LANDFILL

MATERIALS BALANCE

Available Soils (cubic yards)

AREA	ML	CH	TOTAL
A	4,170	2,790	6,960
B	19,750	32,300	52,050
C	65,870	50,480	116,350
TOTAL	89,790	85,570	175,360

Soils Needs (cubic yards)

	ML	CH	TOTAL
Final Cover* (existing area)			50,000
Berm Core		6,220	6,220
Slopes	11,110		11,110
Expansion Cover**			98,070
TOTAL			165,400

Disposal Area Volumes (cubic yards)

	TOTAL	-	COVER	=	REFUSE
A	138,060	-	16,570	=	121,490
B	244,030	-	29,280	=	214,750
C	435,160	-	52,220	=	382,940
D***	338,600	-	40,630	=	297,970
TOTAL	1,155,850	-	138,700	=	1,017,150

* 12% of total fill, refuse plus cover, for intermittent plus final cover of compacted waste materials plus cover of existing refuse.

** 12% of total fill as above.

*** Existing operational area now being phased out.

Prior to the placement of wastes in the expansion area, topsoil and the clayey subsoil will be excavated to a depth of about 4 feet, see Table 1, leaving the plastic clay bottom in place, see "Soils" and "Leachate Collection".

As shown in Table 1, much of the topsoil from the expansion area is employed as final cover at the existing site. Berm construction, stockpiling intermittent cover and excavation and placement of intermittent and final cover in the expansion area account for the balance of the on-site soils, see Tables 1 and 3.

Coffin Butte Landfill accepts all solid wastes as defined by ORS 459.005 with certain exceptions as noted on Department of Environmental Quality's Solid Waste Disposal Permit No. 51.

A review of the volumes of wastes received at Coffin Butte during the past two years indicates that about 35 percent of the annual volume is received during the four summer months (June-September). This amounts to about 91,100 cubic yards (including cover) for summer disposal and a balance of 169,300 cubic yards (including cover) for winter disposal, see Table 2.

TABLE 2

COFFIN BUTTE LANDFILL PROJECTED ANNUAL WASTE VOLUMES, 1977-81

Linn and Benton Counties	
Present volume plus 10% based on 1976 to 1977 growth	58,900 tons/yr.
Polk County	
Transfer station plus direct haul, based on population of 28,000 to be served and .85 tons/capita/yr.	23,800* tons/yr.
Lincoln County (potential)	
Based on NORTEC reported volume of all wastes (17,000 tons/yr.) less demolition wastes and recycling	12,000** tons/yr.
TOTAL	94,700 tons/yr.

94,700 tons/yr. with an in-place density of 800 lbs./yd.^{3} will occupy 236,750 yd.^{3}/yr.

Add 10 percent of in-place volume for cover and the volume is:

260,400 yd.^{3}/yr.

35% Summer 91,100 yd.^{3}

65% Winter 169,300 yd.^{3}

* Chemeketa Region Solid Waste Management Program Appendix Vol. 3 reported in Table E-27 1978 projected waste volume of 22,907 tons/yr.

** Lincoln County Solid Waste Report

The sequential development of the expansion area will begin at the east end (Area C on Plate I) and generally proceed toward the west. Appropriate drainage, leachate collection, sumps, final cover placement, etc., will be carried out as outlined on Table 3. As the area is completed, final cover and development of an area for future expansion will begin.

TABLE 3

COFFIN BUTTE LANDFILL DEVELOPMENT SEQUENCE

Summer 1977
- Fill existing area (lower bench).
- Final cover on 60% of existing area.
- Begin berms for expansion area.
- Install monitoring and production wells in expansion area.

Winter 1977-78
- Fill existing area (upper lift).

Summer 1978
- Complete Area C French drain and leachate sump.
- Fill expansion Area C lower lift.
- Final cover 20% of existing area.
- Final cover lower portion of Area C.

Winter 1978-79
- Fill existing area (final bench).
- Final cover 20% of existing area.

Summer 1979
- Fill expansion Area C lower and second lifts.
- Seed final cover on existing area.

Winter 1979-80
- Fill expansion Area C upper lift.

Summer 1980
- Complete Area A and B French drain and leachate sump.
- Fill expansion Area C upper lift and Area B lower lift.
- Final cover Area B and C lower lift.
  upper

Winter 1980-81
- Fill expansion Area C and B upper lift and Area A lower lift.

Summer 1981
- Fill expansion area A lower and upper lift and Area B upper lift.
- Begin preparation of next expansion area.
- Final cover balance of lower lifts in this expansion area as well as appropriate upper lifts.

Winter 1981-82
- Fill balance of Area B and A and begin any necessary expansion on added lift above Area C.

Summer 1982
- Move to future expansion area.

Leachate Collection and Treatment

The above "Moisture Routing" section describes the theory and procedures for re-routing uncontaminated water away from the refuse, thus minimizing the volume of leachate generated at the site. In addition to the described cutoff systems, etc., an appropriately graded, compacted, and seeded final cover will be placed on the completed fill in order to minimize direct infiltration of precipitation into the compacted refuse.

However, this portion of the Willamette Valley receives about 40 inches of precipitation annually. Most of this falls during the winter months. This condition makes the total elimination of leachate production if not impossible, at least impractical. Therefore, even with the previously described precautions, a contingency leachate collection and treatment system is included in the site design.

The "Soils" section and Appendix A describe the plastic clays, and their attendant low hydraulic conductivity, underlying the expansion area. Concomitant with the movement of the final cover materials, i.e. topsoil, to the existing operational area, the construction of a designed, keyed, compacted down-gradient beam and moisture barrier has been carried out, see Plates I and II. As explained under "Soils" and in Appendix A, this berm in conjunction with the clayey subsoil "should provide a satisfactory barrier against seepage from the (expansion) landfill area".

A down-gradient leachate collection system has been placed at the inside toe of the berm, see Plates I and II. The collection ditches are presently open to facilitate winter measurement of runoff flow and as such estimate the maximum possible leachate flow in the completed collection system. Prior to the placement of refuse in the expansion area, perforated pipe and a gravel backfill will be placed in the appropriate ditches. NOTE: as sequential landfilling proceeds up-slope, the mid-slope ditch will also be converted to a French drain for leachate collection. These French drain systems will then route collected leachate to sumps where the leachate will be pumped to appropriate lagoons and thence to effluent irrigation systems, see Plate I.

