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VIA e-mail

April 30, 2012

Mr. Jeremy A. Carroll, P.E. Manager
Ohio EPA, DMWM
Lazarus Government Center
50 West Town Street, Suite 700
Columbus, OH 43215

Re: Envirosafe Services of Ohio, Inc.
Oregon, Lucas County, Ohio
EPA Identification Number: OHD 045 243 706; Ohio Permit Number: 03-48-0092
Revised CMS Report

Dear Mr. Carroll:

Enclosed, please find a revised Corrective Measures Study ("CMS") Report for Envirosafe Services of Ohio, Inc. ("ESOI"). In accordance with Section E of its Ohio Hazardous Waste Facility Installation and Operation Permit, Envirosafe Services of Ohio, Inc. ("ESOI") is implementing a Corrective Action Program ("CAP") to assess releases of hazardous wastes or hazardous constituents, if any, for the purpose of protecting human health and the environment.

As part of the CAP a CMS Report was submitted on January 7, 2011. Based on Ohio EPA comments, a revision dated August 1, 2011 was also submitted. On September 16, 2011, Ohio EPA provided a second set of comments on the report. ESOI responded to the comments on November 16, 2011 and met with Ohio EPA to discuss them on April 4, 2011. The attached revisions are reflective of both the comments and meeting discussion.

If you have any questions, please do not hesitate to contact Stephen DeLussa at (215) 659-2001 ext. 15.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sincerely,

Douglas E. Roberts
President

enclosure

cc: Lynn Ackerson, NWDO, DERR (2 copies)
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Stephen DeLussa, Envirosource Technologies, Inc.
Ken Humphrey, ESOI
Mark Nielsen, ENVIRON

April 30, 2012

Responses to Ohio EPA March 21, 2011Second NOD Follow-up
Corrective Measures Study Report
Envirosafe Services of Ohio, Inc. Otter Creek Road Facility

On March 21, 2012, Ohio EPA issued comments on the Corrective Measures Study (CMS) Report for the Envirosafe Services of Ohio, Inc. (ESOI) Otter Creek Road facility. On March 22, 2012, ESOI participated in a conference call with Ohio EPA staff to review these comments and agree on the revisions to the CMS Report.

Specific Comments

As discussed on March 22, 2012, ESOI has revised the CMS Report to address the following Specific Comments:

1a. Revise Ground Water Screening Criteria Table for Deep Till. See revisions in Section 9.2.2 and Appendix I.

1b. Provide Groundwater Screening Criteria for Shallow Till, Deep Till and Bedrock Wells. See revisions in Section 9.2.2.3 and Appendix I.

2. Indicate that background levels will be used in the groundwater monitoring program to identify “elevated” inorganics. See revisions in Section 9.2.2.3 and Tables 6a, 6b and 6c.

3. Indicate that ESOI’s groundwater monitoring program will use action leak rates to trigger monitoring of Deep Till Zone wells that are adjacent to only double-lined landfills. See revisions in Section 9.2.2.3 and Table 6b.

5. Indicate that ESOI will consider reducing the Appendix 98 sampling parameter list based on site-specific information; the reduced parameter list would be specified in an updated Permit Module K. See revisions in Section 9.2.2.3.

6. Revised Table 6a as necessary. Table 6a has been revised.

7. Revised Tables 6b and c as necessary. Tables 6b and c have been revised.

As discussed on March 22, 2012, the following comments will be addressed as part of the modification to ESOI’s RCRA Permit following submittal of the revised CMS Report:

2. Deep Till Zone monitoring requirements to be specified in Permit Module K.

3. Action Leak Rates defined in ESOI’s Part B Permit Application Appendix D.32.

4. Shallow Till Zone monitoring requirements to be specified in Permit Module K.

8. Reduction to Appendix 98 sampling parameter list for Cell M based on approved waste codes.

Attachment 1

As discussed on March 22, 2012, ESOI will prepare a draft modification to ESOI’s Part B Permit Application Appendix D.32 for Ohio EPA review.

Attachment 2

As discussed on March 22, 2012, ESOI will prepare a draft modification to Permit Module K for Ohio EPA review.

CORRECTIVE MEASURES STUDY (CMS)
ENVIROSAFE SERVICES OF OHIO, INC.
OTTER CREEK ROAD FACILITY, OREGON, OHIO

U.S. EPA I.D. No. OHD 045 243 706
Ohio EPA I.D. No. 03-48-0092

Submitted by

Envirosafe Services of Ohio, Inc.
Oregon, Ohio

Submitted to

Ohio EPA

Prepared by

ENVIROSOURCE
TECHNOLOGIES, INC.

Willow Grove, Pennsylvania

ENVIRON
Princeton, New Jersey

January 7, 2011
Revised August 1, 2011
Revised April 30, 2012

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1 INTRODUCTION

Envirosafe Services of Ohio, Inc. (ESOI) owns and operates a RCRA-permitted treatment, storage, and disposal facility (TSDF) at 876 Otter Creek Road in Oregon, Ohio (the Facility) which is permitted by USEPA and Ohio EPA under the Resource Conservation and Recovery Act (RCRA). The Facility's USEPA Identification Number is OHD 045 243 706 and its Ohio EPA Identification Number is 03-48-0092. As specified in Section VI of the August 16, 2000 Final Modified Federal RCRA Permit (Federal RCRA Permit) for the Otter Creek Road Facility, in accordance with Sections 3004(u) and 3004(v) of RCRA and regulations promulgated pursuant thereto, ESOI initiated a Corrective Action Program (CAP) to assess releases of hazardous wastes or hazardous constituents, if any, for the purpose of protecting human health and the environment. In April 2002, ESOI was notified by Ohio EPA of its intent to issue an agency-initiated permit modification to ESOI's Hazardous Waste Facility Installation and Operation Permit (State RCRA Permit) to incorporate RCRA corrective action requirements, which would make Ohio EPA (rather than USEPA) the lead regulatory agency overseeing ESOI's CAP (Ohio EPA 2002). The State RCRA Permit modification became effective in January 2004.

As required by the CAP under its RCRA Permits, ESOI has completed and obtained approval for a *Description of Current Conditions* (DOCC) (ENVIRON/MEC 2001) (final approval on April 2, 2002) and *RCRA Facility Investigation (RFI) Report* (ENVIRON 2009) (final approval on June 30, 2009). In the RFI Final Report approval letter, Ohio EPA notified ESOI that it must conduct a Corrective Measures Study (CMS) in accordance with Section E.8 of its State RCRA Permit. A *CMS Work Plan* was submitted by ESOI (Envirosource Technologies/ENVIRON 2009) and approved by Ohio EPA (final approval on February 4, 2010). The CMS has been completed in accordance with the approved CMS Work Plan, taking into consideration the performance of ongoing presumptive corrective measures and the assessment of remedial alternatives identified in the CMS Work Plan. The following Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) are included:

SWMU/AOC	UNIT NAME
SWMU 1	**Landfill Cell F**
SWMU 5	**Millard Road Landfill**
SWMU 6	**Northern Sanitary Landfill**
SWMU 7	**Central Sanitary Landfill**
SWMU 8	**Old Oil Pond #1 (South Pond)**
SWMU 9	**New Oil Pond #2 (North Pond)**
SWMU 10	Ash Disposal Area
SWMU 11	Former Teepee Burner
SWMU 12	Former Bill's Road Oil Operation

AOC 1	**Toledo Water Lines**
AOC 2	Truck Scale
AOC 3	Maintenance/Storage Building “C”
AOC 4	Building “C” Septic Tank and Leach Field
AOC 5	Decontamination Building
AOC 6	**Oily Waste Above Ground Storage Tanks**
AOC 7	**Butz Crock – Concrete Utility Vault**
AOC 8	Staging Area
AOC 9	Cell M Surface Water Retention Basin
AOC 10	Rail Spur
AOC 12	**Building C Heating Oil Tank**

All of the units shown above will be subject to institutional controls regardless of whether a significant risk to human health or the environment was identified in the RFI Baseline Human Health Risk Assessment (HHRA) or Screening Level Ecological Risk Assessment (SLERA). Additional corrective measures have been assessed for the units shown in bold text to address (1) significant risk to human health or the environment that was identified in the HHRA or SLERA or (2) non-risk based enhancements for protection of human health and the environment (e.g., improvements to existing containment systems).

1.1 PROJECT DESCRIPTION

A total of 20 units are addressed in the CMS. As agreed upon with USEPA and Ohio EPA, all 19 SWMUs/AOCs carried forward into the RFI from the DOCC have been retained for the CMS. In addition, a newly identified AOC (AOC 12) was added during the RFI and has also been retained for the CMS. The CMS has been conducted to explore a range of alternatives such as treatment, removal, and control of contaminant source(s) affecting media or contributing to potentially unacceptable exposures.

The study includes the collection and analysis of media determined necessary to evaluate various alternatives of remediation. The CMS does not address all potential corrective measures. The focus is on those corrective measures that will be most appropriate considering site-specific factors characterized during the RFI. To achieve this objective, the CMS considers all of the available data and site-specific information to select among the identified alternatives.

As defined in the State RCRA Permit for the Otter Creek Road Facility, the selected corrective measures must:

(1) be protective of human health and the environment;
(2) attain media clean-up standards;

(3) control the source(s) of releases so as to reduce or eliminate further releases of hazardous waste(s) (including hazardous constituent[s]); and,
(4) comply with all applicable standards for management of wastes.

If two or more of the corrective measures studied meet the threshold criteria set out above, Ohio EPA will authorize the corrective measures implementation by considering remedy selection factors including:

(1) long-term reliability and effectiveness;
(2) the degree to which the corrective measure will reduce the toxicity, mobility or volume of contamination;
(3) the corrective measure's short-term effectiveness;
(4) the corrective measure's implementability; and
(5) the relative cost associated with the alternative.

1.2 CMS SCOPE

In accordance with Section E of its State RCRA permit, ESOI is implementing the CMS at its Otter Creek Road Facility to develop and evaluate the corrective measures alternative(s) and to recommend the corrective measure(s) to be taken at the facility that satisfy the performance objectives specified in Section E.9 of the permit. The CMS consists of four tasks:

- Identification and Development of the Corrective Measures Alternatives;
- Evaluation of the Corrective Measures Alternatives;
- Justification and Recommendation of the Corrective Measures; and
- Reporting.

ESOI has considered the information currently available for (1) the existing condition of each SWMU and AOC identified in the DOCC for further investigation; (2) the findings, conclusions, and recommendations for further action identified in the RFI; (3) the type of units and areas to be addressed (i.e., engineered landfills, waste fill areas, and areas potentially impacted by surface and/or subsurface releases); (4) the pathways associated with potential releases from these SWMUs/AOCs; (5) the performance of previously implemented corrective measures and ongoing implementation of presumptive corrective measures; and (6) the current and reasonably anticipated future land use and groundwater use at and surrounding the Facility. In addition, the scope of the CMS incorporates the fundamental aspects of recent USEPA corrective action program policy developments as detailed in the *Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities*; *Proposed Rule* (USEPA 1996) and *Post-Closure Permit Requirements and Closure Process; Final Rule* (USEPA 1998). In particular, ESOI understands that USEPA's current corrective action implementation principles include the following:

1. Program implementation should focus on results, taking into consideration (1) site-specific circumstances that warrant flexibility in implementing the corrective action process, developing cleanup objectives and selecting appropriate site-specific corrective measures, (2) innovative site characterization techniques to expedite investigations, (3) existing data pertinent to understanding the site conditions to reduce RFI data collection needs, and (4) streamlining initiatives, including presumptive remedy guidance developed under the CERCLA program to expedite investigations and cleanups;
2. Corrective action activities should be phased to focus on areas or pathways of highest concern;
3. Corrective action decisions should be based on a realistic assessment of human health and ecological risk, taking into account current and reasonably expected future land use on-site and off-site, including contamination from off-site unrelated sources that could prevent achieving risk-based cleanup goals solely by addressing Facility-related releases;
4. In determining the need for corrective action, the ecological assessment should focus on characterizing risks to threatened and endangered species, and to populations and communities of valued ecological resources; and
5. Corrective action should employ a flexible combination of corrective action and closure/post-closure requirements to achieve the best regulatory approach for a site, in particular those with a regulated unit in close proximity to one or more SWMUs or AOCs.

In addition, because the types of units identified for corrective measures at the Otter Creek Road Facility include several solid waste landfills, USEPA’s *Presumptive Remedy for CERCLA Municipal Landfill Sites* (USEPA 1993) is particularly relevant to the development of corrective measure alternatives. For solid waste landfills, USEPA’s presumptive approach is containment of the landfill mass, collection and/or treatment of landfill gas, and control of landfill leachate, as necessary to mitigate contamination of groundwater. This alternative is presented below with a focus on exposure pathways outside the landfill and provides performance measures to meet the primary response action objectives for a landfill site, including:

6. Reduction of accumulated leachate through removal and stabilization;
7. Preventing direct contact with the landfill contents;
8. Minimizing infiltration;
9. Controlling surface water runoff and erosion; and
10. Controlling landfill gas.

1.3 CMS PROCESS

As specified in Section E.8 of ESOI's State RCRA Permit, following approval of this CMS Report by Ohio EPA, Ohio EPA will authorize ESOI to proceed with one or more of the corrective measures proposed herein. In addition, the approved CMS Report will be incorporated into ESOI's State RCRA Permit and become an enforceable condition, and ESOI must provide financial assurance in the amount necessary to implement the authorized corrective measures.

Once authorized, ESOI will proceed with the implementation of the selected corrective measures. Corrective measures implementation ("CMI") typically involves detailed remedy design, remedy construction, remedy operation and maintenance, and remedy completion. Components of CMI may include: conceptual design, operation and maintenance, intermediate design plans and specifications, final design plans and specifications, construction work plan, construction completion report, corrective measure completion report, health and safety plan, public participation plan and progress reports; however, in many cases, only a subset of these documents will be required for individual corrective measures implementations. In addition, as described by USEPA (March 2000), when a corrective action includes contamination remaining on site, ongoing obligations regarding long-term containment, operation and monitoring must be considered. In these situations, the goal of "protection of human health and the environment" often is achieved through use of a remedy that allows some contamination to remain in place (e.g., containment), but requires controls (engineering and/or institutional) at the facility to prevent or to limit the risk of exposure through release of contamination that remains following cleanup. In these cases, following remedy implementation, maintenance of controls and continued corrective action related activities (such as monitoring) are fundamental elements of meeting the standard of "protection of human health and the environment." USEPA indicates that a "Corrective Action Complete with Controls" determination provides the owner or operator with recognition that protection of human health and the environment has been achieved, and will continue as long as the necessary operation and maintenance actions are performed, and any institutional controls are maintained and complied with.

Evaluation of the performance of a chosen remedy is necessary to measure progress toward remedial goals and ensure that remedial objectives are achieved. Further, appropriately designed performance monitoring programs can maximize efficiency and cost effectiveness and ensure protection of potential human or ecologic receptors. Therefore, USEPA recommends periodic remedy reviews to evaluate the performance of the implemented remedy to verify that the remedy remains protective of human health and the environment. Based on these periodic reviews, the existing remedy may be adjusted to optimize system operations or modified if it is no longer protective of human health and the environment.

Thus, it is important to ensure that an enforceable mechanism is in place so that there is compliance with and maintenance of in-place corrective measures. Such controls can be documented through the RCRA permit that assures periodic review by the regulatory agency, compliance with any operation and maintenance requirements and institutional controls, and notification to the regulatory agency of transfers of the facility (which allows an opportunity for the agency to confirm that compliance with corrective action requirements will continue).

2 ENVIRONMENTAL SETTING

2.1 LOCATION AND PHYSIOGRAPHY

The Facility is located in the City of Oregon, Lucas County, Ohio, as shown on Figure 1. The Facility lies within the Maumee Lake Plains Physiographic Region and is part of the Huron-Erie Lake Plains Physiographic Section of the Central Lowland Physiographic Province. The Maumee Lake Plains region consists of Pleistocene-age silt and clay formed in a flat-lying Ice-Age lake basin. The Facility is located on a generally flat-lying unmetamorphosed Silurian dolomite sedimentary rock (approximately 410 million years old) overlain by approximately 70 to 90 feet of unconsolidated Wisconsinan tills and lacustrine deposits.

2.2 CLIMATE

Based on records from the National Weather Service for the City of Oregon[1], the climate in the area of the Facility is warm during the summer when temperatures tend to be in the 70s°F and very cold during the winter when temperatures tend to be in the 20s°F. The warmest month of the year is July with an average maximum temperature of 87.1°F, while the coldest month of the year is January with an average minimum temperature of 21.7°F. Temperature variations between night and day tend to be fairly small during summer with a difference that can reach 18°F, and fairly small during the winter with an average difference of 13°F.

The annual average precipitation in Oregon is 33.52 inches. Rainfall is fairly evenly distributed throughout the year. The wettest month of the year is June with an average rainfall of 3.84 inches.

2.3 SURFACE WATER HYDROLOGY

The predominant surface water feature in the vicinity of the Facility is Otter Creek, which is adjacent to the western edge of SWMU 5 and flows northeasterly into Maumee Bay. In addition, there are four ditches near the Facility that receive storm water from portions of the Facility: Gradel Ditch located between the Facility's northern property line and the adjoining Gradel Landfill; Driftmeyer Ditch located northeast of the Facility; an unnamed ditch that runs along old Millard Avenue on the south side of the SWMU 5; and an unnamed ditch that runs between the Millard Avenue overpass and the north side of SWMU 5.

[1] Toledo Blade Newspaper Building Weather Station located 2.26 miles from Oregon.

Figure 2 shows the location of Otter Creek, Gradel Ditch, and Driftmeyer Ditch. This figure also shows the location of the nine active outfalls (001, 002, 003, 006, 009, 010, 011, and 012) and the two former outfalls (007 and 008) that discharge storm water runoff from portions of the Facility to Otter Creek via storm sewers and ditches, and Outfall 004 which discharges toward Driftmeyer Ditch. Storm water discharges are monitored in accordance with ESOI's current NPDES permit (Ohio EPA 2IN00013*HD).

2.3.1 Otter Creek

Otter Creek, a seven mile long perennial stream, flows northeasterly through portions of Toledo and Oregon, Ohio. It discharges to Lake Erie at Maumee Bay. The western edge of the Facility is located adjacent to Otter Creek, approximately two miles from the mouth of the creek. Flow in the creek may be influenced by seiche effects in Lake Erie and Maumee Bay, during which times surface water flow may slow or becomes stagnant; however, such effects were not observed during water level monitoring conducted as part of the RFI.

Storm water from Outfalls 001, 002, 006, 009, 010, 011, and 012 is discharged to Otter Creek west of the Facility either directly or via storm sewer. The catchment areas for the current outfalls that discharge storm water runoff to Otter Creek and their drainage areas are as follows:

- Outfall 001: SWMU 2, SWMU 7, portion of AOC 6, and Facility support building/services area, parking area, and access roads
- Outfall 002: SWMU 4
- Outfall 006: areas outside the hazardous waste limits of active and closed portions of Cell M, storage units, the SCB, and Facility parking areas and access roads
- Outfall 009: southern portion of the SWMU 5
- Outfall 010: northwest portion of SWMU 5
- Outfall 011: northeast portion of SWMU 5
- Outfall 012: northern portion of SWMU 6 and the northeast portion of SWMU 1

2.3.2 Gradel Ditch

Gradel Ditch is a storm water drainage ditch located between the facility's northern property line and the adjoining Gradel landfill. The Gradel Ditch flows westerly and discharges into Otter Creek downstream of the Facility. Typically this ditch exhibits flow conditions only during precipitation events and associated runoff period. Leachate from the Gradel Landfill has also been observed flowing into the Gradel Ditch. For example, during the visual inspection conducted as part of USEPA's RCRA Facility Assessment (RFA), USEPA's contractor noted that leachate was coming directly from the closed landfill north of the Fondessy property and was seen entering the drainage ditch separating the properties (M&E 1987). In addition, during the implementation of the NSL RFI, it was noted that a piezometer on the Gradel Landfill had a flowing artesian potentiometric water level above surrounding ground level, indicating a hydraulic pressure behind leachate seeps which have been observed discharging from the Gradel Landfill (MEC 1997).

The current outfalls that discharge storm water runoff from the Facility to Gradel Ditch and their drainage areas are as follows:

- Outfall 003: SWMU 1, portions of SWMU 6 and SWMU 7, and access roads.
- Outfall 012: northern portion of SWMU 6 and the northeast corner of SWMU 1.

2.3.3 Driftmeyer Ditch

Driftmeyer Ditch is about 2 miles long, originating approximately 0.4 miles south of the BP-Husky Refinery located along Cedar Point Road northeast of the facility. The ditch drains agricultural land, and flows northeasterly through the BP-Husky Refinery before discharging into Maumee Bay.

Storm water from Outfall 004 is discharged to the field on the east side of the facility where it then flows overland toward the Driftmeyer Ditch, located 0.5 to 1 mile east of the facility. The discharge from Outfall 004 consists of storm water runoff from the following areas north of York Street: SWMU 3, portions of SWMU 6 and SWMU 7, and access roads.

2.4 SOIL

The majority of the soil at and around the Facility belongs to the Latty-Toledo-Fulton Association, although on-Facility soils have been disturbed by construction and closure of the TSDF units. The soils map published by the United State Department of Agriculture shows some of the more specific details of the surficial geology at and around the Facility; all of these soils are silty clays or silty clay loams developed on the lacustrine deposits.

St. Clair silty clay loams, which formed in glacial till, are reported along the banks of Duck and Otter Creeks where the streams cut down through the lacustrine material and exposed the underlying glacial till.

2.5 REGIONAL GEOLOGIC SETTING

The regional geology is characterized by generally horizontal and parallel layers of sediments deposited in glacial and postglacial environments over bedrock composed of Silurian Age sedimentary rock. A review of the regional geology is provided in Section 1.3 of the DOCC; key characteristics of the regional geology are summarized below.

- The uppermost bedrock in the region consists of the Greenfield dolomite. The Upper Silurian Greenfield ranges in thickness from 30 to 97 feet. In the Toledo area, the Lockport Group underlies the Greenfield dolomite and consists of approximately 175 feet of white to light gray or brown dolomite. The next underlying formation, the Brassfield, marks the base of the Silurian rocks in northwest Ohio. The Brassfield formation is a distinctive white, light gray or medium brown fine-to-coarse-grained cherty dolomitized limestone. The Brassfield formation is about 50 feet thick in the Toledo area.

- Bedrock is covered by glacial tills deposited in pro-glacial lakes. The glacial geology consists of approximately 30 feet of older till deposited on bedrock, overlain by 30 to 50 feet of younger till. These tills are overlain by 10 to 20 feet of lacustrine deposits.

2.6 SITE GEOLOGY

Geology at the Facility has been investigated through the installation of over 800 soil borings and 400 completed as piezometers and/or monitoring wells. The locations of soil borings and the monitoring wells drilled to provide geologic and hydrogeologic data during the RFI are depicted in Figure 2. A summary of the monitoring well construction logs including screened interval, depth, diameter, and other well data and boring logs for soil borings installed during Phase I and Phase II of the RFI are provided in the RFI Final Report.

2.6.1 Bedrock Geology

Bedrock beneath the facility is first encountered at depths of 70 to 90 feet below ground surface and is known as the Greenfield dolomite, which is a brown, microcrystalline medium-bedded dolomite.

2.6.2 Glacial Geology

The bedrock surface of the Greenfield formation is overlain by three distinct Late Wisconsinan deposits: a lower till, an upper till, and a proglacial lacustrine deposit. Evidence of earlier glacial activity at the facility has not been found.

- **Lower Till**
  The lower till, overlying the bedrock at the facility, is a firm, continuous, compact, very stiff, silty clay-rich till. The lower till is commonly referred to as “hardpan” because of its very hard and dense nature. It exists at the facility at thicknesses ranging from 12 to 30 feet, depending on the elevation of the underlying bedrock. The upper surface of the lower till is between 515 and 530 feet mean sea lever (MSL). The top of Lower Till contour map is provided in Appendix C2 of the RFI Final Report. In soil borings collected at the facility, the lower till is gray and does not exhibit the characteristic features of weathering (subareal exposure). The unit is not discolored, jointed, or bio-turbated.

During drilling of RFI borings into the lower till zone, the unit was described as stiff and hard clay with little moisture. During drilling of the new RFI bedrock monitoring wells, observations of the lower till included an unsaturated lower till zone and a dry gravel/weathered rock zone between the base of the lower till and the top of bedrock; groundwater was encountered under artesian conditions (water levels in the well rose above the top of rock) only after drilling into a water bearing zone within the bedrock.

- **Upper Till**

  Directly overlying the lower till is the upper till. The upper till ranges in thickness from 35 to 50 feet. This unit is similar to the lower till in sand-silt-clay percentages in the matrix. It is very soft by comparison, often appears to be less stoney (fewer pebble and gravel-size sediment) than the lower till, and is characteristically more plastic when retrieved by split spoon or continuous samplers.

  During drilling of RFI borings into the upper till zone, vertical fractures were noted in the interval from 16 to 17 feet below ground surface (bgs). The fractures were filled with sand and described as “iron stained”, an expression used to indicate that there was orange mottling or coloring along the length of the fracture. Below 20 feet bgs, the orange mottling was not observed. Only minor variations in consistency and plasticity were noted in this unit.

- **Contact Zone**

  The contact zone between the two tills consists of a silty, clayey, medium to fine sand with small amounts of coarse sand and gravel. It ranges in thickness from zero to five feet. Grain-size analyses indicate that the unit is highly variable with one to 48 percent of the deposit in the silt, clay, and colloid fraction.

  Investigations have also shown a limited area of potentially higher permeability along the western portion of the facility at the contact zone between the upper till and lower till. This area has been defined utilizing all of the geotechnical borings for Cell G and the monitoring wells for Cell G and Cell M.

2.6.3 Proglacial Lacustrine Deposits

The lacustrine material present above the upper till at the facility is generally 10 feet to 20 feet thick and is comprised of laminated silt and clay layers with traces of sand and gravel. During drilling of RFI borings into the lacustrine zone, there were limited and constrained descriptions of the presence of vertical fractures. The vertical fractures described were in distinct intervals of two feet or less and did not appear to be continuous. Size is not noted for all of the fractures, but any fractures observed during drilling were small and close to hairline in size. Infilling of the fractures and orange mottling were common descriptive traits among the few intervals where the vertical fractures were described.

2.7 SITE HYDROGEOLOGY

The site hydrogeology has been investigated a number of times in the past several decades. These studies which evaluated the occurrence and movement of groundwater were summarized in Section 1.3.2 of the DOCC. Data collected as part of the RFI which supplement these prior studies are summarized below.

2.7.1 Bedrock Groundwater

The bedrock aquifer in northwest Ohio consists of Devonian and Silurian limestone and dolomite. Groundwater in these carbonate rocks moves through a series of complex interconnected openings. Therefore, even though the aquifer comprises different geologic formations, it is considered as a single hydraulic unit. Groundwater in the bedrock formation beneath the Facility is under artesian conditions, with the overlying till unit acting as an aquitard. These conditions were evaluated during the RFI via the installation of two on-site monitoring wells completed in the bedrock aquifer. One of the objectives of these new wells was to investigate whether a saturated zone is present at the top of the bedrock surface which could provide (1) a potential pathway for contaminant migration along the top of the bedrock surface and/or (2) a hydraulic connection between the bedrock and the overlying till zone. Observations during drilling of the new bedrock monitoring wells include an unsaturated lower till zone, a dry gravel/weathered rock zone between the base of the lower till and the top of bedrock, and artesian conditions (water levels in the well rose above the top of rock) only after drilling into a water bearing zone below the upper surface of the bedrock. These data indicate little evidence of hydraulic connection between the bedrock and the lower till.

The potentiometric surface of the bedrock aquifer in the region of the Facility has historically been, and is currently, influenced by pumping from on-site and nearby industrial supply wells. Specifically, the flow direction and gradient at the Facility is influenced by the cyclical pumping of groundwater at the BP-Husky refinery located approximately 0.5 miles northeast of the Facility. The timing of this pumping is controlled by an automatic system that responds to the refinery's demands for cooling water, which occurs primarily during the period of April to October. For example, as shown on the bedrock potentiometric surface map for April and August 1995 (see Appendix C3 of the RFI Final Report), during non-pumping periods, the observed gradient is relatively flat (i.e., on-site water levels all within a few tenths of a foot of each other), but when BP-Husky is withdrawing groundwater (spring through fall), the groundwater levels at the Facility decline and the gradient is steeper toward the northeast. The flow direction and gradient at the Facility can also be influenced by pumping of bedrock groundwater from the Facility’s industrial supply well, as suggested by the October 2005 Preliminary Report of Groundwater Quality for the Facility. Potentiometric surface maps from monitoring events conducted during the RFI timeframe (April 2002 and October 2006) were provided in Appendix C3 of the RFI Final Report. Mapping of recent bedrock water level data collected during 2009 and 2010 is included in Appendix A; as indicated by this water level mapping, the groundwater flow in the bedrock reflects seasonal variability, with the predominant direction of flow during this more recent period ranging from northwest, west, northeast,

east, and southwest, with periods of apparent stagnation and areas of the site where groundwater flow is different than the predominant direction. In summary, based on the data evaluated as part of the RFI and CMS, the predominant groundwater flow in the bedrock has been observed to vary in direction across the perimeter of the facility (1) in response to seasonal changes observed regionally, (2) in response to pumping at on-site and off-site production wells, and (3) depending on the location on the facility.

