PERIODIC REVIEW REPORT
NORSELAND MOBILE ESTATES
PORT ORCHARD, WASHINGTON
Facility ID#: 2627

by

Washington State Department of Ecology

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List of Acronyms and Abbreviations

1.24xCUL	1.24 times a chemical's cleanup level
CAP	Cleanup Action Plan
COD	Chemical Oxygen Demand
CUL	Cleanup Level
Ecology	Washington State Department of Ecology
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram (same as parts per million)
mg/L	milligrams per liter (same as parts per million)
MTCA	Model Toxics Control Act
Norseland	Norseland Mobile Estates
PQL	Practical Quantitation Limit
TOC	Total Organic Carbon
WAC	Washington Administrative Code
μg/L	micrograms per liter (same as parts per billion)
μS	microSiemens

Chapter 1 - Introduction

Norseland Mobile Estates is located near Port Orchard, Washington. It is the site of a former municipal waste landfill. Cleanup actions to protect human health and the environment were conducted at the site as required by Consent Decree No. 00 2 02071 8, State of Washington, Department of Ecology v. Kitsap County and Port of Bremerton (Ecology, 2000).

This report presents the results of a 5-year periodic review of post-cleanup site conditions and monitoring data at Norseland. This work being conducted pursuant to requirements of the Model Toxics Control Act Cleanup Regulation, Chapter 173-340 Washington Administrative Code (WAC).

Periodic review requirements are specified in WAC 173-340-420. A periodic review is required for Norseland because the Washington State Department of Ecology (Ecology) has issued a consent decree that specifies cleanup actions to be taken at the site and those actions required institutional controls as part of the cleanup action. See WAC 173-340-420(2). Section XXV of the consent decree provides that the parties will meet every five years to discuss the status of the site and the need, if any, of further remedial action at the site. Exhibit A of the Consent Decree is the final Cleanup Action Plan (CAP). Exhibit D of the Consent Decree is the Restrictive Covenant required for Norseland. It was recorded in Kitsap County on August 9, 2000.

The evaluation of whether human health and the environment remain adequately protected by the cleanup actions must consider factors specified in WAC 173-340-420(4). These factors are:

- The effectiveness of ongoing or completed cleanup actions, including the effectiveness of engineered controls and institutional controls in limiting exposure to hazardous substances remaining at the site;
- New scientific information for individual hazardous substances or mixtures present at the site;
- New applicable state and federal laws for hazardous substances present at the site;
- Current and projected site and resource uses;
- The availability and practicability of more permanent remedies; and
- The availability of improved analytical techniques to evaluate compliance with cleanup levels.

Chapter 2 - Site Conditions

2.1 Site History

Norseland is the site of a former mobile home park. It is located at 8651 State Highway 3, Port Orchard, Washington (Figure 1). The site is entirely within the Port of Bremerton's Olympic View Business and Industrial Park. The site lies west of State Highway 3. Bremerton National Airport is adjacent to Norseland, on the east side of Highway 3.

The U.S. Navy owned the airport property in 1942, having taken it over from Kitsap County. The U.S. Army acquired adjacent property, including Norseland, in 1943. During the joint Army-Navy possession, the Army constructed barracks, officer's quarters, and several other outbuildings at Norseland. This facility was named Camp Christie. All buildings and debris were removed from the site or burned before the Army transferred the land back to Kitsap County in 1948.

Puget Service Company leased the land and operated a landfill at Norseland between 1951 and 1961. This landfill was operated under a permit from the Bremerton-Kitsap County Health District. The landfill was the disposal site from the City of Bremerton between 1952 and 1961. Most of the time the landfill was operated as a burn dump. There was also a salvage operation. Puget Service Company's contract with the City ended in 1961. Puget Service Company closed the landfill consistent with standards acceptable in 1961.

In 1962 Kitsap County leased property to a developer who created Norseland Mobile Estates. The mobile home park was created on the southeast portion of the area formerly permitted for landfilling. In 1963 Kitsap County gave the property to the Port of Bremerton.

In September 1991 Ecology received reports that transitory odors at the mobile home park had been detected by residents. A variety of health effects were attributed to the odors by some residents. Between 1992 and 2000 a remedial investigation and feasibility study was conducted and a cleanup action plan developed. During this time, the Norseland Mobile Home Park was decommissioned and residents moved to a new mobile home park in Port Orchard.

At the time of entry of the Consent Decree, Norseland was vacant. The Cleanup Action Plan documents the selected cleanup action for Norseland (Ecology, 2000, see Chapter 8). The cleanup actions required the consolidation of waste within a designated area. The waste was covered by a permeable soil cap (minimum of 18 inches) with vegetated topsoil cover (minimum of 6 inches). Figure 2 shows the original location of the landfill material and Figure 3 shows the configuration of the site after remediation. Figure 4 is an aerial photograph of the site taken in 2009. Figure 5 shows photos of the site taken in 2007 and 2011.

Cap maintenance, surface water control, restrictive covenants on the land, and compliance monitoring were required. Compliance monitoring included groundwater monitoring and ambient air monitoring.

The landfill was closed using the standards of WAC 173-340-304, as required by the then-current MTCA Cleanup Regulation [WAC 173-340-710(6)(c)], January 1996 amendment). The 1996 Regulation required that solid waste landfills be closed under the solid waste closure requirements of Chapter 173-304WAC.

The MTCA Regulation provides that the department may grant a variance under provisions of Chapter173-304 WAC [See WAC 173-340-710(4)]. Ecology granted a variance for this cleanup action so that a low-permeability soil cover or synthetic liner would not be required. The basis for this variance is documented in the Cleanup Action Plan (Ecology, 2000, Exhibit A, §8.6.3).

Closure actions are documented in the As-Built Report (Golder, 2001a).

The cleanup action plan required compliance monitoring be conducted for five years after completion of the construction phase of the cleanup actions. In 2002 consolidation of the waste and placement of the permeable soil cap were completed. Groundwater and ambient air were monitored from 2002 until 2006 and operation and maintenance activities were conducted as necessary. The monitoring, operation, and maintenance were conducted in accordance with the Compliance Monitoring Plan and Operation and Maintenance Plan, Norseland Site (Golder, 2001b). A number of reports document the monitoring, operations, and maintenance activities (Golder, 2002-2006).

The Port of Bremerton has submitted a Petition for Removal of the Former Norseland Estates Site (Port Orchard, Washington) from the Hazardous Sites List (Golder, 2007a) to Ecology. The petition summarized site actions to date, evaluated the cleanup status of the site, and petitioned the Washington State Department of Ecology to remove Norseland from the Washington State Hazardous Sites List. The petition was accompanied by an electronic database containing groundwater and air monitoring data collected at the site (Golder, 2007b). Ecology relied upon the data presented in this database to conduct this periodic review. The database submitted was named NORSELAND_Dec2007b.mdb. Ecology archived the database as submitted and worked with a copy named NORSELAND_Dec2007b_EcyAnalysis.mdb. In the working copy, tables starting with "x" or "z: and queries starting with "ECY" were developed by Ecology from the database as submitted. NORSELAND_Dec2007b_EcyAnalysis.mdb is referred to herein as the site database, or simply the database.

Subsequent to the initial cleanup actions the Port raised the grade of the site a minimum of four feet to enable the site to be developed for a future use compatible with site conditions. Currently the Port of Bremerton, in cooperation with the Bremerton Motorsport Park, plans to relocate the present raceway from Port airport property to a new site of which one portion of the project will exist on the former Norseland site.

2.2 Cleanup Levels and Points of Compliance

The Compliance Monitoring Plan specifies that cleanup levels for groundwater as MTCA Method B concentrations (Golder, 2001b, §1.2). Certain adjustments may be made to carcinogenic cleanup levels for chemicals that have a Maximum Contaminant Limit (MCL) set under the Safe Drinking Water Act.

Cleanup levels for ambient air are also specified as MTCA Method B cleanup levels except where background chemicals are present at concentrations that exceed the MTCA Method B cleanup level. In such cases, the background concentration is used as the cleanup level. For such chemicals, the national average suburban ambient air quality concentration was used as the cleanup level. These values were obtained from the EPA-AIRS Database (EPA, 1989).

For this review, the MTCA Method B cleanup level for each chemical in the database was reviewed using Ecology's Cleanup Level and Risk Calculation (CLARC) database. This database is available online at https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx. The lowest of the carcinogenic or noncarcinogenic concentration was used as the cleanup level except for chemicals listed in CAP Table 1, Ambient Air Cleanup Levels, with a cleanup level from the AIRS database. For those chemicals, the national average suburban ambient air quality concentration was used as the cleanup level.

In addition, the groundwater cleanup level for vinyl chloride was adjusted from the MTCA Method B formula value of 0.029 µg/L to 0.29 µg/L. This adjustment is made when a chemical has an MCL exceeding a 10^{-5} carcinogenic risk level. In such cases, the cleanup level is set at the 10^{-5} carcinogenic risk level, rather than the 10^{-5} carcinogenic risk level, per Ecology policy.