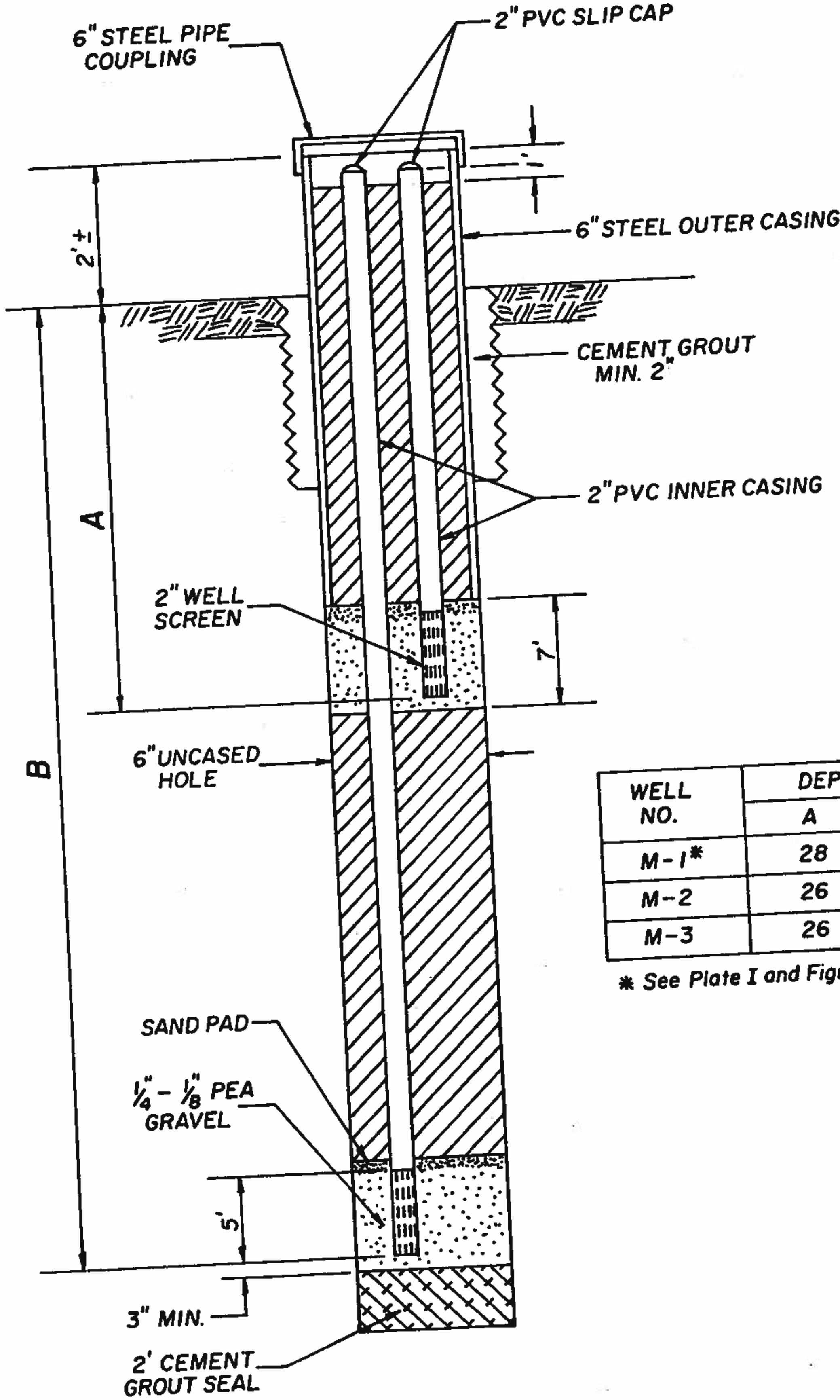
In order to finally check the effectiveness of the plastic clay bottom seal; down-gradient moisture barrier and leachate collection system; and to directly measure their effectiveness, three double completion piezometer monitoring wells have been installed on the down-gradient, south side of the expansion area, see Plate I and Figure 4. A fourth existing well has been cleaned and modified below the present Wah Chang disposal area and a fifth deeper well has been installed and developed to provide domestic water supply, on-site equipment wash-down, and supplemental fire protection, see Plate I.

The piezometers have been installed prior to the placement of any refuse so that their sampling can provide background water quality information. It should also be noted that they are between the fill area and any potential ground-water users, and that they sample both the perched ground water at the weathered bedrock interface and the deeper weathered bedrock aquifer. The still deeper water supply well is cased and sealed through these less productive zones and can provide samples from within the bedrock unit.

LONG RANGE PLAN

Valley Landfills, Inc. and its parent corporation, Waste Control Systems, Inc., are actively involved in resource recovery, see Appendix C of Roche Road Expansion Plan, dated May 9, 1977. As resource recovery is implemented, the volume of waste to be disposed of at the landfill will be reduced. However, since the timing of resource recovery implementation has not yet been firmly established, and given its immediate implementation there would and will be a residuals disposal need, we consider it prudent to continue with long-range disposal planning at the Coffin Butte Regional Sanitary Landfill site.

Valley Landfills, Inc., controls over 200 acres at Coffin Butte, see Figure 1. We anticipate raising the elevation of Area C (Plates I and II) and borrowing final cover for the present expansion area from that portion of the property which is immediately east of this expansion. Movement of this cover will be concomitant with the development of this adjacent area, in a manner similar to that described in this report.



WELL NO.	DEPTH IN FEET	
	A	B
M-1*	28	40
M-2	26	60
M-3	26	55

* *See Plate I and Figure I, No.'s 6-8.*

MULTIPLE COMPLETION MONITORING WELL

FIGURE 4

BIBLIOGRAPHY

Johnsgard, G. A., 1963, Temperature and the Water Balance for Oregon Weather Stations: Ag. Exp. Sta. Spec. Rpt. 150, Ore. St. University, Covallis, 124 p.

Soil Conservation Service, 1975, Soil Survey of Benton County Area, Oregon: U.S.D.A., S.C.S., in co-op. with Oregon Ag. Exp. Sta., 119 p.

Vokes, H. E., et. al., 1954, Geology of the Southwestern Border Area of the Willamette Valley, Oregon: U. S. Geol. Survey Oil and Gas Inv. Map OM-150.

APPENDICES

APPENDIX A

Coffin Butte Landfill
Backhoe Test Pit Data
See Plate I for locations

2/29/77
cloudy w/recent rain

Machine: Case 580C
Operator: Charley Lambery
for Wildish
By: H. R. Sweet

TP #1
Scalped area adjacent to entrance road (cut ~3 ft.)

0-3.0	Dk. Brn. topsoil (~75% clay)
3-7.5	Dk. Brn. clay w/minor gravel frags.
7.5-10.0	Colluvial material w/angular-subangular frags. and silt-clay matrix (dry).

Remarks: all dry below shallow perched surface water.

TP #2
100 ft. N. of driveway entrance on Sulphur Sp. Rd.
@ E. end of expansion area.

0-2.5	Dk. Brn. silty-clay topsoil w/perched water seep @ interface.
2.5-6.5	Lt. Gray clay w/minor silt.
6.5-12.0	Lt. Brn. weathered culluvium w/clayey matrix.

Remarks: dry below perched zone.

TP #3
N 20W from tree adjacent Sulphur Sp. Rd. (@ Hs.) ~100 yds. from Rd. on rise, E. of break.