In 2006, ENVIRON completed a series of slug tests to gather data for calculating the hydraulic conductivity (K-value) of the bedrock aquifer zone in which monitoring wells are screened. Based on testing conducted during the RFI, the geometric mean of the hydraulic conductivities of the bedrock aquifer tests was 5.7×10^{-3} cm/sec and 1.4×10^{-2} cm/sec for the falling head and rising head slug tests, respectively. Additional information on this testing is provided in Section 4.18 of the RFI Final Report.

2.7.2 Groundwater Conditions in the Glacial Deposits

The thick tills that overlay the dolomite bedrock in the vicinity of the Facility contain trapped pore water. As discussed in Section 1.3.2 of the DOCC, a study conducted to determine the age of the groundwater in the glacial deposits indicated that this water is of ancient origin, with adjusted ^{14}C isotope dates ranging from about 9,000 to 13,000 years before the study. In addition, the results indicated that groundwater in these deposits has little or no component of modern, post-1952 recharge present.

Further, studies conducted at the Facility have determined that these units are incapable of providing usable supplies to wells because of low horizontal and vertical permeabilities of the tills. In addition, the sand inclusions within the tills are not interconnected and do not serve as conduits for flow. These characteristics are also demonstrated during the routine groundwater monitoring events where wells are frequently pumped dry during purging prior to sampling and then take several days to recharge. Therefore, the glacial deposits cannot be regarded as aquifers but as semi-confined water bearing zones. Prior evaluations of groundwater elevations in the shallow and deep till wells have shown that there is no discernable regional gradient in these water bearing zones. Finally, the results of on-site hydrogeologic testing indicate that there is no measurable hydraulic connection between the glacial deposits and the bedrock aquifer. The till zone water levels at the Facility reported for monitoring events conducted during the RFI timeframe (April 2002 and October 2006) are provided in Appendix C3 of the RFI Final Report.

In 2006, ENVIRON completed a series of slug tests to gather data for calculating the hydraulic conductivity (K-value) of the till water bearing zones in which wells at the Facility are screened. For purposes of comparison in this discussion, the tests have been grouped into two categories: shallow till wells screened across the lacustrine/upper till contact, and deep till wells screened across the upper till/deep till contact (additional information on this testing is provided in Section 4.18 of the RFI Final Report).

- The geometric mean of the hydraulic conductivities of the lacustrine/upper till contact zone tests was calculated at 1.6 x 10^{-5} cm/sec and 9.8 x 10^{-6} cm/sec for the falling head and the rising head slug tests, respectively. The geometric mean of the hydraulic conductivities for this water bearing zone as calculated by Weston in 1985 based on field testing was 1.8 x 10^{-5} cm/sec using a different subset of wells (ENVIRON/MEC 2001).

- The geometric mean of the hydraulic conductivities of the upper till/deep till contact zone tests was 5.3 x 10^{-6} cm/sec and 2.7 x 10^{-6} cm/sec for the falling head and rising head slug tests, respectively. The geometric mean of the hydraulic conductivities for this water bearing zone as calculated by Weston in 1985 based on field testing was 1.8 x 10^{-7} cm/sec using a different subset of wells (ENVIRON/MEC 2001).

These data confirm the low hydraulic conductivity of the contact zones between the lacustrine/upper till and the upper till/lower till that are monitored as part of ESOI's groundwater monitoring program. It should be noted that these hydraulic conductivity values reflect the horizontal hydraulic conductivity of the contact zones and not the vertical hydraulic conductivity. As described in the DOCC, the vertical hydraulic conductivities are on the order of 1 x 10^{-9} cm/sec for the lower till unit and 1 x 10^{-8} cm/sec for the upper till unit. The differences between the horizontal hydraulic conductivity values and previously measured vertical hydraulic conductivity values are typical of geologic formations with layered heterogeneities, where vertical conductivities can be lower than horizontal hydraulic conductivities by a factor of 10 to 100 (Freeze and Cherry 1979).

2.8 GROUNDWATER-SURFACE WATER INTERACTION

In accordance with the April 22, 2004 Revised *Expedited SWMU 5 Phase II Work Plan* and subsequent comments provided by Ohio EPA, The Mannik & Smith Group, Inc. (MSG) completed a groundwater – surface water interaction evaluation along the west side of SWMU 5. This investigation was completed to better evaluate the potential for hydraulic connection between groundwater and surface water in the vicinity of SWMU 5, in particular, the potential for discharge of shallow groundwater from the lacustrine/upper till zone to Otter Creek along the western facility boundary. This investigation included:

- The installation of new temporary wells along the west side of SWMU 5;
- Installation of a temporary leachate well within the west portion of SWMU 5;
- Installation of a staff gauge for measuring water levels in Otter Creek; and
- The construction of permanent monitoring wells in the locations of former temporary monitoring wells T-17S, T-20S, and T-23S.

Once these monitoring points were installed, monthly surface water/groundwater/leachate elevation monitoring events were initiated and continued monthly for one year. The results of this investigation were submitted in the report entitled *SWMU 5 Groundwater- Surface Water Interaction Investigation* (MSG 2005). These data are provided in Appendix G of the RFI Final Report.

As part of the monthly groundwater – surface water interaction inspections, data collected from the Otter Creek staff gauge were compared to the water levels recorded from Maumee River Water Level Gauging Station No. 9063085. Comparison of the Maumee River Water levels with those from Otter Creek showed an almost direct correlation with the water levels in Otter Creek being consistently one or more feet higher in elevation than those in the Maumee River. Based upon this comparison, there is no indication during this year-long evaluation of the occurrence of seiches.

2.9 LAND USE

The Facility occupies approximately 130 acres in the City of Oregon, Lucas County, Ohio and currently consists of one active waste disposal cell, located in the southern portion of the property, several closed landfill cells and other SWMUs/AOCs located in the northern portion of the property. It is reasonably expected that use of the Facility for waste management activities will continue into the future.

This subsection discusses the current land use patterns around the Facility, trends in the economy, population, and housing in Oregon, the City's plans for revitalization, and the implications of these factors for future land use at the Facility. The information discussed below is based primarily from the *City of Oregon Master Plan* (Zande & Associates 2007).

2.9.1 Land Use Patterns

Zoning in the City of Oregon is divided into 15 districts, which include classes of residential, business, industrial, and other uses. Figure 2.2 of the RFI Final Report shows the zoning districts for the Facility and areas in the vicinity of the Facility. The Facility is located within an industrial/commercial district. Properties adjacent to and east, north and west of the Facility are also zoned for industrial/commercial use. This industrial area encompasses various chemical, petroleum, waste management, recycling, and manufacturing facilities. Residential properties are located south of the adjacent railroad yard. There are no adjacent properties owned by private individuals.

Of particular importance are two inactive landfills located in the vicinity of ESOI's property which are not owned by ESOI. One of these is the Gradel Landfill located to the north and immediately adjacent to the facility (also known as Commercial Oil landfill), and the other is the Westover Landfill located west of the facility across Otter Creek Road and immediately adjacent to Otter Creek. The Gradel Landfill is an abandoned landfill identified by Environmental Data Resources, Inc., of Southport, Connecticut as an Ohio, State Hazardous Waste Site, based upon a review of the Ohio EPA Master Site List. The Gradel Landfill is owned by Commercial Oil Services, Inc.

North of the Gradel Landfill is the Commercial Oil Services, Inc. site which until 1999 included abandoned oil lagoons. The site is listed on the USEPA's Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS), and in 1999 the sludge and liquids within the lagoons was solidified and placed into a landfill constructed on the Commercial Oil site. North of the Commercial Oil Services property is a BP-Husky refinery. Located to the south of the Facility is the Norfolk and Southern Railroad Homestead Yard. Located to the west of the Facility is the City of Toledo water treatment sludge lagoons, a Buckeye Pipeline Company pump station, the inactive Westover Landfill, and AJ's Auto Parts (a commercial business). Located to the east of the Facility is Toledo Edison property (currently operated as farmland) and a Buckeye Pipeline Company storage tank farm.

Within the immediate vicinity of the Facility are major transportation corridors, which include major railroads, highways, and ports. Although such high traffic transportation corridors are unattractive to residential development, they provide essential support to industrial use of the area at and around the Facility.

2.9.2 Economy, Population and Housing Trends

The City of Oregon's economy has historically been centered on the industrial sector because of its water, rail, and surface transportation access. This access to transportation led to the location of two major refineries in Oregon around the turn of the century. Currently, the City's largest employers are two full service community hospitals (Oregon 2007). However, only 49.4% of the population of Oregon is in the labor force (Oregon 2007).

The population in Oregon has increased slowly through time, corresponding with increases in industrial manufacturing. The following shows Oregon's population trend from 1960 to 1999 (Zande & Associates 2007).

Year	Population	Change	% Change
1960	13,319		
1970	16,563	3,244	24%
1980	18,529	1,966	12%
1990	18,334	-195	-1%
2000	19,355	1,021	6%

The City's population projections since the last decennial census to 2007 estimate an approximate 1.3% decrease (Oregon 2007).

While the number of new houses built has decreased from approximately 180 units in 1995 to approximately 60 units in 2005, most of the new residential growth has moved east and along the Maumee Bay shoreline (Oregon 2007).

2.9.3 Industrial Redevelopment Plans

The City of Oregon's Master Plan recommends preserving the City's existing base of businesses and industries and clustering suppliers or related businesses around existing businesses. While there are no specific plans for industrial redevelopment identified in Oregon's Master Plan, a number of incentives are identified as being available to businesses who establish themselves in the City. One of these incentives is the Foreign-Trade Zone (FTZ) which is located in the C-I zoned area northeast of the Facility. The purpose of the FTZ economic area is to stimulate the foreign imports and exports through special tariff status and tax relief. The Facility is not included in the FTZ. The FTZ is located approximately one mile east of the Facility and is centrally located within an area zoned for industrial use.

2.10 GROUNDWATER USE

Groundwater in the bedrock formation beneath the Facility is under artesian conditions, with the overlying till unit acting as an aquitard. Although some sand and gravel inclusions are occasionally encountered within the thick glacial clays overlying the bedrock, these deposits are discontinuous, limited in areal extent, and lack direct recharge. Therefore, all known groundwater supplies in the vicinity of the facility are found in the bedrock formation, which is defined as the uppermost aquifer. Potable water at and around the Facility is provided by municipal sources. The public water supply is obtained from Lake Erie and does not depend on groundwater from the bedrock aquifer. Further, properties in areas to the north and west of the facility, not including the Facility, have received an Urban Setting Designation (USD) from the Ohio EPA's Division of Emergency and Remedial Response Voluntary Action Program. The USD provides official recognition that groundwater is not used as a source of potable water. Bedrock groundwater is used at the Facility for fire protection system makeup water and process water for on-site operations. It is also used at the BP-Husky Refinery, located north of the Facility, for cooling water.

Based on this information, bedrock is identified as a potential source of water under current and reasonably likely future conditions at the Facility (non-potable use) and off-Facility areas that are outside of the USD area (potential potable use), including the property located east of Facility, which under certain groundwater conditions is downgradient of portions of the Facility.

3 SUMMARY OF THE RFI PROGRAM

3.1 RFI PURPOSE

ESOI conducted a RFI to determine whether the SWMUs and AOCs identified in the RCRA Permit, three additional AOCs recommended by Ohio EPA, and one additional AOC requested by USEPA have released hazardous waste or hazardous constituents that pose an unacceptable risk to human health or the environment. ESOI performed a focused RFI at SWMU 6 in 1995 and 1996, and submitted an RFI Report to USEPA in June 1997 (MEC 1997). Based on information reviewed as part of planning for a Facility-wide RFI, 19 SWMUs/AOCs were identified for investigation (ENVIRON/MEC 2001). The Facility-wide RFI was conducted in accordance with the *Resource Conservation and Recovery Act Facility Investigation (RFI) Work Plan* (RFI Work Plan; ENVIRON/MSG 2002), the *Revised Phase II RFI Work Plan* (Phase II Work Plan; ENVIRON 2005b), and supplemental Phase II Work Plan addenda (ENVIRON 2006b and 2007b).

As part of the RFI, baseline risk assessments were conducted to characterize the potential significance of hypothetical human and ecological exposures to releases of detected hazardous waste and hazardous constituents from the investigated units. The methodology and assumptions used for these risk assessments were reviewed with Ohio EPA during the implementation of the RFI and documented in the RFI Report submitted in February 2009. In a March 31, 2008 meeting between Ohio EPA and ESOI, Ohio EPA provided comments on the RFI, including comments on certain aspects of the risk assessment. Based on input from Ohio EPA, the RFI Report was revised for resubmittal. The revised risk assessment methods and assumptions are documented in the RFI Final Report (ENVIRON 2009).

The RFI Final Report was approved by Ohio EPA on June 30, 2009; Ohio EPA's letter stated that the RFI Report submitted on February 20, 2008 and modified on June 4, 2009 is approved with one modification[2] relating to documentation of NAPL encountered in SWMUs 6 and 7, and provided a request that the CMS consider principles of green remediation (Ohio EPA 2009a). As described in Section 3.2 and 3.3, the results of the risk assessments were used in scoping the CMS; a summary of these results are provided below for each SWMU/AOC where an assessment of possible corrective measures was deemed necessary. The locations of these SWMUs/AOCs are shown on Figure 3.

During the implementation of the RFI, ESOI also conducted presumptive corrective measures to address conditions at several of the landfill SWMUs (SWMUs 5, 6 and 7), including the installation of leachate recovery systems and modification of the existing Explosive Gas Monitoring Plan. In addition, ESOI has

[2] Ohio EPA requested that ESOI include all locations where subsurface NAPL was found in SWMUs 6 and 7 during the installation of the leachate collection systems.

implemented cap enhancements for SWMU 1. The presumptive corrective measures were implemented in accordance with work plans submitted as required by Condition E.9 of ESOI's State RCRA Permit and approved by Ohio EPA. The completed corrective measures and ongoing presumptive corrective measures are discussed in Section 5.

3.2 RFI GOALS

The overall goal of the RFI was to determine whether potential risks to human health and the environment associated with hazardous waste or hazardous constituents released from the investigated SWMUs and/or AOCs warrant interim or corrective measures. As proposed in the RFI Work Plan, data necessary to make this determination were collected during a multi-phased investigation (NSL, Phase I and Phase II). After each phase of field investigation, the adequacy of the data to meet the RFI goal was evaluated to determine whether additional data collection was warranted. Risk-based data evaluation techniques were used during the field investigation to streamline this decision-making. Specifically, human health risk-based criteria and ecological benchmarks were used to guide and streamline field investigations and to identify existing conditions that warranted interim measures.

3.3 SWMU 1 – LANDFILL CELL F

3.3.1 Background

Cell F is a closed permitted RCRA hazardous waste landfill unit that encompasses an area of approximately three acres and is located within the northwest portion of the ESOI site. The Cell is bounded to the west by Otter Creek Road, the north by the Gradel Ditch and the Gradel Landfill, owned by Commercial Oil Services, Inc, the east by SWMU 6, and the south by SWMU 2. The cell was operated from 1980 to 1983 for the disposal of both non-hazardous industrial waste and RCRA hazardous waste. Wastes disposed of within this cell were bulk and containerized solids which primarily consisted of treated sludges, landfarm soil, ignitable solids, refinery solids, paint solids and contaminated soils, along with non-hazardous industrial waste solids. Cell F has an estimated waste thickness of 50 to 55 feet, with a total disposed volume of waste of approximately 146,000 tons. Additional information on the construction and closure of Cell F is provided in Section 3.1 of the DOCC.

Cell F is currently maintained and monitored in accordance with the substantive requirements of the post-closure plan, which was included with the Facility's State RCRA Part B Permit and Application. In addition, leachate is removed regularly from this landfill. The ongoing post-closure activities are designed to maintain the integrity of the final cover, liners and other components of the containment system, and the function of the unit's monitoring systems.

3.3.2 RFI Conclusions

The RFI soil and groundwater sampling was determined to adequately characterize the extent of soil and groundwater contamination at this SWMU for risk evaluation purposes. The significance of potential exposures at SWMU 1 was evaluated in the RFI baseline human health risk assessment and screening level ecological risk assessment. The risk assessments determined that there are no unacceptable human health or ecological risks associated with this SWMU. In addition, the RFI determined that the existing cap meets the minimum requirements defined in the RFI Work Plan, and explosive gas measurements did not exceed the screening level of 25% of the lower exposure limit. However, one area of the cap was observed to be accumulating storm water and identified for presumptive corrective measures (See Section 5.2.2).

3.4 SWMU 5 – MILLARD ROAD LANDFILL

3.4.1 Background

SWMU 5, the Millard Landfill, is a pre-RCRA unit that encompasses an area of approximately eight acres located northwest of the intersection of Otter Creek Road and Millard Avenue. It is bounded to the south by old Millard Avenue, to the west by Otter Creek, to the east by Otter Creek Road, and to the north by the ESOI fence and property line. The new Millard Avenue overpass is located north of this unit. It was operated from approximately 1976 to 1981 and was used primarily for disposal of construction and demolition material and solid waste. As stated in the DOCC, facility representatives indicated that the disposed material was principally debris from the demolition of an oil refinery. The in-place waste has an approximate waste thickness of 24 to 50 ft and the volume is reported to be approximately 224,600 cubic yards. Additional information on the construction and closure of the Millard Landfill is provided in Section 3.5 of the DOCC.

ESOI's monitoring and maintenance program for the Millard Landfill is designed to maintain the integrity of the final cover and the function of the unit's monitoring systems. The landfill is equipped with a gas monitoring system and a leachate collection system (installed as part of ESOI's presumptive corrective action activities).

3.4.2 RFI Conclusions

The RFI soil and groundwater sampling was determined to adequately characterize the extent of soil and groundwater contamination at this SWMU for risk evaluation purposes. The significance of potential exposures at SWMU 5 was evaluated in the RFI baseline human health risk assessment and screening level ecological risk assessment. The risk assessments determined that there are no unacceptable human health or ecological risks associated with this SWMU, with the exception of hypothetical exposures of outdoor routine workers to subsurface NAPL observed along the west side of the SWMU and maintenance worker exposure to shallow groundwater at two locations adjacent to the north side and south side of the unit. The RFI determined that the existing cap meets the minimum requirements defined in the RFI Work Plan; however, explosive gas measurements near this unit exceeded the screening level of 25% of the lower exposure limit. The locations of potentially unacceptable human exposure to groundwater and NAPL, and the presence of potential landfill gas at levels of concern were identified for corrective measures assessment. ESOI subsequently conducted an additional explosive gas assessment for Ohio EPA Division of Solid and Infectious Waste Management (DSIWM); the results of this work are summarized in Section 5.2.5.

3.5 SWMU 6 – NORTHERN SANITARY LANDFILL

3.5.1 Background

SWMU 6, the Northern Sanitary Landfill (NSL), is a pre-RCRA unit that encompasses an area of approximately six and one-half acres and is located in the northern portion of the Facility. It is bounded on the west by SWMU 1, the south by SWMU 7, the east by a farm field owned by First Energy Corporation, and the north by Gradel Ditch and the Gradel Landfill, owned by Commercial Oil Services, Inc. The NSL was operated from 1976 through 1981 for disposal of solid waste. Additional information on the construction and closure of the Northern Sanitary Landfill is provided in Section 3.6 of the DOCC. A cross-section of this unit is provided in Figures 4.18a and 4.18b of the RFI Final Report.

ESOI's monitoring and maintenance program for the NSL is designed to maintain the integrity of the final cover and the function of the unit's monitoring systems. The landfill is equipped with a gas monitoring system and a leachate collection system (installed as part of ESOI's presumptive corrective action activities).

3.5.2 RFI Conclusions

The RFI soil and groundwater sampling was determined to adequately characterize the extent of soil and groundwater contamination at this SWMU for risk evaluation purposes. The significance of potential exposures at SWMU 6 was evaluated in the RFI baseline human health risk assessment and screening level ecological risk assessment. The risk assessments determined that there are no unacceptable human health or ecological risks associated with this SWMU, with the exception of hypothetical exposures of outdoor routine workers to surface seeps observed on the northeast corner of the SWMU and maintenance worker exposure to shallow groundwater at one locations adjacent to the northwest corner of the unit. The RFI determined that the existing cap meets the minimum requirements defined in the RFI Work Plan, except in the northeastern corner where surface seeps were observed. In addition, the extent of waste along the northern side of the landfill was found to extend off-site beyond the defined limits of the unit. The locations of potentially unacceptable human exposure to groundwater and off-site waste were identified for corrective measures assessment; the surface seep area was repaired in March 2007, and subsequent monitoring of this area has not identified continuing seeps.

3.6 SWMU 7 – CENTRAL SANITARY LANDFILL

3.6.1 Background

SWMU 7, the Central Sanitary Landfill (CSL), is a pre-RCRA unit that encompasses an area of approximately seven acres and is located in the north central portion of the Facility. This SWMU is bounded to the north by SWMU 6, the east by SWMU 3, the south by SWMU 9 and the west by SWMU 2. SWMU 7 was the first major cell which received solid waste at the Facility and historical data indicate that this landfill was operated from 1969 to 1983. Additional information on the construction and closure of the Central Sanitary Landfill is provided in Section 3.7 of the DOCC. A cross-section of this unit is provided in Figure 4.18b of the RFI Final Report.

ESOI's monitoring and maintenance program for the CSL is designed to maintain the integrity of the final cover and the function of the unit's monitoring systems. The landfill is equipped with a gas monitoring system and a leachate collection system (installed as part of ESOI's presumptive corrective action activities).

3.6.2 RFI Conclusions

The RFI soil and groundwater sampling was determined to adequately characterize the extent of soil and groundwater contamination at this SWMU for risk evaluation purposes. The significance of potential exposures at SWMU 7 was evaluated in the RFI baseline human health risk assessment and screening level ecological risk assessment. The risk assessments determined that there are no unacceptable human health or ecological risks associated with this SWMU. The RFI determined that the existing cap meets the minimum requirements defined in the RFI Work Plan, except at one location where the access road was constructed over the waste. The adequacy of the access roads as a cap over waste was identified for assessment in the CMS.

3.7 AOC 6 – OILY WASTE ABOVEGROUND STORAGE TANKS

3.7.1 Background

AOC 6 consists of Oily Waste Above Ground Storage Tanks located at the northeast corner of SWMU 9. These tanks were erected and placed into operation in approximately 1969 or 1970. Runoff is prevented by a soil berm that surrounds the area; storm water from within the bermed area is removed and managed with the Facility's leachate. Additional information regarding the operations at AOC 6 is provided in Section 3.18 of the DOCC.

3.7.2 RFI Conclusions

The RFI soil and groundwater sampling was determined to adequately characterize the extent of soil and groundwater contamination at this AOC for risk evaluation purposes. The significance of potential exposures at AOC 6 was evaluated in the RFI baseline human health risk assessment and screening level ecological risk assessment. The risk assessments determined that there are no unacceptable human health or ecological risks associated with this AOC. This area was retained for the CMS to consider the adequacy of storm water controls in this area and options for the tank that remains in this area. ESOI subsequently removed these tanks and associated piping, drainage layer, and sump. The soil under the old tank area was excavated, sampled, backfilled, and regraded to promote positive drainage off the unit (see Section 5.2.7).

3.8 INVESTIGATION UNIT A

3.8.1 Background

Investigative Unit (IU) A consists of one SWMU and six AOCs situated along the southern central portion of the Facility immediately north of York Street. These SWMU/AOCs were combined into a single area of investigation for the RFI because of their close proximity to one another. The SWMU/AOCs associated with IU A are described below and shown on Figures 2 and 3.

SWMU 8 - Old Oil Pond #1 (South Pond)

SWMU 8 is a closed pre-RCRA unit located immediately north of York Street, west of SWMU 4. This oil recovery pond operated from the early 1960’s through 1969. It was abandoned in the late 1960’s by pumping the remaining oil into a newly constructed oil pond located immediately north of the old pond (SWMU 9). The area was backfilled with assorted sanitary and municipal waste and covered with a clay cap. Based on available information, it is understood that at least part of the maintenance building (Building C) was constructed on top of SWMU 8. Additional information regarding the operations and closure of the Old Oil Pond is provided in Section 3.8 of the DOCC.

AOC 1 - Toledo Water Lines

AOC 1, the Toledo Water Lines, consists of two low-pressure raw water transmission lines that bisect the Facility in an east/west direction north of York Street. These lines carry raw Lake Erie water to the city of Toledo Collins Park Water Treatment Plant. One of the transmission lines is a 78 inch, bituminous coated, steel pipe, constructed in 1939-1940 at a depth ranging from 11 to 21 ft bgs. Backfilling was accomplished with "selected clay", compacted to 24 inches above the top of the pipe. In 1973-1974 this line was improved by adding a ½-inch thick cement grout lining to the intercore of the pipe. The second line, a 60-inch steel encased prestressed concrete pipe was installed to the north and parallel to the original line in 1967 at a depth ranging from 9 to 18 ft bgs. The easement in which these two lines are located ranges from 80 to 105 feet in width, leaving the outside edges of the lines 7 to 22 feet from the limits of the easement. Monitoring and dewatering trenches are located along both sides of the water lines midway between the adjacent waste areas and the water lines. Each trench was installed at least one foot below the depth of the adjacent water line and is approximately 2.5 feet wide. Trenches are sloped at one percent grade with collection sumps located at each end and the middle of Trenches 1 and 2, each end of Trenches 3, 4, and 5, and the middle of Trench 6. Only the southern side of AOC 1 is included as part of IU A; the north side is included in IU B. The trench between SWMU 8 and the southern waterline is designated as Trench 4. Additional information regarding the construction of the water lines and monitoring trenches is provided in Section 3.13 of the DOCC.

AOC 3 - Maintenance/Storage Building "C"

AOC 3 is located north of York Street and is used for the storage and maintenance of equipment and as office space. As discussed above, it is understood that at least part of this building was constructed on SWMU 8. Potential environmental concerns associated with this AOC may be related to the possible spillage of materials carried in Facility vehicles. There have been no reported releases from this AOC, however oil infiltration, presumably from SWMU 8, has been noted in floor drains**.**

AOC 4 - Building "C" Septic Tank and Leach Field

AOC 4 is a septic tank and leach field that is reported to have received wastewater and other liquids disposed in Building C (AOC 3). The leach field was located west of Building C and was partially removed during the construction of the water line monitoring trenches in May 1987. The septic tank, which was also located west of Building C, was removed in April 1989 concurrent with the installation of a 4,000-gallon capacity, double-wall fiberglass underground holding tank, which remains operational today.

AOC 5 - Decontamination Building

AOC 5 is a former decontamination building located at the northeast corner of SWMU 8. Decontamination water generated in this area was collected in an underground storage tank. The decontamination underground storage tank and another wastewater underground storage tank both remain in this area. The decontamination building and associated components were removed in the winter of 2008.

AOC 7 - Butz Crock Concrete Utility Vault

AOC 7 is a concrete utility vault for access to a water line serving Building C located south of Building C within the footprint of SWMU 8. AOC 7 is an oval cement sewer pipe installed vertically, with the following inside dimensions: 60 inch length; 38 inch width; and 108 inches deep. Ancillary piping associated with AOC 7 extend to two associated utility vaults located on the south side of SWMU 8 east of AOC 7. Oily liquids occasionally observed to accumulate in AOC 7 are believed to originate from SWMU 8. Oily liquids have not been reported in the other two utility vaults.

AOC 8 - Staging Area East of Building C

AOC 8 is the Staging Area and consists of a horseshoe shaped roadway located east of Building C and located on SWMU 8. Incoming trucks use the area as a turn around and parking area.

AOC 12 – Building C Heating Oil Tank

AOC 12 is the underground heating oil storage tank (UST) located adjacent to Building C. This area was identified following an accidental spill in 2000 and identification of an oily sheen at a roof drain discharge near this area in 2007.

3.8.2 RFI Conclusions

The RFI soil and groundwater data from IU A indicate that potentially significant concentrations of hazardous constituents exist at or near some of the areas (SWMU or AOCs) included in this IU. NAPL (described in the field as "oily, sludge-like" and "tar-like" material) has been measured in wells installed into SWMU 8, and has also been observed to seep through the cover soils on top of SWMU 8, as well as into Butz Crock and the Building C floor drains. The RFI soil and groundwater sampling was determined to adequately characterize the extent of potential soil and groundwater contamination at this IU for risk evaluation purposes.