The groundwater point of compliance where groundwater cleanup levels must be met are the perimeter of the solid waste facilities active area as that active area existed at closure of the facility. The ambient air point of compliance is throughout the site.

Groundwater wells and ambient air monitoring stations used to collect samples to assess compliance are shown on Figure 6. Well MW-1 is an upgradient well to assess groundwater quality entering the site. Wells MW-2 and MW-3 are compliance wells.

Four ambient air monitoring stations, AA-1 through AA-4, were used to assess compliance. Station AA-5 was located in close proximity to AA-2 to provide a duplicate location for quality control purposes. Data from stations AA-1 through AA-4 were reviewed for this report to assess compliance.

Chapter 3 - Periodic Review

3.1 Review Procedures

Ecology used the site database and referenced site documents as necessary to perform this review. The site database grouped analysis as follows:

- Field parameters
- Inorganic Parameters
- Metals
- Organic Parameters
- Air Data

As stated above, Ecology reviewed all cleanup levels and developed an updated list of cleanup levels based upon the most recent Cleanup Levels and Risk Calculations database. This is an Ecology database that compiles cleanup levels for chemicals by media (groundwater, soil, air). The updated cleanup levels are in the site database as Tables zGWCULs+CLARC and zAirCULs.

The database contained the certified laboratory data collected during the monitoring period. Ecology relied upon the certification contained in the monitoring reports prepared for each monitoring round (Golder, 2002-2006, Appendix B).

Ecology used the database to develop tables of the data for each of the chemical groups. These tables are in the Excel file GraphSource.xls. The Excel tables were used to develop the summary graphs and tables that are presented in this report.

One important concept was used for presenting all but the field and inorganic parameters. This concept is **normalized concentration**. Each chemical has a different cleanup level and the normalized concentration is a simple means of comparing a chemical's measured concentrations to its cleanup level. The normalized concentration for a chemical is:

$$Normalized\ Concentration = \frac{Measured\ Concentration}{Cleanup\ Level}$$

Hence, if a chemical's normalized concentration is greater than 1, its measured concentration exceeds its cleanup level. This provides a means of rapidly screening many chemicals to identify those chemical that have exceeded their cleanup level in one or more monitoring rounds.

Where chemicals were not detected, the normalized concentration was calculated using the Practical Quantitation Limit:

$$Normalized\ Concentration = \frac{PQL}{Cleanup\ Level}$$

3.2 Groundwater Monitoring Data

3.2.1 Data Collection

Groundwater data was collected in Spring and Fall events from Spring 2002 through Fall 2006. The site database names each of the rounds, Spring 2002, Fall 2002, etc. Actual sampling dates are given in the database. In addition, each round was assigned a nominal sampling date so that data could be plotted by round. The nominal sampling date was the first day of sampling for each round.

Groundwater conditions were monitored in three monitoring wells, MW-1, MW-2, and MW-3 (See Figure 6). MW-1 is on the upgradient side of the landfill with respect to groundwater flow. MW-2 and MW-3 are on the downgradient side of the landfill at the landfill point of compliance.

Unique sets of compliance monitoring parameters were established for the spring and fall periods, to be applied to each of the five years of compliance monitoring. The spring period included volatile organic analysis (EPA Method 8260B), a short list of target metals (iron, manganese, zinc), and landfill indicator parameters (temperature, conductivity, pH, chloride, nitrate/nitrite, ammonia as nitrogen, sulfate, chemical oxygen demand [COD], and total organic carbons [TOC]). In the fall, a more extensive list of parameters was applied, including:

- Volatile organics by EPA 8260B
- Semivolatile organics by EPA 8270C
- Pesticide/polychlorinated biphenyls (Pest/PCB) by EPA 8081A and 8082
- Ammonia nitrogen by EPA 350.2
- Chemical oxygen demand (COD) by EPA 410.2
- 23 Metals by ion coupled plasma (ICP) Method 6010, and ICP/MS Method 6020
- Cyanide by EPA Method 335.2
- Chloride, sulfate, and nitrite/nitrate by EPA Method 300A
- TOC by EPA Method 415.1

3.2.2 Field Parameters

The database lists groundwater parameters measured in the field in Table Field Data1. Field parameters included turbidity, dissolved oxygen, conductivity, temperature, and pH. These data are presented graphically on Figure 7. In summary:

- **Turbidity:** There is no standard for turbidity in groundwater. Turbidity of water from the three wells was similar. MW-1, the background well, had the highest turbidity in several rounds. Turbidity in groundwater samples from wells is often a reflection of difficulties in well development rather than turbidity in groundwater away from the well.

- **Dissolved Oxygen:** There is no standard for dissolved oxygen in groundwater. Dissolved oxygen concentrations in the three monitoring wells were similar.

- **Conductivity:** The cleanup level for conductivity is 700 microSiemens (μS). All measured values were well below the cleanup level. Groundwater from wells MW-1 (background well) and MW-2 were most similar. Well MW-3 was consistently lowest.

- **Temperature:** There is no standard for temperature in groundwater. Values were mostly similar in the three wells. In the Spring 2006 monitoring round, MW-1 (background well) had a significantly higher temperature than the other wells. The cause of this is not known.

- **pH:** There is no standard for pH in groundwater. The pH in the three wells was generally slightly acid, ranging from about 5.6 to 7.0. MW-1 (background well) consistently had the highest pH, and was slightly alkaline (pH > 7) in the Fall 2003 monitoring round.

Dissolved oxygen, conductivity, and pH are the primary parameters of interest for assessing whether landfill biodegradation is affecting groundwater flowing through the site. The general similarity of values for these parameters between the upgradient well (MW-1) and the two downgradient wells (MW-2 and MW-3) indicate that biodegradation of landfill material has been mostly completed. Overall, the field parameters do not indicate significant impacts of landfill material on groundwater flowing through the site. The somewhat greater acidity exhibited by the two downgradient wells could be because biodegradation of landfill contents has not completely stopped.

3.2.3 Inorganic Parameters

The database lists inorganic groundwater parameters in Table GWater_INORGANICS. Inorganic parameters included chloride, sulfate, Nitrate/Nitrite, Cyanide, Ammonia, Chemical Oxygen Demand, and Total Organic Carbon. These data are presented graphically on Figure 8. In summary:

- **Chloride:** The cleanup level for chloride is 250 mg/L. Chloride concentrations were all less than 7 mg/L. Concentrations in MW-1 (background well) and MW-2 were higher and more variable than the concentrations in MW-3.

- **Sulfate:** The cleanup level for sulfate is 250 mg/L. Sulfate concentrations were all less than 5 mg/L. Concentrations were highest in MW-1 (background well).

- **Nitrate/Nitrite:** The cleanup level for Nitrate/Nitrite is 10 mg/L. Nitrate/Nitrite concentrations were all less than 8 mg/L. Concentrations were highest in MW-1 (background well).

- **Cyanide:** Cyanide analyses were performed in the Fall 2005 and Fall 2006 monitoring rounds. Cyanide was not detected in either round. The Practical Quantitation Limit (PQL) was 0.05 mg/L. The cleanup level is 0.2 mg/L.

- **Ammonia:** There is no cleanup level for ammonia. The PQL for ammonia was 0.04 mg/L. Ammonia was detected only in the Fall 2006 monitoring round. Concentrations in the monitoring wells were similar.

- **Chemical Oxygen Demand:** There is no cleanup level for chemical oxygen demand (COD). Measured concentrations were generally similar in all wells. Two "spikes" occurred during the monitoring period, one in MW-2 in Spring 2003, and one in MW-1 (background well) in Fall 2004. All concentrations were below 80 mg/L, and all but the two spikes were below 20 mg/L. The COD data indicate landfill leachate, which typically has COD concentrations well into the thousands during active landfill biodegradation, does not appear to be significantly impacting groundwater flowing through the site.

- **Total Organic Carbon:** There is no cleanup level for total organic carbon (TOC). Measured concentrations were generally similar in all wells. On "spike" occurred in MW-1 (background well) in Fall 2004. The TOC data do not indicate the landfill material is having a significant impact on TOC concentrations of groundwater flowing through the site.

Overall, the inorganic parameters do not indicate significant impacts of landfill material on groundwater flowing through the site.

3.2.4 Metals

The database lists groundwater metals parameters in Table GW+Soil_METALS. Table 1 lists the metals for which analyses were conducted and provides a summary of results for each metal. The only metal detected in excess of its cleanup level was cadmium. Fifteen samples were analyzed for cadmium. It was detected at 1.24 times its cleanup level (1.24xCUL) in Well MW-1 (upgradient well) in Fall 2006.

Iron and manganese are metals of interest for assessment of landfill activity. Both of these metals can be mobilized by landfill leachate resulting in groundwater contamination. Both of these metals had concentrations below their respective cleanup levels in all rounds.

The metals data collected during the 2002-2006 monitoring period indicate landfill material is not causing metal contamination of groundwater.

3.2.5 Organic Parameters

The database lists organic parameters in Table GWater_Organic. Table 2 lists the organic chemicals that had normalized concentrations of less than 1. That is, these chemicals either were not detected and the PQLs were less than the cleanup level, or were detected but at concentrations less than the cleanup level. Detected chemicals are shown in bold.