0-2.5	Dk. Brn. loamy clay topsoil w/perched seep @ interface.
2.5-6.5	Dk. Gray clay w/films, subangular blocky structure.
6.5-12.0	Lt. Brn. & Yellow weathered colluvium w/water seep in sandy seam @~10 ft., otherwise unsat. Silt and clay matrix.

TP #4
Along N. middle fence. Overburden above profile.

0-0.5	Dk. Brn. clayey loam topsoil.
0.5-4.5	Cobbly overburden w/silty clay matrix.
4.5-7.0	Gray clay w/minor silt and gravel, subangular blocky structure and clay films.
7.0-12.0	Weathered colluvium w/clay and silt matrix.

TP #5
NW corner of expansion area, E. of scalped area, near top fence line.

0-3.0	Dk. Brn. clayey loam topsoil w/perched water @ interface.
3.0-12.0	Weathered colluvium w/sand, silt, and clay matrix. Sand seams and water seeps @ 4.5, 5.5, and 7 ft.

TP #6

E. of scalped area @ elev. equal to TP #1.

0-1.5 Dk. Brn. loamy clay topsoil w/perched water @ interface.

1.5-6.5 Dk. Gray clay, subangular blocky structure w/clay films and irregular interface.

6.5-12.0 Weathered Lt. Brn. colluvial material ( ) sandy-clayey matrix.

TP #7

E. of shack and swale, ~100 ft. S. of scalped area E-W baseline.

0-2.0 Dk. Brn. loamy clay topsoil w/minor perched seeps @ interface.

2.0-4.0 Dk. Gray clay w/blocky subangular structure.

4.0-6.5 Dk. Gray clay (dryer) w/blocky structure.

6.5-12.0 Lt. Brn. weathered colluvial materials.

TP #8

SW corner of expansion area, ~ berm area.

0-3.0 Dk. Brn. loamy clay topsoil w/perched seeps @ interface.

3.0-9.0 Dk. Gray heavy clay, unsat., w/clay films.

9.0-12.0 Lt. Brn. weathered colluvium w/sand, silt, and clay matrix.

TP #9

N. of Sulphur Sp. Rd. Junction, ~ berm area.

0-2.0 Dk. Brn. loamy clay topsoil w/perched seep @ interface.

2.0-7.0 Dk. Gray clay, heavy, clay films, unsat.

7.0-9.0 Lt. Brn. weathered colluvium.

TP #10

Apparent rocky zone in scalped portion of expansion area, topsoil stripped.

0-1.0 Gray clay.

1.0-4.0 Lt. Brn. weathered colluvium w/silt and clay matrix. Water seep in weathered gravel @ 4.0.

4.0-9.0 Gravel and boulders, highly weathered, easy breakage w/silt and clay matrix.

Remarks: Lower 4 ft. plus excavable w/backhoe and suitable for daily cover.

Also, appended is CH_2M-Hill data from 9/18/73 w/approximate locations shown on Plate I.

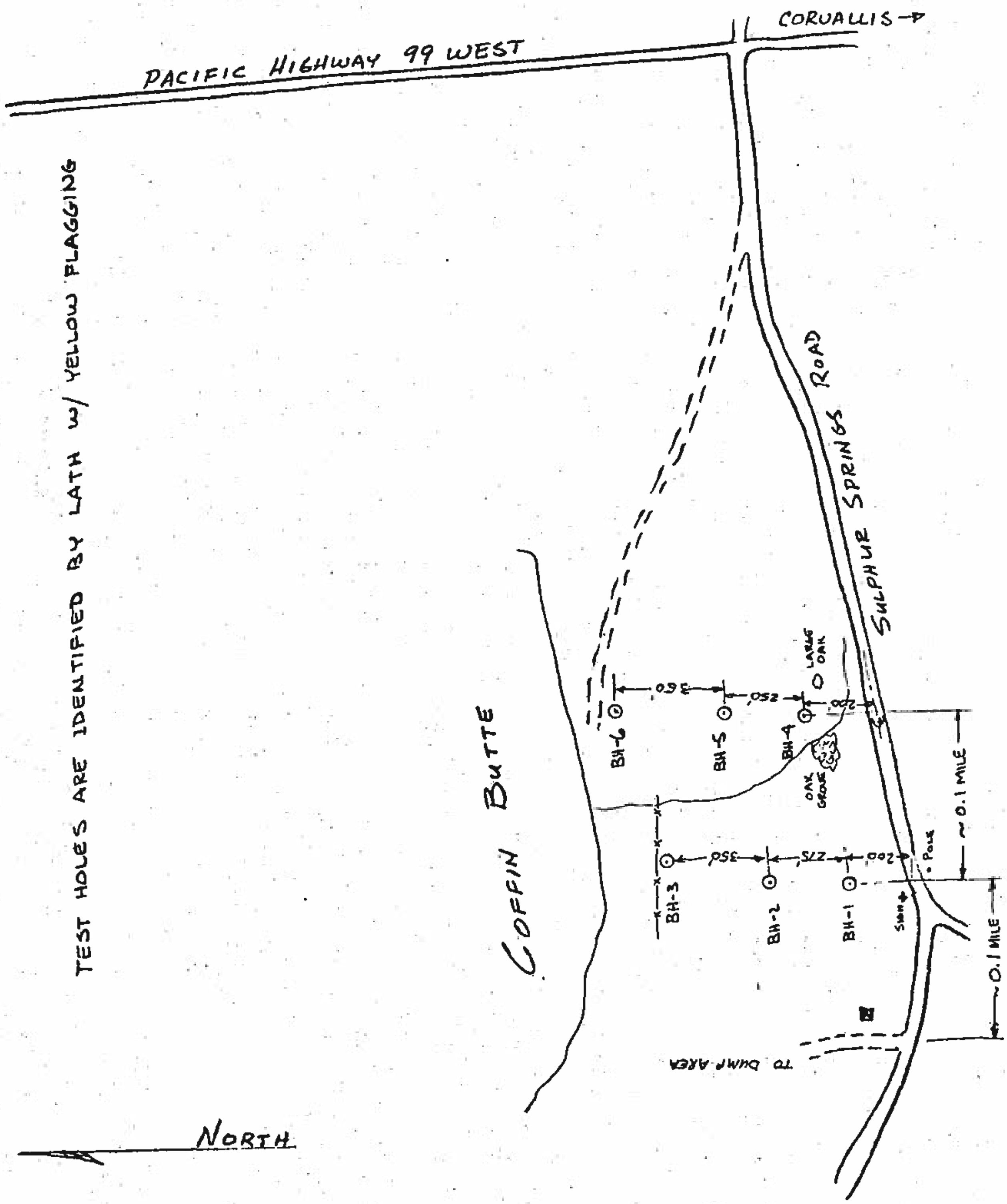
TP #11 & #12

Locations of sampling stations for water content and Atterberg limits determinations, see appended Schroeder report dated 8/2/77.