The significance of potential exposures at IU A was evaluated in the RFI baseline human health risk assessment and screening level ecological risk assessment. The risk assessments determined that there are no unacceptable human health or ecological risks associated with this IU, with the exception of hypothetical exposures of outdoor routine workers to NAPL seeps observed on the on the surface of SWMU 8 and at AOC 7, and maintenance worker exposure to shallow groundwater at one location adjacent to the northeast corner of the unit. NAPL was also encountered in a monitoring well located on the northeast corner of SWMU 8, and in AOC 7. The RFI determined that the existing cap meets the minimum requirements defined in the RFI Work Plan, however, elevated LFG pressure was observed during drilling within SWMU 8, with elevated explosive gas levels detected at several locations within the limits of SWMU 8. The locations of potentially unacceptable human exposure to groundwater, the presence of NAPL, and elevated LFG levels were identified for corrective measures assessment. In addition, the adequacy of existing controls for groundwater seepage into the waterline monitoring trenches adjacent to SWMU 8. The impact of corrective measures on the use of Building C and the associated heating oil tank, the waterlines and utility vaults associated with AOC 7, and the underground storage tanks in AOC 5 were also identified for consideration in the CMS.

3.9 INVESTIGATION UNIT B

3.9.1 Background

Investigative Unit B (IU B) consists of one SWMU and one AOC located at the central portion of the Facility north of York Street. These SWMU/AOCs were combined into a single area of investigation for the RFI because of their close proximity to one another. The SWMU/AOCs associated with IU B are described below:

SWMU 9 - New Oil Pond (North Pond)
SWMU 9 is an approximately 1.6 acre pre-RCRA unit located in the center of the Facility, north of York Street, between SWMU 7 and SWMU 8. This unit was used for waste oil recovery after SWMU 8 was abandoned in the late 1960's; SWMU 9 was operated through 1980. Additional information regarding the operations and closure of the New Oil Pond is provided in Section 3.9 of the DOCC.

AOC 1 - Toledo Water Lines
As described in Section 4.14 of the RFI Final Report, AOC 1 consists of two low-pressure raw water transmission lines that bisect the Facility in an east/west direction north of York Street. The "north side" of AOC 1 is included with IU B. The "south side" of AOC 1 is included as part of IU A. The trench located between SWMU 9 and the northern waterline is designated as Trench 3.

3.9.2 RFI Conclusions

The RFI soil and groundwater data from IU B indicate that potentially significant concentrations of hazardous constituents exist at or near some of the areas included in this IU. An oil water mixture has also been observed to seep through the cover soils in the vicinity of the vent pipes located on top of the SWMU 9. The RFI soil and groundwater sampling was determined to adequately characterize the extent of potential soil and groundwater contamination at this IU for risk evaluation purposes.

The significance of potential exposures at IU B was evaluated in the RFI baseline human health risk assessment and screening level ecological risk assessment. The risk assessments determined that there are no unacceptable human health or ecological risks associated with this IU, with the exception of hypothetical exposures of outdoor routine workers to NAPL seeps observed on the on the surface of SWMU 9, and maintenance worker exposure to shallow groundwater within the waterline monitoring trench. The RFI determined that the existing cap meets the minimum requirements defined in the RFI Work Plan, and LFG readings were below the explosive gas screening levels. The locations of potentially unacceptable human exposure to NAPL seeps and the adequacy of existing controls for groundwater seepage into the waterline monitoring trenches adjacent to SWMU 9 were identified for corrective measures assessment.

3.10 RFI FINAL REPORT CONCLUSIONS

Facility-wide RFI field investigations were conducted at 19 SWMUs/AOCs at the Facility and in Otter Creek adjacent to the Facility during the period from 2002 to 2007, to support the following objectives:

- Determine whether a significant release of hazardous constituents to soil, groundwater, surface water, and sediment has occurred from the SWMUs and AOCs subject to investigation;
- Characterize the source(s) of a release and determine the nature and extent of constituents in soil, groundwater, surface water, and sediment, to support the baseline risk assessments, where a significant release of hazardous constituents is confirmed; and
- Collect data to support development and evaluation of corrective measures alternatives for SWMUs and AOCs where corrective measures are determined to be warranted.

As discussed in Section 4 of the *RFI Final Report* (ENVIRON 2009), sufficient data were collected to identify potentially significant releases of hazardous constituents at and adjacent to the Facility, and to characterize the nature and extent of hazardous constituents as necessary to support a HHRA and SLERA. The HHRA and SLERA were conducted to identify where active corrective measures are warranted under current and reasonably expected future land and groundwater uses at and around the Facility.

Because the HHRA and SLERA were based on the expectation that future land and groundwater uses at the Facility will remain unchanged from current uses, all investigated SWMUs and AOCs have been retained for evaluation in this CMS for limited corrective measures, which includes institutional controls, regardless of whether a significant risk to human health or the environment was identified. Where a significant risk was identified based on field conditions observed during the RFI or the results of the HHRA, active corrective measures are evaluated in this CMS. Based on the SLERA conclusions described in Section 6 and Appendix F of the *RFI Final Report* (ENVIRON 2009), the RFI results were sufficient to conclude that chemicals detected in the areas at and adjacent to the Facility do not pose ecologically significant risks to populations, communities, or ecosystems (a primary risk management consideration according to USEPA [1999]). Therefore, there is no need for further action on the basis of ecological risk.

4 CMS SCOPE

4.1 OBSERVED CONDITIONS TO BE ADDRESSED IN CMS

Based on field observations during the RFI, and other subsequent inspections, the following specific conditions and/or areas are being evaluated for active corrective measures:

- SWMU 1: the ponding of storm water on the top of the landfill cover (ESOI completed presumptive corrective measures to address this condition in 2010; see Section 5.2.2).
- SWMUs 5, 6 and 7: the accumulation of leachate in these solid waste landfills (ESOI is currently implementing presumptive corrective measures to address this condition; see Section 5.2.4).
- SWMUs 5 and 6 and AOC 1: the accumulation of storm water at or adjacent to these areas.
- SWMU 5: the presence of NAPL in a subsurface peat layer and in pore spaces in the soil layers present above and below the peat layer along the western side of this unit, although the RFI field investigation found no evidence that the NAPL is the result of a release from the Facility.[3] The NAPL is from off-site/upstream releases to Otter Creek that occurred prior to construction of the perimeter soil berm for SWMU 5.
- SWMU 6: the presence of off-site waste along the northern side of the landfill and the on-site surface seepage at the northeast corner of the landfill.
- SWMU 7: the accumulation of leachate in the stand-pipe and along the base of the slope on the northwest corner (ESOI completed modifications to the leachate recovery system to address this condition in 2011; see Section 8.2.1).
- SWMU 8: the occurrence of elevated landfill gas pressure, leachate accumulation in the unit, presence of NAPL within the unit, and seepage of a tar-like NAPL to ground surface.

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[3] According to the 1990 Lower Maumee River Remedial Action Plan Stage 1: Investigational Report (http://www.epa.gov/glnpo/aoc/maumee/Maumee-River-RAP_StageI.pdf) the creek has been characterized as having *oil soaked banks* [emphasis added], and nickel and cyanide being detected in the waters from a source located upstream of the ESOI facility.

- SWMU 9: the occurrence of NAPL beneath the soil cover, NAPL/oily water seepage to ground surface, and the cap drainage conditions.

- AOC 6: completion of the regrading of the former tank containment area. AOC 7: the presence of NAPL in this unit.

- AOC 12: the presence of sheen near the roof drain pipe adjacent to the Building C heating oil tank.

4.2 BASELINE RISKS TO BE ADDRESSED IN CMS

The RFI baseline risk assessment determined that certain SWMUs and AOCs potentially pose a significant risk to human health, which warrants active corrective measures. Specifically, the significance of potential exposure to soil, sediment, surface water, groundwater, NAPL, leachate, and indoor air at and adjacent to the Facility was evaluated based on current and reasonably likely future land and groundwater use. Potential receptors evaluated included: on-site and off-site routine workers; on-site and off-site maintenance workers; on-site trespassers; off-site residents; and off-site recreational visitors. Based on the data collected during the RFI, the HHRA presented in Section 5 of the *RFI Final Report* (ENVIRON 2009) evaluated whether a release of hazardous waste or constituent may cause reasonable maximum exposures to be significant enough to warrant corrective measures. Based on the HHRA, corrective measures are warranted to address the following (see Figure 3):

1. AOC 1: potential exposures of on-site maintenance workers to shallow groundwater. It should be noted that workers at the Facility are covered by the Facility's Health and Safety Policy, which has provisions for preventing significant exposures during on-site activities.

2. AOC 7: potential exposure of on-site outdoor routine facility workers to NAPL within Butz Crock, if it is assumed that workers spend every outdoor work day of the entire exposure period of 25 years at this location. It should be noted that workers at the Facility are covered by the Facility's Health and Safety Policy, which has provisions for preventing significant exposures during on-site activities.

3. SWMU 5: potential exposure of on-site outdoor routine facility workers to NAPL identified in subsurface soil, if it is assumed a surficial NAPL seep occurred and that workers spend every outdoor work day of the entire exposure period of 25 years at the seep location. It should be noted that workers at the Facility are covered by the Facility's Health and Safety Policy, which has provisions for preventing significant exposures during on-site activities.

4. SWMUs 5 and 6: potential exposures of on-site maintenance workers to groundwater. When dissolved metals data are used as more representative dermal exposure concentrations, these exposures are not significant. Therefore, risks to maintenance workers from exposure to groundwater at these SWMUs are considered marginal.

5. SWMU 6: potential exposures of on-site outdoor routine facility workers to leachate seeps at SWMU 6, if it is assumed that workers spend every outdoor work day of the entire exposure period of 25 years at the seeps, and leachate concentrations are never diluted with storm water runoff. It should be noted that workers at the Facility are covered by the Facility's Health and Safety Policy, which has provisions for preventing significant exposures during on-site activities.

6. SWMU 8: potential exposure of on-site outdoor routine facility workers to NAPL seeps, if it is assumed that workers spend every outdoor work day of the entire exposure period of 25 years at the seeps. It should be noted that workers at the Facility are covered by the Facility's Health and Safety Policy, which has provisions for preventing significant exposures during on-site activities.

7. SWMU 8: potential exposure of on-site maintenance workers to the NAPL seep at location SWMU 8-2 (corresponding to TLW-202). It should be noted that workers at the Facility are covered by the Facility's Health and Safety Policy, which has provisions for preventing significant exposures during on-site activities.

8. SWMU 8: potential exposures of maintenance workers that encounter shallow groundwater in the vicinity of temporary well T-208 located at the northeast corner of SWMU 8. However, it should be noted that workers at the Facility are covered by the Facility's Health and Safety Policy, which has provisions for preventing significant exposures during on-site excavation activities.

9. SWMU 9: potential exposure of on-site outdoor routine facility workers to NAPL seeps, if it is assumed that workers spend every outdoor work day of the entire exposure period of 25 years at the seeps. It should be noted that workers at the Facility are covered by the Facility's Health and Safety Policy, which has provisions for preventing significant exposures during on-site activities.

4.3 ADDITIONAL CONDITIONS TO BE CONSIDERED IN CMS

In addition, as stated in Ohio EPA's April 6, 2009 Notice of Deficiency for the February 2008 RCRA Facility Investigation Report, the potential for migration downward from the lacustrine/upper till zone must still be considered. Further, in addition to the implementation of leachate collection at SWMUs 5, 6 and 7, Ohio EPA expects the corrective measures for SWMUs 8 and 9 to include source control measures and the corrective measures for all the SWMUs to include continued groundwater monitoring.

4.4 SUMMARY OF CMS ALTERNATIVES SCOPING

Based on the observed site conditions and findings of the RFI baseline risk assessment, the corrective measures alternatives to be considered for the Otter Creek Road Facility address the following conditions:

1. Site-wide restrictions on land use and groundwater use. Limited corrective measures, including institutional controls, for all SWMUs and AOCs investigated during the RFI, regardless of whether a significant risk to human health or the environment was identified in the HHRA and SLERA. The institutional controls will specify that the land use and overburden groundwater use at the Facility is restricted. Facility health and safety protocols shall address the potential for worker exposures to areas where potentially significant releases of hazardous waste and/or hazardous constituents have occurred.

2. SWMU 1:
    - Landfill cap drainage improvements (completed as part of ESOI's presumptive corrective measures activities; see Section 5.2.2).

3. SWMU 5:
    - Leachate extraction and landfill gas monitoring (currently being implemented as part of ESOI's presumptive corrective measures activities; see Sections 5.2.4 and 5.2.5);
    - The presence of NAPL in a subsurface peat layer along the western side of the landfill;
    - Exposures during maintenance activities that encounter shallow groundwater; and
    - Long-term cap maintenance; and
    - Accumulation and potential infiltration of storm water along the east side of the unit.

4. SWMU 6:
    - Leachate extraction and landfill gas monitoring (currently being implemented as part of ESOI's presumptive corrective measures activities; see Sections 5.2.4 and 5.2.5);
    - The presence of off-site waste along the northern side of SWMU 6;
    - Surface leachate seepage at the northeast corner of SWMU 6 (previously addressed as part of ESOI's presumptive corrective measures);
    - Exposures during maintenance activities that encounter shallow groundwater;
    - Long-term cap maintenance; and
    - Accumulation and potential infiltration of storm water along the south side of the unit.

5. SWMU 7:
    - Leachate extraction and landfill gas monitoring (currently being implemented as part of ESOI's presumptive corrective measures activities; see Sections 5.2.4 and 5.2.5);

- o Accumulation of storm water and potential infiltration of storm water, and/or surface leachate seepage in and around the standpipe (currently being assessed as part of ESOI's post 24-month leachate extraction system evaluation; see Section 5.2.8); and
- o Long-term cap maintenance.

6. SWMU 8:
   - o Elevated landfill gas pressure;
   - o Leachate accumulation;
   - o Surface and subsurface NAPL seepage;
   - o Exposures during maintenance activities that encounter shallow groundwater;
   - o Protection of off-site underground utilities along York Street; and
   - o Long-term cap maintenance.

7. SWMU 9:
   - o The occurrence of NAPL and infiltrated storm water accumulating on top of the solidified material and beneath the soil cover, and oily water seepage to ground surface at SWMU 9;
   - o Surface cap drainage improvements; and
   - o Long-term cap maintenance.

8. AOC 1:
   - o Accumulated groundwater removal (currently being implemented in accordance with the agreement with the City of Toledo; see Section 5.1);
   - o Accumulation and infiltration of storm water along a portion of this AOC; and
   - o Exposure during maintenance activities that encounter shallow groundwater.

9. AOC 5
   - o Decontamination wastewater underground storage tanks.

10. AOC 6:
    - o Containment area storm water management (tank removal was completed under Post Closure; see Section 5.2.7).

11. AOC 7:
    - o NAPL seepage into the utility vault.
    - o The ancillary piping and two additional utility vaults

12. AOC 12
    - The presence of sheen near the roof drain pipe adjacent to the Building C heating oil tank.

13. Groundwater monitoring to assess the performance of corrective measures.

5 PREVIOUSLY IMPLEMENTED CORRECTIVE MEASURES

ESOI has previously implemented a number of measures to control and monitor releases of hazardous waste and/or hazardous constituents. In addition, based on the findings of the RFI, and in consultation with Ohio EPA, ESOI has initiated several corrective measures that address a number of the conditions specified in Section 4.4. These corrective measures have already been evaluated, initiated, and/or are in some phase of completion at the facility. These measures are described below and have been taken into consideration during the development of corrective measures alternatives and in the preparation of recommendations for final corrective measures.

5.1 TOLEDO WATERLINE COLLECTION TRENCHES

AOC 1, the City of Toledo Water Lines, consists of two low-pressure raw water transmission lines that bisect the facility in an east/west direction north of York Street. These lines carry raw Lake Erie water to the City of Toledo Collins Park Water Treatment Plant. The easement in which these two lines are located ranges from 80 to 105 feet in width, leaving the outside edges of the lines 7 to 22 feet from the easement. In 1983, the City of Toledo began negotiating with the Facility to obtain safeguards pertaining to the water lines. These negotiations resulted in the March 22, 1984, Fondessy Enterprises, Inc. - City of Toledo Low Pressure Raw Water Line Security Agreement. The security agreement addresses (1) waste area locations, including setbacks for all regulated waste areas, (2) survey and monument installation, (3) waste area design and construction, (4) monitoring systems, (5) site inspection, and (6) termination of the agreement. Since that time, the monitoring agreement has been updated and is now incorporated into the facility's State RCRA Permit.

The section of the agreement that is most relevant to the ongoing CAP was the installation of waterline monitoring and dewatering trenches along both sides of the City of Toledo Water lines (AOC 1) midway between the waste areas and the water lines. These trenches have direct implications with the detection and collection of liquids associated with, but not limited to, SWMUs 8 and 9.

Each of the 6 trenches was installed at least one foot below the depth of the adjacent water line and is approximately 2.5 feet wide. Trenches are sloped at one percent grade with collection sumps at each end and the middle of Trenches 1 and 2, each end of Trenches 3, 4, and 5 and the middle of Trench 6. According to the 1986 Hazardous Waste Groundwater Task Force Evaluation of Fondessy Enterprises, Inc. Oregon, Ohio, the trenches along the north side of the waterlines were backfilled with gravel to a level of 2 feet from the surface and then was sealed with recompacted blue clay to prevent infiltration of surface water. The trench on the south side of the waterlines was backfilled with gravel up to 4.5 feet from the surface and was also sealed with recompacted blue clay to prevent infiltration of surface water.

A 4-inch slotted polyethylene flex hose is located at the bottom of each trench to enhance collection of any liquids. These trenches were installed in various phases from 1984 to 1987.

The sumps in the six trenches are required to be inspected for the presence of liquids on at least a monthly basis during the post closure period. Currently, an individualized schedule is maintained for the inspection of each trench. All trenches are monitored Monday, Wednesday, and Friday for “pumpable” liquids. If pumpable liquids are present, the trench is pumped to cavitation during the week. The inspection includes a review of disposal cell boundaries, monitoring trench cap, water line easement, easement markers, collection sumps, and record keeping. Any liquid collected in the sumps is analyzed by the City of Toledo quarterly for the indicator parameters specified in the Low Pressure Raw Water Line Security Agreement (e.g., pH, specific conductance, TOX, TOC, indicator metals (Pb, Fe, Mn, Na), purgeable organics (BTEX), phenols, oil & grease, sulfates, and chlorides). The City of Toledo and ESOI collect and analyze split-samples semi-annually. In addition to samples split with the City of Toledo, ESOI’s permit requires semi-annual analysis of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), cyanide, total phenols, polychlorinated biphenyls (PCBs), dissolved barium, chromium, cadmium, and lead.

5.2 PRESUMPTIVE CORRECTIVE MEASURES

On January 27, 2005, Ohio EPA provided informal comments to ESOI regarding the ongoing RCRA Facility Investigation (RFI) at ESOI’s Otter Creek Road Facility. Included with these comments, Ohio EPA requested that ESOI consider implementing presumptive corrective measures along the northern property boundary and along Otter Creek based on data collected as part of completed phases of the RFI. ESOI evaluated a slurry wall system along the boundaries, the installation of a temporary cover on SWMU 1, a plan to investigate NAPL seepage on SWMU 9, and the installation of a leachate extraction system on SWMUs 5, 6, and 7. As agreed with Ohio EPA on June 1, 2005, ESOI prepared plans for implementing the following presumptive measures:

1. Installation of a temporary cover on SWMU 1 (Cell F) to minimize infiltration of water in the area where ponding is currently observed on top of the landfill.

2. Investigation of the occurrence of oily liquid on the surface of the SWMU 9 (New Oil Pond) cover.

3. Installation of leachate collection for SWMUs 5 (Millard Road Landfill), 6 (Northern Sanitary Landfill, or NSL), and 7 (Central Sanitary Landfill, or CSL).

On July 29, 2005, ESOI submitted a *Presumptive Corrective Measures Design Work Plan* to Ohio EPA (ENVIRON 2005a). The purpose of the Work Plan was to gather additional data necessary to prepare necessary design plans and specifications. The Work Plan also summarized existing information and provided the scope of work for gathering the necessary supporting data. On October 12, 2006, Ohio EPA provided approval of the work plan with the following modifications:

1. The investigation proposed for SWMU 1 would not lead to a final remedy so it was not approved as part of the plan, but it was recommended that an evaluation of the unit for the purpose of defining the extent of differential settlement and determining cap depths could be completed during Phase II of the RFI;

2. The investigation proposed for SWMU 9 did not address corrective measures for the cap or the potential for landfill gas so it was not approved as part of the plan, but it was recommended that the proposed evaluation be completed during Phase II of the RFI;

3. The leachate collection evaluation for SWMU's 5, 6, and 7 was modified to include additional wells during the pump test evaluation, to include optimization of pump locations, and conditions for management of the leachate extracted during the pump testing; and

4. Schedule changes in conjunction with the above.

ESOI implemented the *Presumptive Measures Design Work Plan* and obtained approved modifications following completion of the first pump test (ENVIRON 2006a). The work was documented in the *Pump Test Report and 30% Presumptive Corrective Measures Design* (MSG 2006a) submitted on August 4, 2006.

Finally, in September 2006, Ohio EPA issued a Director initiated permit modification to ESOI's Hazardous Waste Facility and Installation Permit that incorporated presumptive corrective measures including those that were part of the *Presumptive Corrective Measures Design Plan*. In addition, the permit modification required that ESOI make cap enhancements and/or modifications for SWMU 1 to minimize infiltration of liquids and promote positive drainage of precipitation, and address landfill gas generation in SWMUs 1, 5, 6, and 7. As required by the September 2006 permit modification, ESOI submitted the *Preliminary Cell F Cover Modification Design Analysis, Otter Creek Road Facility* (ENVIRON 2006c) presenting conceptual design alternatives for modifications to the SWMU 1 cover to minimize infiltration of liquids and promote positive drainage of precipitation. Because the alternative designs required that additional cover soil be placed on SWMU 1 to provide for greater slopes to promote drainage, ESOI conducted a settlement test to evaluate the potential for long term waste settlements resulting from the increased surcharge loading. This test was conducted in accordance with the *In-Situ Settlement Test Plan for Cell F Cover Modification Design Analysis* (ENVIRON 2007a) approved by

Ohio EPA on September 25, 2007. The test was completed in May 2008. In addition, ESOI has modified the leachate collection manhole located on SWMU 1 to minimize infiltration of storm water around the manhole. Based on the results of the field test, a grading plan for Cell F was completed and presented in the *Conceptual Design of Cell F Cover Modification, Otter Creek Road Facility* (ENVIRON 2008b) submitted in November 2008.

The following summarizes the progression of work at each area.

5.2.1 Boundary Cutoff Wall

In accordance with Ohio EPA's January 27, 2005 informal comments, ESOI conducted a preliminary evaluation of the following options for a subsurface barrier wall along the northern property boundary and between SWMU 5 and Otter Creek:

1. Slurry wall or sheet pile wall along the west side of SWMU 5, adjacent to Otter Creek.
2. Slurry wall or sheet pile wall along the north side of SWMU 5.
3. Slurry wall or sheet pile wall along the northern property line, east of Otter Creek Road and north of SWMU 1 (Cell F) and SWMU 6 (Northern Sanitary Landfill).

For each section of wall, two depths for the wall were evaluated:

- Into the upper till zone to cut off potential migration along the lacustrine/upper till contact interface.
- Into the lower till zone to cut off potential migration along the Upper Till/Lower Till contact interface.

Additionally, a groundwater collection system behind the wall at the depth of the Lacustrine/Upper Till contact interface and Upper Till/Lower Till contact interface were considered.

ESOI provided information including the Facility location, description and settings, the Facility background and operations, site geology, site hydrogeology, and drawings to contractors to obtain estimated costs associated with these scenarios. The estimated cost for installation of a shallow slurry wall for the three boundary areas defined above totaled approximately $1.9 million. The cost for a deep slurry wall was approximately $3.6 million. Based on preliminary evaluation of the information being collected from the RFI, including a screening-level assessment indicating that there was not a potential for significant current or future exposures, a cutoff wall was determined not to be warranted as a presumptive corrective measure. In addition, the construction of a barrier wall is estimated to only reduce the potential leachate generation resulting from seepage into these landfills by less than 10% (see Appendix D). ESOI did not recommend and Ohio EPA did not request that it be included in the Presumptive Corrective Measures Design Work Plan.

5.2.2 Cap Improvement for SWMU 1

During the RFI, ponding of storm water on the SWMU 1 cover was observed. ESOI considered two alternatives for a permanent solution to address ponding of water on the SWMU 1 cap. The first included modifying the landfill top and side slopes to lower the peak height of the landfill so that positive slopes could be created while maintaining a required separation between the landfill and the overhead power lines. The second option involved the filling of the low areas of the cap to achieve positive slopes. This second alternative would also require raising the overhead power lines to maintain the required separation. Since the second alternative was preferred and the utility had contacted ESOI about raising the power lines (not in association with ESOI's Corrective Action Program), ESOI and Ohio EPA conceptually agreed that a temporary measure should be considered. The design plan included an evaluation for the placement of a temporary geomembrane liner and anchor system over the low area of the cap. This temporary liner would be placed to collect rainwater on the cover while further minimizing infiltration of the accumulated water; accumulated water would be periodically removed. Data collection including topography, surface area, and cover thickness was proposed to support the evaluation of the alternative designs.

Ultimately, Ohio EPA determined that the evaluation of a temporary measure for SWMU 1 would not lead to a final remedy. That decision in conjunction with an evaluation of the possible cap modifications resulted in a Director initiated permit modification requiring that ESOI prepare preliminary design alternatives for the SWMU 1 cover system that would minimize the infiltration of liquids and promote positive drainage of storm water. The assessment of alternative cover designs was documented in *Preliminary Cell F Cover Modification Design Analysis, Otter Creek Road Facility* submitted to Ohio EPA on December 11, 2006 (ENVIRON 2006c). Based on discussions with Ohio EPA on March 28, 2007 regarding these alternatives, ESOI agreed to assess potential landfill settlement that may result from the placement of additional cap material required for several of the design alternatives. The *In-Situ Settlement Test Plan for Cell F Cover Modification Design Analysis, Otter Creek Road Facility* (ENVIRON 2007a) was submitted on August 3, 2007 and approved on September 25, 2007. The settlement testing was completed in May 2008, and the *Cell F Settlement Study Report Otter Creek Road Facility* was submitted on August 28, 2008 (ENVIRON 2008a). Based on the results of this testing, the *Conceptual Design of Cell F Cover Modification, Otter Creek Road Facility* (ENIVRON 2008b) was submitted to Ohio EPA on November 10, 2008 and approved on February 27, 2009. The approval required ESOI to submit a permit modification with the final design and an implementation schedule. The permit modification was submitted on March 28, 2009 and approved by Ohio EPA on June 2, 2009. Construction of the final design was completed during the 2009 construction season (MSG 2009). Ohio EPA provided comments to ESOI on July 16, 2010 regarding observed ponding of storm water directly west of the leachate collection system concrete access port. ESOI responded and corrected these conditions by August 31, 2010; documentation of this work was submitted to Ohio EPA on September 2, 2010.

In addition to these actions, in reviewing leachate collection records for 2006 it was noted that a significant increase in leachate accumulation in SWMU 1 was being observed. Inspection of the landfill indicated that storm water was accumulating at the leachate collection manhole. It was determined that settlement of the cover had occurred and that the existing landfill cover grade resulted in storm water runoff being directed toward the manhole area. On April 20, 2007, ESOI modified the leachate collection manhole located on SWMU 1 to minimize infiltration of storm water around the manhole. This effort included the addition of a second concrete collar keyed into the clay cover and placed around the existing concrete manhole. The area between the concrete collar and manhole was grouted and cover was regraded to direct storm water away from the manhole. A significant decrease in leachate removal was immediately noted (ENVIRON 2008a). Data collected since April 20, 2007 continue to demonstrate the effectiveness of the cap regarding and manhole improvements; the assessment of effectiveness of the current cap is discussed in Section 8.2.2.

5.2.3 Investigation of SWMU 9 Surface Seeps

During the RFI, ponding of oily water was observed on the SWMU 9 cover in the area where several pipes had been installed through the cover for the purpose of recovering oily water that accumulates under the cap. These pipes are routinely pumped to remove the oily water and managed in the oily water storage containers (AOC 6). To identify the source of the oily water seeps, ESOI excavated a portion of the SWMU 9 soil cover during the RFI to examine these soils for evidence of upward seepage of oily water through the cover. The cover excavation activity suggested that any upward seepage of oily water (which could not be distinguished from reinfiltration of backflow liquids during extraction operations) may occur along the existing oil recovery wells that were previously installed in SWMU 9 and not from seepage through the cover soils.

