Site Suitability Review of the Casper Volk Landfill

by
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Prepared by the
North Dakota Geological Survey
and the
North Dakota State Water Commission

ND Landfill Site Investigation No. 29

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Bismarck, North Dakota
1994

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INTRODUCTION

Purpose

The North Dakota State Engineer and the North Dakota State Geologist were instructed by the 52^{nd} State Legislative Assembly to conduct site-suitability reviews of the solid waste landfills in the state of North Dakota. These reviews are to be completed by July 1, 1995 (North Dakota Century Code 23-29-07.7). The purpose of this program is to evaluate site suitability of each landfill for disposal of solid waste based on geologic and hydrologic characteristics. Reports will be provided to the North Dakota State Department of Health and Consolidated Laboratories (NDSDHCL) for use in site improvement, site remediation, or landfill closure. A one time ground-water sampling event was performed at each site, and additional studies may be necessary to meet the requirements of the NDSDHCL for continued operation of solid waste landfills. The Casper Volk solid waste landfill is one of the landfills being evaluated.

Location of the Casper Volk Landfill

The Volk solid waste landfill is located about five miles south of the City of Rugby in Township 155 North, Range 73 West, NE 1/4 Section 1 (Fig. 1). The active area of the landfill encompasses approximately 25 acres.

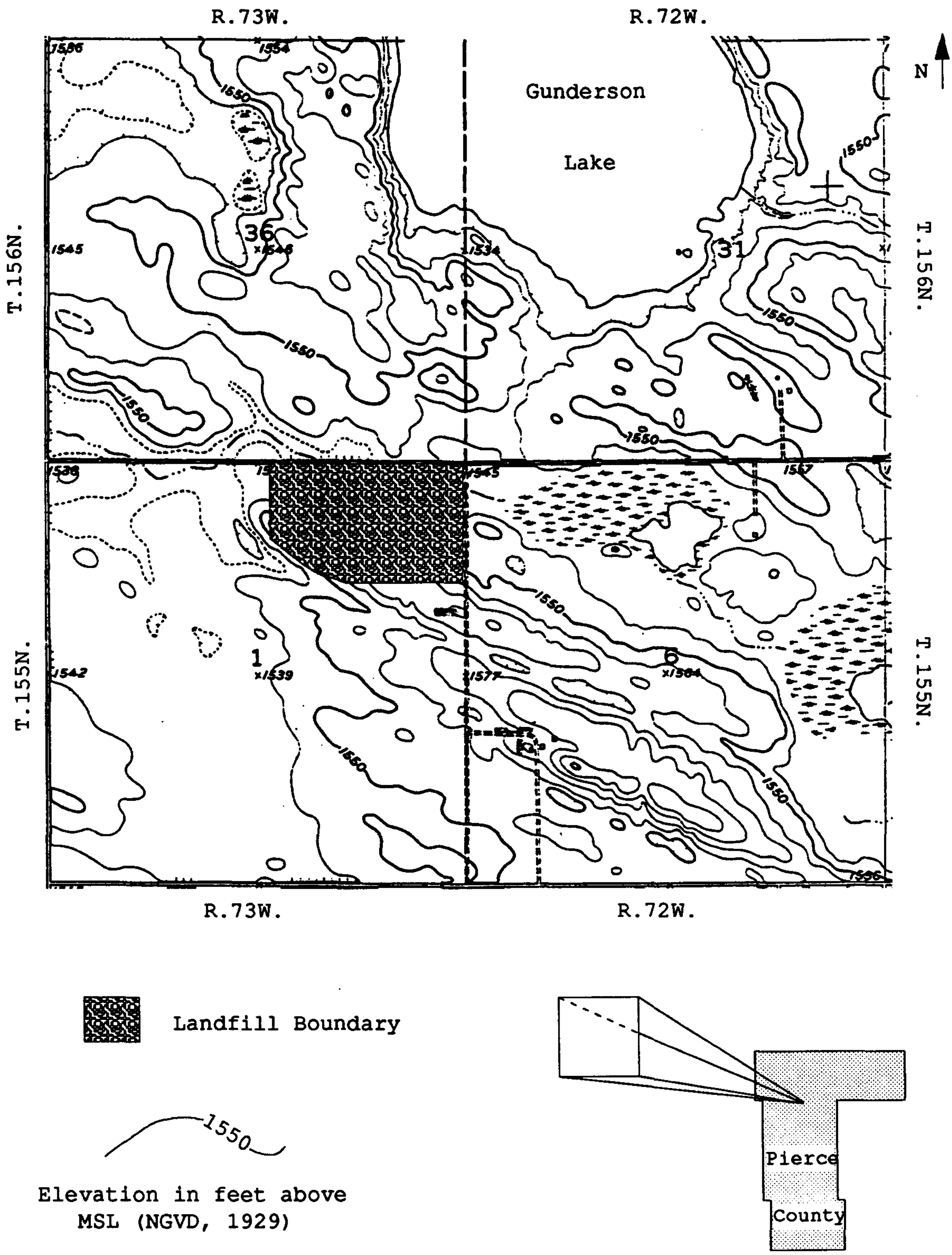

Figure 1. Location of the Casper Volk landfill in the NE 1/4, section 1, T.155N., R.73W.

Previous Site Investigations

Two soil borings were drilled at the landfill in 1984. The subsurface materials were described as sandy loam, silt loam, and clay loam.

Methods of Investigation

The Casper Volk study was accomplished by means of: 1) drilling test holes; 2) constructing and developing monitoring wells; 3) collecting and analyzing water samples; and 4) measuring water levels. Well abandonment procedures were followed for non-permanent monitoring wells.

Test-Drilling Procedure

The drilling method was based on the site's geology and depth to ground water, as determined by the preliminary site evaluation. A hollow-stem auger rig was used at the Volk landfill because the sediments were poorly consolidated and the depth to the water table was expected to be less than 70 feet. The lithologic descriptions were determined from the drill cuttings. The water used with the rig was obtained from municipal water supplies.

Monitoring Well Construction and Development

Four test holes were drilled at the Volk landfill and monitoring wells were installed in each test hole. The number of wells installed at the Casper Volk landfill was based on the geologic and topographic characteristics of the site. The depth and intake interval of each well was selected to monitor the water level at the top of the uppermost aquifer. The test holes were located around the active area of the landfill.