CH2M HILL — ENGINEERS, PLANNERS, ECONOMISTS

SUBJECT: LOCATION OF TEST HOLES
CORVALLIS DISPOSAL COMPANY
SOLID WASTE DISPOSAL SITE

BY R. J. BELL DATE 18 SEPT 73
SHEET NO. 1 OF 2
PROJECT NO. C7140.0



CH2M HILL — ENGINEERS, PLANNERS, ECONOMISTS

SUBJECT: SOIL PROFILE FOR CORVALLIS DISPOSAL COMPANY SOLID WASTE DISPOSAL SITE

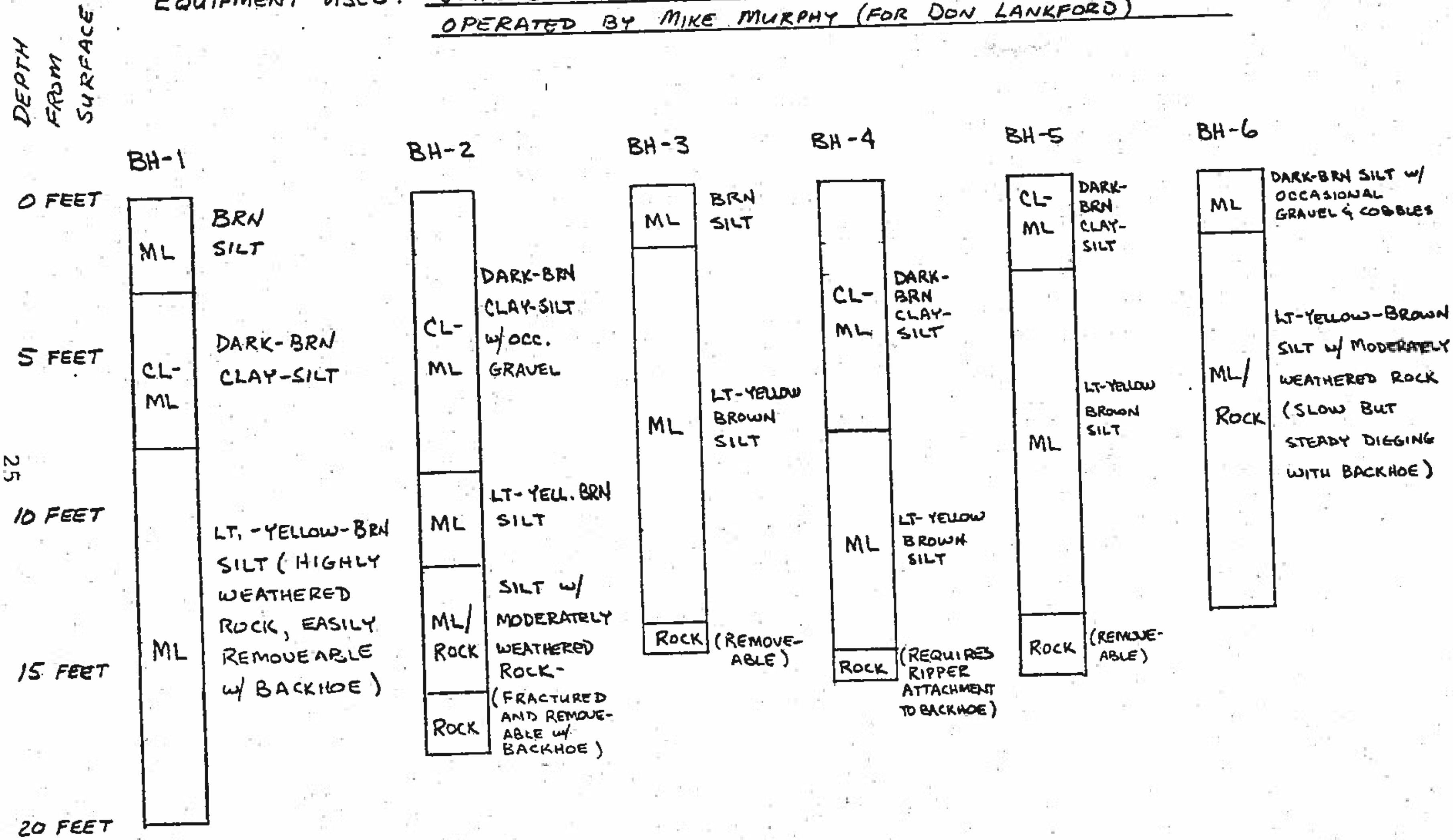
BY R.J.BELL DATE 18 SEPT 73

SHEET NO. 2 OF 2

PROJECT NO. C7140.0

LOCATION: SOUTH EAST SIDE OF COFFIN BUTTE, BENTON COUNTY

EQUIPMENT USED: JOHN DEERE JD 500 SERIES B BACKHOE OPERATED BY MIKE MURPHY (FOR DON LANKFORD)



FORM 18

W. L. SCHROEDER
GEOTECHNICAL ENGINEER

529 N.W. 34TH STREET
CORVALLIS, OREGON 97330

August 2, 1977

Valley Landfills, Inc.
P.O. Box 1
Corvallis, OR 97330

ATTENTION: Mr. Bill Webber, Project Manager

Dear Mr. Webber:

We have monitored, at your request, the construction of an embankment to enclose the proposed expansion of the Coffin Butte landfill site near Corvallis, Oregon. The scope of our work was limited to the investigation and testing of near-surface soils and the specifications for and quality control of compaction work for the core of the embankment.

Examination of two shallow excavations and laboratory testing of typical soil samples from those excavations indicated that the typical soil profile at the site consists of a 2-foot cover of a friable, low plasticity silt underlain by a 4 to 6-foot layer of highly plastic clay. These soils would be classified as ML and CH, respectively in the Unified Soil Classification System. The clay (CH) may be considered relatively impervious. Table 1 summarizes the natural water contents and Atterberg limits determined for the two soil types encountered.

Table 1. Natural water contents and Atterberg limits for typical soils.

Sample No.	Sample depth (ft.)	Water content W_n (%)	Plastic Limit PL	Liquid Limit LL	Plasticity Index PI
1	1	variable	30	45	15
2	3	30-31	31	68	37

Two moisture-density curves (ASTM D698) were determined for samples of the fill material used in the embankment core. These tests showed that the clay soil had an average maximum dry density of 97 pcf at an optimum water content of 24 to 27 percent.

The constructed embankment has a 10-foot high, 6 to 8-foot wide core of relatively impervious clay with adjacent embankments of silty topsoil. The outer slopes of the fill are 2:1 and 3:1 on the inboard and outboard faces, respectively (see Figure 1). The core region was keyed into the existing clay layer to a depth of about 2 to 3 feet.

The purposes of the embankment core are to retain, together with the underlying clay layer, any leachate from the landfill and to prevent contamination of the local groundwater. The permeability of the core is, therefore, of primary concern.

The permeability of compacted fine-grained soils depends on the volume and size of intergranular voids, the water content of the soil during compaction, and the type of soil. The in-place clay had an average water content of about 30 to 31 percent and an in-place dry density equivalent to about 85 to 86 percent relative compaction. Highly plastic clays, such as those encountered, have coefficients of permeability ranging, typically, from 10^{-6} to 10^{-8} cm/sec; that is, they are relatively impervious.