As part of the *Presumptive Corrective Measures Design Work Plan* (ENVIRON 2005a), ESOI proposed the development of a plan to inspect the area on a monthly basis to determine if this seepage occurs only along the exterior of the existing recovery pipes, or is simply the result of liquid recovery operations. ESOI also proposed to delineate the extent of free liquid under the cap as part of the study. The delineation of free liquids under the cap was conducted during the RFI (ENVIRON 2009). In June 2010, visual inspection of SWMU 9 identified oily water seepage along the eastern portion of the unit and near certain vent pipes. Similar to prior observations, storm water ponding was evident on the unit in the vicinity of the vent pipes. ESOI has also been conducting routine inspections and removes accumulated water from the cover area as needed. Permanent alternatives have been evaluated as part of the CMS and are included in Section 8.2.5.

5.2.4 Leachate Extraction from SWMUs 5, 6 and 7

SWMUs 5, 6, and 7 are pre-RCRA waste landfill units that did not have leachate recovery systems installed at the time of construction. The RFI identified significant volumes of accumulated leachate in these units and identified it as the probable source of contamination found in the contact zone waters immediately surrounding them. As such, the presumptive measure evaluated was to install a leachate recovery system in each of these units. To support the design of these systems, data regarding the sustainable leachate recovery rate, area of influence for a leachate extraction well, and leachate characteristics were required. To obtain this information, ESOI prepared a *Presumptive Corrective Measures Design Work Plan* (ENVIRON July 2005a) which included the performance of leachate recovery testing on SWMU 6. Based on the results of the tests at SWMU 6, a *Presumptive Corrective Measures Design Work Plan Modification* (ENVIRON 2006a) was submitted to Ohio EPA. This plan included the results from the SWMU 6 testing, and provided the scope of work for similar testing on SWMU 5 and 7.

ESOI submitted the results of the predesign studies for SWMUs 5, 6 and 7 in the *Pump Test Report and 30% Presumptive Corrective Measures Design* (MSG 2006a). Based on these study results, ESOI proposed to install a recovery well system of 2, 5 and 3 recovery wells in SWMUs 5, 6, and 7, respectively. The report was approved by Ohio EPA by letter dated November 13, 2006. The *90% Presumptive Corrective Measures Design* for equipment and layout was completed in December 2006 (MSG 2006b). ESOI submitted a permit modification request to include detailed performance objectives and a performance monitoring program to Ohio EPA on January 12, 2007. The performance objectives include 1) reducing head levels within the SWMUs, 2) establishing an inward hydraulic gradient, and 3) achieving target leachate levels by specified dates. The permit modification was approved on March 16, 2007. Installation of the leachate recovery systems was performed during February through June 2007, and the systems became fully operational on July 1, 2007.

The *Corrective Measures Completion Report, Operations and Maintenance and Performance Monitoring ("OMPM") Plan, and Construction Completion Report* (Completion Report) was submitted to Ohio EPA on August 15, 2007 (MSG 2007). As part of this report, it was found that an assumption utilized during the design phase of the project was inaccurate. Specifically, it had been assumed that the base contour for each of these landfills is flat based on one boring installed through each unit during the RFI; i.e., for calculation purposes it was assumed that this base elevation found for each unit during the RFI was the same for the entire unit. However, upon installation of all of the proposed extraction wells and monitoring piezometers during construction of the systems, the base of the landfills were better defined. With this additional information, the calculations utilized to develop performance objectives, specifically the average target leachate elevations to achieve a 90% reduction in head level were refined to reflect these additional data. The re-calculated target leachate elevations were submitted with the Completion Report.

The system has since been optimized as necessary to produce the highest leachate recovery possible. Optimization included programming individualized pump rates for each well to achieve as close to an uninterrupted flow from each well as possible, addition of heaters to control panels to prevent freezing of electronics during very cold weather, and installation of external stroke counters on control panels so they do not have to be opened to obtain the data. Based upon several conversations and meetings with Ohio EPA regarding the OMPM Plan, ESOI conducted a preliminary assessment of the pumping system; the results were provided in a December 8, 2008 letter *RE: Evaluation of Pump Performance in Leachate Recovery Wells 1 through 10, SWMUs 5, 6, and 7, Envirosafe Services of Ohio, Inc., 876 Otter Creek Road, Oregon, Ohio 43616* (MSG 2008) submitted to Ohio EPA on December 30, 2008. The objective of this assessment was to determine (1) how the performance of each leachate recovery pump compares with design performance, and (2) the ability of the systems to achieve the permitted target leachate levels and compliance dates without modifying the target levels to account for the refined landfill base contours. All recommendations developed from the preliminary assessment have been addressed, most notably including:

- Installing reliable weatherproofing of the wire connections for the pump actuator limit switches;
- Evaluating the down hole components of recovery well RW-10;
- Discontinuing use of the automatic level controls and operating the pumps in manual mode with the pump speeds set to run continuously at 5 strokes per minute
- Eliminating stoke counts as a means of estimated flow as it has been proven to be unreliable;
- Adding a tap on the recovery well discharge to estimate the rate of flow using a calibrated bucket; and
- Evaluating chemical methods (e.g., dispersants) to dissolve viscous organic material that may be blinding the recovery wells screens and filter packs. A chemical has been identified and field testing is going to be conducted.

There has been one significant failure of the system to date -- leachate recovery well RW-10 located on SWMU 7 is currently out of service. As noted in the MSG preliminary pumping system evaluation, RW-10 often had no discharge when operated. In February 2009, the pump was tested in response to this performance, and all down-hole components were found to be operating properly. Subsequently, it was again noted that there was no discharge coming from the well. On March 24, 2009 another inspection of the pump was going to be performed. However, as it was being lifted out, an obstruction was encountered causing a piece of the pump to break off and fall to the bottom of the well. It was discovered that the well pipe itself is broken and there may be other problems in the screen portion of the well. The piece of pump that fell to the bottom is not retrievable and the well is no longer useable. Ohio EPA was notified of the incident on March 24, 2009. This incident was also documented in the March 2009 progress report submitted by ESOI.

Notwithstanding the failure of well RW-10, the leachate extraction system for SWMU 7 which consists of three recovery wells has been successful in moving toward achieving the performance objectives. To date, the first two performance objectives have been achieved ahead of schedule. As such, it was recommended to Ohio EPA that no immediate action be taken to address RW-10.

The systems have removed more than 2.5 million gallons of leachate in the first 3 years of operation and achieved the first two performance objectives ahead of schedule:

- Reducing head levels as demonstrated by documenting that the head levels at established interior piezometers have a decreasing trend; and

- Demonstrating an inward hydraulic gradient by documenting that the leachate levels at the SWMUs interior piezometers have an average head potential 1-foot lower than the measured liquid potential in established perimeter shallow till wells.

The final remaining performance objective of achieving the target leachate levels within specified timeframes is continued to be monitored and adjustments made as necessary to achieve these limits.

As of July 1, 2009, 24 months of the leachate recovery systems operation had been completed for SWMUs 5, 6 and 7. As outlined in the OMPM Plan, a full review of the entire system was conducted to assess the systems performance and ability to achieve its objectives. This review evaluated the need to make adjustments to all three solid waste landfill recovery systems, as necessary, to achieve all performance objectives. Several recommendations were made including the addition of seven (7) new piezometers that could be converted to extraction wells, if necessary, and conversion of two (2) existing piezometers to extractions wells. Also recommended was a series of actions to improve the production, efficiency, and overall effectiveness of the existing systems. In addition, the target leachate levels were recalculated based on volume based information and supporting guidance from other landfills (MSG 2010a). The recommended improvements to the leachate recovery system and the new volume based target leachate levels were approved by Ohio EPA in August 2010, included as part of a permit modification, and implemented in 2010.

In 2011, additional modifications were recommended to further enhance the recovery systems to achieve performance objectives. These recommendations included installation of eight new nested recovery well and piezometers in SWMUs 5, 6 and 7 and installation of passive gas vents PV-9 and PV-10 on the west slope of SWMU 5. Also recommended was the conversion of 4 existing piezometers to dual purpose recovery well/piezometers and redevelopment of 2 existing piezometers. The recommended improvements to the leachate recovery system were implemented in 2011.

5.2.5 Landfill Gas Monitoring at SWMUs 1, 5, 6, and 7

As required by the director initiated permit modification, ESOI prepared the *Presumptive Corrective Measures Design Work Plan* (ENVIRON July 2005a) to ensure collection and evaluation of sufficient information to complete a final design of any necessary landfill gas mitigation system or systems for SWMUs 1, 5, 6, and 7. On December 11, 2006, ESOI submitted the results of its assessment of landfill gas for SWMUs 1, 5, 6 and 7 in the report entitled *Landfill Gas Formation & Migration Potential for Envirosafe Services of Ohio, Inc. SWMU 1, 5, 6 & 7* (MSG 2006c). This report provided background information; an assessment of landfill gas formation, production, and potential hazards; landfill gas mitigation potential; methods to monitor gas migration; and a discussion of the current landfill gas monitoring operations at the ESOI landfills and conclusion.

In accordance with OAC Rule 3745-27-12, ESOI previously submitted an *Explosive Gas Monitoring Plan* to the Ohio EPA DSWIM dated September 1999 (ESOI Revised 2002 and 2005) to address the potential generation and migration of explosive gasses from ESOI's Otter Creek Road facility. During a December 7, 2006 meeting the Division of Hazardous Waste Management ("DHWM") acknowledged that an approved *Explosive Gas Monitoring Plan* would adequately address the permit condition. ESOI subsequently received additional comments on the *Explosive Gas Monitoring Plan* on February 27, 2007 and submitted a response and revised plan on April 30, 2007. Ohio EPA approved the plan on April 24, 2008 and the plan is currently being implemented.

Subsequent to the submittal of a semi-annual report as required by the *Explosive Gas Monitoring Plan*, the DSWIM requested that ESOI evaluate concentrations exceeding the explosive gas threshold limit (EGTL) for punch bars PB-3, PB-4, PB-7, and PB-11 located north of SWMU 1 and SWMU 6 and monitoring probe MP-13 located northwest of SWMU 5. It was concluded that there is essentially no potential for adverse impacts from the explosive gas concentrations that have been observed in the punch bars north of SWMUs 1 and 6 or from the explosive gas concentrations that have been observed in MP-13 at SWMU 5 (MSG 2010c). However, it was recommended that a passive vent (PV-7) be installed on the north side slope of SWMU 6 opposite the midway point between PB-11 and PB-10 and to eliminate the area of stressed vegetation and desiccation cracks. It was also recommended along with other procedural and administrative actions that the swale north of SWMU 6 be regraded to insure proper drainage. This evaluation was submitted to DSIWM with the August 2010 semi-annual report; DSIWM responded in September 2010 that the recommendations should be implemented. This work has been completed by ESOI and a revision to the *Explosive Gas Monitoring Plan* including the newly installed passive gas vent was submitted to Ohio EPA. Subsequently, upon notification from Ohio EPA DSIWM, ESOI submitted proposed remedies for monitoring wells PB-3, PB-4, and MP-13 and installed two new vents (PV-9 and PV-10) at SWMU 5 near MP-13 (installed July 2011).

5.2.6 Fuel Oil Tank Management

On April 13, 2000, ESOI reported an estimated 50 gallon accidental spill of #2 fuel oil at Building C. The incident occurred as a result of the manhole cover to the Underground Storage Tank (UST) being replaced off-center after being filled which resulted in the copper feed line to the boiler being partially severed. As fuel flowed to the boiler, some oil escaped into the access hatch from the break in the line. The spilled fuel was subsequently carried by storm water along the outside of a roof drainage pipe going under the roadway adjacent to the UST. The pipe exited on the opposite side of the road down a slight embankment adjacent to York Street. Fuel oil was noted around the discharge point and the surrounding area. Corrective measures were taken by removing the impacted soil and installing a protective outer sleeve of steel piping that extends into the access hatch area, preventing damage to the feedline in the future.

In 2007, a sheen was again noted at the discharge of the roof drain pipe. ESOI excavated the surrounding soil and re-routed the roof drain to another down spout and also rerouted an adjacent ice machine drain away from the area. Permanent alternatives have been evaluated as part of the CMS and are included in Section 8.2.4.

5.2.7 AOC 6 Above Ground Tank Removal

AOC 6 consisted of Oily Waste Above Ground Storage Tanks located at the southeast corner of SWMU 7. ESOI recently completed the installation of a replacement 12,250 gallon tank in the leachate tank farm area located between SWMU 7 and Cell H as part of the Post-Closure program. The new tank eliminated the need for the AOC 6 tanks. Therefore, ESOI decontaminated and removed the remaining tanks from this area. The drainage layer, associated piping, and sump were also removed. Following removal of the existing tank, the old area was excavated and post-excavation samples were collected and analyzed for residual hazardous constituents. The area was then capped and regraded to allow storm water runoff to the drainage ditch located immediately adjacent to this area. The excavated material was placed in the active on-site RCRA Subtitle C Landfill (Cell M). Results from the post-excavation samples and comparison of these data with RFI risk-based screening levels are presented in Appendix A.

5.2.8 Surface Drainage Inspections

In a comment letter dated December 23, 2009, Ohio EPA directed ESOI to make various revisions to the 2-Year Report and the Operation, Maintenance and Performance Monitoring Plan for leachate collection systems installed in SWMUs 5, 6, and 7, as well as ESOI's State RCRA Permit, including documenting and correcting surface drainage problems. ESOI engaged MSG to perform a comprehensive evaluation of surface drainage issues that potentially affect leachate recharge in SWMUs 5, 6, and 7. The evaluation included detailed site inspections and ground surveys. MSG conducted a preliminary site inspection of the storm water systems on March 18, 2010, and additional ground surveys on May 18 and 24, and June 24, 2010. Data from the surveys are tabulated in Appendix A.

6 CORRECTIVE MEASURES STUDY OBJECTIVES

As described by USEPA in the Advance Notice of Proposed Rulemaking - *Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities* (USEPA 1996), the purpose of the corrective action program is to stabilize releases and clean up RCRA facilities in a timely manner. A fundamental goal in the corrective action program is to control or eliminate unacceptable risks to human health and the environment. Therefore, risk-based decision making is especially important in the corrective action program, where it should be used to ensure that corrective action activities are fully protective given reasonable exposure assumptions and consistent with the degree of threat to human health and the environment at a given facility.

USEPA expects that certain combinations of site-specific conditions are often addressed by similar corrective measures approaches (USEPA 1996). These remedial expectations allow corrective measures plans to focus on the most practicable alternatives. USEPA expectations for corrective measures include the following:

- Use treatment to address principle threats such as contamination that is highly toxic, highly mobile, or cannot be reliably contained.

- Use engineering controls for wastes that can be reliably contained, pose relatively low long-term threats, or for which treatment is impracticable.

- Use a combination of methods (e.g., treatment, engineering controls and institutional controls), as appropriate, to achieve protection.

- Use institutional controls primarily to supplement engineering controls to prevent or limit exposure; institutional controls will not often be the sole corrective measure.

- Consider using innovative technology.

- When restoration of groundwater is not practicable, prevent or minimize further plume migration, prevent exposure to groundwater, and evaluate further risk reduction. Control or eliminate sources of groundwater contamination.

- Remediate contaminated soil as necessary to prevent or limit direct contact exposure, and prevent the transfer of unacceptable concentrations from soil to other media.

USEPA specifies that the objective of a Corrective Measures Study is to identify and evaluate potential remedial alternatives for facilities undergoing corrective action (USEPA 1996). The CMS does not necessarily have to address all potential remedies for every corrective action facility, rather, USEPA advises that the CMS be focused on realistic remedies and tailored to the extent, nature and complexity of releases and contamination at a given facility (USEPA 1996). In cases where a presumptive remedy has been developed by USEPA, the CMS should confirm that the presumptive remedy is appropriate to facility-specific conditions. In addition, during the CMS, one or more remedial alternatives should be evaluated based on site-specific conditions and a preferred remedial alternative selected as the remedy. As part of the CMS, performance standards, including soil and groundwater screening criteria points of compliance and compliance timeframes should be developed.

7 IDENTIFICATION OF CORRECTIVE MEASURES ALTERNATIVES

7.1 IDENTIFICATION OF PRESUMPTIVE CORRECTIVE MEASURES

As discussed in Section 5, presumptive corrective measures have been completed at the solid waste landfill units (SWMUs 5, 6, and 7). These presumptive measures are consistent with the approach for landfill waste containment, collection and/or treatment of landfill gas, and control of landfill leachate as necessary to mitigate contamination of groundwater described in USEPA's *Presumptive Remedy for CERCLA Municipal Landfill Sites* (USEPA 1993). Other corrective measures that have been implemented at the Facility include:

- improvements for the SWMU 1 (Cell F) cover (completed);
- installation and operation of water line monitoring trenches along AOC 1 (the Toledo Water lines) (ongoing);
- periodic recovery of oily liquid from SWMU 9 (ongoing);
- implementation of the revised Explosive Gas Monitoring Plan for mitigation of landfill gas at SWMUs 1, 5, 6, and 7 and installation of an additional passive vent on the north slope of SWMU 6 (completed);
- improvements for the storm water runoff management systems around SWMUs 5, 6, and 7 (ongoing); and
- removal of the AOC 6 aboveground storage tanks and regrading (completed).

These ongoing corrective measures are summarized on Table 1 and have been considered as part of the CMS to determine whether they are sufficient as the final corrective measure or whether additional corrective measures should also be considered.

7.2 IDENTIFICATION OF CORRECTIVE MEASURES TECHNOLOGIES

The RFI identified specific conditions and/or areas to be evaluated for active corrective measures. Taking into consideration the types of conditions to be addressed by active corrective measures, generalized corrective measures approaches to be evaluated in the CMS have been identified for each SWMU/AOC. General corrective measures are media-specific response actions, such as institutional controls, engineering controls, monitoring, in-situ or ex-situ groundwater treatment, source removal, and in-situ or ex-situ soil treatment, which satisfy the corrective action objectives. These alternatives include corrective measures that would supplement existing corrective measures, as necessary, to meet the corrective measures objectives discussed in Section 6.

The general corrective measures evaluated in the CMS are listed for each unit on Table 2. The details for each corrective measures alternative, including any associated remedial technology are included in Section 8.

8 EVALUATION OF CORRECTIVE MEASURES ALTERNATIVES

The evaluation of corrective measures alternatives has been conducted in a two-phased process. The first phase screens potential corrective measures against “threshold criteria”. Corrective measure that meet the threshold criteria were then evaluated against “balancing criteria” to identify the corrective measures alternative that provides an appropriate combination of performance attributes. As part of the CMS, a comparative evaluation of the corrective measures alternatives with respect to these evaluation criteria was conducted. The results of this evaluation serve as the basis for recommending the final corrective measures.

As defined in the State RCRA Permit, the site-specific corrective action measures alternatives that would be proposed at SWMUs/ AOCs at the Otter Creek Facility must satisfy the following threshold criteria and balancing criteria as defined in the State RCRA Permit:

Threshold Criteria

1. Be protective of human health and the environment: Proposed corrective measures must be protective of human health and the environment through active (e.g., source control, media cleanup, management of wastes) and/or protective (e.g., institutional controls, deed restrictions) means. Where appropriate, long-term monitoring should be proposed to ensure ongoing protection of human health and the environment.

2. Attain media clean-up standards: Proposed corrective measures should be assessed for their ability to attain cleanup standards appropriate to the site-specific conditions. Media cleanup standards may be derived from existing regulations or from site-specific risk assessments. Attaining media cleanup standards does not necessarily entail removal or treatment of all contaminated media above specified constituent concentrations. Corrective measures may attain media cleanup standards through various combinations of removal, treatment, engineering controls, and institutional controls.

3. Control the source(s) of releases: Proposed corrective measures should control potential sources (e.g., leachate and product) to the extent practical so as to reduce or eliminate further releases of hazardous waste(s) (including hazardous constituent[s]) which could result in potentially significant exposure. An effective source control program ensures the long-term effectiveness and protectiveness of the corrective measure.

4. Comply with all applicable standards for management of wastes: Proposed corrective measures that require removal of waste and/or contaminated media must be performed in accordance with applicable waste disposal regulations.

Balancing Criteria

5. Long-term Reliability and Effectiveness: Considers whether the proposed corrective measures have been used effectively under analogous site conditions, and if failure of the corrective measures would have an immediate impact on potential receptors and the useful life span of the alternative.

6. Reduction in Toxicity, Mobility or Volume of Wastes: Considers whether the corrective measures are capable of eliminating or substantially reducing the potential for the contaminants to cause future risks to human health and the environment.

7. Short-term Effectiveness: Short-term effectiveness is relevant where waste characteristics are such that risks to workers, the general public, or to the environment are high and special protective measures during remedy implementation are needed. The risks posed to workers and the community during remedy implementation can be evaluated either qualitatively or quantitatively, depending on conditions at the site. A quantitative evaluation of short-term risks is most likely to be useful when the types, levels and/or exposure of hazardous substances are expected to change significantly as a result of remediation.

8. Implementability: Considers the ease of implementing a remedy. Implementability is assessed by considering the following factors: administrative activities such as permits, rights of way, off-site approvals and the time consumed by these activities; constructability, time for implementation, and time for beneficial results; availability of adequate off-site treatment, storage capacity, disposal services, necessary technical services and materials, and availability of prospective technologies for each corrective measures alternative; the constructability of the remedy; and the availability of materials and specialized services required for remedy implementation and operation.

9. Cost: The relative cost of a corrective measure is an appropriate consideration where several different technical alternatives for remediation will offer equivalent protection of human health and the environment but may vary widely in cost. Cost estimates may include: site preparation, materials, construction, engineering, waste management and disposal, permitting, health and safety measures, and operation and maintenance. For cost comparisons between alternatives to be accurate, USEPA recommends they should include capital costs plus operation and maintenance costs for the anticipated life of the remedy, and the net present value of these costs. Expected accuracy range of the cost estimate is consistent with USEPA guidance for feasibility

study level estimating (e.g., –30 to +50 percent for detailed analysis of alternatives; USEPA 2000a).

During the evaluation of corrective measures alternatives and associated technologies, ESOI also considered USEPA's April 2008 *Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites* to evaluate reasonable "green" remediation technologies as part of the CMS (USEPA 2008). Specifically, ESOI has proposed alternatives meeting the threshold and balancing criteria that are expected to require an overall lower level of manpower, energy and/or materials consumption to achieve the same level of protectiveness.

8.1 GENERAL CORRECTIVE MEASURES ELEMENTS

As indicated in the CMS Work Plan, there are several corrective measures that will be implemented by ESOI to achieve the site-wide corrective action objectives. These common elements will be implemented regardless of the additional unit-specific corrective measures selected based on the alternatives analysis presented in later sections.

8.1.1 Institutional and Engineering Controls

Institutional controls are passive measures that are used to reduce potential exposure to contaminants resulting from land use activities and also to protect in-place remedies. Institutional controls are generally used in conjunction with engineering controls or measures. The institutional controls considered in this corrective measure include legal controls (land use and deed restrictions), and long-term access controls (signage). ESOI will establish institutional controls on land use and groundwater use that are consistent with the land use and groundwater use assumptions reflected in the RFI baseline risk assessment. Further, in accordance with the facility Closure and Post-Closure Plan (ESOI 2010b), ESOI will continue to maintain the following perimeter security fencing and gate security to limit access to the facility; the existing perimeter fencing, gates and security locations are shown on Figure 2.

- The facility is surrounded by a 6-foot high chain-link fence with three strands of barbed wire at the top for all new areas, with limited areas covered by a five foot high barbed wire topped section. The fenceline is routinely inspected and repaired, as needed. When the five foot high sections are identified for repair, ESOI is replacing these sections with a 6-foot high chain-link fence with three strands of barbed wire at the top.
- The main access gate to the facility is an automated gate operated by ESOI or site security personnel. Routine entrance to the site is through this gate. Secondary facility gates are closed and locked unless they are being used by ESOI personnel for maintenance or construction activities.
- Warning signs are posted at all perimeter fence gates and other fence locations around the active portions of the facility (approximately every 200 feet).

Additional information regarding ESOI's security systems is provided in Section F of ESOI's RCRA Permit Application. Based on a site inspection conducted in June 2010, and ESOI's ongoing permit-required facility inspection program, with the exception of waste delineated outside the northern facility boundary at SWMU 6, all areas subject to corrective action are fenced and have manned security at active access points. The off-site waste at SWMU 6 is addressed in Section 8.2.2. Therefore, no changes to fencing, access or security is warranted.

Consistent with regulations on closure of hazardous waste management units and Ohio Uniform Environmental Covenants Act (Ohio Revised Code (ORC) 5301.80 - 5301.92), ESOI will have the property deed amended to include the restrictions on the use of the property. This deed notice will notify in perpetuity that: (a) the land has been used to manage hazardous waste; (b) use of the property is restricted under Ohio EPA regulations; (c) use of overburden groundwater on the Facility is restricted; and (d) the survey plat and record of the type, location, and dimensions of the waste management unit have been filed with the local zoning authority and Ohio EPA. In addition, an environmental covenant will be completed as part of the Corrective Action Implementation. The environmental covenant is anticipated to include the following elements:

1. The Real Property has been used to manage hazardous wastes, and the use of the Real Property is restricted under rules 3745-55-10 through 3745-55-20 and rules 3745-66-10 through 3745-6620 of the Ohio Administrative Code. The use of the Property is also restricted in accordance with the approved Closure/Post-Closure Plans for the Envirosafe Otter Creek Road Facility. The survey plat and record of the type, location and quantity of hazardous wastes disposed of within each cell or other hazardous waste disposal unit at the Real Property have been filed with the City of Oregon Department of Building and Zoning Inspections and the Director of the Ohio EPA in accordance with rules 3745-55-16, 3745-55-19, 3745-66-16 and 3745-66-19 of the Ohio Administrative Code.

2. The Real Property may be used for any other lawful uses or purposes that are not inconsistent with the requirements of this Deed Notice. No person shall fill, grade, or excavate the land, or build, drill, or mine the land at the Premises without prior authorization of the Director of Ohio EPA, or his successor, except as otherwise provided by law, except for the performance of disposal activities at the active Cells.

3. Pursuant to rules 3745-55-19 and 3745-66-19 of the Ohio Administrative Code, this Deed Notice shall be of perpetual duration and may not be amended or terminated in whole or in part except by a recorded instrument executed by Grantor, or its successors in interest, as owners of the Real Property, and approved by the Director or Ohio EPA, or his successor, prior to recording.

8.1.2 Health and Safety Program

In accordance with Section F of its State RCRA Permit Application, ESOI maintains procedures to prevent hazards at the facility. In addition, as proposed in the CMS Work Plan, ESOI has amended Section F (Procedures to Prevent Hazards) of its Part B Permit Application to clearly identify and appropriately address the locations where potentially significant exposures could occur, as determined in the RFI Report. Upon approval of the CMS Report, ESOI will submit a permit modification request to Ohio EPA to incorporate these revisions. Approval of this permit modification request is subject to Ohio EPA review and approval independent of the CMS. A copy of the amended health and safety protocol is included in Appendix B.

8.1.3 Monitoring Program

Monitoring of the performance of selected corrective measures is necessary to assess progress toward corrective action objectives and ensure that these objectives are achieved. Performance monitoring is a particularly critical aspect of alternatives that rely on engineering controls (e.g., liners, barrier walls) in order to ensure that these measures control releases over the long-term. Following the completion of corrective action, a performance evaluation will be conducted to demonstrate that the constructed corrective action meets the SWMU/AOC unit-specific corrective action objective. These unit-specific performance measures will be defined during the corrective measures design and will be used to evaluate and demonstrate the effectiveness of selected corrective measure(s). Where appropriate, a phased approach to corrective remedy implementation will be followed, in which monitoring results will be used to assess the need for supplemental measures or change in approach. If corrective actions are found to be inadequate to address conditions which triggered these actions, the failure mechanism(s) will be determined and appropriate additional measures will be identified to address the inadequate elements of the implemented corrective action.

In addition to a corrective action monitoring program, ESOI is required to maintain a facility-wide groundwater monitoring program in accordance with its RCRA permit. Therefore, based on the selected corrective measures, ESOI has reviewed the existing RCRA groundwater monitoring program to identify opportunities for efficiently assessing improvements in groundwater conditions that are expected to result from implementation of the selected corrective measures. This review of the RCRA groundwater monitoring program included consideration of: (1) RCRA regulations for detection monitoring; and (2) the results of the RFI sampling and the ongoing RCRA groundwater monitoring program. This review of the corrective action monitoring requirements and RCRA groundwater monitoring program, and the proposed integrated program is discussed in Section 9.2 of this CMS Report.