Wells were constructed following a standard design (Fig. 2) intended to comply with the construction regulations of the NDSDHCL and the North Dakota Board of Water Well Contractors (North Dakota Department of Health, 1986). The wells were constructed using a 2-inch diameter, SDR21, polyvinyl chloride (PVC) well casing and a PVC screen, either 5 or 10 feet long, with a slot-opening size of 0.012 or 0.013 inches. The screen was fastened to the casing with stainless steel screws (no solvent weld cement was used). After the casing and screen were installed into the drill hole, the annulus around the screen was filled with No. 10 (grain-size diameter) silica sand to a height of two feet above the top of the screen. High-solids bentonite grout and/or neat cement was placed above the silica sand to seal the annulus to approximately five feet below land surface. The remaining annulus was filled with drill cuttings. The permanent wells

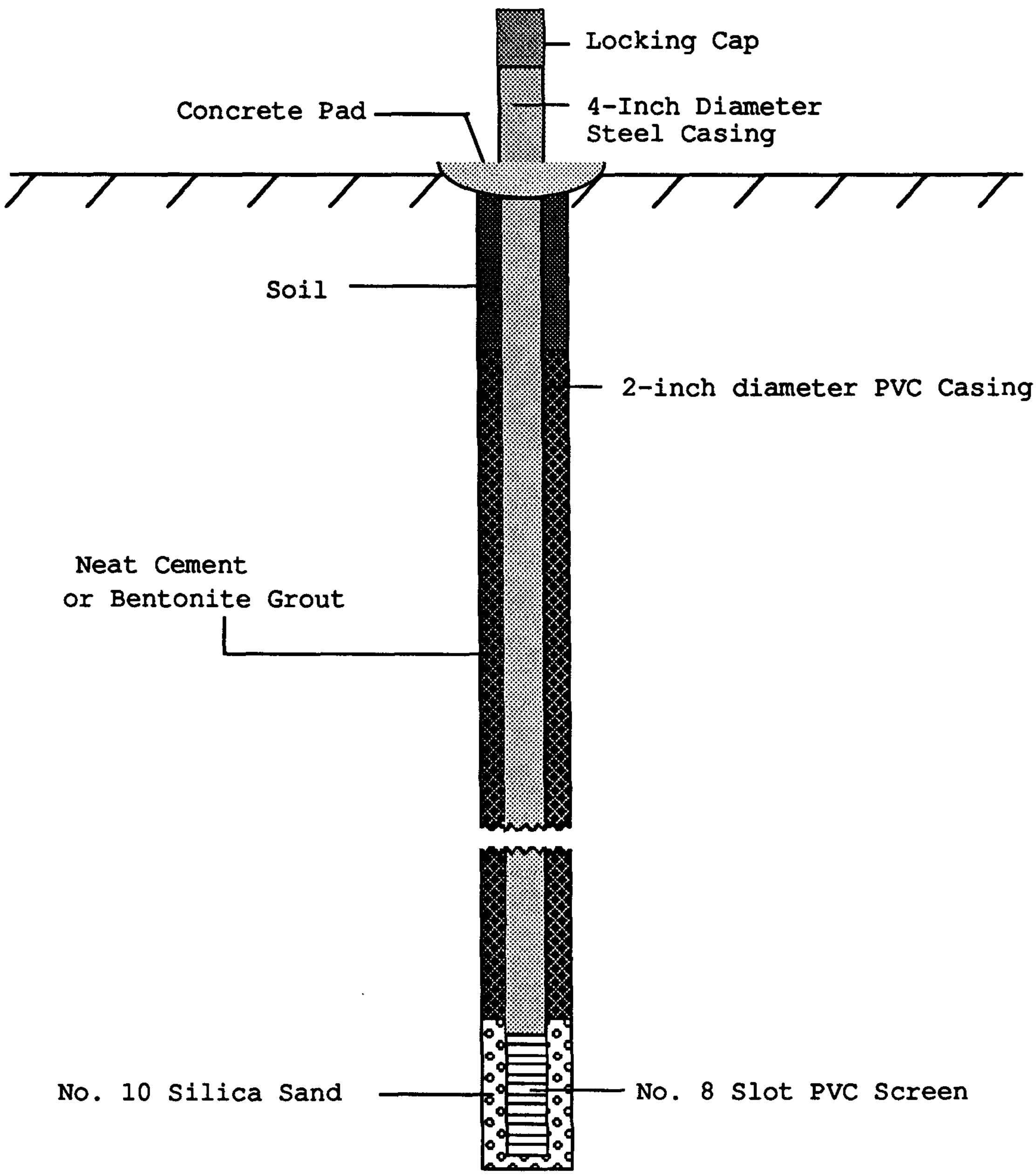

Figure 2. Construction design used for monitoring wells installed at the Casper Volk landfill.

were secured with a protective steel casing and a locking cover protected by a two-foot-square concrete pad.

All monitoring wells were developed using a stainless steel bladder pump or a teflon bailer. Any drilling fluid and fine materials present near the well were removed to insure movement of formation water through the screen.

The Mean Sea Level (MSL) elevation was established for each well by differential leveling to Third Order accuracy. The surveys established the MSL elevation at the top of the casing and the elevation of the land surface next to each well.

Collecting and Analyzing Water Samples

Water-quality analyses were used to determine if leachate is migrating from the landfill into the underlying ground-water system. Selected field parameters, major ions, and trace elements were measured for each water sample. These field parameters and analytes are listed in Appendix A with their Maximum Contaminant Levels (MCL). MCLs are enforcable drinking water standards that represent the maximum permissible level of a contaminant as stipulated by the U.S. Environmental Protection Agency (EPA).

Water samples were collected using a bladder pump constructed of stainless steel with a teflon bladder. A teflon bailer was used in monitoring wells with limited transmitting capacity. Before sample collection, three to four well volumes were extracted to insure that unadulterated formation water was sampled. Four samples from each well were collected in high density polyethylene plastic bottles as follows:

1) Raw (500 ml)
2) Filtered (500 ml)
3) Filtered and acidified (500 ml)
4) Filtered and double acidified (500 ml)

The following parameters were determined for each sample. Specific conductance, field pH, bicarbonate, and carbonate were analyzed using the raw sample. Sulfate, chloride, nitrate*, and dissolved solids were analyzed using the filtered sample. Calcium, magnesium, sodium, potassium, iron, and manganese were analyzed from the filtered, acidified sample. Cadmium, lead, arsenic, and mercury were analyzed using the filtered double-acidified samples.

One well was sampled for Volatile Organic Compounds (VOC) analysis. This sample was collected at a different time than the standard water-quality sample. The procedure used for collecting the VOC sample is described in Appendix B. Each sample was collected with a plastic throw-away bailer and kept chilled. These samples were analyzed within the permitted 14-day holding period. The standard water-quality analyses were performed at the North Dakota State Water Commission (NDSWC) Laboratory and VOC analyses were performed by the NDSDHCL.