It is presumed that the embankment is not intended to carry any structural loads. It is intended as a water barrier. It was felt, therefore, that compacted densities equal to or exceeding the insitu material would ensure a relatively impervious barrier with uniform properties which would adequately impede the flow of water and contain the fill. A minimum relative compaction of 85 percent was specified for the compaction work in the embankment core. The fill material in the core was placed slightly wet of optimum water content. Fills compacted wet of optimum tend to have lower permeability than fills placed dry of optimum and are less susceptible to cracking over a period of years.

The core material was placed in approximately 12 inch lifts and compacted with a sheepsfoot roller. Within the critical key area, the fill was compacted with up to 20 passes of the roller. Higher, and less critical, lifts were compacted with an average of 6 to 8 roller passes, according to our periodic observations.

Five sand core field density tests (ASTM D1556) were conducted within the core at various depths of fill. The compacted dry densities equaled or exceeded the specified value in four of five tests. Pockets of silt encountered occasionally within the core were found to be isolated and should not significantly affect permeability characteristics of the core. Summarized test results are enclosed.

It is our opinion that the core for the embankment was constructed to specifications with satisfactory compaction. We further believe it will be conservative to assume a value for the coefficient of permeability of 10^{-6} cm/sec for the core in any subsequent analysis, although if sensitive analyses are required, tests should be run to confirm this. The embankment core should, in our opinion, provide a satisfactory barrier against seepage from landfill areas.

Sincerely,

W. L. Schroeder, P.E.

,dm

Enc

3 AUGUST 1977
W.L. SCHROEDER
FOR VALLEY LANDFILLS, INC.

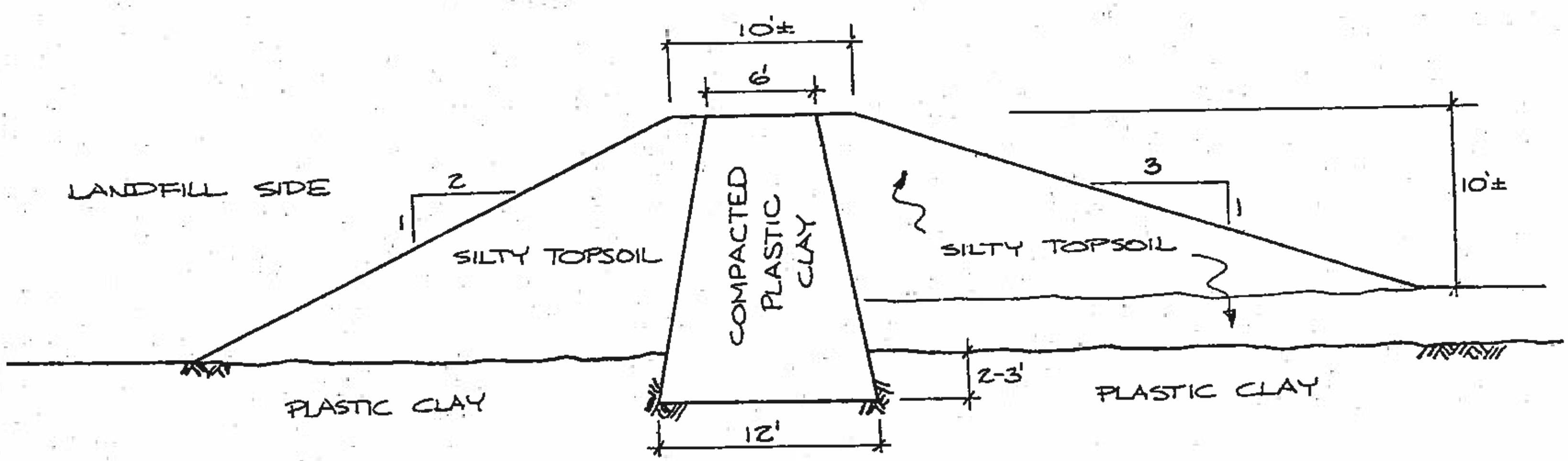


FIGURE 1
TYPICAL EMBANKMENT SECTION
COFFIN BUTTE LANDFILL
CORVALLIS, OREGON

W. L. SCHROEDER
GEOTECHNICAL ENGINEER
529 N.W. 34TH STREET
CORVALLIS, OREGON 97330

FIELD DENSITY TEST REPORT

Project: Coffin Butte Landfill

Test Date: July 13, 1977

Test Method: Sand Cone--ASTM D1556

Test Location: 200 ft. from end of west core section

Fill Depth: 3 ft.

Test Depth: 6 in.

Field Dry Density (A): 88.9 pcf

Field Water Content: 26.0%

Laboratory Maximum Dry Density * (B): 97.0 pcf

Laboratory Optimum Water Content *: 25.5%

Relative Compaction (100 A/B): 92.0%

Specified Relative Compaction: 85.0%

Specified Field Water Content: Min. 24.0%

W.L. Schroeder, P.E.

* [X] ASTM D698 (AASHTO T99) [ ] ASTM D 1557 (AASHTO T180)

W. L. SCHROEDER
GEOTECHNICAL ENGINEER
529 N.W. 34TH STREET
CORVALLIS, OREGON 97330

FIELD DENSITY TEST REPORT

Project: Coffin Butte Landfill

Test Date: July 13, 1977

Test Method: Sand Cone--ASTM d1556

Test Location: 100 ft. from west end of dike

Fill Depth: 3 ft.

Test Depth: 6 in.

Field Dry Density (A): 90.7pcf

Field Water Content: 25.9%

Laboratory Maximum Dry Density * (B): 97.0 pcf

Laboratory Optimum Water Content *: 25.5%

Relative Compaction (100 A/B): 94.0%

Specified Relative Compaction: 85.0%

Specified Field Water Content: min. 24.0%

WLS

W.L. Schroeder, P.E.

* [X] ASTM D698 (AASHTO T99) [ ] ASTM D 1557 (AASHTO T180)

W. L. SCHROEDER
GEOTECHNICAL ENGINEER
529 N.W. 34TH STREET
CORVALLIS, OREGON 97330

FIELD DENSITY TEST REPORT

Project: Coffin Butte Landfill

Test Date: July 15, 1977

Test Method: Sand Cone--ASTM D1556

Test Location: 300 ft. from west end

Fill Depth: 6 ft.

Test Depth: 6 in.

Field Dry Density (A): 79.0 pcf

Field Water Content: 23.8%

Laboratory Maximum Dry Density * (B): 97.0%

Laboratory Optimum Water Content *: 25.5%

Relative Compaction (100 A/B): 81%

Specified Relative Compaction: 85.0%

Specified Field Water Content: min. 24.0%

W.L. Schroeder, P.E.