Table 3 lists the organic chemicals that had normalized concentrations greater than 1. For all but two of the chemicals, the chemical was not detected but the PQL exceeded the cleanup level in one or more rounds.

Two chemicals were actually detected: bis(2-ethylhexyl)phthalate and aldrin. Bis(2-ethylhexyl) phthalate was detected in 3 of 30 samples. The concentrations of the three detections were actually less than the cleanup level and are believed to be due to contamination of the method blank. That is, there were quality control problems with these detections. The remaining bis(2-ethylhexyl)phthalate analyses did not detect the compound, but some PQLs were above the CUL. The highest PQL was 2.29xCUL.

Aldrin was detected in one sample at 5.38xCUL. This detection was in Well MW-2 in the Fall 2006 monitoring round. The well was resampled in Winter 2007 and aldrin was not detected; the PQL for this sample was 3.65xCUL.

One compound of interest at landfills is vinyl chloride. Vinyl chloride was not detected in groundwater, but the PQL ranges from 0.69xCUL to 3.45xCUL. The 3.45xCUL corresponds to a PQL of 1 µg/L. The MTCA cleanup level for vinyl chloride is 0.29 µg/L and the maximum contaminant limit under the Safe Drinking Water Act Maximum Contaminant Level (MCL) is 2 µg/L. Hence, vinyl chloride is not present at concentrations above the MCL. The PQL for vinyl chloride was below the CUL for one or more rounds in each monitoring well. Landfill material does not appear to be contributing significant amounts of vinyl chloride, if any, to water flowing through it. This indicates biodegradation of the landfill material is substantially complete.

3.3 Air Monitoring Data

The database lists air parameters in Table AIR Data. Table 4 lists the chemicals that had normalized concentrations of less than 1. That is, these chemicals either were not detected and the PQLs were less than the cleanup level, or were detected but at concentrations less than the cleanup level. Detected chemicals are shown in bold.

Table 5 lists the chemicals that had normalized concentrations greater than 1. For all but two of the chemicals, the chemical was not detected but the PQL exceeded the cleanup level in one or more rounds. 1,2-dichloroethane was detected in 1 of 40 samples. This detection was at station AA-1 in Fall 2005. This was an upwind station. (See Table 6)

Chloromethane was detected in all air samples, exceeding its cleanup level in 5 of 40 samples. The highest exceedance was 1.18xCUL.

Chloromethane is produced naturally in the oceans by the action of sunlight on biomass and chlorine in sea foam. It was once used as a refrigerant and for producing lead-based additives for gasoline.

Chloromethane air data are summarized in Table 6 and on Figure 9. Table 6 shows that chloromethane results were similar at all sampling stations, varying from 9% to 25% about the average for the four air sampling stations for each monitoring round. Figure 9 shows the variation of concentrations over the five-year monitoring period. These results indicate that landfill material is not contributing significant chloromethane to the ambient air.

Air monitoring indicates landfill material at the Norseland site is not significantly contributing contaminants to ambient air at the site.

The Cleanup Action Plan requires that any building built on the footprint of the landfill cap must be designed to prevent the accumulation of landfill gasses inside the structures. Any site development over the refuse area must be designed to avoid the subsurface gas accumulation under structures (Ecology, 2000, Exhibit A, p. 31). These requirements remain in force.

3.4 Review of Operation and Maintenance Activities

The Norseland site was visited On ***, 2011. The landfill cap was in good condition. Erosion, cap settling, and weather damage were not visible. Stormwater conveyance structures were in good condition. Portions of the stormwater ditches needed mowing, and the Port indicated this maintenance was scheduled.

The landfill cap will need continued maintenance to ensure only appropriate vegetation grows on the cap.[1] In addition, security measures will be necessary to prevent unauthorized access and the potential for damage to storm water grates and pipes by vandalism.

3.5 Petition to Remove the Site from the Hazardous Sites List

The Port of Bremerton has submitted a petition to remove the Norseland Mobile Estates site from the Hazardous Sites List (Golder, 2007a). The petition concluded that the advanced age of the landfill and the results of the 5-year monitoring effort confirm that the landfill poses a low threat to public health and the environment.

[1] Deeply-rooted vegetation could create pathways for rain to seep through the cap and should be removed from the cap if observed.

Chapter 4 - Conclusions and Recommendations

Ecology concurs with the statement in the Port of Bremerton's petition for removing the site from the Hazardous Site List that that the advanced age of the landfill and the results of the 5-year monitoring effort confirm that the landfill poses a low threat to public health and the environment. This concurrence is based upon the following may review findings:

- **Field parameters** indicate that dissolved oxygen groundwater concentrations and groundwater conductivity is similar at upgradient and downgradient monitoring wells. Conductivity is well below its CUL.
- **Inorganic parameters** were all well below CULs for the parameters that have standards. Concentrations of those parameters that had CULs were highest in the upgradient well. Chemical oxygen demand and total organic carbon concentrations were similar among all wells.
- **Metals parameters** were not detected in excess of their cleanup level with the except of a single exceedance of cadmium at 1.24xCUL. Key landfill indicator metals iron and manganese were not detected above their CULs.
- **Organic parameters** showed only two chemicals were detected. Only one detection exceeded the chemical's CUL. This was a detection of aldrin in 1 of 16 samples collected during the monitoring period. Aldrin was not detected in a subsequent resampling round. PQLs exceeded the Method B CUL based upon formula values for many chemicals. The regulation provides that where PQLs exceed the Method B formula value, the PQL is the cleanup standard.
- **Air parameters** monitoring detected only two chemicals in concentrations exceeding CULs. 1,2-dichloroethane was detected in 1 of 40 samples; this detection was at an upwind air monitoring station. Chloromethane, a compound naturally present in air, was detected in all air samples, exceeding its cleanup level in 5 of 40 samples. The highest exceedance was 1.18xCUL. PQLs exceeded the Method B CUL based upon formula values for many chemicals. The regulation provides that where PQLs exceed the Method B formula value, the PQL is the cleanup standard.
- **Engineering controls** are currently well-maintained.
- **Institutional controls** are in place to ensure the continued security and maintenance of the landfill, and proper construction of any structures on the landfill cap.

Overall, the compliance monitoring data indicate what one would expect of a landfill that was closed in the 1960s. Biodegradation is substantially complete and the landfill no longer poses a significant threat the human health and the environment in its current configuration, so long as current engineering and institutional controls are maintained.

The Norseland Mobile Estates site should be removed from the Hazardous Sites List and oversight returned to the Kitsap County Health District. The landfill will remain under closure permit from the Health District. All requirements or conditions under any applicable solid waste regulations and the closure permit remain in effect.

The Kitsap County Health District may require that additional monitoring be done.

All construction activities at the site are subject to the review by the Health District and shall conform to BKCBH Ordinance 2004-2, Section 460 "Construction and Notification Standards near Landfills." This shall include methane studies and monitoring where appropriate.

The delisting of this site is based on the conditions listed below. Should either of these statements no longer be true this site may be listed again as a Hazardous Site.

- Results of groundwater and ambient air monitoring that indicate there are no hazardous substances leaving the site above the agreed upon cleanup levels.

- The requirements of the "Compliance Monitoring Plan & Operation and Maintenance Plan" (December 26, 2001) have been substantially met.

Chapter 5 - References

Ecology, 2000, Consent Decree No. 00 2 02071 8, State of Washington, Department of Ecology v. Kitsap County and Port of Bremerton. Ecology File# Norseland/SIT8.5.4.

EPA, 1989, AIRS (Aerometric Information Retrieval System) User's Guide Volumes I-VII – Updated 1997. Research Triangle Park, N.C. Office of Air Quality Planning and Standards. Website: www.epa-gov/ttn/AIRS.

Golder, 2007a, Petition for Removal of the Former Norseland Estates Site (Port Orchard, Washington) from the Hazardous Sites List on November 1, 2007. Submitted by Golder Associates on behalf of the Port of Bremerton. Ecology File# Norseland/SIT5.16.

Golder, 2007b, Norseland Chemical Database, (Access database NORSELAND_Dec2007b.mdb). Submitted by Golder Associates on behalf of the Port of Bremerton. Ecology File# Norseland/SIT5.16, 1 CD-ROM. *Ecology archived this database and worked with a copy named NORSELAND_Dec2007b_EcyAnalysis.mdb. In the working copy, tables starting with "x" or "z: and queries starting with "ECY" were developed by Ecology. NORSELAND_Dec2007b_EcyAnalysis.mdb is referred to herein as the site database, or simply the database.*

Golder, 2001a, Norseland Site As-Built Report. Prepared by Golder Associates for the Kitsap Public Authority Team. Ecology File# Norseland/SIT5.8.

Golder, 2001b, Compliance Monitoring Plan, Operations and Maintenance Plan, Norseland Site. Prepared by Golder Associates for the Kitsap Public Authority Team. Ecology File# Norseland/SIT5.7.

Golder, 2002-2006, Compliance Monitoring Reports for Years 2002-2006. Prepared by Golder Associates for the Kitsap Public Authority Team. Ecology File#s Norseland/SIT5.10 through SIT5.15.