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* No special preservative techniques were applied to nitrate samples and as a result reported nitrate concentrations may be lower than actual.

Water-Level Measurements

Water-level measurements were taken at least three times at a minimum of two-week intervals. The measurements were taken using a chalked-steel tape or an electronic (Solnist 10078) water-level indicator. These measurements were used to determine the shape and configuration of the water table.

Well-Abandonment Procedure

The test holes and monitoring wells that were not permanent were abandoned according to NDSDHCL and Board of Water Well Contractors regulations (North Dakota Department of Health, 1986). The soil around the well was dug to a depth of approximately three to four feet below land surface (Fig. 3) to prevent disturbance of the sealed wells. The screened interval of the well was plugged with bentonite chips to a height of approximately one foot above the top of the screen and the remaining well casing was filled with neat cement. The upper three to four feet was then filled with cuttings and the disturbed area was blended into the surrounding land surface. Test holes were plugged with high-solids bentonite grout and/or neat cement to a depth approximately five feet below land surface. The upper five feet of the test hole was filled with soil cuttings.

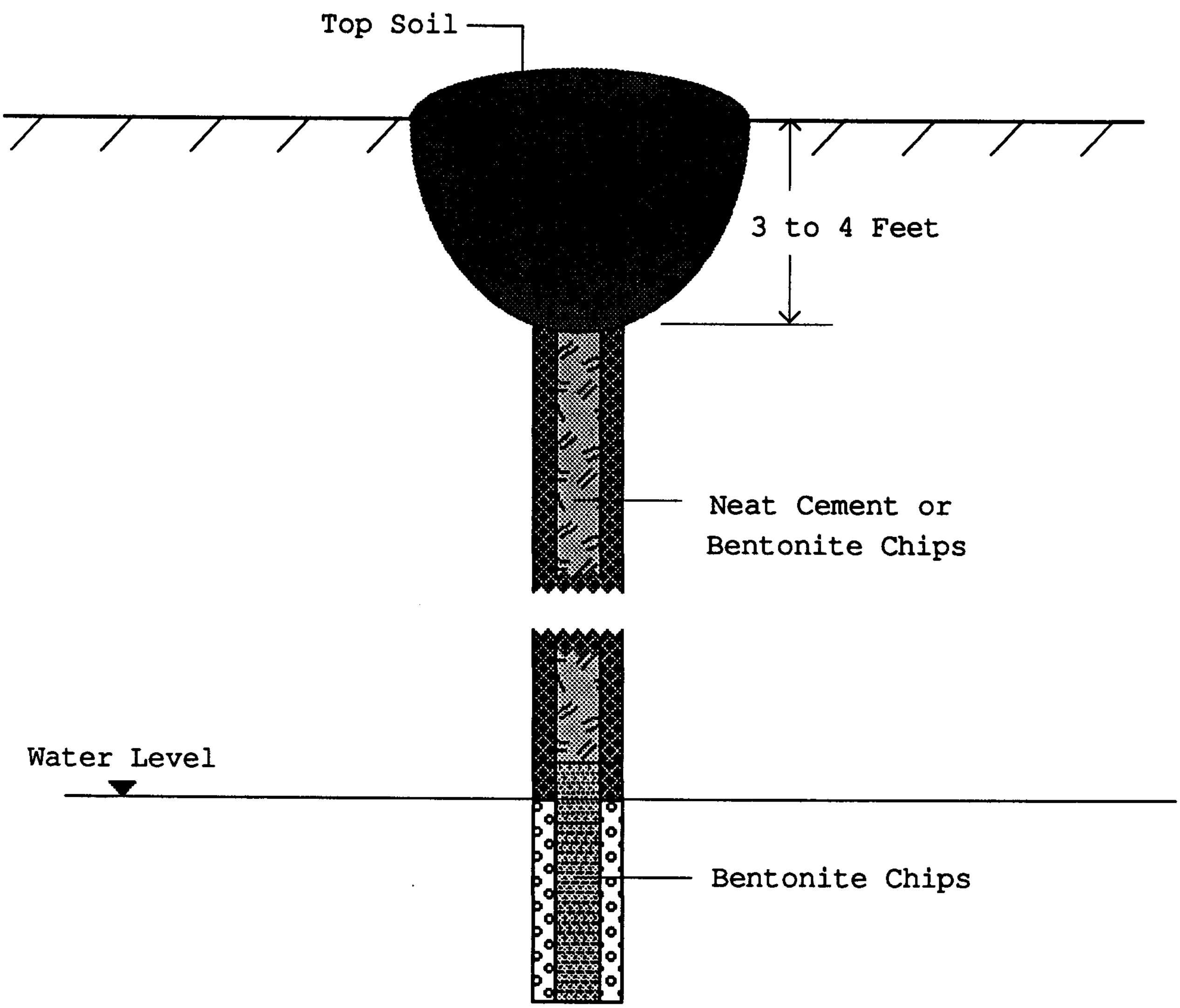

Figure 3. Monitoring well abandonment procedures.

Location-Numbering System

The system for denoting the location of a test hole or observation well is based on the federal system of rectangular surveys of public land. The first and second numbers indicate Township north and Range west of the 5th Principle Meridian and baseline (Fig. 4). The third number indicates the section. The letters A, B, C, and D designate, respectively, the northeast, northwest, southwest, and southeast quarter section (160-acre tract), quarter-quarter section (40-acre tract), and quarter-quarter-quarter section (10-acre tract). Therefore, a well denoted by 155-073-01ACA would be located in the NE1/4, SW1/4, NE1/4, Section 1, Township 155 North, Range 73 West. Consecutive numbers are added following the three letters if more than one well is located in a 10-acre tract, e.g. 155-073-01ACA1 and 155-073-01ACA2.

GEOLOGY

Regional Geology

The Volk landfill is situated within the glacial Lake Souris plain. The Pleistocene sediments in the area are assigned to the Coleharbor Group and include lacustrine deposits, windblown deposits, till, and outwash. Ice-thrust masses are common, especially to the north and east of Rugby.