* [X] ASTM D698 (AASHTO T99)   [ ] ASTM D 1557 (AASHTO T180)

W. L. SCHROEDER
GEOTECHNICAL ENGINEER
529 N.W. 34TH STREET
CORVALLIS, OREGON 97330

FIELD DENSITY TEST REPORT

Project: Coffin Butte Landfill

Test Date: July 15, 1977

Test Method: Sand Cone--ASTM D1556

Test Location: 200 ft. from west end

Fill Depth: 6 ft.

Test Depth: 6 in.

Field Dry Density (A): 87.0 pcf

Field Water Content: 28.5%

Laboratory Maximum Dry Density * (B): 97.0 pcf

Laboratory Optimum Water Content *: 25.5%

Relative Compaction (100 A/B): 89.7%

Specified Relative Compaction: 85.0%

Specified Field Water Content: min. 24.0%

W.L. Schroeder, P.E.

* [X] ASTM D698 (AASHTO T99)   [ ] ASTM D 1557 (AASHTO T180)

W. L. SCHROEDER
GEOTECHNICAL ENGINEER

529 N.W. 34TH STREET

CORVALLIS, OREGON 97330

FIELD DENSITY TEST REPORT

Project: Coffin Butte Landfill

Test Date: July 19, 1977

Test Method: Sand Cone--ASTM D1556

Test Location: 400 ft. from west end

Fill Depth: 10 ft.

Test Depth: 6 in.

Field Dry Density (A): 82.6 pcf

Field Water Content: 33.3%

Laboratory Maximum Dry Density * (B): 97.0 pcf

Laboratory Optimum Water Content *: 25.5%

Relative Compaction (100 A/B): 85.1%

Specified Relative Compaction: 85.0%

Specified Field Water Content: min. 24.0%

W.L. Schroeder, P.E.

* [X] ASTM D698 (AASHTO T99)   [ ] ASTM D 1557 (AASHTO T180)

W. L. SCHROEDER
GEOTECHNICAL ENGINEER
529 N.W. 34TH STREET
CORVALLIS, OREGON 97330

FIELD DENSITY TEST REPORT

Project: Coffin Butte Landfill

Test Date: July 19, 1977

Test Method: Sand Cone--ASTM D1556

Test Location: in-place material, in front of dike

Fill Depth: N/A

Test Depth: 6 in.

Field Dry Density (A): 85.6 pcf

Field Water Content: 32.9%

Laboratory Maximum Dry Density * (B): 97.0 pcf

Laboratory Optimum Water Content *: 25.5%

Relative Compaction (100 A/B): 88.0%

Specified Relative Compaction: 85.0%

Specified Field Water Content: min. 24.0%

W.L. Schroeder, P.E.

* [X] ASTM D698 (AASHTO T99) [ ] ASTM D 1557 (AASHTO T180)

APPENDIX B

WATER WELL DATA
(see Figure 1)

1. Albert Armstrong - see attached log
Route 1, Box 174
Monmouth, OR

2. Chris Whitaker - see attached log
Route 1, Box 176 A4
Monmouth, OR

3. Robert Bunn - see attached log
well abandoned and re-developed for
monitoring purposes, M-1

4. C. Reed - no log available
Reported 46 ft. with no seal.
To be abandoned during expansion.

5. Valley Landfills - see attached log
Production well

6. Valley Landfills - M-2

7. Valley Landfills - M-3

8. Valley Landfills - M-4

9. S. F. Phillips
Route 1, Box 304 A
Monmouth, OR

10. Frank W. Helm
Route 1, Box 303 L
Monmouth, OR

11. Route 1, Box 305 A (Duplex - no log)

12. Spring

COFFIN BUTTE EXPANSION
MONITORING WELLS

M-1*

0-2 topsoil
2-8 brown clay (sticky)
8-40 brown weathered basalt (broken)
water: 1/2 gal/min @ 24 ft.
2 gal/min @ 52 ft.

	Perforated	Gravel Pack
piez. 1	23-28	21-28
piez. 2	35-40	34-40

M-2

0-1 topsoil
1-7 brown clay (sticky)
7-60 brown weathered basalt (broken)
water: 1/2 gal/min @ 23 ft.
1/2 gal/min @ 34 ft.
1 gal/min @ 54 ft.

	Perforated	Gravel Pack
piez. 1	21-26	19-26
piez. 2	55-60	54-60

M-3

0-1 topsoil
1-9.5 brown clay (sticky)
9.5-55 brown weathered basalt (broken)
water: 1/2 gal/min @ 24 ft.
2 gal/min @ 52 ft.

	Perforated	Gravel Pack
piez. 1	21-26	20-26
piez. 2	50-55	48-55

M-4

See Bunn Well Log.
Bore hole cleaned for monitoring use.

*see Plate I and Figure 1 .

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

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

(Do not write above this line)

State Well No. ....

State Permit No. ....

(1) OWNER:
Name: Valley Land Fill Inc.
Address: P.O.Box 1
Corvallis, Oregon 97330

(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 60 ft. Gage .250
...... " Diam. from ...... ft. to ...... ft. Gage ......
...... " Diam. from ...... ft. to ...... 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.

(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.
" " " "
Tested with [illegible]
Bailer test 12 gal./min. with [illegible] ft. drawdown after [illegible] hrs.
Artesian flow ...... g.p.m.
Temperature of water ...... Depth artesian flow encountered ...... ft.

(9) CONSTRUCTION:
Well seal—Material used [illegible]
Well sealed from land surface to ...... ft.
Diameter of well bore to bottom of seal ...... in.
Diameter of well bore below seal ...... in.
Number of sacks of cement used in well seal ...... sacks
How was cement grout placed? ....
Pumped through tremie
[illegible]

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: ......

(10) LOCATION OF WELL:
County Benton Driller's well number S/76/K
¼ ¼ Section 15 T. 10S R. 5W W.M.
Bearing and distance from section or subdivision corner ....

(11) WATER LEVEL: Completed well.
Depth at which water was first found 89 ft.
Static level 20 ft. below land surface. Date 8/3/77
Artesian pressure ...... lbs. per square inch. Date ......

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 125 ft. Depth of completed well 125 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
[illegible]	0	1	
[illegible]	1	3	
[illegible]	3	14	
Brown sandstone [illegible]	14	52	
[illegible]	52	80	
[illegible]	80	83	
Black [illegible]	83	89	
[illegible]	89	91	
[illegible]	91	107	
Brown [illegible]	107	109	
[illegible]	109	125	

Work started 8/3/77 19 Completed 8/3/77 19
Date well drilling machine moved off of well 8/3/77 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] [illegible] (Drilling Machine Operator) Date 8/4/77 19
Drilling Machine Operator's License No. 609

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 Corvallis Drilling Co. Inc. (Person, firm or corporation) (Type or print)
Address 3440 SW 3rd St. Corvallis, Oregon
[Signed] [signature] (Water Well Contractor)
Contractor's License No. 560 Date 8/4/77 19

38

See Figure 1, 1

RECEIVED FEB 1 1 STATE ENGINEER SALEM, OREGON

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. 10/5W-13E

State Permit No. ....