Port of Bremerton, 2007, Application for Remedial Action Grant. Ecology File# Norseland/SIT5.

Table 1: Metal Analysis Results

Metal	Summary of Results
Aluminum	0/14 detections. No standard. Aluminum is not a regulated chemical in groundwater.
Antimony	1/14 detections. Detection was 0.27xCUL in MW-2. For the nondetects, the PQL exceeded the CUL in Fall 2002 and Fall 2005.
Arsenic	0/16 detections. PQL in Fall 2005 round exceeded CUL.
Barium	6/15 detections, all well below the cleanup level.
Beryllium	0/14 detections. PQL exceeded CUL in the Fall 2005 round by 0.001 mg/L. but MDL was less than the CUL.
Cadmium	1/15 detections. Detection was 1.24xCUL in MW-1 (background well) in Fall 2006. PQL was less than or equal to the cleanup level in all rounds.
Calcium	No standard. Not a regulated chemical for groundwater.
Chromium	2/16 detections, at 1/10th the cleanup level. PQLs less than CUL.
Cobalt	0/14 detections. No standard.
Copper	0/17 detections. All PQLs less than CUL.
Iron	1/29 detections. Detection was 0.33xCUL in MW-3. All PQLs were less than the CUL.
Lead	0/16 detections. PQL exceeded CUL in Fall 2005. PQLs for other rounds were less than CUL.
Magnesium	No standard; not a regulated chemical for groundwater.
Manganese	2/29 detections. Both detections and the PQLs for the nondetects were below the CUL.
Mercury	0/14 detections. PQL was 1/10th the CUL.
Nickel	0/14 detections. PQL was 1/5th the CUL or less.
Potassium	No standard. Not a regulated chemical for groundwater.
Selenium	0/15 detections. PQL exceeded the CUL in Fall 2005 round, but the MDL was less than the PQL.
Silver	0/15 detections. PQL was less than the CUL in all rounds.
Sodium	No standard. Not a regulated chemical in groundwater.
Thallium	0/14 detections. PQL exceeded the CUL in most rounds.
Vanadium	0/14 detections. PQL was less than the CUL in all rounds.
Zinc	5/29 detections. All detections and PQLs well below CULs.

0/14 detections indicates zero detections in 14 analysis. CUL = Cleanup Level.
PQL = Practical Quantitation Limit. MDL = Method Detection Limit

Table 2: Organic Chemicals with Normalized Concentrations < 1*

(Bold = Detected. Not bold = not detected, PQL < CUL or no CUL*)

1,1,1,2-Tetrachloroethane
1,1,1-Trichloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,1-Dichloropropene
1,2,3-Trichlorobenzene
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dibromoethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3,5-Trimethylbenzene
1,3-Dichlorobenzene
1,3-Dichloropropane
1,4-Dichlorobenzene
1-Methylnaphthalene
2,2-Dichloropropane
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
2-Butanone
2-Chloroethyl vinyl ether
2-Chloronaphthalene
2-Chlorophenol
2-Chlorotoluene
2-Hexanone
2-Methylnaphthalene
2-Methylphenol
2-Nitroaniline
2-Nitrophenol
3 & 4 Methylphenol
3,3'-Dichlorobenzidine
3-Nitroaniline
4,4'-DDD
4,4'-DDE
4,4'-DDT
4,6-Dinitro-2-methylphenol
4-Bromophenylphenylether
4-Chloro-3-methylphenol
4-Chloroaniline
4-Chlorophenyl phenyl ether
4-Chlorophenylphenylether
4-Chlorotoluene
4-Chlorotoluene
4-Isopropyltoluene
4-Nitroaniline
4-Nitrophenol
4-Nitrophenol
Acenaphthene
Acenaphthylene
Acetone
alpha-BHC
alpha-Chlordane
Anthracene
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Benzo(g,h,i)perylene
Benzofluoranthene
Benzoic Acid
Benzyl Alcohol
beta-BHC
bis(2-Chloroethoxy)methane
bis(2-Chloroisopropyl)ether
bis(2-Ethylhexyl)phthalate
Bromobenzene
Bromochloromethane
Bromoform
Bromomethane
Butyl benzyl phthalate
Carbazole
Carbon Disulfide
Chlorobenzene
Chlorobromomethane
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
delta-BHC
Dibenzofuran
Dibromomethane
Dichlorobromomethane
Dichlorodifluoromethane
Diesel Range Petroleum
Diethylphthalate
Dimethylphthalate
Di-n-butylphthalate
Di-n-octylphthalate
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Endrin ketone
Ethylbenzene
Ethylene Dibromide
Fluoranthene
Fluorene
gamma-BHC (Lindane)
gamma-Chlordane
Gasoline Range Petroleum
Heavy Oil Range Petroleum
Heptachlor
Heptachlor epoxide
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Iodomethane
Isophorone
Isopropylbenzene
m,p-Xylene
Methoxychlor
Methyl Isobutyl Ketone
Methyl t-Butyl Ether
Methylene chloride
m-Xylene & p-Xylene
Naphthalene
n-Butylbenzene
Nitrobenzene
N-nitroso-di-n-propylamine
N-Nitrosodiphenylamine
n-Propylbenzene
o-Xylene
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1260
Phenanthrene
Phenol
Pyrene
sec-Butylbenzene
Styrene
t-Butylbenzene
technical Chlordane
tert-Butylbenzene
Toluene
trans-1,2-Dichloroethene
Trichloroethene
Trichlorofluoromethane
Vinyl Acetate

*Normalized concentration < 1 indicates the chemical was not detected in excess of its cleanup level or there was no cleanup level for the chemical. PQL = Practical Quantitation Limit, CUL = Cleanup Level)

Table 3: Organic Chemicals with Normalized Concentrations > 1*

Chemical	Summary of Results
1,1,2,2-Tetrachloroethane	0/30 detections. PQL was 4.55xCUL in 27/30 samples. PQL was 0.91xCUL in 3/30 samples
1,2,3-Trichloropropane	0/30 detections. PQL was 159xCUL in 27/30 samples. PQL was 32xCUL in 3/30 samples.
1,2-Dibromo-3-chloropropane	0/30 detections. PQL was 10xCUL in 3/30 samples. PQL was 5xCUL in 27/30 samples.
Aldrin	**1/16 detections. Detection was 5.38xCUL in MW-2, Fall 2006.** 15/16 nondetects had PQL 0.37-7.62xCUL.
Benzene	0/30 detections. PQL was 1.25xCUL in 27/30 samples. PQL was 0.25xCUL in 3/30 samples.
Benzo(a)anthracene:	0/15 detections. PQL 1.58-39.67xCUL.
Benzo(a)pyrene	0/15 detections. PQL was 1.58-39.67xCUL.
Bis(2-Chloroethyl)ether	0/15 detections. PQL 4.73-50.00xCUL.
Bis(2-ethylhexyl)phthalate	**3/30 detections. Detections were 0.09-0.11xCUL, and B1* qualified.** PQL for nondetects was 0.22-2.29xCUL.
Bromodichloromethane	0/21 detections. PQL was 0.28xCUL in 3/30 samples. PQL was 1.42xCUL in 18/21 samples.
Carbon Tetrachloride	0/30 detection. PQL was 0.59xCUL in 3/30 samples. PQL was 2.97xCUL in 27/30 samples.
Chrysene	0/15 detections. PQL was 1.58-39.67xCUL.
Dibenz(a,h)anthracene	0/15 detections. PQL was 1.58-39.67xCUL.
Dibromochloromethane	0/21 detections. PQL was 0.38xCUL in 3/21 samples. PQL was 1.92xCUL in 18/21 samples.
Dieldrin	PQL was 0.35xCUL in 2/16 samples. PQL was 3.44-7.20xCUL in 14/16 samples.
Hexachlorobenzene	0/15 detections. PQL was 0.34-0.35xCUL in 9/15 samples. PQL was 3.44-3.64xCUL in 6/15 samples.
Indeno(1,2,3-cd)pyrene	0/15 detections. PQL was 1.58-39.67xCUL.
PCB-1254	0/7 detections. PQL was 0.29-0.30xCUL in 3/7 samples. PQL was 1.50xCUL in 4/7 samples.
Pentachlorophenol	0/15 detections. PQL was 0.26-0.45xCUL in 9/15 samples. PQL was 2.60-8.47xDUL in 6/15 samples.
Tetrachloroethene	0/30 detections. PQL was 0.25xCUL in 3/30 samples. PQL was 1.23xCUL in 27/30 samples.
Toxaphene	0/16 detections. PQL was 0.12xCUL in 2/16 samples. PQL was 1.18-1.24xCUL in 14/16 samples.
Trans-1,3-Dichloropropene	0/30 detections. PQL was 0.83xCUL in 3/30 samples. PQL was 4.17xCUL in 27/30 samples.
Vinyl Chloride	0/30 detections. PQL was 0.69xCUL in 6/30 samples. PQL was 3.45xCUL in 24/30 samples.