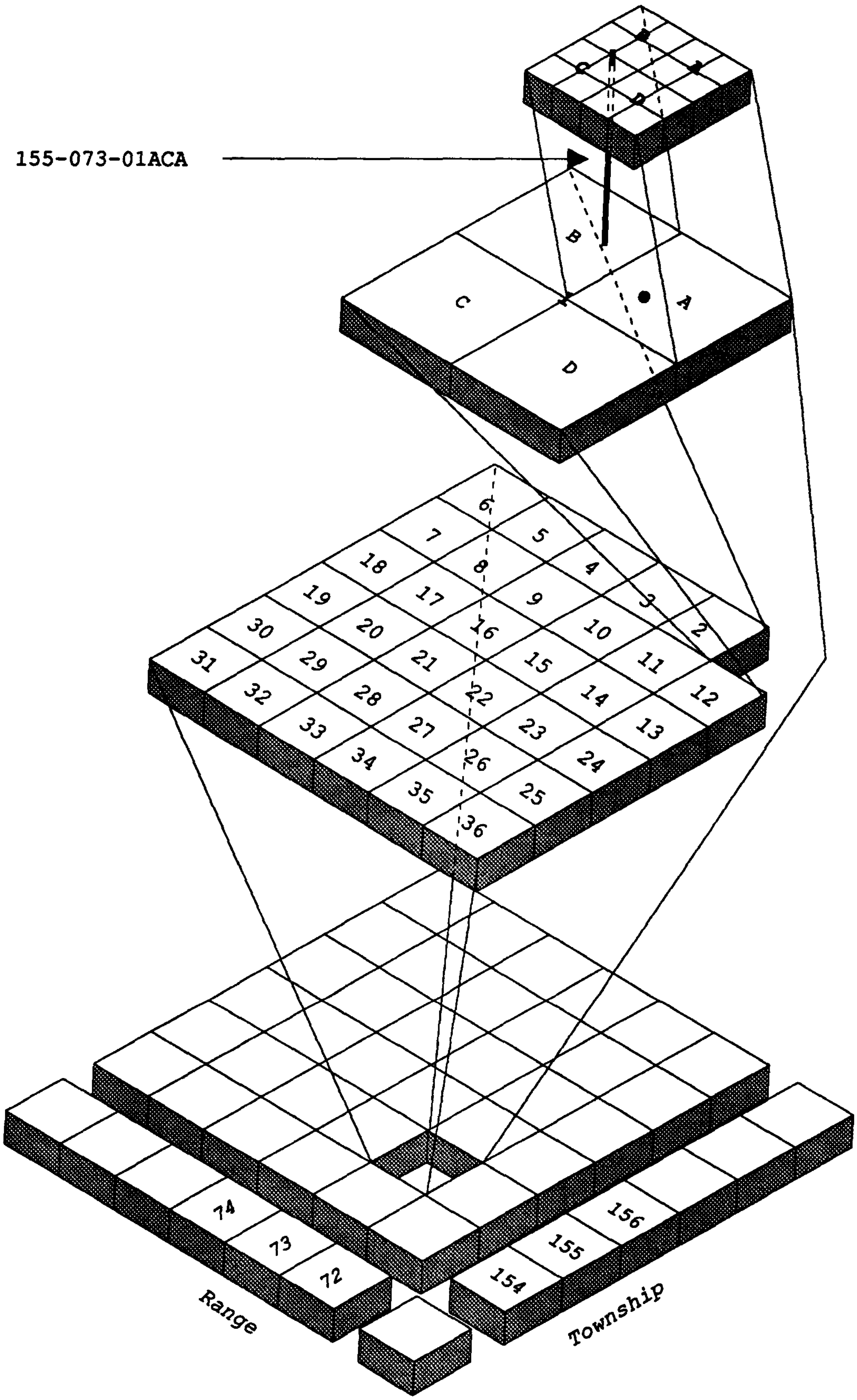

Figure 4. Location-numbering system for the Casper Volk landfill.

These thrust blocks formed near the margin of the glacier during the last glacial advance (Clayton, 1980).

A narrow zone from Rolette (about 20 miles north of Rugby) to Balfour (about 50 miles southwest of Rugby) contains numerous drumlins--low ridges molded by glaciers. The long axes of drumlins are parallel to the direction of ice movement. In this region the last glacial advance came across Lake Souris from the northwest, and the drumlins trend northwest-southeast.

The Pleistocene sediments in the area surrounding the landfill are relatively thin. Test holes drilled within four miles of the landfill show Pleistocene sediments ranging from 22 feet to 63 feet thick (Randich, 1971). The test holes indicate that the Coleharbor Group is underlain by the Fox Hills Formation except in a small area west of the landfill where the Pierre Formation directly underlies the Coleharbor Group.

Local Geology

The Volk landfill is located on a northwest trending ridge which rises about 40 feet above the surrounding lowlands. The refuse has been placed along the crest of the ridge (Fig. 5).

The test holes for this study were located as follows: one near the top of the ridge, one on the south slope of the ridge, one on the northwest end of the ridge, and one north