8.1.4 Leachate Treatment

The existing leachate collection from closed pre-RCRA landfills SWMUs 5, 6, and 7 consists of a network of twenty-two recovery/extraction wells. Leachate from these solid waste landfills is subsequently pumped to on-site storage tanks and periodically trucked off-site for treatment at the City of Toledo POTW. Leachate collection at the closed RCRA permitted landfill SWMU 1 (Cell F) consists of four 6-inch perforated lateral pipes that convey leachate to a central collection sump. Leachate from this SWMU is subsequently pumped to on-site hazardous waste storage tanks and periodically trucked off-site for treatment at an appropriately permitted facility with leachate from ESOI's other closed hazardous waste landfills.

As part of this CMS, ESOI evaluated two alternatives to the current method of off-site trucking to manage leachate from SWMUs 5, 6 and 7: (1) the installation of a direct connection to the City of Toledo sewer, and (2) the construction of an on-site leachate pretreatment system with direct discharge to the sanitary sewer. These alternatives are described below. Supporting documentation is provided in Appendix C.

Summary of Alternatives

- **Alternative 1: Direct Connection to Sewer System**

  This leachate management option includes the construction of a discharge sewer line to convey nonhazardous landfill leachate directly from the facility to an existing public sewer line. Leachate would be accumulated in on-site equalization tanks and discharged to the sewer system under manual control. It is assumed that this connection would be to an existing sanitary sewer manhole located along York Street within City of Toledo limits and approximately 2,500 ft from the facility. This alternative would reduce the leachate management costs incurred under the current leachate disposal process by eliminating off-site trucking, and reduce energy requirements associated with truck transportation.

  The estimated construction cost for on-site tanks, pumps and sewer connection is approximately $180,000 to construct and $47,000/year to operate based on ESOI's current cost for disposal of leachate at the POTW; this is compared with the current annual cost of $70,500 to transport and dispose of the leachate at the same POTW. Considering a 30-year operating period, the net present value for leachate disposal via a direct sanitary sewer connection is $1,138,000 compared with the cost of the current approach of $1,440,000.

- **Alternative 2: Pre-Treatment Plant**

  This leachate management option provides for on-site pre-treatement of leachate prior to discharge to the municipal sanitary sewer system. As detailed in Appendix C, the requirements for an on-site leachate pretreatment plant have been evaluated based on historical leachate loading rates for these SWMUs 5, 6 and 7 using data collected during the period of July 2007 to May 2010. Based on the maximum annual leachate generation of 1.1 million gallon (MG), and assuming standard work hours for batch operation (5 days a week, 8 hours a day), the minimum capacity of the leachate pretreatment system would be approximately 10 gpm. Considering potential future improvements to the leachate collection system that would yield higher volumes and fluctuations inherent in leachate collection systems, the pretreatment system is assumed to be sized to treat a maximum of 20 gpm.

Based on the POTW treatment requirements and analytical data available, a conceptual pretreatment process was developed for managing the leachate from the solid waste landfills; a process flow diagram of a conceptual treatment system is included in Appendix C. As described in Appendix C, the pretreatment process would likely consist of primary settling tanks, rapid mix tanks for flash mixing of chemicals for pH adjustment and coagulation of heavy metals and cyanide, flocculation tanks, primary and secondary inclined plate settling tanks, pH adjustment back to neutral, sand filtration for suspended solids control, GAC adsorption for removal of organics, and effluent storage. The pretreatment would also include chemical feed systems, oil skimmers, sludge removal, and filter press for dewatering of sludge.

The influent leachate would be conveyed to primary settling tanks, where heavier solids like grit sink and lighter substances like oil and grease float. Primary settling tanks would be equipped with oil skimmers to remove floating oil and scum. The primary settling tanks also provide leachate flow and load equalization. Influent from the primary tanks would then be pumped to a two stage rapid mix tank where caustic soda and ferric sulfate are added to the flow prior to settling tanks for pH adjustment and as a coagulant, respectively. Fine flocs formed in the flash mixers would agglomerate in the flocculation tanks and following flocculation, the heavier particles will be settled out on inclined settling plates. The settled particles would be stored in a hopper located directly underneath the settling plates. The clarified effluent would then flow to a collection tank where it would be neutralized and pumped to sand filters for removal of remaining unsettled fine suspended solids. Effluent from the sand filters would then enter the GAC vessels for adsorption of organics. The treated effluent would then be stored in effluent storage tanks from where it would be discharged to POTW sewer line. The sand filter, GAC vessels would require periodic backwashing. The settled sludge from primary clarifiers, inclined plate hoppers will be periodically withdrawn and stored in sludge tanks where polymers would be added for further thickening of the sludge. The thickened sludge will then be dewatered through belt filter press and the cake staged in bins or boxes for disposal.

The estimated construction cost for the leachate pretreatment system described above is approximately $879,000 to construct and $123,400/year to operate, including an annual leachate disposal costs of $33,495 (note, it is assumed that pretreating leachate would reduce the POTW leachate disposal fees by approximately 25% as the current rate includes a surcharge for treatment of certain leachate constituents). The annual cost for leachate pretreatment and disposal is compared with the current annual leachate transportation and disposal cost of $70,500. Considering a 30-year operating period, the net present value for the pretreatment alternative is $3,395,000.

Comparison of Alternatives

All three leachate management alternatives (i.e., the current off-site transportation and disposal and Alternatives 1 and 2) provide for proper management of leachate from SWMUs 5, 6 and 7. The current procedures have been demonstrated by ESOI to be effective and reliable. Alternative 1 provides an improvement to the current process by eliminating off-site transportation related requirements (both energy and cost), and is considered readily implementable and cost effective. By comparison, on-site treatment prior to discharge reduces the contaminant loading at the POTW and eliminates the off-site transportation requirements compared with the current process, but would have higher energy requirements than the direct discharge option. In addition, Alternative 2 is estimated to cost significantly more than Alternative 1.

Based on these considerations, ESOI proposes to implement Alternative 1 as part of the corrective measures program. If future monitoring of leachate characteristics indicates that direct discharge is no longer viable (e.g., including the discharge of leachate from other sources such as SWMU 8), then Alternative 2 will be reassessed.

8.1.5 Restoration

As proposed in the CMS Work Plan, all areas disturbed as a result of implementing the selected corrective measures will be restored to existing conditions. The scope and cost for restoration is included in the evaluation of each alternative presented in Section 8.2.

8.2 EVALUATION OF CORRECTIVE MEASURES ALTERNATIVES

Corrective measures alternatives for each SWMU/AOC identified for a unit-specific corrective measures assessment were summarized on Table 2. To streamline the evaluation of corrective measures alternatives, several unit-specific alternatives are grouped based on media or activity into the following categories:

- Leachate (SWMU 1,5,6, and 7)
- Landfill gas (SWMU 1,5,6, and 7)

- Landfill cap (SWMU 1,5,6, and 7)

In addition, several areas were addressed separately due to the unique characteristics of the units (e.g., SWMU 8 and SWMU 9). For these areas, which also involve multimedia issues, technologies were assembled into comprehensive alternatives for evaluation. The evaluation of corrective measure alternatives or technologies relative to the threshold criteria and balancing criteria is presented in Tables 3a, 3b, 3c, 3d, 3e, 3f and 3g and summarized in the following sections below.

8.2.1 Landfill Leachate – SWMUSs 1, 5, 6 and 7

Four existing landfills, SWMUs 1, 5, 6 and 7 were identified as requiring assessment for corrective measures to address the accumulation of leachate that may be contributing to groundwater impacts in adjacent shallow and/or deep till zone monitoring wells. As proposed in the CMS Work Plan and summarized in Section 7.2, the corrective measures alternatives considered for addressing accumulated leachate in these landfills include:

1. Maintaining existing system operations;
2. Expanding/improving leachate recovery; and/or
3. Enhancing the leachate system maintenance program

The evaluation of these alternatives considered the performance of the existing system operations and the recently completed assessment of leachate recovery performance for SWMUs 5, 6 and 7 (MSG 2010a) approved by Ohio EPA on July 27, 2010.

8.2.1.1 SWMU 1- Landfill Cell F

As part of ESOI's post closure management of SWMU 1, leachate is regularly removed via a leachate collection system consisting of a leachate collection sump (see Figure 4) and laterals installed in the unit at the time of construction. In accordance with the post-closure plan for this unit, the leachate collection sump is periodically checked for accumulated liquids, and pumped if accumulated leachate is observed. As part of presumptive corrective measures previously completed for this unit (see Sections 5.2.2 and 5.2.3), the landfill cap was regraded to promote positive drainage of storm water and the leachate collection manhole was repaired to minimize infiltration of storm water around the manhole. The leachate recovery rates since January 2002, including the period after completion of these presumptive corrective measures, are summarized in Appendix D. Though no specific problems have been encountered with the current leachate collection system, the following options have been evaluated relative to the threshold and balancing criteria (see Table 3a).

Summary of Alternatives

- **Alternative 1: Maintain Existing System**

  The existing leachate collection system is fully operational, complies with the facility's approved post-closure plan and is consistent with the *Presumptive Remedy for CERCLA Municipal Landfill Sites* (USEPA 1993). RFI groundwater sampling and characterization concluded that leachate has not impacted surrounding groundwater, indicating that the existing leachate extraction system is controlling outward migration from the unit; as shown in Appendix I the leachate levels in SWMU 1 are below the level of the surrounding shallow Till/Lacustrine contact zone. However, based on the recent semi-annual groundwater sampling results (April 2010, October 2010, April 2011), monitoring well F-2S has been designated as an Affected well. However, a comparison of the Affected Constituents for well F-2S (which include 1,1-dichloroethane, 1,2-dichloroethane, 1,2-dichloroethene, and tetrahydrofuran) with the list of hazardous constituents detected during the period of RFI sampling in leachate from SWMU 1 and SWMU 6 indicates that a number of the Affected Constituents are not related to this unit but rather are likely from another source (e.g., the adjacent uncontrolled Gradel Landfill); specifically, 1,1-dichloroethane and 1,2-dichloroethane were detected in well F-2S but were not detected in the leachate in either SWMU 1 (samples collected in 2004 and 2005 as part of the annual leachate testing requirements specified in condition B.3(b) of ESOI's RCRA permit) or SWMU 6 (samples collected in 2002 as part of the RFI). It is noted that the detection limits for these two constituents at SWMU 1 were higher (2.5 ppm) in 2005, but were lower (1 ppm) in 2004. 1,2-dichloroethene, which was identified as an affected constituent at well F-2S, was not analyzed in the leachate at SWMU 1 or SWMU 6 (see Appendix D). Only tetrahydrofuran was detected both in the groundwater and the leachate. Cell F has always contained an active leachate collection system that is operated and maintained. Historical data show that the unit generates a small amount of leachate that is removed in a timely manner. As no unacceptable human health or ecological risks associated with leachate migration to groundwater were identified in the RFI, and ongoing monitoring of this unit indicates that following implementation of the presumptive corrective measures described in Section 5.2.4, the existing system is adequately maintaining leachate levels, this option meets all threshold criteria and is retained for further consideration under the corrective action program. However, the long-term performance may decline if not adequately maintained (e.g., cap settlement allows for ponding of storm water on the cap, or lateral leachate collection piping clogs as a result of biological growth or particulate deposits).

- **Alternative 2: Expand/Improve Leachate Recovery Program**

  The leachate recovery for SWMU 1 may be improved by adding a maintenance program for cleaning/jetting the existing 6-inch perforated lateral leachate collection pipes. This improvement would be low cost and would ensure the continued effectiveness of the leachate collection system. Simple Green, a non-toxic cleanser/degreaser, has been successfully field tested in SWMUs 5, 6, and 7 for cleaning of recovery well screens and filter packs and could also be used in this landfill to ensure that the leachate collection pipes remain clear of clogging due to particulate deposits or biological material buildup. This option is considered an enhancement to Alternative 1 and therefore will meet the objective of preventing the release of leachate from the SWMU and complying with the approved post-closure plan for this unit. Groundwater monitoring as discussed in Section 9.2 will provide continuing verification of attainment of media clean-up standards.

Comparison of Alternatives

As summarized on Table 3a, both alternatives meet the threshold and balancing criteria and are therefore retained for consideration. Alternative 1 reflects the current leachate recovery program being implemented by ESOI in accordance with its approved post-closure program. This existing recovery system and maintenance program has been demonstrated to be effective at maintaining low leachate head levels, thus minimizing impacts to adjacent groundwater. Alternative 2 is a minor modification to the existing program, which builds on ESOI's experience with improving leachate extraction at SWMUs 5, 6 and 7. It is expected that implementation of the enhanced leachate system maintenance program, while resulting in a marginal increase in the current post-closure costs for this unit, will improve the long-term performance of the existing system.

Based on these considerations, ESOI proposes to implement Alternative 2.

8.2.1.2 SWMUs 5, 6, and 7

As described in Section 5.2.4, ESOI has implemented presumptive corrective measures to reduce the accumulated leachate observed during the RFI in SWMUs 5, 6, and 7. The CMS Work Plan specified that improvements and/or expansion of these systems be evaluated. This evaluation of existing leachate recovery system performance was conducted as required by the approved OMPM Plan (MSG 2010b) to determine if the systems would achieve the following objectives:

1. Minimizing potential impacts to groundwater
2. Establishing an inward hydraulic gradient
3. Reducing head levels by removing leachate to the lowest level practicable.

The layout of the existing recovery wells is provided on Figure 4.

Summary of Alternatives

- **Alternative 1: No Additional Action**

  This alternative assumes continued implementation of the presumptive corrective measures as originally designed. As reported in the 2-Year Evaluation Report (MSG 2010a), this system has been effective at reducing leachate head within the landfill and creating an inward gradient. However, modification to the system layout and operations have been recommended and approved by Ohio EPA. Therefore, Alternative 1 is rejected, as the originally designed system has been determined to require modification to achieve the performance objectives specified for this unit in the timeframe established in ESOI's RCRA Permit.

- **Alternative 2: Expand/Improve Leachate Recovery**

  As reported in the 2-Year Evaluation Report (MSG 2010a) and the Construction Completion Report (MSG 2012), modification to the system layout and operations have been recommended and approved by Ohio EPA in order to achieve the stated objectives for these systems with the specified timeframe; the recommendations resulting from this evaluation included the following:

  SWMU 5:
    - Conversion of existing piezometer PZ-8 to a leachate recovery well (RW-11).
    - Installation of three new 4-inch diameter interior piezometers (PZ-21, PZ-22, and PZ-23).
    - Inclusion of three additional exterior monitoring wells (MR-1SA, MR-7S, and G-1S).
    - Drilling 1/8 inch vent holes in the sidewalls of piezometers and modification of water level measurement procedures.
    - Installation of two new nested 6-inch recovery wells and 2-inch diameter piezometers (NRP-14 and NRP-31).
    - Installation of a two new passive gas vents on the west slope (PV-9 and PV-10).

  SWMU 6:
    - Discontinuing operation of pumps in recovery wells RW-6 and RW-7, and RW-5.
    - Installation of new piezometer PZ -16.
    - Conversion of existing RW-5 to PZ-17.
    - Installation of a new passive gas vent (PV-7).
    - Drilling 1/8 inch vent holes in the sidewalls of piezometers and modification of water level measurement procedures.

- Installation of four new nested 6-inch recovery wells and 2-inch diameter piezometers (NRP-25, NRP-26, NRP-27 and NRP-28).
- Conversion of existing piezometer PZ-16 to a dual purpose leachate extraction well/piezometer DPW-16.

SWMU 7:

- Conversion of existing piezometer PZ-12 to a recovery well RW-12.
- Installation of three new 4-inch diameter interior piezometers (PZ-18, PZ-19, and PZ-20) (note: RW-10 is not useable as an extraction well or piezometer so it was left in place as a vent).
- Drilling 1/8 inch vent holes in the sidewalls of piezometers and modification of water level measurement procedures.
- Installation of two new nested 6-inch recovery wells and 2-inch diameter piezometers (NRP-29 and NRP-30).
- Abandonment of the PVC standpipe in the northwest corner.
- Conversion of existing piezometers PZ-18, PZ-19 and PZ-20 to dual purpose leachate extraction wells/piezometers DPW-18, DPW-19 and DPW-20.

A routine maintenance program involving the application of Simple Green in the recovery wells to minimize fouling of the well screens is also being implemented. In addition, groundwater monitoring as discussed in Section 9.2 will provide continuing verification of performance of these systems.

Comparison of Alternatives

As summarized on Table 3a, only Alternative 2 meets the threshold and balancing criteria; therefore, Alternative 1 is not considered further. The recommendations described for Alternative 2 are based on the findings of the post 24-month evaluation of the leachate extraction systems which was approved by Ohio EPA; the recommended modifications have been implemented by ESOI. Reduction in leachate levels will continue to be monitored to ensure that these improvements are adequate for ensuring that target leachate levels are met by the permit target date. As summarized on Table 3a, this alternative achieves the threshold and balancing criteria for SWMUs 5, 6 and 7. Therefore, this alternative is retained.

8.2.2 Landfill Caps – SWMUs 1, 5, 6 and 7

Four existing landfills, SWMUs 1, 5, 6 and 7, were identified as requiring assessment for corrective measures to address the accumulation of leachate that may be contributing to groundwater impacts in adjacent shallow and/or deep till zone monitoring wells. As proposed in the CMS Work Plan and summarized in Section 7.2, the corrective measures alternatives considered to address generation of leachate in these landfills include:

1. Maintaining existing landfill covers;
2. Improving surface water drainage; and/or
3. Upgrading the cover to a composite geomembrane/clay cap.

The evaluation of these alternatives considered the characteristics of the existing landfill caps, the recently completed assessment of leachate recovery performance for SWMUs 5, 6 and 7 (MSG 2010a) approved by Ohio EPA on July 27, 2010, and the inspection of existing drainage conditions (see Appendix A).

Current cap conditions were evaluated by ENVIRON during the RFI and again in June 2010 during a visit conducted by ENVIRON and Ohio EPA. As discussed in Section 5.2.8, a comprehensive inspection of the drainage systems on and around the landfills was also conducted in March through June 2010 to identify areas where drainage improvements are warranted. In addition, in accordance with the approved Post-Closure Plan, ESOI performs weekly, monthly and semi-annual inspections of the landfill cover conditions. Areas of storm water accumulation and ponding at several discrete areas have been documented and repaired, as necessary. Leachate production in the landfills is dependent on the infiltration of precipitation through the caps. Therefore, the prior assessment of physical characteristics of the landfill caps, as well as storm water drainage are jointly considered for evaluating alternative corrective measures for each landfill cell.

8.2.2.1 SWMU 1 – Cell F

During the RFI, the SWMU 1 landfill cap was tested for the geotechnical requirements of hydraulic conductivity and thickness. It was determined that the clay cap was sufficiently thick (ranging from 9-10 feet in test areas) and the conductivity was sufficiently low (i.e., less than or equal to 10^{-6} cm/sec). As discussed in Section 5.2.2, as part of ESOI's early implementation of presumptive corrective measures, the cap on Cell F was regraded to improve drainage and correct potential leakage into the cell at the leachate recovery sump; this work was performed in accordance with the approved *Cell F Modified Cover Design* (ENVIRON 2008b). As discussed in Section 5.2.2, and summarized Appendix D, a decrease in leachate production was immediately noted following the completion of these corrective measures.

In addition, the storm water conveyance systems and retention area on SWMU 1 were inspected and found to provide adequate drainage off the cap (note, a portion of drainage system located at the southeast corner of this unit was evaluated as part of SWMU 6 and is discussed in that section).

Based on the current conditions of the landfill following completion of the presumptive corrective measures, the additional corrective measures considered for SWMU 1 are described below. These options have been evaluated relative to the threshold and balancing criteria (see Table 3b).

Summary of Alternatives

- **Alternative 1: No Additional Action**

  The regrading of areas of observed storm water accumulation has resulted in successfully promoting positive storm water drainage off the landfill cap. The storm water conveyance and retention areas were inspected and found to provide adequate drainage. As illustrated in Appendix D, recent data obtained for 2009 and 2010 indicate that there is no apparent correlation between leachate generation and precipitation. Since the recent cap improvements continue to provide sufficient drainage, maintenance of the existing cap with continued monitoring of the cell is a viable alternative. However, because of the settlement noted during the June 2010 inspection, this monitoring program would need to include settlement monitoring. The long-term management will include management of leachate (see Appendix D); the net present value for this alternative is approximately $62,000 (net present value). The cost for continued monitoring of cap conditions is included in ESOI's existing post-closure program.

- **Alternative 2: Install a Composite Cover**

  As an alternative to the existing clay cap, a composite cover would be installed over the entire unit in order to reduce the potential for rainfall infiltration into the unit, thus further reducing leachate production. The process of upgrading the cap on the unit would require clearing the existing vegetation and a portion of the existing cover soil, and installing the composite cover. To protect the geomembrane cover from freezing and damage, at least 24-inches of clay cap and one foot of sand would need to be placed; the sand layer (or equivalent geosynthetic) would provide drainage off the impermeable layers in addition to providing protection. The final layer of the cap would require topsoil placement and seeding. The composite layer would extend off the unit into a perimeter anchor trench.

  Utilizing the Hydrologic Evaluation of Landfill Performance (HELP) Model (USEPA 1994), the potential reduction in leachate production resulting from the placement of a geomembrane/clay composite cover was evaluated. The results of this simulated leachate generation is presented in Appendix D, and indicate that a composite cover could significantly reduce leachate generation rates from the time of closure. However, leachate production in this unit has already been reduced over the more than 20 years of active leachate extraction, such that the incremental reduction from current conditions is not likely to be as significant as suggested by the simulation results. In addition, a comparison of leachate generation rates for Cell F with Cells G, H and I (i.e., existing landfills with composite covers) indicates that the difference on a per acre basis is less than projected by the modeling.

The estimated cost for constructing a composite cover over the 3 acre SWMU 1 is approximately $473,000. Assuming a 95% reduction in long-term annual steady-state production of leachate resulting from the installation of the composite cover (based on modeling), the net present value for this alternative is $478,000.[4] Note that this cost may be higher if the assumed reduction in leachate is less than predicted using the HELP Model.

Comparison of Alternatives

As summarized in Table 3b, both alternatives achieve the threshold and balancing criteria and are therefore retained for consideration. Alternative 1 reflects the current conditions following completion of presumptive corrective measures for the landfill cap; these improvements have been demonstrated to reduce leachate production from storm water infiltration. Alternative 2 represents a marginal enhancement to the existing clay cap by incorporating a geomembrane to further reduce the potential for leachate generation.

Given that the existing clay cap, as modified by the completed corrective measures, meets the minimum requirements for overall thickness and hydraulic conductivity specified in the RFI, and has reduced the leachate generation to relative low levels, Alternative 1 will meet the corrective action objectives. While Alternative 2 may provide for marginal reduction in leachate generation, the additional effort required to reconstruct the landfill cover and associated cost is not warranted based on the actual performance data for this unit. Therefore, ESOI proposes to implement Alternative 1 for the SWMU 1 cap.

8.2.2.2 SWMU 5 – Millard Landfill

During the RFI, the landfill cap was tested for the geotechnical requirements of hydraulic conductivity and thickness. It was determined that the cap for SWMU 5 was sufficiently thick (ranging from 6.5-17 feet in test areas) and the hydraulic conductivity was sufficiently low. However, based on a review of leachate generation data, leachate levels and precipitation data for the period of 2008 through 2010, there is some indication that leachate recovery and leachate levels in the central portion of the landfill may be influenced by the precipitation events; recorded leachate levels and recovery volumes are summarized in Appendix D. In addition, for the time period that this potential correlation between rainfall and leachate levels was noted, significant maintenance activities were being conducted on the leachate wells and pumps to increase leachate production. Nonetheless, as reported in the 2-Year Evaluation Report for the Presumptive Corrective Measures (Leachate Collection Systems) at Solid Waste Management Units 5, 6, and 7 (MSG 2010a) , the leachate collection system has been successful at controlling the accumulation of leachate in the landfill.

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[4] Note, in developing the landfill cap cost estimates, it is assumed that the long-term maintenance costs will be similar regardless of alternative, and therefore, these base costs are not included these calculations.

In 2010, ENVIRON observed the cap to be in good condition, although inspection of the perimeter storm water ditches identified ponding in four areas on the sloped sides of the unit due to depressions in the grass swales or due to excessive vegetation growth (see Appendix A). The corrective measures being considered to improve the cap performance and prevent storm water ponding and infiltration in SWMU 5 are presented below. These options have been evaluated relative to the threshold and balancing criteria (see Table 3b).

<u>Summary of Alternatives</u>

- **Alternative 1: Improve Storm Water Drainage**

  As the existing soil cap meets the minimum requirements specified in the RFI, this alternative involves the improvement to the drainage systems to reduce the potential for storm water ponding and infiltration into the landfill.

  Storm water runoff flows via sheet flow into the grass swale that surrounds SWMU 5 and direct water to Outfalls 009 (in the southern corner), 010 (in the northwest corner) and 011 (in the northeast corner). Removing the existing vegetation, eliminating depressions within these swales, and lining the swales with a geomembrane liner or similar impermeable material will prevent storm water ponding and infiltration into the landfill. It is assumed that approximately 1,600 feet of perimeter ditch would be improved as part of this alternative.

  The estimated cost to implement this alternative is approximately $28,000; including long-term management of leachate assuming long-term steady-state leachate generation (estimated using the HELP Model; see Appendix D) following the initial 2 years of initial corrective measures to reduce leachate levels, the net present value for this alternative is approximately $151,000 (net present value).

- **Alternative 2: Install a Composite Cover**

  As an alternative to the existing clay cap, a composite cover would be installed over the entire unit in order to reduce the potential for rainfall infiltration into the unit, thus further reducing leachate generation. The process of upgrading the cap on the unit would require clearing the existing vegetation and a portion of the existing cover soil, and installing the composite cover. To protect the geomembrane cover from freezing and damage, at least 24-inches of clay cap and one foot of sand or backfill would need to be placed; the sand layer (or equivalent geosynthetic) would provide drainage off the impermeable layers in addition to providing protection. The final layer of the cap would require topsoil placement and seeding. The composite layer would extend off the unit into a perimeter anchor trench.

Utilizing the HELP Model, the potential reduction in leachate production resulting from the placement of a geomembrane/clay composite cover was evaluated. The results of this simulated leachate generation is presented in Appendix D, and indicate that a composite cover would reduce leachate generation rates. However, current leachate production from this unit has already been stabilized by the active extraction corrective measures, such that the incremental reduction from current conditions is not likely to be as significant as suggested by these simulations.

The estimated cost for constructing a composite cover over the 8 acre SWMU 5 is approximately $1,283,000. Assuming a 95% reduction in annual steady-state production of leachate (based on modeling) resulting from the installation of the composite cover, the net present value for this alternative is $1,286,000.[5] Note that this cost may be higher if the assumed reduction in leachate is less than predicted using the HELP Model.

Comparison of Alternatives

As summarized in Table 3b, both alternatives achieve the threshold and balancing criteria and are therefore retained for consideration. Alternative 1 reflects the current conditions with improvements to the storm water drainage to reduce the potential for infiltration of ponded storm water. Alternative 2 represents marginal enhancement to the existing clay cap by incorporating a geomembrane to further reduce the potential for leachate generation.

Given that the existing clay cap meets the minimum requirements for overall thickness and hydraulic conductivity specified in the RFI, and is expected to minimize leachate generation to relative low levels, Alternative 1 will meet the corrective action objectives. Storm water drainage improvements will reduce the potential for ponding and resultant increased infiltration. While Alternative 2 may provide for further reduction in leachate generation, the additional effort required to reconstruct the landfill cover and associated cost is not warranted based on the actual performance data for this unit. Therefore, ESOI proposes to implement Alternative 1 for the SWMU 5 cap.

8.2.2.3 SWMU 6 – Northern Sanitary Landfill

During the RFI, the landfill cap was tested for the geotechnical requirements of hydraulic conductivity and thickness. It was determined that the cap for SWMU 6 was sufficiently thick in all but one area of the northeast corner (ranging from 1.2 – 5.9 feet in test areas) and the hydraulic conductivity was acceptable in all areas. The cap in the northeast corner was measured at 1.2 ft thick whereas the minimal acceptable thickness is 2 feet. Storm water or leachate seepage was observed during the RFI in this corner of the landfill with landfill gas bubbling through a crack in the cap. As a presumptive corrective measure, the

[5] Note, in developing the landfill cap cost estimates, it is assumed that the long-term maintenance costs will be similar regardless of alternative, and therefore, these base costs are not included these calculations.

cap was repaired in March 2007. In addition, on the north, south and east side of SWMU 6, the waste extends beneath the road so that the road is serving as the cap. The soil cap under the road bed was evaluated as part of the RFI and generally found to provide an adequate cover. Therefore, no additional cover is needed for the roadway areas.