*Normalized concentration > 1 indicates the chemical's practical quantitation limit exceeded the cleanup level or the chemical was detected in excess of its cleanup level. 0/14 detections indicates 0 detections in 14 analyses. CUL = Cleanup Level. PQL = Practical Quantitation Limit. B1 qualified = This analyte was detected in the associated method blank. The analyte concentration was determined not to be significantly higher than the associated method blank (less than 10X the concentration reported in the blank).

Table 4: Air Analytes with Normalized Concentration < 1
(Bold = Detected. Not bold = not detected, PQL < CUL or no CUL*)

1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dichlorobenzene
1,2-Dichloropropane
1,3,5-Trimethylbenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,4-Dioxane
2-Butanone (Methyl Ethyl Ketone)
2-Hexanone
2-Propanol
4-Ethyltoluene
4-Methyl-2-pentanone
Acetone
alpha-Chlorotoluene
Benzene
Bromodichloromethane
Bromomethane
Carbon Disulfide
Chlorobenzene
Chloroethane
Chlorotoluene
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Cumene
Cyclohexane
Dibromochloromethane
Ethanol
Ethyl Benzene
Freon 11
Freon 113
Freon 114
Freon 12
Heptane
Hexachlorobutadiene
Hexane
m,p-Xylene
Methyl tert-butyl ether
Methylene Chloride
o-Xylene
Propylbenzene
Propylene
Styrene
Tetrachloroethene
Tetrahydrofuran
Toluene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
Trichloroethene
Vinyl Acetate
Vinyl Chloride

Table 5: Air Analytes with Normalized Concentration > 1

Chemical	Summary of Results
1,1,2,2-Tetrachloroethane	0/40 detections. PQL ranged from 24.40 to 47.05xCUL.
1,1,2-Trichloroethane	0/40 detections. PQL ranged from 5.21 to 10.05xCUL.
1,2-Dibromoethane (EDB)	0/40 detections. PQL ranged from 114.36 to 137.24xCUL.
1,2-Dichloroethane	**1/40 detections. PQL ranged from 0/68 to 6.75xCUL. Detection was 21.25xCUL at Station AA-1 (upwind station) in Fall 2005.**
1,3-Butadiene	0/40 detections. PQL ranged from 2.13 to 4.06xCUL
Bromoform	0/40 detections. PQL ranged from 3.34 to 1.3xCUL.
Carbon Tetrachloride	0/40 detections. PQL ranged from 0.74 to 1.42xCUL
Chloroform	0/40 detections. PQL ranged from 2.33 to 4.50xCUL
Chloromethane	**40/40 detections. Detections ranged from 0.63 to 1.18xCUL. Five Detections exceeded the CUL, ranging from 1.01 to 1.18xCUL.**

Table 6: Chloromethane Air Data - Normalized Concentrations[*]
(Bold and underlined indicates upwind stations)[†]

Round	AA-1	AA-2	AA-3	AA-4	Variation About Average	Weather Data
Spring 2002	0.79	0.80	0.98	0.98	22%	Wind speed 0 to 4.8 mph. Wind direction from the N, NE, and SE. No definitive upwind stations.
Fall 2002	1.00	0.95	0.92	0.92	9%	Wind speed 0 to 6 mph. General wind direction variable. No definitive upwind stations.
Spring 2003	0.90	0.97	**0.92**	0.80	18%	Wind speed 0 to 8.4 mph. General wind direction from the SW. Upwind station would be AA-3.
Fall 2003	**0.82**	0.82	1.18	**1.00**	9%	Wind speed 0 to 11.5 mph. General wind direction from the NNE. Upwind station would be AA-1 and AA-4.
Spring 2004	**0.97**	0.97	0.92	1.03	12%	Wind speed 0 to 16.1 mph with gusts to 21.8 mph. Wind direction from the NE. AA-1 is generally upwind stations.
Fall 2004	0.93	0.80	0.93	0.93	14%	Wind speed 0 to 11.5 mph. Wind direction NNE 17% of the time, SSW 33% of the time, calm 50% of the time. No dominant upwind monitoring station.
Spring 2005	0.56	0.64	**0.61**	0.56	14%	Wind speed 2.3 to 10.4 mph. Wind direction from the SSE and SSW. AA-3 is best upwind station.
Fall 2005	**0.72**	0.74	0.63	**0.61**	19%	Wind speed 0 to 5.8 mph. Wind direction from NNE 80% of time; N 10%, calm 10%. AA-1 and AA-4 were definitive upwind stations.
Spring 2006	1.01	1.11	0.90	0.87	25%	Wind speed 0 to 12.7 mpg; highest during last haf hour.Wind from SE and SW until evening, then from NE. No definitive upwind station.
Fall 2006	**1.00**	1.05	0.89	**0.85**	20%	Wind speed 8 mph for first hour, then averaged 3.6 mph. AA-1 and AA-4 were definitive upwind stations.

[*]Normalized concentrations are measured results divided by the cleanup level.
[†]Not all monitoring rounds has sufficiently consistent wind directions for an upwind station to be identified.

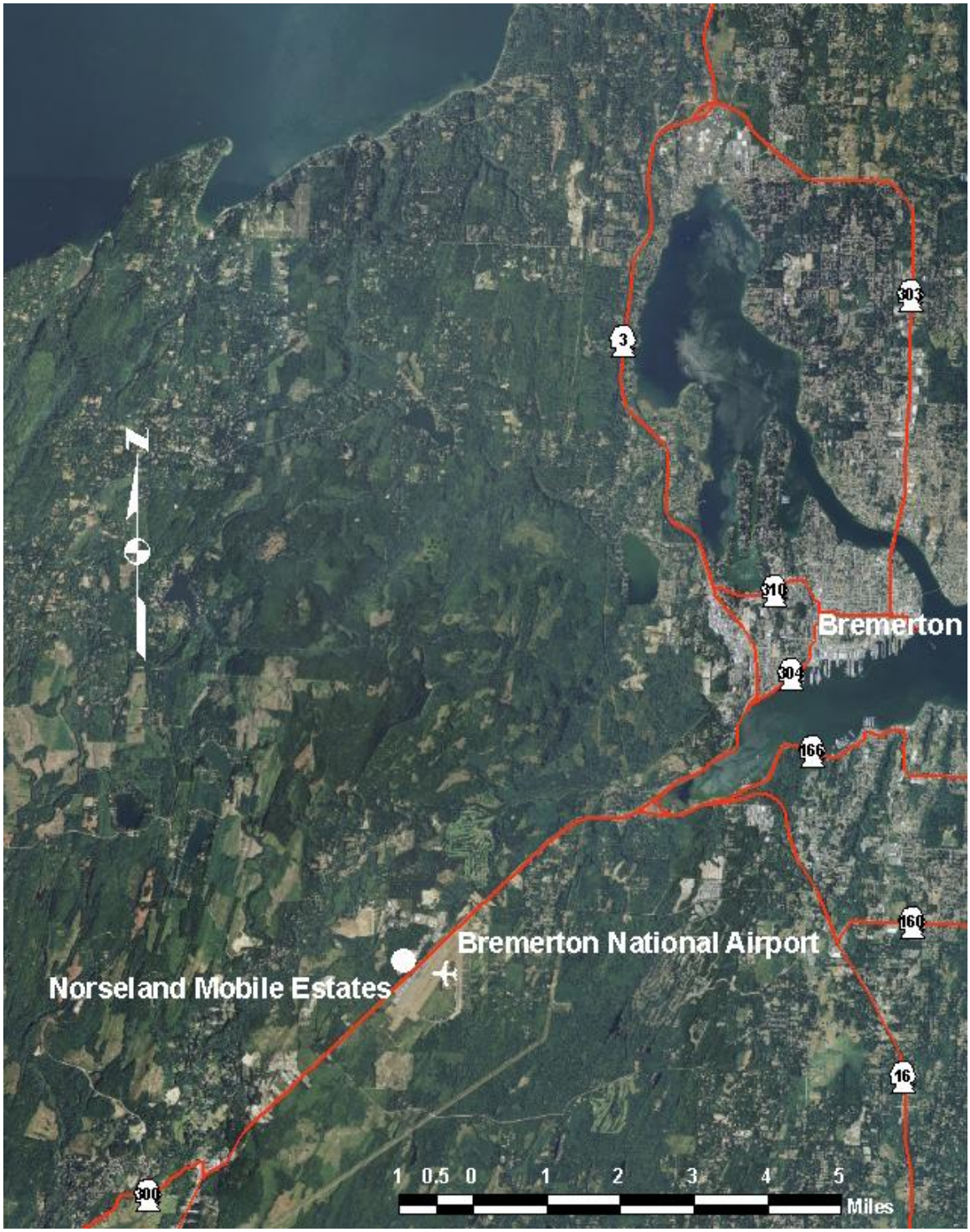


Figure 1: Site Location Map.