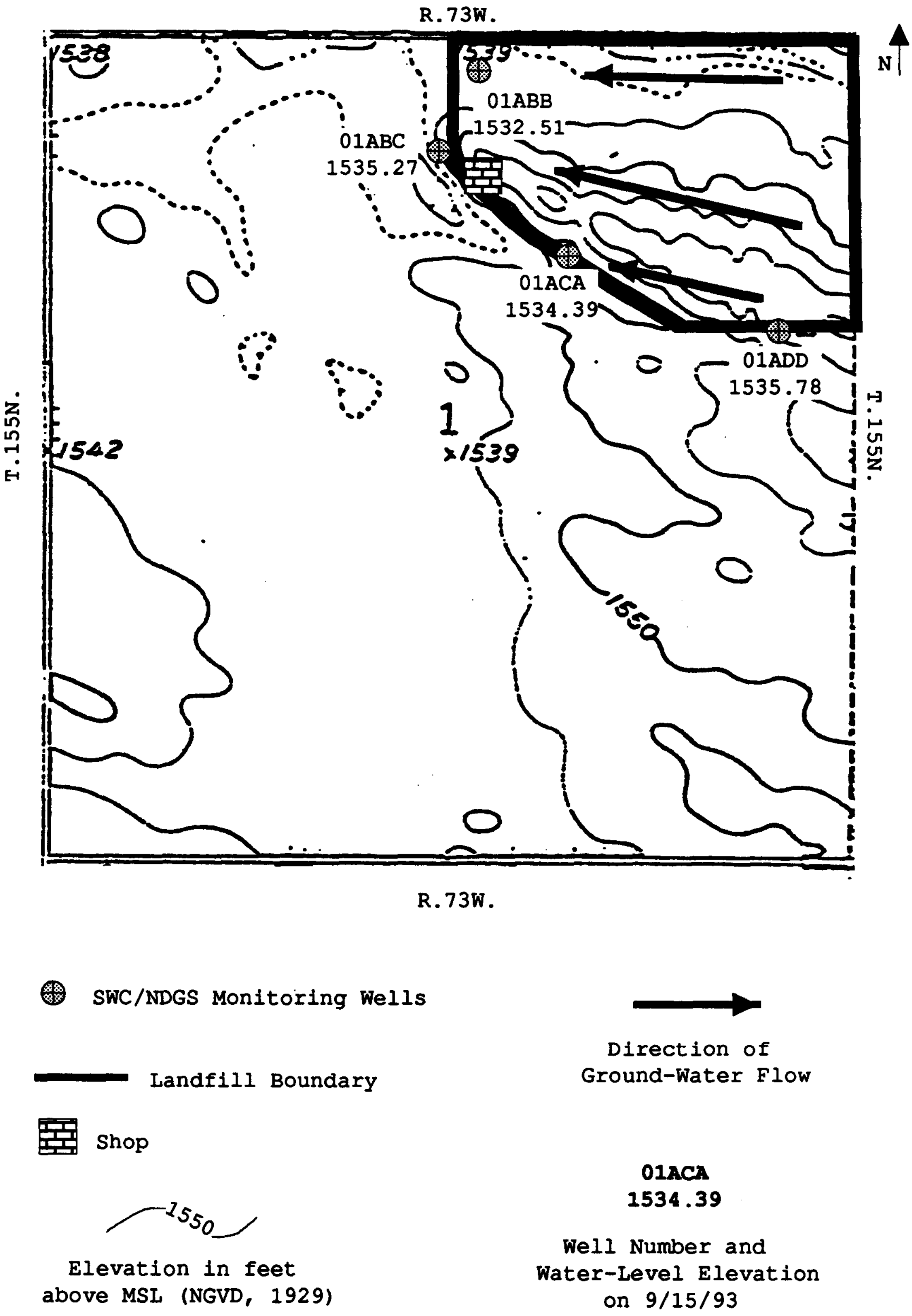

Figure 5. Location of monitoring wells at the Casper Volk landfill.

of the ridge. The four test holes intersected sandy silt, clayey silt, and fine-grained, silty sand (Fig. 6, lithologic logs in Appendix C). Thin intervals of fine to coarse sand with gravel were also encountered in test holes 155-073-01ABB and ABC. A layer of silty clay was encountered in test hole 155-073-01ABC.

The sediments at the landfill appear to be lacustrine or windblown deposits. Although the last glacier deposited a thin layer of till over the region, no till was observed in any of the test holes at the landfill. Till was also absent in two soil borings drilled in 1984. None of the test holes reached bedrock.

The ridge is classified as a drumlin on the basis of its shape, orientation, and lithology. The geologic materials in the ridge have been reworked by the southeast-moving glacier. The ridge may have been a hill or an island in Lake Souris before the last glacial advance.

HYDROLOGY

Surface-Water Hydrology

Surface water in the vicinity of the Volk landfill consists of Gunderson Lake which is located about one-half mile northeast of the landfill, a temporary wetland located about one-half mile east of the landfill, and an intermittent

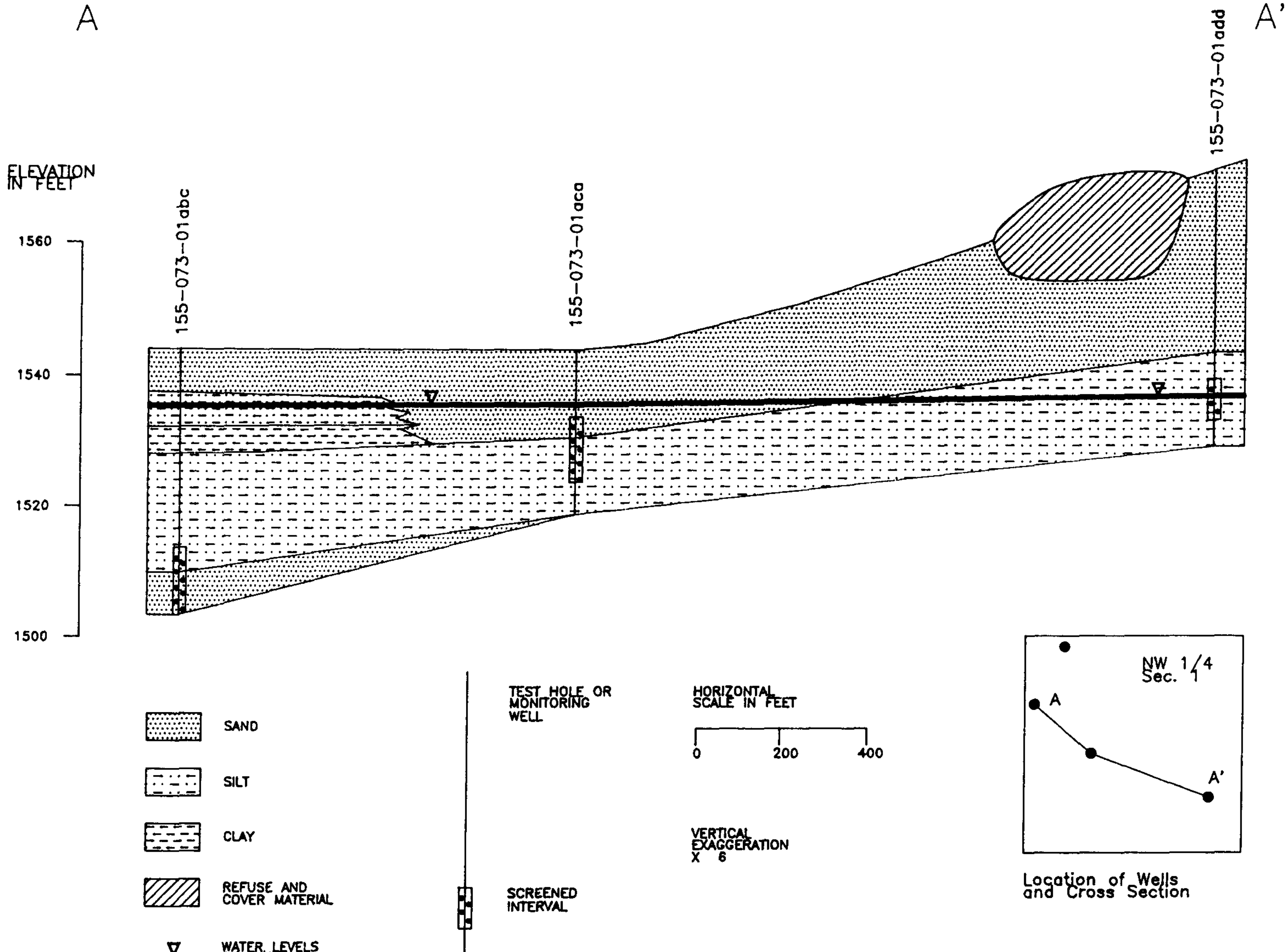

Figure 6. Geohydrologic section in the Volk landfill.

stream located along the northern boundary of the landfill (Fig. 1). Gunderson Lake and the temporary wetland should not be affected by the landfill due to their up-gradient location. The intermittent stream flows to the northwest and discharges into Rush Lake. The intermittent stream is located along the north boundary of the landfill and may recieve contaminanted surface runoff.