(1) OWNER:
Name Albert Armstrong
Address 3520 Spicer Rd
Albany Oregon

(2) LOCATION OF WELL:
County N.W Benton Driller's well number 9
SW ¼ NW ¼ Section 13 T. 10 S R. 5 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 +1 ft. to 28 ft. Gage 250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? ☒ Yes ☐ No
Type of perforator used Torch
Size of perforations 1/2 in. by 9 in.
15 perforations from 19 ft. to 23 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. X Slot size X Set from X ft. to X ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Well seal—Material used in seal Cement Grout
Depth of seal 5 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: X
Gravel placed from X ft. to X ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Soft Depth of strata 23'
Method of sealing strata off X

(10) WATER LEVELS:
Static level 4 ft. below land surface Date 2-10-64
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 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 below casing 6
Depth drilled 28 ft. Depth of completed well 28 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
Sand + Cavings	19	22
New Basalt	22	28

Work started 2-6 1964 Completed 2-10 1964
Date well drilling machine moved off of well 2-10 1964

(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 Ace Drilling Co.
(Person, firm or corporation) (Type or print)
Address Albany Oregon
Drilling Machine Operator's License No. 32
[Signed] Bill Hamilton
(Water Well Contractor)
Contractor's License No. 85 Date 2-12, 1964

(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 97310
within 30 days from the date of well completion.

RECEIVED JUL 9 1964 STATE ENGINEER SALEM, OREGON

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

State Well No. 10/5W-13

State Permit No.

(1) OWNER:
Name Chris Whitaker
Address Rt 1, Box 176-A4 Monmouth, Oregon 97361

(2) LOCATION OF WELL:
County Benton Driller's well number
¼ ¼ Section 13 T. 10 S R. 5W 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 45 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 ~~Bentonite~~ Cement
Depth of seal 30 ft. Was a packer used?
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 7 ft. below land surface Date 7-7-64
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 10 gal./min. with all ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water 51 Was a chemical analysis made? ☐ Yes ☐ No

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 50 ft. Depth of completed well 50 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
Soil	0	9
Blue Grey Clay	9	20
Broken Up Clay	20	24
Brown Clay	24	43
Yellow Sand	42	
Black Sand	43	
Sand, Gravel Clay	43	50
O.K. 7.5.		
No Iron Usable		
9 gr hard		

Work started 7-3 1964 Completed 7-7- 1964
Date well drilling machine moved off of well 7-7 1964

(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 Willamette Irrigation & Equip Co
(Person, firm or corporation) (Type or print)
Address Star Route #2, Box 5, Lebanon
Drilling Machine Operator's License No. 31
[Signed] Carl. H Saunders
(Water Well Contractor)
Contractor's License No. 49 Date 7-7, 1964

(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 10, OREGON within 30 days from the date of well completion.

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

State Well No. 10S/5W-13

State Permit No.

(1) OWNER:
Name Robert Bunn
Address 910 Fairhaven Hts.
Corvallis Ore

(2) LOCATION OF WELL:
County Benton Driller's well number
¼ ¼ Section 13 T. 10 S. R. 5 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 20 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 Bentonite
Depth of seal 18 ft. Was a packer used?
Diameter of well bore to bottom of seal 9 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 20 ft. below land surface Date July-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?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "
Bailer test 1½ 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 below casing 6
Depth drilled 50 ft. Depth of completed well 50 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	0	6
Brown Broken Rock	6	19
Black Basalt	19	50

Work started July 1962 Completed July 1962
Date well drilling machine moved off of well July 27 1962

(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 Bill Howell
(Person, firm or corporation) (Type or print)
Address Rt 2 Corvallis
Drilling Machine Operator's License No. 79
[Signed] Bill Howell
(Water Well Contractor)
Contractor's License No. 50 Date July, 1962

(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 97310
within 30 days from the date of well completion.

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

RECEIVED
JAN 26 1976
WATER RESOURCES DEPT
SALEM, OREGON

State Well No. ......
State Permit No. ......

(1) OWNER:
Name Sam Phillips
Address Rt 1 Box 304N
Corvallis Oregon

(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 60 ft. Gage .250
...... " Diam. from ...... ft. to ...... ft. Gage ......
...... " Diam. from ...... ft. to ...... 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.

(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 40 gal./min. with 35 ft. drawdown after 1 hrs.
Artesian flow ...... g.p.m.
Temperature of water 52 Depth artesian flow encountered ...... ft.

(9) CONSTRUCTION:
Well seal—Material used Cement
Well sealed from land surface to 20 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 10 sacks
Number of sacks of bentonite used in well seal ...... sacks
Brand name of bentonite ......
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 ~~Linn~~ Benton Driller's well number ......
¼ ¼ Section 13 T. 10 S R. 4 W W.M.
Bearing and distance from section or subdivision corner ......

(11) WATER LEVEL: Completed well.
Depth at which water was first found 30 ft.
Static level 22 ft. below land surface. Date 12-20-75
Artesian pressure ...... lbs. per square inch. Date ......

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 103 ft. Depth of completed well 103 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
Soil	0	2	
Brown sand (sticky)	2	30	22
Sand (fine brown)	30	60	
Grey Sandstone	60	75	22
Sandstone (Creamy Color)	75	80	
Grey White Sandstone (quartz)	80	92	
Blue Quartz in Sandstone	92	87	
Quartz	92	103	

Work started 12-1 1975 Completed 12-20 1976
Date well drilling machine moved off of well 12-20 1976

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] Carl H. Saunders (Drilling Machine Operator) Date 12-20, 1975
Drilling Machine Operator's License No. 31

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 Willamette Irrigation & Equip. (Person, firm or corporation) (Type or print)
Address Star Route #2 Box 5 Lebanon
[Signed] Carl H. Saunders (Water Well Contractor)
Contractor's License No. 49 Date 12-20, 1975

(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 - 7 1971
STATE ENGINEER
SALEM OR

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

State Well No. ....
State Permit No. ....

(1) OWNER:
Name Don Helm
Address 966 N. W. Sequoia St Corvallis, Oregon

(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 41 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to 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.

(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.
" " "
~~Tested with air estimated 300~~ GPH "could fluctuate"
~~Bailer test~~ gal./min. with 347 ft. drawdown after 1 hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Cement Grout
Well sealed from land surface to 39 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 6 sacks
Number of sacks of bentonite used in well seal sacks
Brand name of bentonite
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 Benton Driller's well number
¼ ¼ Section 24 T. 10S5W R. W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 76 ft.
Static level 43 ft. below land surface. Date 9-18-71
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing 6
Depth drilled 400 ft. Depth of completed well 400 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	3	
Yellow Clay	3	11	
Clay & Boulders	11	24	
Brown Sandstone soft	24	33	
Blue Sandstone	33	37	
Black Basalt	37	109	
Blue Black Cong.	109	163	
Black Basalt (Broken)	163	171	
Black Basalt	171	296	
Bleu Black Sandstone Cong	296	400	

Work started 9-16-71 19 Completed 9-18-71 19
Date well drilling machine moved off of well 9-18-71 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] [signature] (Drilling Machine Operator) Date 9-30-71, 19
Drilling Machine Operator's License No. 160

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 Casey Jones Well Drilling Co Inc (Person, firm or corporation) (Type or print)
Address R 8 Box 695 Pleasant Hill, Oregon
[Signed] [signature] (Water Well Contractor)
Contractor's License No. 105 Date 9-30-71, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

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APPENDIX C

COFFIN BUTTE - GEOLOGICAL AND GEOPHYSICAL INVESTIGATION

Location and Purpose

Coffin Butte Landfill site is located on the west and southwest side of Coffin Butte in Benton County, Section 13, Township 10 south, Range 5 west, W.M.