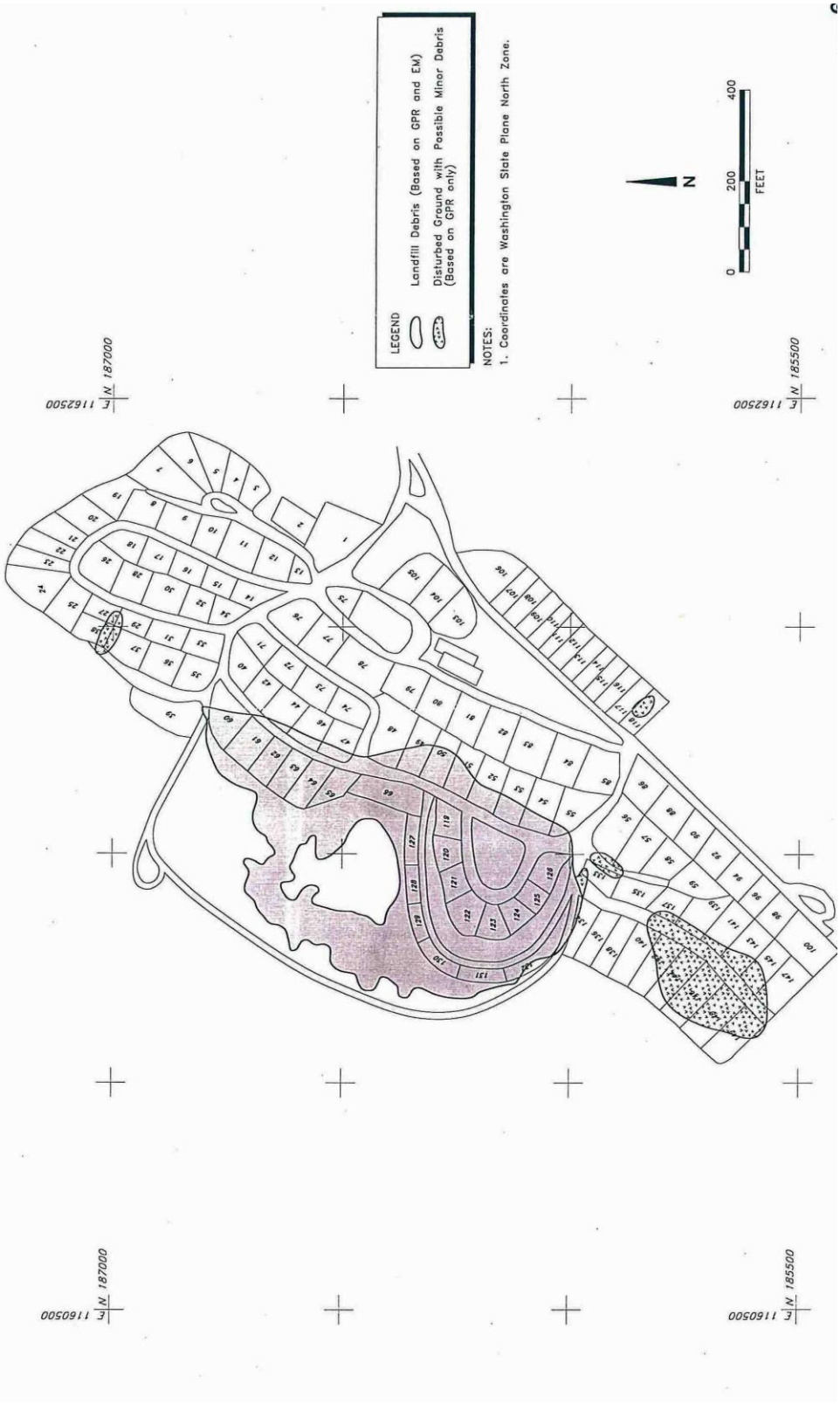


Figure 2: Original Location of Landfill Material (north to left of page).

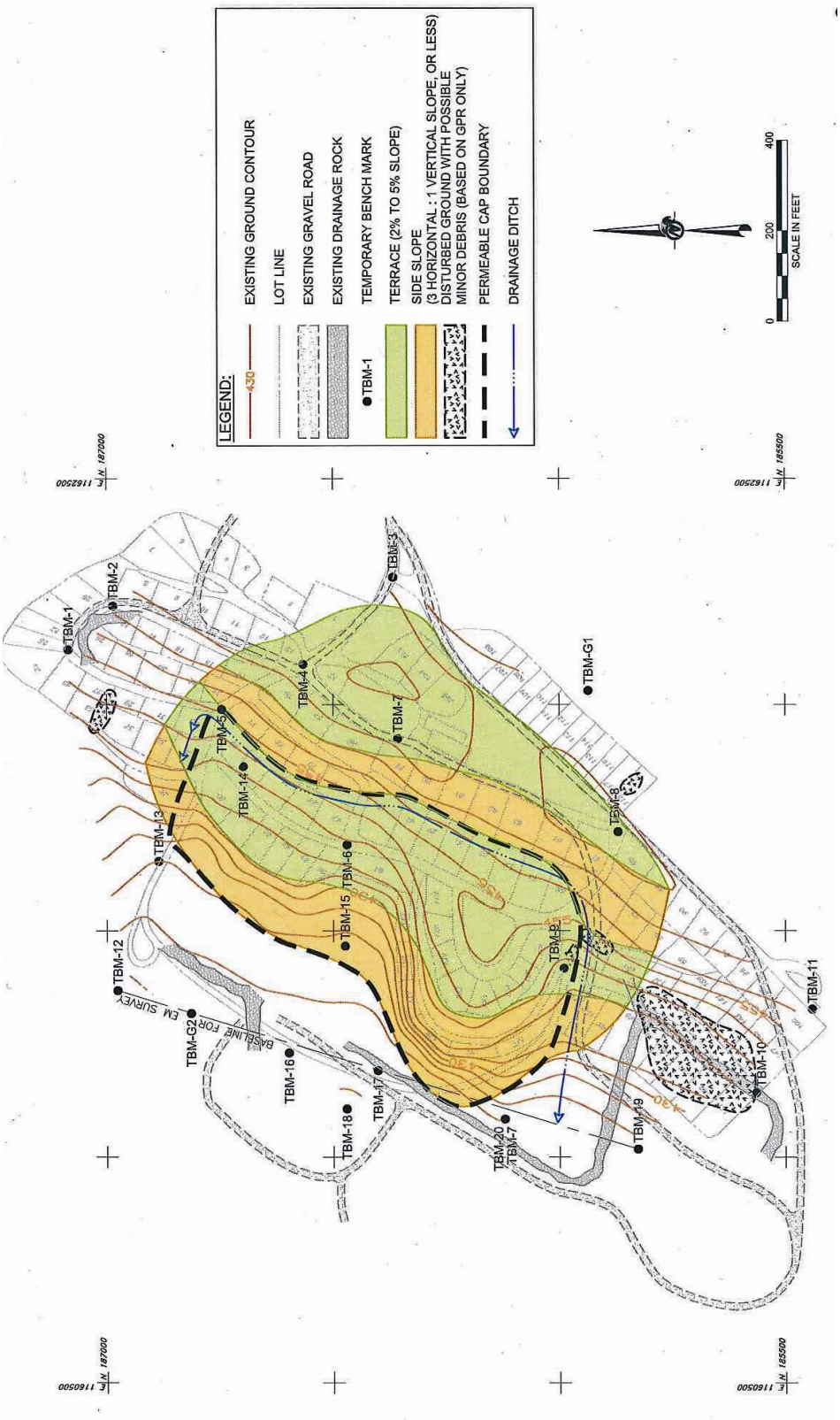


Figure 3: Configuration of Site After Remediation (north to left of page).