Regional Ground-Water Hydrology

Regional bedrock aquifers in the area of the Volk landfill consist of the Dakota aquifer, Pierre aquifer, and Fox Hills aquifer. The Dakota aquifer occurs at about 1,600 feet below land surface. The Dakota aquifer is characterized by a sodium-sulfate type water. This aquifer should not be affected by contaminant migration from the landfill due to its depth and the occurrence of intervening layers of clay and shale.

The Pierre Formation is a source of ground water in areas of extensive fracturing. The Pierre aquifer is characterized by a sodium-sulfate type water in the upper regions of the aquifer and by a sodium-chloride type water in the lower regions (Randich, 1977). This aquifer should not be susceptible to contaminant migration from the landfill due to its depth.

If the Fox Hills aquifer occurs in the study area it may directly underlie the surficial silts and sands at the Volk landfill. The depth of this aquifer is about 75 feet below land surface. The Fox Hills aquifer is characterized by a mixed sodium-bicarbonate-sulfate type water (Randich, 1977). Recharge to the Fox Hills aquifer is by infiltration of precipitation, leakage from streams and lakes, and lateral flow from adjacent glacial deposits (Randich, 1977). This aquifer may be susceptible to contaminant migration from the landfill due to its shallow depth and the occurrence of overlying Pleistocene deposits.

There are no major glacial aquifers within a two-mile radius of the Volk landfill. Undifferentiated sand and gravel aquifers are found throughout the region. These aquifers are not extensive and small quantities of water are usually found with slow recharge potential. The water chemistry of these aquifers is variable.

Local Ground-Water Hydrology

Four monitoring wells were installed at the Volk landfill. The well screens were placed near the top of the uppermost aquifer. Four water-level measurements were taken over a five-week period (Appendix D). Three wells are located near the top of the south slope that defines the southern and western boundaries of the landfill (Fig. 5). Well 01ABB is located at the northwest corner of the property near the intermittent stream. The direction of local ground-water flow is to the west-northwest (Fig. 5).

Water Quality

Chemical analyses of water samples are shown in Appendix E. Three wells indicate the undiffentiated aquifer is characterized by a calcium-bicarbonate type water while well 01ABB indicated a calcium-sulfate type water.

Well 01ABB detected higher concentrations of sodium (170 mg/L), sulfate (1500 mg/L), chloride (68 mg/L), and total dissolved solids (2340 mg/L) as compared with other wells in the landfill area. The source of these concentrations may be indicative of contaminant migration from the landfill.

Trace element analyses in well 01ABB, detected higher concentrations of selenium (6 µg/L), molybdenum (91 µg/L), and strontium (1100 µg/L) as compared to other wells. This well is located down-gradient of the landfill and the elevated trace element concentrations may be indicative of contaminant migration from the landfill.

Results of the VOC analyses, from wells 01ABC and 01ACA, are shown in Appendix F and G. There were no VOC compounds detected in either of the water samples.

CONCLUSIONS

The Volk landfill is located on a ridge within the glacial Lake Souris plain. Surface waters near the landfill consist of an intermittent stream along the north boundary of the landfill, a wetland one-half mile to the east, and Gunderson Lake one-half mile to the north. Surface drainage is to the north and west.

The sediments at the site are composed mainly of silt and silty sand of the Coleharbor Group. The sediments probably originated as lacustrine or windblown deposits. The Coleharbor Group is less than 100 feet thick and is underlain by bedrock of the Fox Hills or Pierre Formations.

The main regional aquifers occur in the Fox Hills, Pierre, and Dakota Formations. If the Fox Hills aquifer exists in the area of the landfill, it may be susceptible to contaminant migration from the landfill due to its shallow depth and the occurrence of high permeable Pleistocene deposits.

No major glacial aquifers are present near the landfill, but small undifferentiated aquifers occur within the Pleistocene sediments. The direction of ground-water flow in the shallow uppermost undifferentiated aquifer is toward the west-northwest.

The water quality associated with the landfill area was generally within the range found naturally in the area. However, well 155-033-01ABB contained higher concentrations of sodium, sulfate, chloride, total dissolved solids, selenium, molybdenum, and strontium as compared with the other three wells. This well is located down-gradient from the landfill. The source of these elevated concentrations may be indicative of contaminant migration from the landfill. No volatile organic compounds were detected in the VOC analyses from wells 155-073-01ABC and ACA.

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APPENDIX A

WATER QUALITY STANDARDS AND CONTAMINANT LEVELS

Water Quality Standards and Contaminant Levels

Field Parameters	
appearance	color/odor
pH	6-9(optimum)
specific conductance	-----
temperature	-----

Constituent	**MCL (µg/L)**
Arsenic	50
Cadmium	10
Lead	50
Molybdenum	100
Mercury	2
Selenium	10
Strontium	*

*EPA has not set an MCL for strontium. The median concentration for most U.S. water supplies is 100 µg/L (Hem, 1989).

	SMCL (mg/L)
Chloride	250
Iron	>0.3
Nitrate	50
Sodium	20-170
Sulfate	300-1000
Total Dissolved Solids	>1000

	Recommended Concentration Limits (mg/L)
Bicarbonate	150-200
Calcium	25-50
Carbonate	150-200
Magnesium	25-50
Hardness	>121 (hard to very hard)

APPENDIX B

SAMPLING PROCEDURE FOR VOLATILE ORGANIC COMPOUNDS

SAMPLING PROCEDURE FOR 40ML AMBER BOTTLES

Sample Collection for Volatile Organic Compounds

by
North Dakota Department of Health
and Consolidated Laboratories

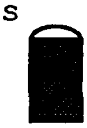
1. Three samples must be collected in the 40ml bottles that are provided by the lab. One is the sample and the others are duplicates.

2. A blank will be sent along. Do Not open this blank and turn it in with the other three samples.

3. Adjust the flow so that no air bubbles pass through the sample as the bottle is being filled. No air should be trapped in the sample when the bottle is sealed. Make sure that you do not wash the ascorbic acid out of the bottle when taking the sample.