Based on a review of leachate generation data, leachate levels and precipitation data for the period of 2008 through 2010, there is no obvious correlation noted until April 2010, when leachate volume increased with rainfall; recorded leachate levels and recovery volumes are summarized in Appendix D. However, precipitation was higher in May 2010 and leachate generation did not increase in May. In addition, for the time period that this potential correlation between rainfall and leachate levels was noted, significant maintenance activities were being conducted on the leachate wells and pumps to increase leachate production. Nonetheless, as reported in the 2-Year Evaluation Report for the Presumptive Corrective Measures (Leachate Collection Systems) at Solid Waste Management Units 5, 6, and 7 (MSG 2010a), the leachate collection system has been successful at controlling the accumulation of leachate in the landfill.

In 2010, ENVIRON observed the SWMU 6 cap to be in good condition and to generally provide adequate drainage, including the cap area in the northeast corner of the landfill. However, an area of storm water accumulation was observed at the southwest corner of SWMU 6, and the drainage system inspection (see Appendix A) identified several areas on the sloped sides of the unit where ponding was observed due to depressions in the grass swales, and a raised culvert inlet which does not allow for free drainage near the southwest corner of the unit. A standpipe was also identified near the electrical tower that was accumulating water (Structure 16, Storm Water Report, July 2010; see Appendix A). Sampling of this water by ESOI confirmed that the water accumulating in this pipe is representative of storm water (provided in Appendix D). The corrective measures being considered to improve the cap and prevent storm water ponding and infiltration in SWMU 6 are presented below. In addition, these alternatives address the off-site waste delineated during the NSL RFI. These options have been evaluated relative to the threshold and balancing criteria (see Table 3b).

Summary of Alternatives

- **Alternative 1: Improve Storm Water Drainage**

  As the existing soil cap meets the minimum requirements specified in the RFI, this alternative involves the improvement to the drainage systems to reduce the potential for storm water ponding and infiltration into the landfill.

  Storm water flows from SWMU 6 predominately by sheet flow to perimeter grass swales that convey the water to the northeast, southeast and southwest corners of the landfill. The storm water collection point at the southwest corner of the landfill also receives flows from SWMU

1 and SWMU 7. After large rain events, ponding of storm water is observed in this area. Removing the existing vegetation from the drainage ditches, eliminating depressions within these ditches, and lining the swales with a geomembrane liner or similar impermeable material will prevent storm water ponding and infiltration into the landfill. Similarly, the storm water collection area at the southwest corner of the landfill would also be lined to prevent infiltration of detained storm water. In addition, intermediate drainage ditches would be installed on the north and south slopes of the landfill to intercept sheet flow and direct this storm water off the landfill to reduce flows in the north and south perimeter ditches, with the addition of a small retention area at the northeastern corner of the facility and relocation of the outfall to the western end of this new basin. This alternative will also reduce the accumulation of storm water at the southwest corner of the landfill. It is estimated that approximately 1,950 feet of perimeter drainage ditch will be improved and 900 feet of new drainage ditch will be added on the sideslopes.

As part of this alternative, off-site waste delineated north of the property boundary would be excavated and transported to ESOI’s active landfill for disposal. Based on the delineation sampling conducted as part of the NSL RFI, approximately 0 to 5 feet of soil cover is present over the layer of off-site wastes. These soils would be stockpiled and reused for backfill. Additional backfill would be provided to restore existing grades. The area would be restored with a vegetative cover.

The estimated cost to implement this alternative is approximately $138,000, including the removal of off-site wastes. Including long-term management of storm water structures and leachate assuming long-term steady-state leachate generation (estimated based on the HELP Model; see Appendix D) following the initial 2 years of initial corrective measures to reduce leachate levels, the net present value for this alternative is approximately $355,000.

- **Alternative 2: Install a Composite Cover**

  As an alternative to the existing clay cap, a composite cover would be installed over the entire unit in order to reduce the potential for rainfall infiltration into the unit, thus further reducing leachate production. The process of upgrading the cap on the unit would require clearing the existing vegetation and a portion of the existing cover soil, and installing the composite cover. To protect the geomembrane cover from freezing and damage, at least 24-inches of clay cap and one foot of sand or backfill would need to be placed; the sand layer (or equivalent geosynthetic) would provide drainage off the impermeable layers in addition to providing protection. The final layer of the cap would require topsoil placement and seeding. The composite layer would extend off the unit into a perimeter anchor trench.

Utilizing the HELP Model, the potential reduction in leachate production resulting from the placement of a geomembrane/clay composite cover was evaluated. The results of this simulated leachate generation is presented in Appendix D, and indicate that a composite cover would reduce leachate generation rates from the time of closure. However, current leachate production from this unit has already been stabilized by the active extraction corrective measures, such that the incremental reduction from current conditions is not likely to be as significant as suggested by these simulations.

As part of this alternative, off-site waste delineated north of the property boundary would be excavated and transported to ESOI's active landfill for disposal. Based on the delineation sampling, approximately 0 to 5 feet of soil cover is present over the layer of off-site wastes. These soils would be stockpiled and reused for backfill. Additional backfill would be provided to restore existing grades. The area would be restored with a vegetative cover.

The estimated cost for constructing a composite cover over the approximately 7 acre SWMU 6 is approximately $1,167,000, including the removal of off-site wastes. Assuming a 95% reduction in annual steady-state production of leachate resulting from the installation of the composite cover, the net present value for this alternative is $1,182,000.[6] Note that this cost may be higher if the assumed reduction in leachate is less than predicted using the HELP Model.

Comparison of Alternatives

As summarized in Table 3b, both alternatives achieve the threshold and balancing criteria and are therefore retained for consideration. Alternative 1 reflects the current conditions with improvements to the storm water drainage to reduce the potential for infiltration of ponded storm water. Alternative 2 represents marginal enhancement to the existing clay cap by incorporating a geomembrane to further reduce the potential for leachate generation. Both alternatives address the presence of off-site waste north of the facility property line.

Given that the existing clay cap meets the minimum requirements for overall thickness and hydraulic conductivity specified in the RFI, and is expected to minimize leachate generation to relative low levels, Alternative 1 will meet the corrective action objectives. Storm water drainage improvements will reduce the potential for ponding and resultant increased infiltration. While Alternative 2 may provide for further reduction in leachate generation, the additional effort required to reconstruct the landfill cover and associated cost is not warranted based on the actual performance data for this unit. Therefore, ESOI proposes to implement Alternative 1 for the SWMU 6 cap.

[6] Note, in developing the landfill cap cost estimates, it is assumed that the long-term maintenance costs will be similar regardless of alternative, and therefore, these base costs are not included these calculations.

8.2.2.4 SWMU 7 – Central Sanitary Landfill

During the RFI, the cap was tested for the geotechnical requirements of hydraulic conductivity and thickness. It was determined that the cap in SWMU 7 was sufficiently thick (ranging from 2 to 10.5 feet in test areas) and the hydraulic conductivity was sufficiently low, although the average conductivity determined through testing of core samples was slightly higher than observed on SMWUs 1, 5 and 6. In addition, on the north, west and east side of SWMU 7, the waste extends beneath the road so that the road is serving as the cap. The soil cap under the road bed was evaluated as part of the RFI and generally found to provide an adequate cover. However, as directed by Ohio EPA, the cap in one area of roadway identified as location S7-202 will be further evaluated as part of the corrective measures implementation. For the purpose of this CMS, it is assumed that soil borings will be collected through the roadway at S7-202 and south, east and west of location S7-202 for geotechnical testing, and that soils within the roadway in this delineated area will be excavated to a depth of 4-feet and recompacted to meet the minimum requirements set forth in the RFI Work Plan (MSG/ENVIRON 2002).

Based on a review of leachate generation data, leachate levels and precipitation data for the period of 2008 through 2010, there may be some indication of a correlation between rainfall and leachate levels, and leachate recovery increased in April 2010, during a time of increasing rainfall; recorded leachate levels and recovery volumes are summarized in Appendix D. However, precipitation was higher in May 2010 and leachate generation did not increase in May. In addition, for the time period that this potential correlation between rainfall and leachate levels was noted, significant maintenance activities were being conducted on the leachate wells and pumps to increase leachate production. Nonetheless, as reported in the 2-Year Evaluation Report for the Presumptive Corrective Measures (Leachate Collection Systems) at Solid Waste Management Units 5, 6, and 7 (MSG 2010a), the leachate collection system has been successful at controlling the accumulation of leachate in the landfill.

In 2010, ENVIRON observed the cap to be in good condition and to provide adequate drainage, although the runoff from SWMU 7 also contributes to the accumulation of storm water at the southwest corner of SWMU 6. The drainage system inspection (see Appendix A) also identified ponding in several areas on the sloped sides due to depressions in the grass swales and a defective culvert. In addition, liquid in a 6" PVC standpipe, originally installed to control leachate seepages, was measured at a level four to five feet higher than that of monitoring wells in the vicinity. Sampling of the liquid in this standpipe by ESOI in October 2010 indicated that liquid is mostly from storm water, but does contain some leachate related constituents (data provided in Appendix D). This standpipe was subsequently abandoned in 2011 as part of the modification to the leachate recovery system, as discussed in Section 8.2.1.2. The corrective measures being considered to improve the cap and prevent storm water ponding SWMU 7 are presented below. These options have been evaluated relative to the threshold and balancing criteria (see Table 3b).

Summary of Alternatives

- **Alternative 1: Improve Storm Water Drainage**

  As the existing soil cap meets the minimum requirements specified in the RFI, this alternative involves the improvement to the drainage systems to reduce the potential for storm water ponding and infiltration into the landfill.

  Storm water flows from SWMU 7 predominately by sheet flow to perimeter grass swales that convey the water to the northeast and northwest corners of the landfill. The storm water flow to the northwest accumulates at the base of SWMU 6. After large rain events, ponding of storm water is observed in this area. Removing the existing vegetation from the drainage ditches, eliminating depressions within these ditches, and lining the swales with a geomembrane liner or similar impermeable material will prevent storm water ponding and infiltration into the landfill. In addition, intermediate drainage ditches would be installed on the north and west slopes of the landfill to intercept sheet flow and direct this storm water off the landfill to reduce flows in the northwest. This alternative would reduce the accumulation of storm water at the northwest corner of the SWMU 6. It is estimated that approximately 3,000 feet of perimeter drainage ditch will be improved and 600 feet of new drainage ditch will be added on the sideslopes.

  The estimated cost to implement this alternative is approximately $56,000. Including long-term management of leachate assuming long-term steady-state leachate generation (estimated based on HELP modeling; see Appendix D) following the initial 2 years of initial corrective measures to reduce leachate levels, the net present value for this alternative is approximately $937,000.

- **Alternative 2: Upgrade Cap to a Composite Cover**

  As an alternative to the existing clay cap, a composite cover would be installed over the entire unit in order to reduce the potential for rainfall infiltration into the unit, thus further reducing leachate production. The process of upgrading the cap on the unit would require clearing the existing vegetation and a portion of the existing cover soil, and installing the composite cover. To protect the geomembrane cover from freezing and damage, at least 24-inches of clay cap and one foot of sand or backfill would need to be placed; the sand layer (or equivalent geosynthetic) would provide drainage off the impermeable layers in addition to providing protection. The final layer of the cap would require topsoil placement and seeding. The composite layer would extend off the unit into a perimeter anchor trench.

Utilizing the HELP Model, the potential reduction in leachate production resulting from the placement of a geomembrane/clay composite cover was evaluated. The results of this simulated leachate generation is presented in Appendix D, and indicate that a composite cover would reduce leachate generation rates from the time of closure. However, current leachate production from this unit has already been stabilized by the active extraction corrective measures, such that the incremental reduction from current conditions is not likely to be as significant as suggested by these simulations.

The estimated cost for constructing a composite cover over on SWMU 7 is approximately $1,009,000, including repairs to roadway cap at S7-202. Assuming a 95% reduction in annual steady-state production of leachate resulting from the installation of the composite cover, the net present value for this alternative is $1,014,000.[7] Note that this cost may be higher if the assumed reduction in leachate is less than predicted using the HELP Model.

Comparison of Alternatives

As summarized in Table 3b, both alternatives achieve the threshold and balancing criteria and are therefore retained for consideration. Alternative 1 reflects the current conditions with improvements to the storm water drainage to reduce the potential for infiltration of ponded storm water. Alternative 2 represents marginal enhancement to the existing clay cap by incorporating a geomembrane to further reduce the potential for leachate generation. Given that the existing clay cap meets the minimum requirements for overall thickness and hydraulic conductivity specified in the RFI, and is expected to minimize leachate generation to relative low levels, Alternative 1 will meet the corrective action objectives. Storm water drainage improvements will reduce the potential for ponding and resultant increased infiltration. While Alternative 2 may provide for further reduction in leachate generation, the additional effort required to reconstruct the landfill cover and associated cost is not warranted based on the actual performance data for this unit. Therefore, ESOI proposes to implement Alternative 1 for the SWMU 7 cap.

8.2.3 Landfill Gas – SWMUs 1, 5, 6 and 7

Four existing landfills, SWMUs 1, 5, 6 and 7, were identified as requiring assessment for corrective measures to address potential landfill gas generation and migration. As proposed in the CMS Work Plan and summarized in Section 7.2, the corrective measures alternatives considered to address generation of leachate in these landfills include:

1. Maintaining existing landfill gas venting and monitoring program; or
2. Installing passive venting and/or active gas extraction.

[7] Note, in developing the landfill cap cost estimates, it is assumed that the long-term maintenance costs will be similar regardless of alternative, and therefore, these base costs are not included these calculations.

The evaluation of these alternatives considered the landfill gas characterization conducted as part of the RFI, ESOI's ongoing monitoring program, and the recently completed assessment of leachate recovery performance for SWMUs 5, 6 and 7 (MSG 2010a) approved by Ohio EPA on July 27, 2010.

As discussed for each of the four landfills below, prior testing for landfill gas did not identify evidence of significant gas generation. However, as part of the construction of the leachate recovery systems at SWMUs 5, 6 and 7, the recovery wells were designed to function as passive gas vents to dissipate trapped gas that may be encountered during the lowering of leachate levels. In addition, ESOI currently implements the Explosive Gas Monitoring Plan (EGMP) designed to monitor gas accumulation near or in buildings, either on-site or off and to assess gas migration along potential pathways (e.g., utility trenches). Monitoring probes along the perimeter of SWMU 1, SWMU 5, and SWMU 6, along with points near the office buildings, are monitored semi-annually. Three points are currently monitored weekly as methane levels above the perimeter Explosive Gas Threshold Limit (EGTL) of 5% are regularly recorded. The EGTL within a building is 1.25% methane (25% of the lower explosive limit). No specific regulations within the EGMP dictate a requirement for implementing an active gas system. However, a contingency plan is provided with the EGMP in the event that levels are detected above the EGTL; this plan involves notifying officials at the Ohio EPA after verifying sustained readings of exceedances. Contingency monitoring will be performed by installing portable barhole probes to define the source of emissions, gradient, and to determine the migration rate of combustible gas. The monitoring probe that had exceedances will be monitored on a monthly basis. If a meter reading of 25% of the LEL is obtained within a structure, the structure will be deemed "off limits" for personnel until the area is repaired to prevent further occurrence. On February 17, 2011, Ohio EPA DSIWM notified ESOI to submit proposed remedies for monitoring wells PB-3, PB-4, and MP-13. Subsequently, ESOI met with Ohio EPA on March 3, 2011 to review options for addressing the continued contingency monitoring in accordance with the Explosive Gas Monitoring Plan at PB-3 and PB-4, and MP-13. It was agreed upon that 2 new vents will be installed at SWMU 5 near MP-13 (installed July 2011). After the vents are installed, monitoring will continue for the next semiannual report period. If no changes are observed ESOI will submit a request to change the contingency monitoring requirements. ESOI will also continue to monitor PB-3 and PB-4 until the leachate levels are further reduced to the July 2012 target threshold leachate levels. The locations of the recovery well gas vents and perimeter gas vents are shown on Figure 4.

8.2.3.1 SWMU 1 – Cell F

SWMU 1 does not currently have gas vents installed within the unit. In 1998 and 1999 six passive gas vents were installed on the northeast corner of SWMU 1 to the northwest of the adjacent SWMU 6 in response to elevated gas levels in four of the gas monitoring points on the northern border of SWMU 6 (PB-3, PB-4, PB-7 and PB-11). As part of the RFI in 2002, ENVIRON collected landfill gas samples from three points within the unit, one in the center , one in the northwest corner and one in the southeast corner. Explosive gas measurements did not exceed the screening level of 25% of the lower explosive limit. ESOI monitors landfill gas at one point north of the unit, PB-22, on a semi-annual basis and ten readings have been collected from April 2007 to November 2011 at this point. The initial and sustained LEL/CH_4 concentrations have been recorded as zero for nine of these ten monitoring events. In May 2008, the initial reading at this point was recorded at 27% LEL and was sustained at 20% LEL. Subsequent readings in November 2008, May 2009, November 2009, June 2010, October 2010, June 2011 and August 2011had initial and sustained readings of 0% LEL. Additionally, gas monitoring trends were evaluated in SWMU 1 and SWMU 6 in July 2010 and it was concluded that the potential for off-site migration of landfill gas is highly unlikely due to localized elevated gas levels, low pressures in the monitoring points and the presence of saturated ground in the Gradel Landfill to act as a barrier for migration. Finally, given the age of the landfill, substantial new gas generation is not likely. Based on these results, no action has been identified for landfill gas generation at SWMU 1.

The corrective measures evaluated for landfill gas at SWMU 1 are presented below. These options have been evaluated relative to the threshold and balancing criteria (see Table 3c).

Summary of Alternatives

- **Alternative 1: Maintain Current Program**

  The majority of the monitoring over the past 2 years has not indicated landfill gas accumulation to be a concern at this unit. This option would require continuation of the existing monitoring program specified in the EGMP.

- **Alternative 2: Install Passive Landfill Gas Venting System**

  To allow for venting of landfill gas, vents would be installed within and around the perimeter of the unit to prevent accumulation and off-site gas migration. As vents have already been installed in the northeastern corner of the unit, vents would be installed within the unit and/or additional vents would be installed along the northern and western border of the unit that adjoins the property line and Otter Creek Road as a preventative measure. However, based on the monitoring trends discussed above, and considering the age of the landfill, gas migration has been shown to be of minimal concern; hence this option will not be retained for further consideration.

- **Alternative 3: Install Active Landfill Gas Recovery System**

  As an alternative to the current venting system, gas recovery wells would be installed throughout the unit which would then be connected to a piping system and a blower to create a vacuum within the unit to remove any landfill gas. The Explosive Gas Threshold Limit (EGTL), as stated in the OEPA approved EGMP, is 5% methane and has not been exceeded in PB-22. Therefore, an active system is not required and this option will not be retained for further consideration.

Comparison of Alternatives

As summarized in Table 3b, only Alternative 1 has been retained, as current conditions do not warrant more intrusive action that would be required for the installation of either passive or active gas venting wells within the landfill. This determination is consistent with Ohio EPA's concurrence with ESOI's August 27, 2010 recommended actions regarding explosive gas levels at the facility (Ohio EPA 2010). Costs for this alternative are included in ESOI's post-closure program.

8.2.3.2 SWMU 5 – Millard Landfill

SWMU 5 has two passive gas vents that were installed as integral elements of the leachate extraction well system. ESOI also maintains eight passive landfill gas vents in the northwest corner of the unit and one in the southeast corner of the unit. As part of the RFI in 2002, ENVIRON collected six landfill gas samples from within the unit. Three of the samples detected LEL readings of 8-13%, which did not exceed the RFI gas screening level (25% LEL). The other three points were measured at 0% LEL. ESOI routinely monitors nine points at SWMU 5 on a semi-annual basis: one on the south corner and seven on the west boundary, north of Millard Avenue South. The final point is just north of the property boundary on the west edge of the Buckeye Pipeline right-of-way. The majority of the readings collected from these points have had sustained readings recorded at 0% LEL, dating to April 2007. In May 2008, sustained readings from SWMU 5 were higher than historical values, ranging from 5% to 33% LEL. In subsequent events, readings decreased to historical levels (0% LEL). One point, MP-13, is monitored weekly due to methane readings that are consistently higher than the EGTL (5%), ranging from 16-49% methane, and once as high as 72% methane. MP-13 is the northern most point within the property boundary. Additionally, MSG evaluated gas monitoring trends in SWMU 5 in July 2010 (MSG 2010c); two of the three readings collected from MP-13 in July were below the EGTL. Upon examination of the boring log, it was concluded that the screen for MP-13 is constructed in a peat layer and naturally produced methane gas may be contributing to the elevated methane readings at this point (SWMU 5 is constructed in a former wetlands area). Further, it was concluded that the saturated soils near Otter Creek are acting as a barrier such that the gas does not migrate off-site. Finally, given the age of the landfill, substantial new gas generation is not likely. No further action was recommended for this area (MSG 2010c).

The corrective measures evaluated for landfill gas at SWMU 5 are presented below. These options have been evaluated relative to the threshold and balancing criteria (see Table 3c).

Summary of Alternatives

- **Alternative 1: Maintain Current Program**

  This option would require continued implementation of the current monitoring of the recovery well/gas vents and passive landfill gas vents as specified in the leachate recovery program Operations, Maintenance, and Performance Monitoring (OMPM) Plan (MSG 2010b) and EGMP. The majority of the readings over the past 2 years have not shown landfill gas accumulation to be a significant concern, except at MP-13 which has consistently shown elevated levels of methane. As outlined in the Ohio EPA response to ESOI's August 27, 2010 monitoring report (Ohio EPA 2010), this option would require continued implementation of the current monitoring plan, sampling the eight points semi-annually and MP-13 weekly. . Subsequently, based on the Ohio EPAs March 2011 review to address elevated levels of methane during continued contingency monitoring, two new passive vents (PV-9 and PV-10), were installed (July 2011) in the northwest corner of SWMU 5 (see Figure 4). Contingency monitoring will continue for the next semi-annual period in accordance with EGMP. . The need for additional passive or active landfill gas recovery system will be evaluated based on future monitoring results.

- **Alternative 2: Expand Passive Landfill Gas Venting System**

  As an addition to the current monitoring program, additional gas vents would be installed within and around the perimeter of the unit to prevent accumulation and off-site gas migration. Six vents already exist and two additional vents have already been installed near MP-13 in the northern and western border of SWMU 5, where the highest concentrations of methane have been recorded, and in the area of the stressed vegetation. As passive vents have already been installed and because gas migration has been shown to be of minimal concern, and considering the age of the landfill, this option will not be retained for further consideration in the corrective measures program.

- **Alternative 3: Install Active Landfill Gas Recovery System**

  As an addition to the current monitoring program, gas recovery wells would be installed throughout the unit which would then be connected to a piping system and a blower to create a vacuum within the unit to remove any landfill gas. If necessary, the gas would pass through a flare stack to be burned off at a controlled rate. However, elevated gas levels are only measured at one monitoring point, which may be due, in part, to naturally occurring methane associated with peat soils. An active landfill gas recovery system is therefore not required to control the gas at this unit and this option will not be retained for further consideration in the corrective measures program.

Comparison of Alternatives

As summarized in Table 3c, only Alternative 1 has been retained, as current conditions do not warrant more intrusive action that would be required for the installation of either passive or active gas venting wells within the landfill. This determination is consistent with Ohio EPA's concurrence with ESOI's August 27, 2010 recommended actions regarding explosive gas levels at the facility (Ohio EPA 2010). Costs for this alternative are included in ESOI's post-closure program. ESOI recently installed the additional vents described as part of Alternative 1 pursuant to the recommendations of the Ohio EPA.

8.2.3.3 SWMU 6 – North Sanitary Landfill

SWMU 6 has five passive gas vents that were installed as integral elements of the leachate extraction well system. ESOI also maintains twelve additional passive gas vents installed the northern side of SWMU 6 in response to elevated gas levels in four of the gas monitoring points (PB-3, PB-4, PB-7 and PB-11). As part of the RFI, ENVIRON collected seven landfill gas samples from within the unit in 2002 which were measured at 0% LEL. ESOI also monitors sixteen points along the northern property line of SWMU 6 on a semi-annual basis. Two points, PB-3 and PB-4 are monitored weekly due to methane levels that are generally higher than the EGTL (5%). The majority of the readings collected from the 12 points monitored semi-annually have sustained readings recorded at 0% LEL with occasional sustained readings between 1 and 11% LEL, dating back to April 2007. In May 2008, sustained readings from SWMU 6 were higher than historical values, ranging from 1% to 27% LEL. In subsequent events, readings decreased to historical levels. The two points that are monitored weekly have sustained methane levels ranging from 3.3 to 40% methane.

Additionally, MSG evaluated gas monitoring trends in Cell F and SWMU 6 in July 2010 (MSG 2010c); based on this evaluation, it was concluded that the potential for off-site migration of landfill gas is highly unlikely due to localized elevated gas levels, low pressures in the monitoring points and the presence of saturated ground in the Gradel Landfill to act as a barrier for migration. Further, given the age of the landfill, substantial new gas generation is not likely. The Ohio EPA response to these conclusions did not require any additional actions except for the installation of an additional vent, as described below (Ohio EPA 2010).

As part of recent landfill gas monitoring, MSG reported cracks and stressed vegetation in the landfill cap near several dewatering standpipes on the north side of the unit (MSG 2010c). ESOI subsequently removed the standpipes and regraded the area. ESOI also installed an additional passive gas vent (PV-7) between PB-10 and PB-11 to address the cracks and stressed vegetation in that area, as recommended in Ohio EPA (2010). Ohio EPA concurred with ESOI's proposal to reduce the monitoring frequency on monitoring points PB-7 and PB-11, continue weekly monitoring on PB-3 and PB-4 until 4 sequential readings are below the EGTL and to regrade the ditch. Contingency monitoring will be continued at these monitoring points until the leachate levels are further reduced to the July 2012 target threshold leachate levels.

The corrective measures evaluated for landfill gas at SWMU 6 are presented below. These options have been evaluated relative to the threshold and balancing criteria (see Table 3c).

Summary of Alternatives

- **Alternative 1: Maintain Current Program**

  This option would require continued implementation of the current monitoring of the recovery well/gas vents and passive landfill gas vent as specified in the leachate recovery program OMPM Plan and EGMP. In addition, based on the landfill gas levels currently being reported for this unit, monitoring would continue at the frequency recommended by Ohio EPA (Ohio EPA 2010). If an increased level of landfill gas was recorded at a semi-annual point, weekly monitoring could be implemented to determine if landfill gas is accumulating. Additional passive or active landfill gas recovery system would be evaluated in the future based on monitoring results.

- **Alternative 2: Expand Passive Landfill Venting System**

  As an addition to the current monitoring program, additional gas vents would be installed within and around the perimeter of the unit to prevent accumulation and off-site gas migration. As additional vents have already been installed in the north slope of the unit, three to four additional vents would be installed along the northern border of the unit.

- **Alternative 3: Install Active Landfill Gas Recovery System**

  As an addition to the current monitoring program, gas recovery wells would be installed throughout the unit which would then be connected to a piping system and a blower to create a vacuum within the unit to remove any landfill gas. If necessary, the gas would pass through a flare stack to be burned off at a controlled rate. Although PB-3 and PB-4 continue to demonstrate methane levels above the EGTL, the other monitoring points along the perimeter do not, leading to the conclusion that the potential for off-site gas migration is minimal. An active landfill gas recovery system is not required to control gas and also was not recommended by the OEPA, and therefore is not retained as a necessary corrective measure.

Comparison of Alternatives

As summarized in Table 3c, Alternatives 1 and 2 have been retained, as current conditions do not warrant more intrusive action that would be required for the installation of active gas venting wells within the landfill. This determination is consistent with Ohio EPA's concurrence with ESOI's August 27, 2010 recommended actions regarding explosive gas levels at the facility (Ohio EPA 2010). ESOI recently installed the additional vents described as part of Alternative 2 pursuant to the recommendations of the Ohio EPA. Costs for this alternative are included in ESOI's post-closure program.

8.2.3.4 SWMU 7 – Central Sanitary Landfill

SWMU 7 has three passive gas vents that were installed as integral elements of the leachate extraction well system. As part of the RFI, ENVIRON collected six landfill gas samples within the unit in 2002 of which six were measured at 0% LEL and one was measured at 1% LEL. ESOI does not have any monitoring points along the perimeter of SWMU 7.

The corrective measures evaluated for landfill gas at SWMU 7 are presented below. These options have been evaluated relative to the threshold and balancing criteria (see Table 3c).

Summary of Alternatives

- **Alternative 1: Maintain Current Program**
  This option would require continued implementation of the current monitoring of the recovery well/gas vents as specified in the leachate recovery program OMPM Plan and EGMP. A passive or active landfill gas recovery system would then be evaluated based on monitoring results.

- **Alternative 2: Install Passive Landfill Gas Venting System**

  As an addition to the current monitoring program, gas vents would be installed within and around the perimeter of the unit to prevent accumulation and off-site gas migration. Because past measurements have not indicated elevated levels of landfill gas and considering the age of the landfill, this option will not be retained for further consideration in the corrective measures program.