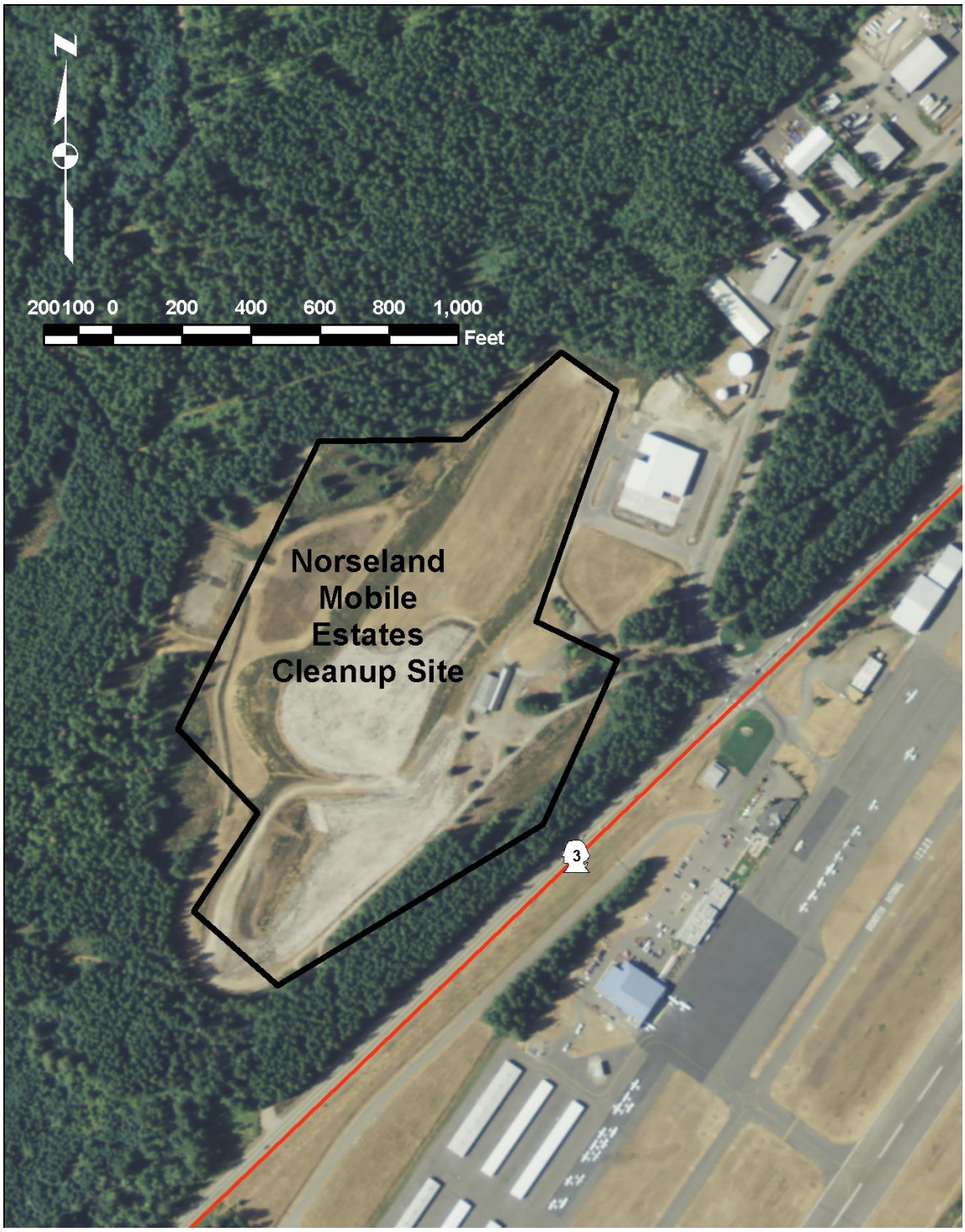


Figure 4: Aerial Photograph of Norseland Site, 2009. The capped area is the area northwest of State Route 3 without trees, labeled Norseland Mobile Estates Cleanup Site.

Figure 5a: Norseland, November 14, 2007. This photo was taken just after a minimum of four feet of fill was added on top of the required permeable cover. Straw has been placed to control erosion until vegetation can be established.

Figure 5b: Photo of Norseland, April 1, 2011. Grass is now growing on the cover surface.

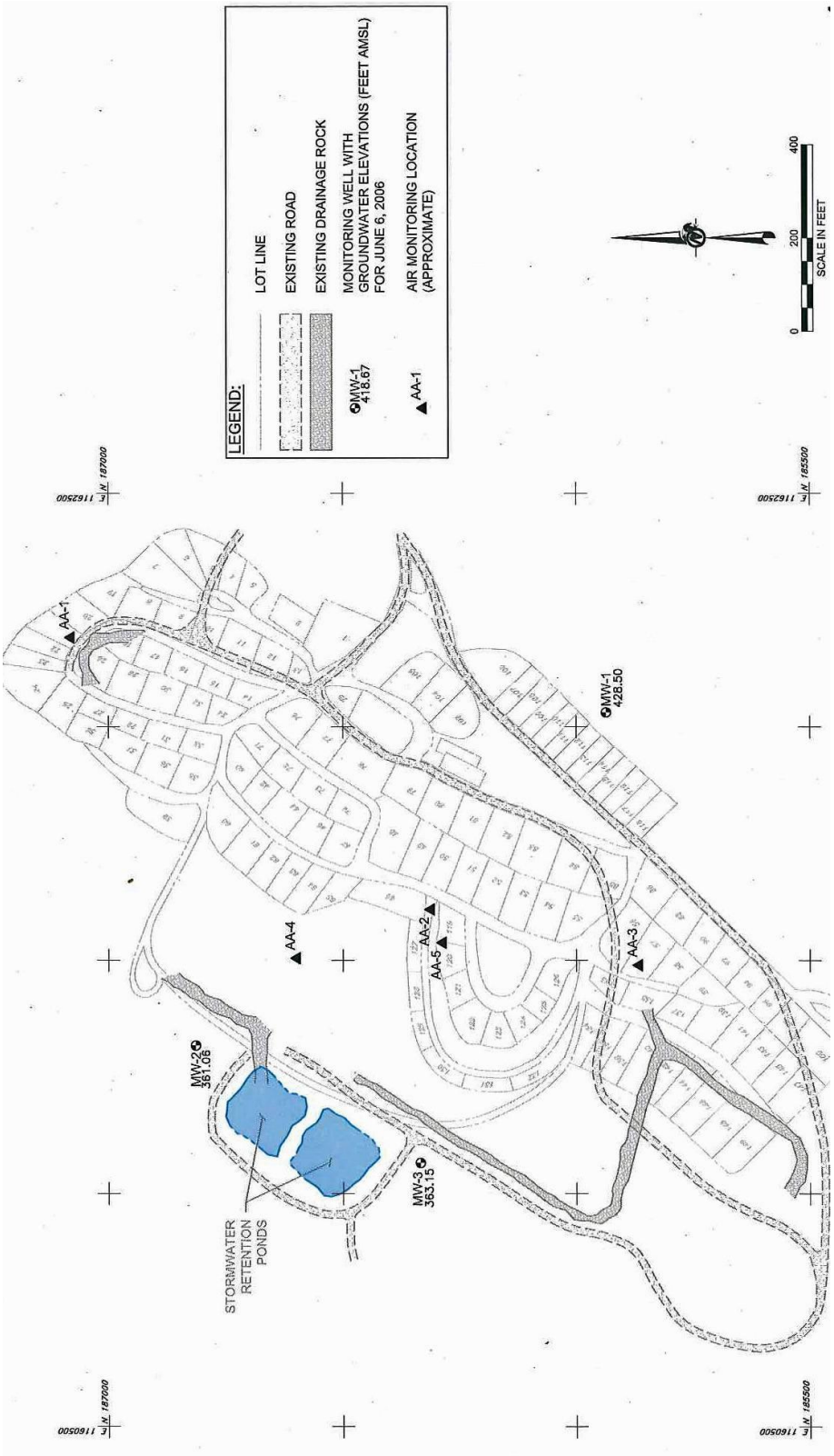


Figure 6: Sampling Stations (north to left of page).