4. The meniscus of the water is the curved upper surface of the liquid. The meniscus should be convex (as shown) so that when the cover to the bottle is put on, no air bubbles will be allowed in the sample.

convex meniscus



5. Add the small vial of concentrated HCL to the bottle.

6. Screw the cover on with the white Teflon side down. Shake vigorously, turn the bottle upside down, and tap gently to check if air bubbles are in the sample.

7. If air bubbles are present, take the cover off the bottle and add more water. Continue this process until there are no air bubbles in the sample.

8. The sample must be iced after collection and delivered to the laboratory as soon as possible.

9. The 40 ml bottles contain ascorbic acid as a preservative and care must be taken not to wash it out of the bottles. The concentrated acid must be added after collection as an additional preservative.

APPENDIX C

LITHOLOGIC LOGS
OF WELLS AND TEST HOLES

155-073-01ABB
NDSWC

Date Completed:	8/23/93	Purpose:	Observation Well
L.S. Elevation (ft):	1536.56	Well Type:	2" PVC
Depth Drilled (ft):	15	Aquifer:	Undefined
Screened Interval (ft):	5-15	Source:	
		Owner:	VOLK

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-1
SAND	VERY FINE GRAIN, SILTY, MODERATE YELLOWISH-BROWN, 10YR5/4.	1-3
SAND	FINE GRAINED, MODERATE YELLOWISH-BROWN WITH DARK YELLOWISH-ORANGE MOTTLES.	3-5
SAND	FINE GRAINED, CLAYEY, MODERATE YELLOWISH-BROWN, 10YR5/4.	5-8
SAND	FINE TO COARSE GRAIN, TRACE OF GRAVEL, MODERATE YELLOWISH-BROWN, 10YR5/4.	8-12
SAND	FINE GRAINED, CLAYEY, OLIVE GRAY, 5Y4/1.	12-15

155-073-01ABC

NDSWC

Date Completed:	7/21/93	Purpose:	Observation Well
L.S. Elevation (ft):	1542.84	Well Type:	2" PVC
Depth Drilled (ft):	40	Aquifer:	Undefined
Screened Interval (ft):	30-40	Source:	
		Owner:	VOLK

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-1
SAND	FINE GRAINED, SILTY, MODERATE YELLOWISH-BROWN, 10YR5/4.	1-6
CLAY	SILTY, SANDY, MODERATE YELLOWISH-BROWN, 10YR5/4.	6-11
CLAY	SILTY, MODERATE YELLOWISH-BROWN, 10YR5/4.	11-15
SILT	CLAYEY, LIGHT BROWNISH-GRAY, 5YR6/1.	15-19
SILT	CLAYEY, OLIVE GRAY, 5Y4/1.	19-28
SILT	OLIVE GRAY, 5Y4/1.	28-34
SAND	FINE TO MEDIUM GRAINED WITH A TRACE OF GRAVEL, OLIVE GRAY, 5Y4/1.	34-40

155-073-01ACA

NDSWC

Date Completed:	7/21/93	Purpose:	Observation Well
L.S. Elevation (ft):	1542.78	Well Type:	2" PVC
Depth Drilled (ft):	25	Aquifer:	Undefined
Screened Interval (ft):	10-20	Source:	
		Owner:	VOLK

Lithologic Log

Unit	Description	Depth (ft)
TOPSOIL		0-2
SAND	FINE GRAINED, SILTY, MODERATE YELLOWISH-BROWN, 10YR5/4.	2-13
SILT	SANDY, MODERATE YELLOWISH-BROWN, 10YR5/4.	13-16
SILT	SANDY, OLIVE GRAY, 5Y4/1.	16-25

155-073-01ADD

NDSWC

Date Completed:	7/21/93	Purpose:	Observation Well
L.S. Elevation (ft):	1570.66	Well Type:	2" PVC
Depth Drilled (ft):	42	Aquifer:	Undefined
Screened Interval (ft):	32-42	Source:	
		Owner:	VOLK

Lithologic Log

Unit	Description	Depth (ft)
SAND	FINE GRAINED, SILTY, MODERATE YELLOWISH-BROWN, 10YR5/4.	0-6
SAND	FINE GRAINED, SILTY, DARK YELLOWISH-BROWN, 10YR4/2	6-8
SAND	FINE GRAINED, SILTY, MODERATE YELLOWISH-BROWN, 10YR5/4.	8-21
SAND	FINE GRAINED, SILTY, CLAYEY, MODERATE YELLOWISH-BROWN, 10YR5/4.	21-28
SILT	CLAYEY, SANDY, MODERATE YELLOWISH-BROWN, 10YR5/4.	28-34
SILT	SANDY, BLUISH-GRAY, 5B5/1.	34-35
SILT	CLAYEY, SANDY, OLIVE GRAY, 5Y4/1.	35-42

APPENDIX D

WATER-LEVEL TABLES

Rugby Water Levels
8/30/93 to 10/04/93

155-073-01ABB LS Elev (msl,ft)=1536.56
Undefined Aquifer SI (ft.)=5-15

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/30/93	3.06	1533.50	09/15/93	4.05	1532.51
09/01/93	3.23	1533.33	10/04/93	4.74	1531.82

155-073-01ABC LS Elev (msl,ft)=1542.84
Undefined Aquifer SI (ft.)=30-40

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/30/93	7.45	1535.39	09/15/93	7.57	1535.27
09/01/93	7.44	1535.40	10/04/93	7.75	1535.09

155-073-01ACA LS Elev (msl,ft)=1542.78
Undefined Aquifer SI (ft.)=10-20

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/30/93	7.94	1534.84	09/15/93	8.39	1534.39
09/01/93	7.98	1534.80	10/04/93	9.26	1533.52

155-073-01ADD LS Elev (msl,ft)=1570.66
Undefined Aquifer SI (ft.)=32-42

Date	Depth to Water (ft)	WL Elev (msl, ft)	Date	Depth to Water (ft)	WL Elev (msl, ft)
08/30/93	33.87	1536.79	09/15/93	34.88	1535.78
09/01/93	34.76	1535.90	10/04/93	34.98	1535.68