The purpose of this report is to describe the geology, hydrology, and hydrogeology of the site. The location, quality and volume of on-site basaltic rocks is calculated. Surface and relatively shallow subsurface runoff is described. Recommendations for the removal of the basaltic rocks and development of the disposal site is outlined.

Geology

Coffin Butte has been mapped as part of the Siletz River volcanic series by Vokes et. al. (1954). This series reportedly includes the oldest rocks cropping out in the area and consists of "A thick sequence of zeolitic pillow lava, basalt flows, flow breccia, minor amounts of interbedded tuffaceous siltstone and fine tuff, and an overlying sequence of thin-bedded tuffaceous siltstone and tuff that is somewhat shaly in places".

In the western quarry exposures flow volcanics and pillow lavas crop out. Bedded sandstone, siltstone, and shale crop out in the area of the deck (see map). There has been some apparent shear along the bedding planes and the formation of secondary silicic minerals. At the deck, gray-black aphanitic basaltic rocks with pyroxene phenocrysts crop out. To the east, highly weathered pillow lavas with palagonitic rinds and secondary zeolitic mineralization crop out. North and east of this area are fine grained melanocratic (gabbroic ?) rocks with pyroxene phenocrysts.

None of the rock examined in the field could be described as high quality. Because of the ubiquitous weathering products including clays, secondary mineralization such as zeolites, and excessive fracture in some of the pillow lavas, none is probably suitable for such uses as black topping. One exception may be the rocks cropping out in the northeast of the area shown on the map as having the "most usable" rocks. Experience at the site has shown that the deeper, less weathered, basaltic bedrock can be employed for rock fill, driveway rock, and other limited uses.

Geophysical Work

Seismic probing with a Bison Model 1570 B Signal Enhancement Seismograph was carried out to find the locations and approximate depths of the denser, less weathered, basaltic bedrock. The locations of the profiles are shown on the map and logs of the seismic profiles are appended. The profile information was used to develop the attached cross-sections.

Using the seismic data and information gathered in the field, an area of over 20,000 square yards has been outlined on the map as having the greatest potential for immediate development. Quarrying this area to a depth of 30 feet would produce over 220,000 cubic yards of rock. Increasing the depth of the quarrying would obviously result in a proportional increase in the volume of available rock.

According to Caterpillar Tractor Company, a D9 tractor with a mounted No. 9 ripper can rip undisturbed basaltic bedrock with a seismic velocity of up to 7,800 - 8,800 feet per second. The "better" quality rock being quarried at the site has required blasting. With this in mind the amount of overburden which must be removed to expose the usable bedrock is shown on the cross-sections. Apparent seismic velocities indicate that usable bedrock is available at reasonable depths throughout most of the upper, northern, portion of the site, see map.

In the lower portion of the site, soil and weathered bedrock, all apparently rippable, are found to a depth of 10 to over 30 feet. Excavation to these depths will only be limited by the existence of ground water.

Soils and Cover Material

Silt (ML) and silty clay (CL) materials are available to an average depth of 10 feet in the lower area. These materials have a poor workability in wet weather but also have a very low hydraulic conductivity and make excellent final cover. More than a half million cubic yards of this material is available in the lower portion of the site which has been proposed for development. Underlying the ML-CL materials is the weathered surface of the bedrock. Seismic velocities in this material indicates that it is rippable to a depth of over 30 feet. This weathered bedrock is suitable for use as a daily and intermediate cover. The blocky nature of this material makes it more trafficable and thus less troublesome to work during the winter months.

Hydrology

Surface runoff from the upper portions of Coffin Butte flows down-slope as sheet runoff as well as via a number of poorly developed swales, see map. In the lower portion of the site these drainage channels are better developed but remain effectively intermittent in the nature. Much of the natural surface drainage has been disrupted by previous quarrying activities at the site.

Some surface water infiltrates into the soil and weathered bedrock. In the upper portion of Coffin Butte this water generally percolates to the interface between the denser basaltic bedrock and overlying weathered surface materials. The perched ground water then moves down-gradient along this interface. Much of it is discharged to the surface again in the quarry walls, road cuts, and other areas where the surface of the denser bedrock has been exposed. This water is an obvious hinderance in the operation of a sanitary landfill.

In order to control and redirect the flow of surface as well as shallow perched ground water, an up-gradient cutoff system will be necessary at the site. A shallow cutoff above the area presently operated has been installed. Unfortunately, it only "scratches the surface" of the weathered bedrock and is ineffective. If it is to be made operational, it will be necessary to deepen the cut considerably, perhaps as much as 20 feet. This will require the movement of about 50-75 cubic yards of material per lineal yeard of cutoff trench. About 75 percent of this will be made up of clayey and rocky soils, the remainder will be predominaely weathered bedrock, see map, cross-sections, and attached detail.

It may be necessary to line part or all of this trench with compacted fine grained materials. The CL material described earlier in the lower portions of the site should be adequate.

It may also be necessary to construct a cutoff system such as this in the upper portion of the area proposed for future development, see map. However, the initial excavation of a shallower 6 to 8 feet deep cutoff located in the upper fan area as shown on the attached map and detail is suggested. The removal of about 4 cubic yards of material per lineal yard of cutoff will be required. No blasting should be necessary in its construction. The trench should be contoured and graded to discharge to the surface drainageways as shown on the map. The trench system should be left open to facilitate its cleaning and/or deepening should it become necessary.

In order to test the effectiveness of this cutoff a series of shallow monitors, drive points or augered and cased bore holes, should be installed down-gradient. These monitors will make it possible to accurately determine to what depth a landfill can be developed.

If the down-gradient, fan, cutoff trench described above is found to be inadequate or the upper area is to be developed for quarrying and/or landfilling, an extension of the cutoff system described for the presently operating area will be necessary. This sytem would also discharge to an existing drainageway as shown on the map.

Vokes, H. E., Myers, D. A., and Hoover, L., 1954, Geology of the southwestern border area of the Willamette Valley, Oregon: U. S. Geol. Survey Oil and Gas Inv. Map OM 150.

Sweet, H. R., 1973, Report to the Oregon Dept. of Environmental Quality from the Oregon State Engineer's Office. Well log information was taken from this report.