- **Alternative 3: Install Active Landfill Gas Recovery System**

  As an addition to the current monitoring program, gas recovery wells would be installed throughout the unit which would then be connected to a piping system and a blower to create a vacuum within the unit to remove any landfill gas. If necessary, the gas would pass through a flare stack to be burned off at a controlled rate. An active landfill gas recovery system is therefore not required to control the gas at this unit and this option will not be retained for further consideration in the corrective measures program.

Comparison of Alternatives

As summarized in Table 3c, only Alternative 1 has been retained, as current conditions do not warrant more intrusive action that would be required for the installation of either passive or active gas venting wells within the landfill. Costs for this alternative are included in ESOI's post-closure program.

8.2.4 SWMU 8 – Old Oil Pond

As described in Section 4.1, the RFI indentified conditions at SWMU 8 requiring corrective measures, including the occurrence of elevated landfill gas levels, accumulated leachate and NAPL, seepage of a tar-like NAPL to ground surface, and seepage of NAPL into an adjacent waterline appurtenance. During the RFI, the cap was tested for physical characteristics (hydraulic conductivity and thickness), and it was determined that the cap is sufficiently thick (ranging from 7-15 feet in test areas) and the conductivity was sufficiently low, although the tar-like NAPL seepage indicates preferential pathways for seepage induced by excess landfill gas pressure. Gas monitoring from points installed in this unit exceeded the OVA screening level (50 ppm) and exhibited sustained methane levels above the EGTL (5% methane), although perimeter monitoring conducted by ESOI indicates that off-site gas migration is not a problem. The RFI Report concluded that the only unacceptable human health risks are for routine facility and maintenance worker exposure to NAPL seeps and maintenance worker exposure to shallow groundwater/leachate.

In June 2010 ENVIRON collected additional field data from the unit, including leachate and NAPL levels from seven temporary leachate wells and three temporary monitoring wells to assess any changes since the RFI data were collected; as summarized in Appendix A, these data indicate:

- Leachate levels ranging from 5.8 to 22 feet below ground surface; NAPL was observed in five of the ten temporary wells with a thickness of 4.4 to 20 feet.
- Landfill gas pressure measurements indicating that gas is accumulating under the cap of the unit.
- Seepage through the cap was noted within the boundary of this unit.
- Some subsidence of Building C.

These data and observations are consistent with data collected and conditions observed during the RFI. Waste characterization data for SWMU 8 are provided in Appendix E.

8.2.4.1 Corrective Measures Alternatives

Based on the findings of the RFI and subsequent monitoring, and considering USEPA's Presumptive Remedy Guidance for Landfills, the corrective action alternatives identified for SWMU 8 include:

- In-place containment. In-place management of the waste in SWMU 8 would require several components to achieve containment:

  - Repair existing cap at seep location,
  - landfill gas recovery/venting system,
  - leachate and NAPL recovery, and
  - an enhanced barrier (to prevent lateral migration).

- Removal and disposal. This alternative involves the complete removal of wastes from SWMU 8 for disposal. This alternative would require management of existing leachate and NAPL contained within the cell. The cell would be backfilled so the area does not accumulate storm water.

Both in-place and removal based alternatives will require the removal of Building C (with replacement at another on-facility location. In addition, SWMU 8 also encompasses three other AOCs to be addressed as part of the corrective measures program:

- AOC 5 (Decontamination Building): The two underground storage tanks associated with the former decontamination building are also addressed in alternatives evaluated for SWMU 8.

- AOC 7 (Butz Crock): During prior facility site inspections and during the RFI field investigation, oily liquids were occasionally observed collecting in the concrete vault located south of Building C. The RFI determined that this oily liquid was originating from SWMU 8. Further, it was determined that this oily seepage might present a possible unacceptable human health risk to outdoor routine facility workers. The corrective measures alternatives evaluated for SWMU 8 also address this AOC and associated ancillary piping and vaults near the York Street gate.

- AOC 12 (Building C Heating Oil Tank): Subsequent to the RFI, impacts from a release associated with the heating oil UST located adjacent to Building C was observed to be causing an oily sheen at a roof drain discharge near this area. The corrective measures alternatives evaluated for SWMU 8 also address this AOC.

The alternatives evaluated for SWMU 8 will also address the potential contribution of this unit to contamination observed in the waterline monitoring trench adjacent to this unit (AOC 1). Supporting documentation for the SWMU 8 alternatives analysis is provided in Appendix E.

Summary of Alternatives

- **Alternative 1: Manage Waste In-Place**

  Alternative 1 involves the management of wastes within the existing SWMU 8 cell, with upgrades to the containment system and the addition of leachate/NAPL and landfill gas recovery systems. As part of this alternative, the existing cap would be excavated at locations where

NAPL tar seeps have been observed. The task of improving the cap on the unit would require removing Building C (including the floor slab), AOC 12, and AOC 7, clearing portions of the existing cover, and filling or grading the low points of the cover. Finally, this alternative would include the installation of a barrier wall surrounding the unit to prevent lateral migration of leachate and/or NAPL into the adjacent waterline trenches, the lacustrine/upper till contact zone, and adjacent utility corridors.

Leachate Collection and Gas Venting

As part of this alternative, leachate collection and landfill gas venting systems would be added. The leachate collection would rely on the use of extraction wells similar to those installed in SWMUs 5, 6 and 7. The leachate system would be operated initially to reduce the accumulated leachate and NAPL to the maximum extent practicable, after which it would be used to maintain a minimal leachate head within the cell. The landfill gas venting system would rely on passive gas vents drilled into the waste. Monitoring would be conducted to determine if treatment is warranted for these vents.

Lateral Containment

The lateral containment system for this unit would include the installation of a 35-feet barrier wall surrounding the limits of waste. This barrier wall would be comprised of a sheet pile wall keyed into the upper clay till unit[8]. Accumulation of leachate within the confinement cell would be managed using the leachate collection system described above. In addition, three shallow till monitoring wells (G-4S, T-42S and T-54S; see Figure 5c) would be monitored for water levels and water quality to verify the effectiveness of this lateral containment[9]. The wells would be included in the shallow till monitoring program which is described in Section 9.2.2.3.

The estimated cost for this alternative is approximately $6,440,000 assuming a sheet pile barrier wall is installed and limited cap improvements are conducted. This includes the cost of removing Building C, AOC 12 and AOC 7, and replacing Building C elsewhere on the facility. The long-term leachate recovery and monitoring of this unit is estimated to be approximately $563,600 over 30-years (net present value).

- **Alternative 2: Construction of Corrective Action Management Unit (CAMU)**

  Alternative 2 involves the construction of a new waste management cell in the same location of SWMU 8. The construction of a new landfill cell would be conducted in phases so that only a portion of the waste is exposed at a given time. SWMU 8 is approximately 6.7 acres and the

[8] Based on costs for slurry walls provided by contractors in 2005 for the interim corrective measures evaluation compared with lower unit costs identified for steel sheet pile, a barrier wall constructed of steel sheet pile is assumed for this alternatives evaluation.

[9] Wells T-42S and T-54S will be re-designated as permanent wells or replaced as necessary.

thickness of the waste averages 10 feet in thickness, with a resultant estimated volume of approximately 108,000 cubic yards, with an additional 65,000 cubic yards associated with removal of the existing cap.

For the purposes of this assessment, it is assumed that waste excavation would be initiated at the eastern end of the unit, with the exhumed waste being placed in a temporary storage pad located within the limits of SWMU 8. Once waste has been removed from an approximately a 1-acre area, construction of the liner system would begin. The excavated waste would be placed back into the newly constructed subcell, and excavation of waste would proceed, with waste from the second subcell area being placed into the preceeding lined subcell (in this way, only the excavation for the first subcell would require temporary storage). Based on the characterization of the waste in this unit, it is expected that stabilization of the waste for handling stability would be required prior to placement for handling/stability. The final footprint of the CAMU would be less than the existing 6.7 acre SWMU 8, allowing for reclaiming of a portion of the facility for reuse.

As part of this alternative, the existing cap would be removed and stockpiled for reuse in the cover system. The task of construction the CAMU would require removing Building C (including the floor slab), AOC 12, AOC 7 and associated vaults and piping, and two underground storage tanks associated with AOC 5. During construction, accumulated leachate and NAPL would be recovered from the working area for off-site disposal. In addition, it is assumed that one-foot of soil at the base of this unit would also be removed and managed in the CAMU. Post-excavation samples would be collected to determine if additional soil removal would be warranted.[10] Finally, this alternative would include the installation of a composite landfill cover.

Liner System

The CAMU liner system would be constructed consistent with ESOI’s active hazardous waste landfill design consisting of a double liner with leachate collection and leak detection.

Cover System

A CAMU cover would be constructed consistent with ESOI’s active hazardous waste landfill design consisting of a composite cover with a gas vent layer. The landfill gas venting system would rely on passive gas vents, with monitoring would be conducted to determine if treatment is

[10] Post-excavation sampling results would initially be compared with USEPA’s regional screening levels for nonresidential soil. Depending on the screening results, the data may be compared to the soil screening criteria used in the RFI (see Appendix A) and further evaluated following the methodology described in the RFI Final Report for assessing site-specific exposures to subsurface soils.

warranted for these vents. In addition, three shallow till monitoring wells (G-4S, T-42S and T-54S) would be monitored to verify the effectiveness of this lateral containment.

The cost for this alternative is estimated at $8,271,000 assuming the CAMU cell covers the existing SWMU 8 footprint. This includes the cost of removing Building C, AOC 12 and AOC 7, and replacing Building C elsewhere on the facility. Reducing the CAMU footprint by 40% would result in an approximately 10% cost reduction associated with the liner and cap construction costs.[11] The long-term leachate management and monitoring of this unit is estimated to be approximately $563,600 over 30-years (net present value).

8.2.4.2 Option Analysis

The evaluation of the two alternatives with respect to the threshold and balancing criteria is presented on Table 3e. As indicated on Table 3e, both alternatives will meet the threshold criteria to varying degrees. Both alternatives rely on containment to reduce the potential for unacceptable exposures identified in the human health risk assessment, including the lateral migration of hazardous constituents into adjacent utility features. Alternative 1 does not directly address the potential for vertical migration from the unit into the underlying upper till unit, but will reduce this potential by reducing the leachate head that would contribute to this vertical migration. In addition, the physical characteristics of the upper till unit (i.e., low hydraulic conductivity) provide a natural barrier to vertical migration. Both alternatives meet applicable waste management strategies.

Both alternatives are generally comparable in terms of the balancing criteria. Both will reduce the mobility of wastes via leachate/NAPL recovery and off-site treatment/disposal. All three alternatives and utilize existing technologies that have been proven to provide effective long-term management of solid waste. With respect to short-term effectiveness, Alternative 1 represents the lowest potential impact to on-site workers and the surrounding community during implementation since the waste will remain in-place with disturbance limited to the installation of leachate and landfill gas recovery systems. By comparison, Alternative 2 requires ex-situ management of a large volume[12] of wastes and associated liquids.

Both alternatives are considered feasible in terms of implementability. The estimate cost for Alternatives 1 and 2 are generally comparable, although Alternative 2 has greater uncertainty with respect to materials

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11 ESOI assumed that it may be possible to consolidate the western portion of the existing unit overtop of the eastern portion of the unit, keeping the CAMU footprint to 60% of the existing area. This reduces the cost of the liner system (HDPE liner, geotextile) and cover system (geotextile vent layer), resulting in an overall construction cost reduction of about 10%. However, the larger cost items are fixed – e.g, building removal/reconstruction, thus limiting the overall cost savings associated with the reduction in the CAMU area.

12 "Large volume" is defined by USEPA as quantities ranging from many thousands of cubic yards to over 100,000 cubic yards (USEPA 1989, 1990; USEPA 1993)

handling and the extent to which stabilization will be necessary prior to placement in the constructed CAMU.

Based on the evaluation of the two alternatives, Alternative 1 is recommended as it meets the threshold and balancing criteria, with the lowest short-term impacts and scope uncertainty.

8.2.5 SWMU 9 – New Oil Pond

As described in Section 4.1, the RFI identified conditions at SWMU 9 requiring corrective measures. Specifically, the presence of oily water and accumulated storm water on the top of the unit indicated that releases through the cap are occurring. During the RFI, the cap was tested for physical characteristics (i.e., hydraulic conductivity and thickness) and it was determined that the cap is sufficiently thick (ranging from 6 to 9 feet in test areas) and the conductivity was sufficiently low. As discussed in Section 5.2.3, as part of ESOI's presumptive corrective measures activities, the cap was excavated and recompacted in the areas of observed seepage. However, during the June 2010 site inspection, ENVIRON observed oily water accumulation on top of the unit. NAPL surface seeps have also been observed in the vicinity of S9-209 on north side on the unit and S9-218 on east side of the unit. Storm water accumulation was also noted in the vicinity of the existing vent pipes, and along drainage ditches due to depressions in the grass swales and blockage at one of the culverts.

As proposed in the CMS Work Plan and summarized in Section 7.2, the corrective measures alternatives considered to address the cap drainage and the surface seeps at SWMU 9 are:

1. Repairing the existing cap and improving storm water drainage; or
2. Upgrading the existing soil cap to a composite cap.

The following characteristics are considered in the assessment of both the alternatives.

1. The waste throughout the unit does not contain significant free liquids and/or NAPL;
2. The waste is stable enough to support the load from the cap and equipment; the cap has not subsided since the unit was closed as evidenced from historical pictures, however, the cap design should include performing settlement testing (similar to the cover design tests conducted as part of the presumptive corrective measure for SWMU 1) and settlement monitoring to assess potential future settlements;
3. Much of the drainage from the cap is diverted from the City of Toledo water line easement by trenches that border the south side of the unit.

In addition, both the alternatives address the low area on the eastern portion of the unit, and surface seeps in the vicinity of S9-209 and S9-218.

Supporting documentation for the SWMU 9 alternatives analysis is provided in Appendix F.

Summary of Alternatives

- **Alternative 1: Cap Repair and Storm Water Drainage Improvements**

  This alternative provides for recontouring of the landfill cover to provide positive drainage, and minimize accumulation and infiltration of storm water. Regrading will include the low area on the east portion of the unit and surface seeps in the vicinity of S9-209 and S9-218. Conceptual plans and cross-sections showing the extent of impacted area are included in Appendix F. Prior to implementing the cap regrading, additional dewatering wells would be installed within the delineated NAPL area in order to remove free liquids to the extent practicable. As part of this activity, the existing soil cover in the area of the seeps would then be recompacted, and additional fill placed to improve the slopes at the top of the cell, similar to work recently completed on Cell F. In addition, the existing drainage systems would be cleared of vegetation and lined to improve conveyance of storm water off the cap. Long-term monitoring would be provided, including inspection of potential seeps, ponding of storm water and areas of settlement. Monitoring of the adjacent waterline monitoring trench would be included in this program; the inspection and monitoring of the trenches south of SWMU 9 is discussed in Section 8.2.7. The final cover would be maintained at a slope that promotes proper drainage as described in Section I-3f of ESOI's Part B Permit Application. Monitoring of the final as-built cover elevations would be conducted at 5 year intervals following construction and continue for 30 years as calculated from the date of cap modification completion certification. The interval may be shortened in order to place it on the same schedule as all or some of the on-site units. Existing elevations would be compared to final as-built information to determine if settlement has occurred. In the event adverse settlement is determined (e.g., significant ponding of storm water on the cap), corrective maintenance would be performed to correct the deficiency.

  The estimated cost for this alternative is approximately $365,000 including performance of a settlement test. The long-term costs for inspections and settlement monitoring of the cap is estimated to be approximately $42,000 over 30 years (net present value).

- **Alternative 2: Upgrade Cap to a Composite Cover**

  Alternative 2 would include recontouring of the SWMU cover similar to the work described for Alternative 1. In addition, an upgraded composite cover would be installed to reduce the potential for infiltration into the waste.

As part of the implementation of this remedy, the current cap would be excavated down to the top of the solidified waste over the area in which NAPL was delineated during the RFI. Prior to implementing the cap repairs, additional dewatering wells would be installed within the delineated NAPL area in order to remove free liquids to the extent practicable. The portion of the cover soil – waste interface zone would be removed for disposal in ESOI's active hazardous waste landfill; this excavation would extend into the top of the solidified waste to remove the top zone of waste that may be saturated from prior rainfall infiltration. A composite cover would then be constructed over this collection system. The composite cover would be constructed utilizing the existing clay cover with the addition of a geomembrane layer and a drainage layer.

To protect the cover from freezing and damage, at least one foot of soil would need to be placed, which provides drainage in addition to protection. The final layer of the cap would require topsoil placement and seeding. The composite layer would extend off the top of the unit into a perimeter anchor trench system. As part of this alternative, the perimeter drainage ditches would be cleaned out and lined to improve runoff from the capped area. Long-term monitoring would be provided, including inspection of potential seeps, ponding of storm water and areas of settlement. Monitoring of the adjacent waterline monitoring trench would be included in this program; the inspection and monitoring of the trenches south of SWMU 9 is discussed in Section 8.2.7. The final cover will be maintained at a slope that promotes proper drainage as described in Section I-3f of the Part B Permit Application. Monitoring of the final as-built cover elevations will be conducted at 5 year intervals following construction and continue for 30 years as calculated from the date of cap modification completion certification. The interval may be shortened in order to place it on the same schedule as all or some of the on-site units. Existing elevations will be compared to final as-built information to determine if settlement has occurred. In the event adverse settlement is determined (e.g., significant ponding of storm water on the cap), corrective maintenance shall be performed.

The estimated cost for this alternative is approximately $703,000, including performance of settlement test. The long-term costs for inspections and settlement monitoring of the cap is estimated to be approximately $42,000 over 30 years (net present value).

- **Alternative 3: Excavation of Unit and Disposal**

Alternative 3 consists of the corrective measures alternative specified for consideration by Ohio EPA, and requires the removal of all waste from SWMU 9 for off-site landfill disposal. The estimated volume of waste in SWMU 9 is on the order of 90,000 to 100,000 cubic yards (see Appendix F), not including the impacted soil cover materials, which would represent a "large volume" of waste to be managed (USEPA 1989, 1990, USEPA 2003) requiring over 5,000 truck trips to transport this waste to another disposal location. In addition, this unit is bordered on three sides by other landfills and the maximum thickness of waste in this unit as determined during the

RFI is approximately 70 feet, thus presenting a significant excavation effort. In reviewing this alternative, it is noted that the RFI Report did not conclude that a potentially significant risk of exposure to the contaminated media in SWMU 9 exists. Because a risk-based justification for excavation of the waste and contaminated media at SWMU 9 does not exist, an evaluation of excavation and appropriate disposal of all of SWMU 9 waste and contaminated media is not appropriate and conflicts with principals of USEPA's Presumptive Remedy Guidance and green remediation. Therefore, this alternative was rejected for comparison with Alternatives 1 and 2.

The basis for this decision to not pursue a removal alternative was submitted to Ohio EPA on March 10, 2010 (ESOI 2010a). In summary,

- The unit was drained of free liquid;
- A suitable stabilizing agents for in situ solidification of the remaining sludge was selected;
- The waste was stabilized in place; and
- The stabilized waste was capped with clay and topsoil.

The RFI found that the completed closure method was effective in solidifying the sludge. For example, the RFI did not observe liquid throughout or at the bottom of the solidified waste mass, and the RFI did not find adverse groundwater impacts as a result of a release from this unit. However, the RFI found that the cap has settled and storm water is collecting on top of the cap. This condition is allowing water to infiltrate through the cap and into the top of the stabilized waste mass. The extent of this liquid was mapped during the RFI. ESOI has been collecting this water for a number of years through pipes that were installed through the cap. The approved CMS Work Plan requires that based on field observations during the RFI and other inspections conducted as part of facility's O&M program, active corrective measures be conducted to address the occurrence of liquid beneath the soil cover, seepage to ground surface, and cap drainage conditions. Specifically, the approved CMS Work Plan requires that the following be addressed:

- The occurrence of NAPL and infiltrated storm water accumulating on top of the solidified material and beneath the soil cover and oily water seepage to ground surface at SWMU9;
- Surface cap drainage improvements; and
- Long-term cap maintenance.

The required corrective measures elements are incorporated into Alternatives 1 and 2 described above. ESOI believes that the above Alternatives 1 and 2 are appropriate for the identified issues to be addressed and are consistent with USEPA's Presumptive Remedy Guidance for landfill units (containment, leachate removal, gas management). Further, an intrusive alternative requiring excavation and disposal of all SWMU 9 waste and contaminated media is not commensurate with the risks quantified by the RFI. Specifically, the potential risk to human health quantified in the RFI does not warrant such an intrusive method. Therefore, this alternative is not included in the comparison of alternatives discussed below.

8.2.5.1 Option Analysis

The evaluation of the two retained alternatives with respect to the threshold and balancing criteria is presented on Table 3f. As indicated on Table 3f, both Alternatives 1 and 2 will meet the threshold criteria to varying degrees. Alternatives 1 and 2 rely on containment to reduce the potential for unacceptable exposures identified in the human health risk assessment, including the seepage of oily water to the ground surface. Alternative 1 reduces the potential for infiltrating storm water to reach the solidified waste layer through improved runoff. It is expected that Alternative 2 will provide greater reduction in infiltration by improved surface drainage and the installation of an impermeable composite cap.

Both Alternatives 1 and 2 are generally comparable in terms of the balancing criteria, with the exception of costs. Alternatives 1 and 2 will reduce the mobility of wastes reduction of free liquid in the cell. Further, both alternatives utilize existing technologies that have been proven to provide effective long-term management of solid waste (as exemplified for SWMU 1). With respect to short-term effectiveness, Alternative 1 represents the lowest potential impact to on-site workers and the surrounding community during implementation since the waste will remain in-place with disturbance limited during cover repair and regrading. By comparison, Alternatives 2 requires exposure of a large area of stabilized waste and ex-situ management of a portion of this waste and associated liquids.

Both Alternatives 1 and 2 are considered feasible in terms of implementability. However, the cost for Alternative 2 is substantially higher than the cost for Alternative 1. In addition, Alternative 2 has greater uncertainty with respect to materials handling and requirements that may be required to manage the waste encountered at the cover soil-waste interface.

Based on the evaluation of the two alternatives, Alternative 1 is recommended as it meets the threshold and balancing criteria, addresses the existing conditions and provides for improved cap performance.

8.2.6 SWMU 5 - LNAPL

During RFI field investigation, subsurface NAPL was recovered from monitoring wells installed into a peat layer along the west side of SWMU 5. A summary of the NAPL measurements and characterization of this liquid is provided in Appendix G. The presence of this material was determined to present a potentially unacceptable human health risk to outdoor routine facility workers if NAPL surficial seepage of this material occurred. It was noted in the RFI that the NAPL is from off-site/upstream releases to Otter Creek that occurred prior to construction of the perimeter soil berm for SWMU 5. Nonetheless, ESOI has proposed to address the presence of NAPL on the facility as part of its corrective measures program. The corrective measures considered for addressing recoverable NAPL at SWMU 5 include passive recovery and active recovery systems. For either option, the recovery efforts would be performed to recover the NAPL to the extent practicable given there have been no observed surface outbreaks of this material that would result in the hypothetical exposures evaluated in the RFI baseline risk assessment. Supporting documentation for the two alternatives, including estimated recovery costs, is provided in Appendix G.

Summary of Alternatives

- **Alternative 1: Passive Recovery**

  One accepted method of recovering subsurface NAPL is to utilize in-well skimmers to recover NAPL that is "floating" on the water column in a well. For this alternative, it is assumed that four recovery wells would be installed in the area between wells T-20S(2) and T-20S(5) where measurable NAPL has been consistently observed. NAPL collection would be accomplished by placing passive collection skimmer/bailers in each of the recovery wells. These skimmer/bailers would be routinely monitored and emptied as necessary. In addition, LNAPL monitoring would continue at four wells (T-20S[2], T-20S[5], T-20S[7] and T-20S[8]) in this area. Once recovery using this system reaches practical limits, adsorbent socks would be used to address any measurable NAPL that continues to accumulate in the well(s).

  This alternative is estimated to require up to 15 years to complete, based on a conservative estimate of the volume of recoverable NAPL present in the peat layer. The costs associated with this option include the cost for weekly maintenance to empty the skimmers and one year of monthly changeout of the absorbent socks. The estimated construction cost is approximately $31,000. The total net present value for this alternative, including the long-term operation and maintenance is $183,000.

- **Alternative 2: Active Recovery**

  As an alternative to passive recovery, NAPL collection would be accomplished by installing an active NAPL skimmer in the area of T-20S(2) and T-20S(5). For this alternative, it is assumed that two recovery wells would be installed and a vacuum enhanced skimmer system would be installed in each well. To minimize infrastructure and energy requirements, a solar powered system would be utilized. The skimmer system extracts NAPL and discharges it into a storage drum. In addition, LNAPL monitoring would continue at four wells (T-20S[2], T-20S[5], T-20S[7] and T-20S[8]) in this area. Once recovery using this system reaches practical limits, adsorbent socks would be used to address any measurable NAPL that continues to accumulate in the well(s).

This alternative is estimated to require up to 3 years to complete, based on a conservative estimate of the volume of recoverable NAPL present in the peat layer and system performance uptime. The costs associated with this option include the cost for weekly maintenance for the system and one year of monthly changeout of the absorbent socks. The estimated construction cost is approximately $36,000. The total net present value for this alternative, including the long-term operation and maintenance, and monitoring of adjacent existing wells along the west side of SWMU 5 for evidence of NAPL is $54,000.

Comparison of Alternatives

As summarized in Table 3d, both alternatives achieve the threshold and balancing criteria. Further, both alternatives reflect low energy approaches, although Alternative 2 is expected to achieve the reduction in recoverable NAPL in a shorter timeframe. Based on the estimated time and cost for each alternative, ESOI proposes to implement Alternative 2.

8.2.7 AOC 1 – Toledo Water Line

As discussed in Section 5.1, six monitoring and dewatering trenches were installed adjacent to the Toledo water lines (pressurized water supply lines) by ESOI to prevent migration of groundwater from the adjacent waste management areas into the waterline right-of-way. These trenches are equipped with collection sumps located at each end and the middle of the Trench 1 [identified as trench sumps I-1(T-1E), I-2 (T-1M), and I-3 (T-1W)] and Trench 2 [sumps II-1(T-2E), II-2 (T-2M), and II-3 (T-2W)]; each end of Trench 3 [sumps III-1(P-3E) and III-3 (T-2W)], Trench 4 [sumps IV-1(P-4E) and IV-3 (T-4W)], and Trench 5 [sumps V-1(P-5E) and V-3 (T-5W)]; and the middle of Trench 6 (sump TR-6). All the sumps are inspected every Monday, Wednesday, and Friday for accumulation of pumpable liquids, and accumulated water is withdrawn. If water level is above a trigger elevation (0.5 feet below the invert elevation for the dewatering trenches and 1.0 feet below the invert elevation for monitoring trenches), trench is pumped within 24 hours. Anytime a water level is above a trigger elevation, the trenches are inspected daily and level measurements taken until the water level is below the trigger elevation. In addition, water samples are collected semi-annually and analyzed for dissolved metals, VOCs, SVOCs, PCBs, halogens, total phenols and cyanide. Currently, three trenches are deemed “dewatering trenches” based on the detection of hazardous constituents in the samples. The remaining trenches (deemed “monitoring trenches”) are not contaminated. The dewatering trenches are 3, 4 and 5; Trench 3 is located adjacent to SWMU 9, Trench 4 is located adjacent to SWMU 8 and Trench 5 is located adjacent to Cell G. Constituents detected above the PQL in the dewatering trenches include dissolved metals, benzene, tetrahydrofuran, total organic halogens, and 1,4-dioxane. The analytical results from the May 2010 sampling event are summarized in Appendix H. As reported in the RFI Final Report, concentrations in the western sump of Trench 3 (sump III-2) were identified as posing a potential risk if exposure to maintenance workers occurred during excavation activities or during liquid removal activities. This area is addressed by the amended health and safety protocols described in Section 8.1.2.

In addition, the rate of water recovery is also recorded as part of the monitoring program. A comparison of the volume of storm water collected in the trenches indicates some correlation with the rainfall (see Appendix H) suggesting that storm water is infiltrating into the trenches, specifically due to recirculation of water from storm water ditch on the southside of Cell H into Trench 1. Some influence from City of Toledo waterline valve leaks, which occurs when waterline is shutdown and then restarted, may also be reflected in these data. ESOI has communicated this concern regarding leaks from the waterline values to the City of Toledo. The average annual volume of water collected in each trench is:

Trench	Total Annual Volume (gal)/foot of trench
1	6,175
5	4,057
2	3,178
3	2,610
6	2,042
4	788

At the current frequency of inspection and water recovery, there has been no indication of excess build-up of water within the trenches warranting a more frequent inspection/pumping program. As proposed in the CMS Work Plan and summarized in Section 7.2, the corrective measures alternatives considered due to the presence of site-related contaminants in the collection trenches are:

- Maintain existing water recovery and monitoring program;
- Improve cover and drainage to reduce infiltration
- Install barrier wall to reduce lateral inflow of groundwater.