APPENDIX E

MAJOR ION AND TRACE-ELEMENT CONCENTRATIONS

Casper Volk Landfill Water Quality
Major Ions

Location	Screened Interval (ft)	Date Sampled	SiO_2	Fe	Mn	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	Cl	F	NO_3	B	TDS	Hardness as $CaCO_3$	NCH	% Na	SAR	Spec Cond (µmho)	Temp (°C)	pH
			(milligrams per liter)																					
155-073-01ABB	5-15	09/01/93	17	0.05	0.05	350	94	170	52	170	0	1500	68	0.2	0.5	0.08	2340	1300	1100	22	2.1	2700	14	8.37
155-073-01ABC	30-40	09/01/93	29	0.16	0.41	120	42	45	7	415	0	210	14	0.3	0	0.12	672	470	130	17	0.9	962	8	6.61
155-073-01ACA	10-20	09/01/93	25	0.05	0.45	110	41	45	7.6	417	0	200	13	0.2	3	0.1	650	440	100	18	0.9	933	8	6.72
155-073-01ADD	32-42	09/01/93	18	0.04	0.22	83	33	16	1.8	348	0	62	6.7	0.2	22	0.07	414	340	58	9	0.4	645	8	6.82

Trace Element Analyses

Location	Date Sampled	Selenium	Lead	Cadmium	Mercury	Arsenic	Molybdenum	Strontium
		(micrograms per liter)						
155-073-01ABB	9/1/93	6	0	0	0	2	91	1100
155-073-01ABC	9/1/93	0	0	0	0	2	6	460
155-073-01ACA	9/1/93	0	0	0	0	1	11	470
155-073-01ADD	9/1/93	1	0	0	0	1	6	210

APPENDIX F

VOLATILE ORGANIC COMPOUNDS FOR WELL 155-073-01ACA

Volatile Organic Compounds
and
Minimum Concentrations

Concentrations are based only on detection limits. Anything over the detection limit indicates possible contamination.

Constituent	Chemical Analysis µg/L
Benzene	<2
Vinyl Chloride	<1
Carbon Tetrachloride	<2
1,2-Dichlorethane	<2
Trichloroethylene	<2
1,1-Dichloroethylene	<2
1,1,1-Trichloroethane	<2
para-Dichlorobenzene	<2
Acetone	<50
2-Butanone (MEK)	<50
2-Hexanone	<50
4-Methyl-2-pentanone	<50
Chloroform	<5
Bromodichloromethane	<5
Chlorodibromomethane	<5
Bromoform	<5
trans1,2-Dichloroethylene	<2
Chlorobenzene	<2
m-Dichlorobenzene	<5
Dichloromethane	<5
cis-1,2-Dichloroethylene	<2
o-Dichlorobenzene	<2
Dibromomethane	<5
1,1-Dichloropropene	<5
Tetrachlorethylene	<2
Toluene	<2
Xylene(s)	<2
1,1-Dichloroethane	<5
1,2-Dichloropropane	<2
1,1,2,2-Tetrachloroethane	<5
Ethyl Benzene	<2
1,3-Dichloropropane	<5
Styrene	<2
Chloromethane	<5
Bromomethane	<5
1,2,3-Trichloropropane	<5
1,1,1,2-Tetrachloroethane	<5
Chloroethane	<5
1,1,2-Trichloroethane	<5

* Constituent Detection

VOC Constituents cont.

2,2-Dichloropropane	<5
o-Chloroluene	<5
p-Chlorotoluene	<5
Bromobenzene	<5
1,3-Dichloropropene	<5
1,2,4-Trimethylbenzene	<5
1,2,4-Trichlorobenzene	<5
1,2,3-Trichlorobenzene	<5
n-Propylbenzene	<5
n-Butylbenzene	<5
Naphthalene	<5
Hexachlorobutadiene	<5
1,3,5-Trimethylbenzene	<5
p-Isopropyltoluene	<5
Isopropylbenzene	<5
Tert-butylbenzene	<5
Sec-butylbenzene	<5
Fluorotrichloromethane	<5
Dichlorodifluoromethane	<5
Bromochloromethane	<5
Allylchloride	<5
2,3-Dichloro-1-propane	<5
Tetrahydrofuran	<50
Pentachloroethane	<5
Trichlorotrofluoroethane	<5
Carbondisufide	<5
Ether	<5

* Constituent Detection

APPENDIX G

VOLATILE ORGANIC COMPOUNDS
FOR WELL 155-073-01ABC

Volatile Organic Compounds
and
Minimum Concentrations

Concentrations are based only on detection limits. Anything over the detection limit indicates possible contamination.

Constituent	Chemical Analysis µg/L
Benzene	<2
Vinyl Chloride	<1
Carbon Tetrachloride	<2
1,2-Dichlorethane	<2
Trichloroethylene	<2
1,1-Dichloroethylene	<2
1,1,1-Trichloroethane	<2
para-Dichlorobenzene	<2
Acetone	<50
2-Butanone (MEK)	<50
2-Hexanone	<50
4-Methyl-2-pentanone	<50
Chloroform	<5
Bromodichloromethane	<5
Chlorodibromomethane	<5
Bromoform	<5
trans1,2-Dichloroethylene	<2
Chlorobenzene	<2
m-Dichlorobenzene	<5
Dichloromethane	<5
cis-1,2-Dichloroethylene	<2
o-Dichlorobenzene	<2
Dibromomethane	<5
1,1-Dichloropropene	<5
Tetrachlorethylene	<2
Toluene	<2
Xylene(s)	<2
1,1-Dichloroethane	<5
1,2-Dichloropropane	<2
1,1,2,2-Tetrachloroethane	<5
Ethyl Benzene	<2
1,3-Dichloropropane	<5
Styrene	<2
Chloromethane	<5
Bromomethane	<5
1,2,3-Trichloropropane	<5
1,1,1,2-Tetrachloroethane	<5
Chloroethane	<5
1,1,2-Trichloroethane	<5

* Constituent Detection

VOC Constituents cont.

2,2-Dichloropropane	<5
o-Chloroluene	<5
p-Chlorotoluene	<5
Bromobenzene	<5
1,3-Dichloropropene	<5
1,2,4-Trimethylbenzene	<5
1,2,4-Trichlorobenzene	<5
1,2,3-Trichlorobenzene	<5
n-Propylbenzene	<5
n-Butylbenzene	<5
Naphthalene	<5
Hexachlorobutadiene	<5
1,3,5-Trimethylbenzene	<5
p-Isopropyltoluene	<5
Isopropylbenzene	<5
Tert-butylbenzene	<5
Sec-butylbenzene	<5
Fluorotrichloromethane	<5
Dichlorodifluoromethane	<5
Bromochloromethane	<5
Allylchloride	<5
2,3-Dichloro-1-propane	<5
Tetrahydrofuran	<50
Pentachloroethane	<5
Trichlorotrofluoroethane	<5
Carbondisufide	<5
Ether	<5

* Constituent Detection