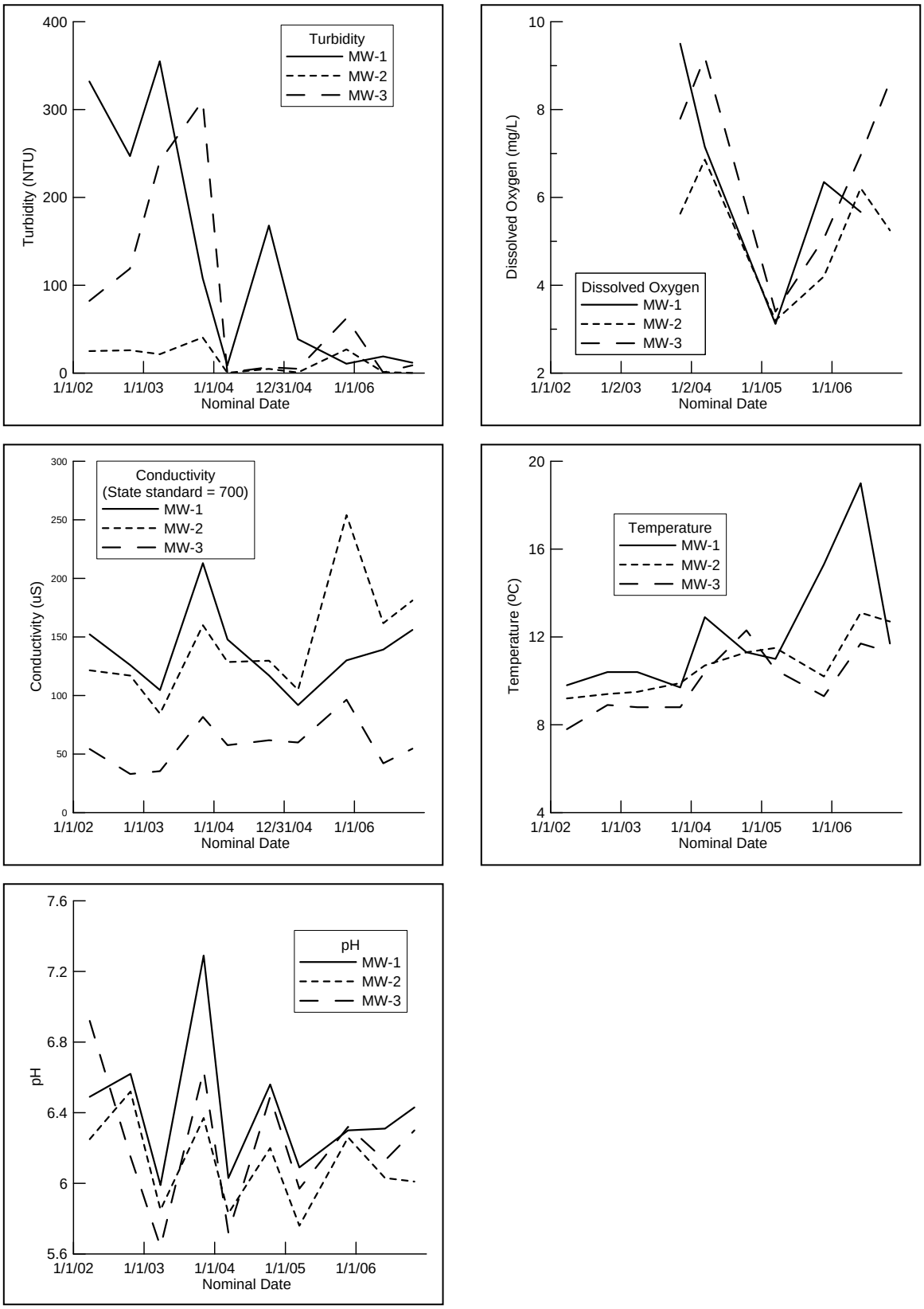
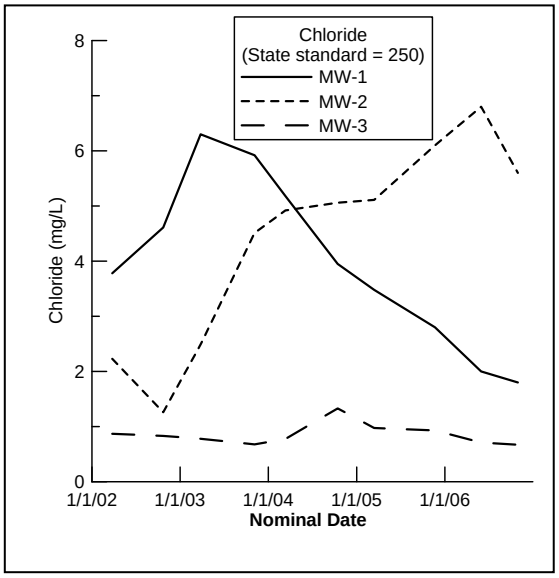
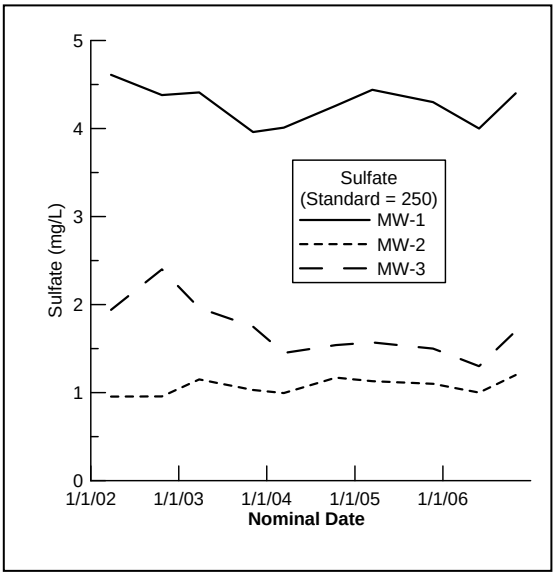
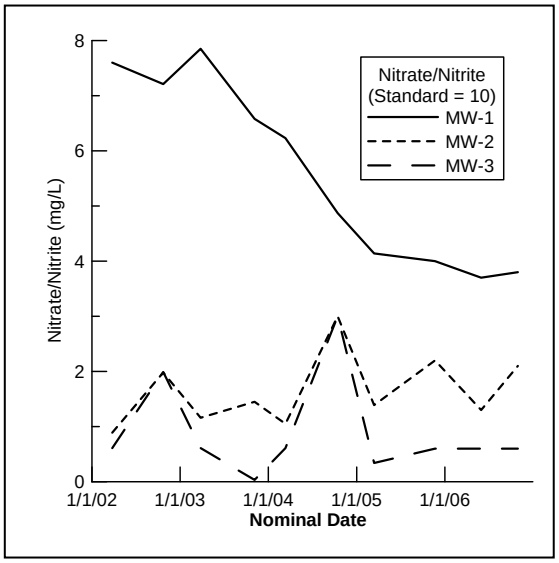


Figure 7: Groundwater Field Parameters







Cyanide:

Cyanide analyses were performed in the Fall 2005 and Fall 2006 monitoring rounds. Cyanide was not detected in either round. The practical quantitation limit was 0.05 mg/L. The cleanup level is 0.2 mg/L.

Ammonia:

The practical quantitation limit for ammonia was 0.04 mg/L. Ammonia was detected only in the Fall 2006 monitoring round. Concentrations in the monitoring wells were similar (see table). There is no cleanup level for ammonia.

Well	Concentration
MW-1 (upgradient)	0.075 mg/L
MW-2	0.082 mg/L
MW-3	0.052 mg/L

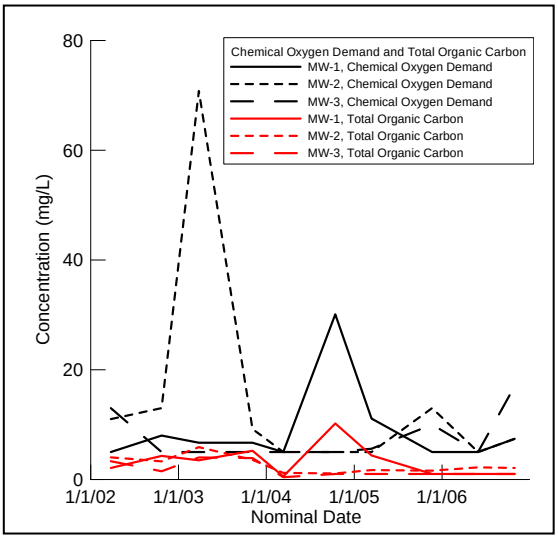


Figure 8: Groundwater Inorganic Parameters

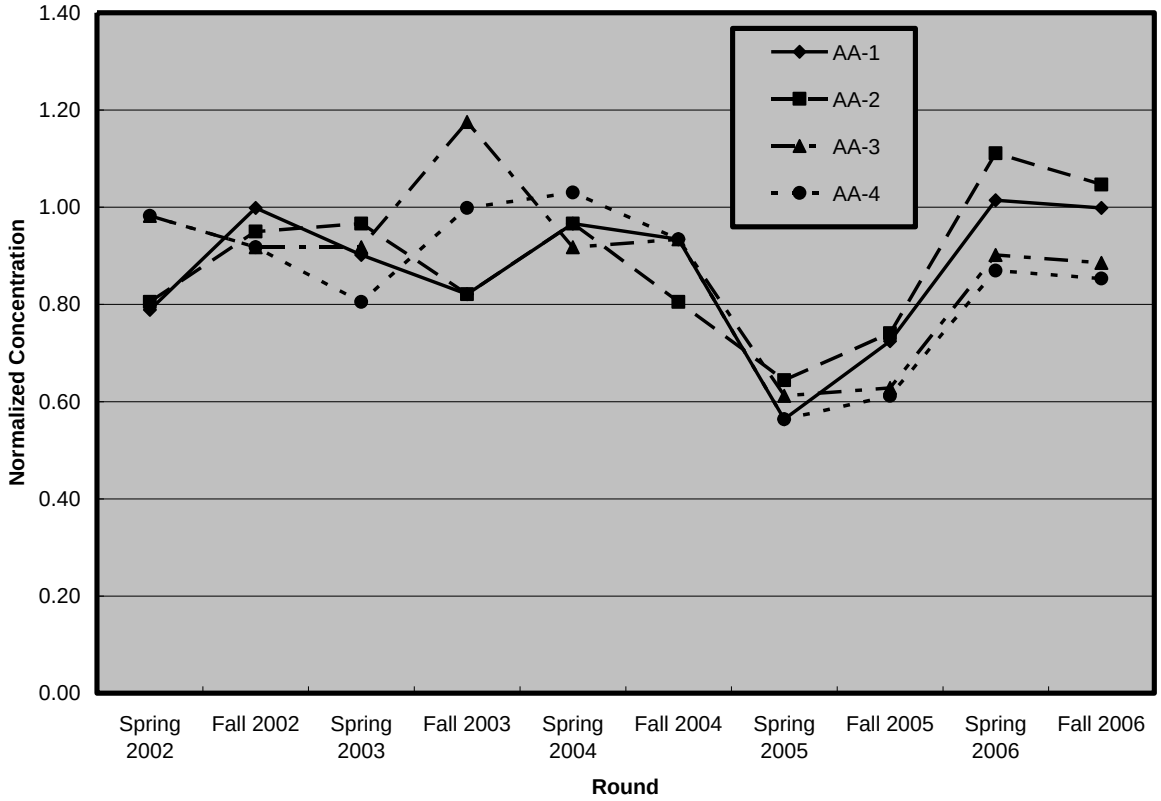


Figure 9: Chloromethane Air Data.