These alternatives are considered in addition to those evaluated for SWMUs 8 and 9 which may be contributing to contaminants detected in the dewatering trenches. These options have been evaluated relative to the threshold and balancing criteria (see Table 3g). Supporting documentation, including the estimated costs for each alternative, is provided in Appendix H.

<u>Summary of Alternatives</u>

- **Alternative 1: Maintain Existing Program**

  As noted above, presence of contamination in the water collected in the sumps has been documented during the semi-annual sampling events. The detected constituents are similar to those observed in groundwater samples, suggesting that shallow groundwater is migrating into the trench lines and collecting in the sumps.

Under this alternative, the current program of inspection, water recovery and testing would be continued. In addition, ESOI is designing an automated system to remove liquids from the trenches, including Trench III, which is scheduled to be in place later in 2012. Liquids pumped out of the trenches will be held in tanks, which will be monitored for the presence of oil. The trenches will also be monitored for the presence of oil. Inspections will be conducted on a schedule to be agreed upon by ESOI and the City of Toledo. If oil is observed in Trench III subsequent to the installation and implementation of the automated system, ESOI will continue to pump or remove oil as necessary. The volume of oil removed will be documented and recorded over time.

- **Alternative 2: Improve Cover over Waterline Right-of-Way**

  In order to reduce the management of infiltrating storm water and improve efficiency of the existing collection system operations (e.g., reducing the volume of water to be managed), this alternative would include removing vegetation from drainage ditches along this AOC, and regrading and recapping the area to improve the runoff and reduce infiltration. It is assumed that this work would be performed within 100 feet from the eastern end of the AOC (near the southeast corner of Cell H/northeast corner of Cell I) and extend to western end of SWMU 8 – a total length of approximately 1,800 feet. In addition, the storm water ditches on each side of AOC 1 would be lined to reduce infiltration. Inspections, water recovery and testing would continue as described for Alternative 1. Costs to regrade/recap the area would be approximately $115,000.

- **Alternative 3: Installation of Barrier Walls**

  In order to prevent contaminated groundwater from entering the collection trenches, a barrier wall would be constructed into the upper till zone (35 feet) along the border of this AOC. Since concentrations of concern were identified during the RFI in Trench 3, this alternative would include the installation of a sheet pile wall on the north side of Trench 3. This barrier wall would connect with the existing sheet pile wall surrounding Cell G and extend to the southeast corner of SWMU 9. In addition, the storm water ditches on each side of AOC 1 would be lined to reduce infiltration. Control of shallow groundwater inflow from the southern side of the AOC (i.e., SWMU 8 side) is addressed as part of the corrective measures for SWMU 8. The estimated cost for this alternative is $1,064,000.

Comparison of Alternatives

As summarized in Table 3g, all three alternatives achieve the threshold and balancing criteria to some extent. Combined with the facility health and safety program, Alternative 1 reduces the volume of contaminated groundwater present in the water line trenches and prevents groundwater from migrating into the waterline area where excavation, if needed, is most likely to occur in this AOC. Thus, the system is operating consistent with the design objectives. Alternative 2 represents an enhancement to the existing program by reducing the volume of water that must be managed in the collection system. Alternative 3 provides the greatest control by reducing lateral migration of contaminated shallow groundwater into AOC 1 where potential exposures could occur. However, the potential risks identified in the RFI for this AOC would only occur in the unlikely event that excavation outside the collection trench is required. The more likely excavations would occur between the collection trench and the waterline. Because of the low potential for exposure in this AOC, and the exposure controls provided by the facility health and safety program, the level of effort and cost associated with the more extensive Alternative 3 is not warranted. However, reduction of infiltrating storm water into the trenches would reduce the water management requirement associated with the existing program. Therefore, ESOI proposes to implement Alternative 2 to reduce the need to manage storm water that collects in the trenches. In addition, ESOI will utilize the data from continued water line trench inspection and monitoring to assess the performance and effectiveness of the corrective measures selected for SWMUs 7, 8 and 9 in reducing migration of contaminated groundwater into the trenches.

8.2.8 Groundwater Containment Systems – SWMUs 5 and 6

8.2.8.1 SWMU 5

The RFI baseline risk assessment identified two shallow monitoring locations adjacent to SWMU 5 (one on north side and one on south side) where potentially significant risks were identified if contact with groundwater occurs. These areas are addressed by the amended health and safety protocols described in Section 8.1.2. In addition, as discussed in Section 5.2.1, installation of slurry or sheet pile walls along the north and west boundaries of SWMU 5 was evaluated in response to Ohio EPA’s January 27, 2005 informal request for evaluation of presumptive corrective measures. Based on consideration of the site conditions and likelihood of exposure, it was decided that a barrier wall was not necessary as part of presumptive corrective measures. While installing a groundwater containment system would be protective of human health and the environment by mitigating off-site migration of groundwater in these areas, the existing leachate extraction system and associated groundwater monitoring near SWMU 5 ensures continued progress toward attainment of media clean-up standards by creating an inward gradient to the property and preventing further contribution of hazardous constituents to shallow groundwater. Therefore, this option will not be retained for further consideration in the corrective action program.

8.2.8.2 SWMU 6

The RFI baseline risk assessment identified two shallow monitoring locations (one on northwest corner and one on the northeast) where potentially significant risks were identified if contact with groundwater occurs. These areas are addressed by the amended health and safety protocols described in Section 8.1.2. In addition, as discussed in Section 5.2.1, installation of slurry or sheet pile walls along the northern boundary of SWMU 6 was evaluated in response to Ohio EPA’s January 27, 2005 informal request for evaluation of presumptive corrective measures. Based on consideration of the site conditions and likelihood of exposure, it was decided that a barrier wall was not necessary as part of presumptive corrective measures. While installing a groundwater containment system would be protective of human health and the environment by mitigating off-site migration of groundwater in these areas, the existing leachate extraction system and associated groundwater monitoring near SWMU 6 ensures continued progress toward attainment of media clean-up standard (see Section 9.2) by creating an inward gradient to the property and preventing further contribution of hazardous constituents to shallow groundwater. Therefore, this option will not be retained for further consideration in the corrective action program.

9 PROPOSED FINAL CORRECTIVE MEASURES

The purpose of this CMS is to identify, assemble, and evaluate corrective measures alternatives and recommend the corrective measure(s) to be taken at the Otter Creek Road Facility. As part of this CMS process, corrective measures alternatives were identified based on the observed site conditions, the results of the RFI baseline risk assessment, and effectiveness of completed or ongoing corrective measures. These alternatives were screened against CMS corrective action objectives defined in the CMS Work Plan, and based on this screening evaluation, ESOI has recommended alternatives for each of the SMWUs/AOCs retained for corrective measures. In addition, ESOI is recommending modifications to its RCRA groundwater monitoring program to incorporate the findings of the RFI, and integrate corrective action monitoring.

9.1 RECOMMENDED CORRECTIVE MEASURES

ESOI is recommending additional corrective measures at the Otter Creek facility to improve the performance of existing in-place waste management units and the potentially significant exposures to hazardous waste/hazardous constituents detected at several on-facility locations. These additional corrective measures will be implemented to complement existing containment and monitoring systems, and ongoing presumptive corrective measures. As described in Section 8, ESOI is recommending the corrective measures alternatives that are expected to efficiently and effectively address the observed conditions, commensurate with the risks characterized in the RFI. Further, the recommended alternatives generally reflect the options that achieve the acceptable level of protection of human health and the environment, while reducing the uncertainty associated with successful implementation of the remedy; minimizing the potential exposure to wastes associated with remedy implementation; and minimizing manpower, energy and/or material consumption associated with remedy construction and long-term maintenance. The recommended alternatives for each SWMU/AOC are presented on Table 4.

9.2 GROUNDWATER MONITORING PROGRAM

9.2.1 Review of Existing Program

ESOI has conducted extensive groundwater monitoring at the Otter Creek Road Facility as required by the provisions of OAC 3745-54-91 for more than 20 years. The groundwater monitoring program has included not only the required monitoring of the upper-most aquifer but also additional monitoring of (1) groundwater in the contact zone between the lacustrine and upper till, and (2) groundwater in the contact zone between the upper till and lower till, which are both above the upper-most aquifer. Monitoring of these discrete water-bearing zones above the upper-most aquifer was originally included to provide early warning of releases from the Facility that could adversely affect the upper-most aquifer.

Currently, the groundwater monitoring program includes a network of 124 monitoring wells, which consist of 29 wells that monitor the upper-most aquifer (bedrock wells), 50 wells that monitor the contact zone between the shallow and deep tills (deep till wells), and 45 wells that monitor the contact zone between the lacustrine and shallow till (shallow till wells). The 95 deep till and shallow till wells are not required under OAC 3745-54-91, and were installed prior to the extensive groundwater monitoring and additional RFI field investigation which in combination have provided a comprehensive understanding of site hydrogeology and source characteristics that was not available when these early warning monitoring wells were installed. The 124 monitoring wells are location on the perimeter of the Facility and along York Street, which bisects the Facility (see Figures 5a through 5c).

The network of wells is monitored semiannually for the parameters listed in Tables K-1, K-2, and K-3 of Module K of ESOI's May 2008 RCRA Hazardous Waste Permit ("Permit Tables"). These parameters include: 15 VOCs; total phenols; dissolved barium; dissolved cadmium, dissolved chromium, dissolved lead, cyanide; pH, specific conductance, temperature, and turbidity.

In detection monitoring under Module K of ESOI's permit, groundwater data from the monitoring network for the parameters in Permit Table K-1 are compared to the practical quantitation limits (PQLs) in Table K-1 to identify "elevated concentrations." The monitoring data for parameters in Permit Table K-2 are compared to intra-well prediction limits to identify elevated concentrations. Monitoring wells from any groundwater unit with elevated concentrations are designated as "Affected Wells".

Currently, the monitoring network has no Affected Wells in the upper-most aquifer, but 11 of the 95 early warning wells that monitor the shallow and deep till contact zones are Affected Wells. The 11 Affected Wells include 6 wells located around SWMU 5 (4 shallow till wells MR-1SA, MR-2S, MR-3S, and MR-4S; and 2 deep till wells MR-2D and MR-3D) and 5 wells located around SWMU 6 (4 shallow till wells SW-1S, SW-2S, SW-3S, and F-2S [located at northwest corner of SWMU 6 and northeast corner of SWMU 1]; and 1 deep till well SW-3D). The Affected Wells are identified on Figures 5b and 5c. Associated with the Affected Wells are 20 Adjacent Wells (i.e., wells on each side of an Affected Well) and 19 Clustered Wells (i.e., wells clustered with an Affected Well that monitor either deeper or shallower zones). Per Module K of ESOI's permit, the Affected, Adjacent, and Clustered Wells are all subject to the compliance monitoring requirements of OAC 3745-54-99 even though they are not monitoring the upper-most aquifer.

The Affected Wells are sampled each April for Appendix 98 constituents; wells Adjacent to and Clustered with a newly designated Affected Well are sampled for Appendix 98 constituents when the well is initially designated as Affected. The Appendix 98 monitoring data are compared to PQLs for non-naturally occurring constituents and are compared to intra-well statistical limits or PQLs for naturally-occurring parameters, to identify elevated concentrations.

As part of this monitoring program, elevated concentrations in the shallow till and deep till wells are evaluated using the ACL model to determine their environmental significance (i.e., potential to adversely affect human health and the environment), and the need for corrective action under OAC 3745-54-100. In addition, the groundwater data were fully evaluated with respect to their environmental significance as part of ESOI's facility-wide corrective action program (ENVIRON 2009).

The bedrock monitoring well network and bedrock groundwater flow directions were also reviewed to identify modifications that may enhance coverage around the disposal units. As discussed in Section 2.7, groundwater flow direction in the bedrock varies seasonally, with the predominant directions of flow being to the northwest, west, northeast, east, and southwest. As shown in Table 5, the spacing of bedrock wells along the facility perimeter adjacent to disposal units is no more than 700 ft, in the predominant direction of groundwater flow, which is believed to be adequate. The spacing of bedrock wells along the rest of the facility perimeter adjacent to disposal units (including York Street which bisects the facility) is also believed to be adequate, in that it is no more than 800 ft, except along the southeastern corner of Cell I where the spacing is almost 1,200 ft. Based on this review, ESOI proposes to install one additional bedrock monitoring well on the east side of Cell I to reduce the well spacing consistent with the spacing along the rest of the facility perimeter adjacent to disposal units (see Figure 5a). In addition, at Ohio EPA's request, ESOI will recondition existing bedrock well DUG-1 so that it may be used for groundwater quality sampling, in addition to its current use for groundwater elevation measurements.

ESOI also will install a bedrock monitoring well on the north side of SWMU 6 where Ohio EPA had requested a bedrock monitoring well between R-16 and R-3 at the approximate location of former bedrock monitoring well QD-3R. QD-3R was sampled for Appendix IX parameters in 1995 and 1996 during USEPA's RFI for SWMU 6, and the results demonstrated that the bedrock groundwater was not contaminated. In the subsequent years until mid-2008 when QD-3R was inadvertently plugged, neither USEPA nor Ohio EPA required inclusion of QD-3R in the Facility's groundwater monitoring network. The potential for a future release from SWMU 6 is even lower now since ESOI is performing corrective measures at SWMUs 5, 6, and 7 which are designed to greatly minimize the chance of a release from the units. Even if a release were to occur at SWMU 6, findings from the recent RFI indicate that the release would have very low, if any, potential to affect bedrock groundwater because essentially no hydraulic connection exists between the deep till contact zone and the bedrock aquifer. This absence of hydraulic connection was determined in the investigation conducted under Ohio EPA oversight at SWMU 6 at bedrock monitoring well R-24 during the recent RFI. In drilling R-24, the deep till was found to be dry down to the bedrock interface, and bedrock groundwater was encountered only after drilling continued into the bedrock; groundwater was found to be under pressure (i.e., has an upward pressure gradient). Notwithstanding the apparent lack of hydraulic connection, if a release from SWMU 6 were to reach bedrock groundwater, the new monitoring well at the location of former QD-3R may only minimally enhance detection of the release since bedrock groundwater under SWMU 6 flows to the north during only a small fraction of time, as shown in Appendix I, which includes a figure that summarizes the bedrock groundwater flow directions at SWMU 6 from 2006 to 2011 based on the semiannual monitoring events.

9.2.2 Program Modifications

9.2.2.1 Factual Basis

As part of the CMS, the current RCRA groundwater monitoring program at the Facility was re-evaluated to identify modifications that would: (1) provide timely assessment of changes in groundwater quality as a result of implementing the selected corrective measures; and (2) improve efficiency of the monitoring program by accounting for key findings from the recently completed RFI, findings from the 20+ years of groundwater monitoring, and provisions of the RCRA Hazardous Waste Permit apart from groundwater monitoring that provide for early warning of a release from the regulated disposal units.

The identification of appropriate modifications to the current RCRA groundwater monitoring program was based on the following facts:

- Extensive RCRA groundwater monitoring data and RFI data demonstrate that the Facility has not affected the upper-most aquifer.
- A few shallow and deep till monitoring wells adjacent to unlined disposal units (specifically SWMUs 5 and 6) have detected releases to discrete water-bearing zones above the upper-most aquifer. However, based upon estimations of fate and transport presented in the RFI Final Report (ENVIRON 2009), the elevated concentrations in these wells are below levels that could adversely affect the upper-most aquifer.
- The rate of groundwater flow in the lacustrine/shallow till contact zone ranges from 0.12 ft/yr to 5.6 ft/yr. Details of the flow rate estimation were presented in the Supporting Evaluation for the Request for Permit Modification to Change Groundwater Monitoring Frequency (ENVIRON 2001); see Appendix I.
- The rate of groundwater flow in the shallow/deep till contact zone ranges from 0.014 ft/yr to 0.52 ft/yr (ENVIRON 2001).
- The travel time for groundwater in the shallow/deep till contact zone to reach the upper-most aquifer is approximately 200 years, based on the parameters and assumptions specified in the ACL model (Appendix E.12, Part B Permit Application). The transport times for constituents with an elevated concentration are at least twice as long, based on their physical-chemical properties and the characteristics of the lower till.
- There is no evidence of a release from any lined disposal unit, based upon historical groundwater data from the shallow and deep till wells, and the bedrock wells.

- The rate of leachate generation for each of the lined disposal units has decreased substantially over the past 20 years. These rates are shown on the figures in Appendix I.
- For the lined disposal units, the RCRA Hazardous Waste Permit includes provisions for ongoing assessment of leachate generation rates against criteria such as the action leakage rates (ALRs), and for response actions that provide early detection and correction of any problems with the leachate management systems that could impact groundwater. The details of these provisions can be found in Appendix D.32 of ESOI's 2006 Part B Permit Application (e.g., ALRs are in Table 6-1, response actions when flow rates are less than the ALRs are in Section 6.1, and response actions when a flow rate exceeds an ALR are in Section 6.2).

9.2.2.2 Program Goals

Given the above facts and the objectives of both the RCRA corrective action program and the RCRA groundwater monitoring program, the following are believed to be appropriate goals of a modified groundwater monitoring program:

- The upper-most aquifer (i.e., bedrock) should remain in detection monitoring, since it has not been affected by any release from the Facility, as demonstrated by extensive monitoring over time. This monitoring would satisfy all of the requirements for groundwater monitoring under OAC 3745-54-91.
- In addition to satisfying the requirements of OAC 3745-54-91, current Affected Wells that monitor the two contact zones above the upper-most aquifer around SWMUs 5 and 6 should be monitored under OAC 3745-54-101 to assess the effectiveness of the selected corrective measures for these units, which includes the evaluation of whether additional correctives measures or modification of the selected corrective measures are warranted.
- In addition to satisfying the requirements of OAC 3745-54-91, the shallow till and deep till wells that are adjacent to unlined disposal units (and are not Affected Wells) should be monitored as necessary to detect releases from the unlined units, and to assess if a release poses a significant risk as determined using the risk assessment methodology from the recently completed RFI.
- The shallow till and deep till wells that are not Affected Wells and adjacent to only lined disposal units (i.e., not also adjacent to an unlined disposal unit) should be maintained to allow for future groundwater monitoring in the event that such monitoring is determined to be warranted based on the assessment of leachate management performance of the lined disposal units as required in the RCRA Hazardous Waste Permit.

9.2.2.3 Key Elements

Based on the above considerations, the key elements of the modified RCRA groundwater monitoring program are summarized on Tables 6a, 6b, and 6c, and are discussed below.

Bedrock (Upper-Most Aquifer)

As discussed above, ESOI will add three wells to the bedrock monitoring network: (1) a bedrock monitoring well will be installed along the east side of Cell I to reduce the spacing of bedrock wells in this portion of the perimeter monitoring network consistent with the spacing along the rest of the facility perimeter adjacent to disposal units; (2) existing bedrock well DUG-1 will be reconditioned to allow for groundwater sampling; and (3) a bedrock monitoring well will be installed on the north side of SWMU 6 at the approximate location of former bedrock monitoring well QD-3R. Other than these additional wells, no modification of the current groundwater monitoring program for the bedrock (upper-most aquifer) is necessary. The existing bedrock monitoring program has been in place for many years, the coverage is adequate in the predominant bedrock groundwater flow directions, and a review of the RCRA groundwater monitoring data and the recent RFI groundwater data found no basis for modifying the program. The key elements in Table 6a for the upper-most aquifer are consistent with the current detection monitoring program.

Deep Till Contact Zone Monitoring

The current RCRA groundwater monitoring program includes 50 wells that monitor the deep till contact zone. Three of these wells are currently designated as Affected Wells: MR-2D and MR-3D at SWMU 5; and SW-3D at SWMU 6. As indicated in Table 6b, the modified monitoring program would monitor these wells for Appendix 98 parameters every 5 years. The Appendix 98 parameters to be monitored will be determined by identifying the hazardous constituents that have been detected in the Facility's existing leachate and groundwater sampling data. Deep till wells that are not designated as Affected Wells and are located adjacent to an unlined unit will be monitored for the parameters on Permit Table K-1 to Table K-3 every 5 years.

Elevated organic constituents in the monitoring data will continue to be identified by concentrations that exceed PQLs. Elevated metal constituents will be identified by concentrations that exceed background levels, which will be based on the maximum intra-well prediction limits among all deep till wells. The predictions limits will be calculated using dissolved metals data when available; otherwise, they will be calculated using "total" metals data. As required by its RCRA permit, ESOI will submit updated background levels to Ohio EPA following the April 2012 monitoring event.

The potential for elevated constituent concentrations to adversely affect the uppermost aquifer will be initially evaluated by comparison to screening criteria calculated using the methodology described in USEPA's Soil Screening Guidance ("SSG"; USEPA 1996) for assessing the potential for contaminant infiltration from a source to impact underlying groundwater. No other risk-based criteria are relevant to groundwater in the deep till contact zone since no exposure pathway aside from potential migration to bedrock exists, as discussed in the RFI Report. Screening criteria for migration to bedrock groundwater are calculated using a dilution factor estimated using Equations 11 and 12 from the SSG with parameter values that are representative of conditions at the Facility, and with potable water criteria applicable to the bedrock aquifer (see Appendix I)[13]. The dilution factor for each SWMU and the parameters used for the calculation of screening criteria are summarized in Appendix I. Appendix I also shows the groundwater screening criteria that have been calculated following this methodology for the Permit Table K-1 and Table K-2 parameters.

Elevated constituent concentrations that do not exceed the screening criteria will be added to the list of monitoring parameters for the particular unit so that future monitoring can assess any temporal trends. Elevated constituent concentrations that exceed the screening criteria will be assessed to determine whether the cumulative cancer risk and HI exceed 10^{-5} and 1, respectively. If the cumulative cancer risk or HI exceeds these limits, the need for additional corrective measures or modification of the existing corrective measures will be evaluated. The identification of new elevated constituents would also trigger sampling of adjacent deep till wells for the new elevated constituent(s) and Appendix 98 constituents in the same analyte group.

The monitoring frequency for the deep till wells (both Affected Wells and unaffected wells adjacent to an unlined unit) is being reduced to every 5 years from the current frequency of every 6 months on the basis that constituent travel time from the deep till zone to bedrock groundwater is approximately 200 years or more, based on the specification of the ACL model. Given the long travel times for potential migration of constituents from the deep till contact zone to bedrock groundwater, a 5 year monitoring frequency should provide sufficient time with a wide margin of safety for taking action to address a potential problem.

The deep till wells that are not designated as Affected Wells and are adjacent only to lined disposal units will be monitored for the parameters on Permit Tables K-1 to K-3 only if such monitoring is determined to be warranted based on the assessment of leachate management performance as specified in the RCRA Hazardous Waste Permit. The key provision of the Permit requirements that would trigger monitoring of these wells is an exceedance of an action leak rate (ALR) specified in Appendix D.32, Table 6-1 of ESOI's Part B permit application, with exceedances of the secondary-leachate concentration limits specified in Appendix D.32, Table 6-2 (which may be updated in the future as part of a permit modification to reflect changes in drinking water standards, toxicity values, and other factors that are appropriate to setting action limits for secondary leachate systems). Appendix D.32 of ESOI's Part B

[13] Criteria for protection of the bedrock aquifer are based on standards established under the Safe Drinking Water Act; these values are divided by a factor of 10 for screening purposes. For constituents without a drinking water standard, an equivalent risk-based criterion was calculated with a target cancer risk and HQ of 10^{-6} and 0.1, to facilitate efficient evaluation of monitoring data.

permit application provides ALRs and action limits for Cells G, I, and M, which are all double-lined units.

The use of ALRs to trigger monitoring of the deep till wells that are adjacent to only a double-lined unit is appropriate because regulatory agencies have determined that leaks into leak detection systems below the ALR are sufficiently low that a release from the unit is unlikely, as discussed in the preamble to USEPA's final rule on Liners and Leak Detection Systems for Hazardous Waste Land Disposal Units (57 FR 3462, January 29, 1992), which states:

> The action leakage rate is a leakage rate [into the leak detection system] that requires implementation of a response action to prevent hazardous constituent migration out of the unit. The Agency has determined, the public comments support, the need for an ALR and response actions that the ALR triggers. EPA believes that the ultimate goal of the liner and leak detection system requirements is to prevent the release of hazardous constituents from the unit, thereby protecting the ground water and surface water. A system in place to detect leaks at the earliest practical time should be complemented by early follow-up actions to effectively minimize the chance for migration of hazardous constituents from the unit. Furthermore, it is often more effective to address leaks within the liners than to later address ground-water contamination through corrective action. (emphasis added)

Since leakage into the leak detection system that exceeds the ALR triggers response actions to minimize the chance for a release from the unit, it is logical to conclude that leakage into the leak detection system below the ALR should not warrant response action to minimize the chance of a release. That is, the final rule essentially established that when leakage into the leak detection system is low enough (i.e., below the ALR), the chance of a release from the unit is too low to warrant response action (such as monitoring the deep till wells adjacent to the double-lined unit).

Shallow Till Contact Zone Monitoring

The current RCRA groundwater monitoring program includes 45 wells that monitor the shallow till contact zone. In addition, three monitoring wells (G-4S, T-42S and T-54S) adjacent to SWMU 8 will be added to the list of shallow till wells, as discussed in Section 8.2.4. Eight of the current monitoring program wells are currently designated as Affected Wells: MR-1SA, MR-2S, MR-3S, and MR-4S at SWMU 5; and SW-1S, SW-2S, SW-3S, and F-2S at SWMU 6. As indicated on Table 6c, the modified monitoring program would continue to monitor these wells semiannually for the parameters on Permit Tables K-1 to K3 and elevated constituents as long as the leachate level in the adjacent SWMU is above the shallow till contact zone elevation. These wells will also be sampled biennially for Appendix 98 parameters. The Appendix 98 parameters to be monitored will be the same as those for the deep till wells; i.e., determined by identifying the hazardous constituents that have been detected in the Facility's existing leachate and groundwater sampling data. Shallow till wells that are not designated as Affected Wells also will be monitored semiannually for the parameters on Permit Table K-1 to Table K-3 as long as the average leachate level in the adjacent SWMU is above the shallow till contact zone elevation.

Elevated constituents in the monitoring data will continue to be identified by concentrations that exceed background or PQL. The identification of a new elevated constituent would trigger Appendix 98 sampling of the well in which the elevated constituent was found and sampling of adjacent wells for the new elevated constituents and Appendix 98 constituents in the same analyte group.

The criteria for responding to elevated concentrations under the modified monitoring program would be criteria based on the potential to pose a significant risk under the exposure scenarios identified during the RFI baseline risk assessment. Specifically, these criteria are calculated using the methodology that was used in the RFI risk assessment to assess the groundwater data from the shallow till monitoring wells as described in Section 5.5.2 of the RFI Report. Screening criteria for these exposure scenarios are calculated using a target cancer risk and HQ of 10^{-6} and 0.1, to facilitate efficient evaluation of monitoring data (see Appendix I for the parameters on Permit Tables K-1 to K-2). Concentrations below these screening criteria would require no further evaluation. Concentrations exceeding these screening criteria would trigger an assessment to determine whether the cumulative cancer risk and HI exceed 10^{-5} and 1, respectively. If the cumulative cancer risk or HI exceeds these limits, the need for additional corrective measures or modification of existing corrective measures will be evaluated. Monitoring wells that were identified during the RFI with concentrations exceeding the cumulative cancer risk limit or HI limit are shown on Figure 5c. These wells include SW-2S, T-3S, T-16S, and T-24S, which are located at SWMUs 5 and 6 where ESOI is currently performing corrective measures. ESOI will evaluate any changes in the groundwater data from these wells to determine if additional corrective measures or modification of the current corrective measures are warranted.

When the average interior leachate level in a SWMU is below the average level of the exterior shallow till contact zone, shallow till wells that are not designated as Affected Wells will be monitored annually for water levels only, and Affected Wells will be monitored annually for water levels and biennially for the constituents with concentrations that exceed the cumulative cancer risk or HI limit. The reduction in monitoring when the leachate level is below the shallow till contact zone is appropriate because leachate cannot migrate into the shallow till zone under this condition. Normally, the leachate elevation in lined SWMUs is below the shallow till contact zone because the RCRA Hazardous Waste Permit requires keeping the leachate level from rising more than 1 foot above the top liner, and this level is below the screen bottom of the shallow till wells. A comparison of current leachate levels and the leachate compliance levels to the contact zones adjacent to each landfill unit is included in Appendix I, which shows that the current leachate levels at the lined disposal units are all below the shallow till contact zone.

The leachate elevation in the lined SWMUs will be monitored quarterly. In the unlikely event that the leachate level in a lined unit rises above the screen bottom of a shallow till well (e.g., due to a prolonged problem with the leachate management system) at any time after the last groundwater monitoring event, the shallow till well will be monitored for the parameters on Permit Table K-1 to K-3 on a schedule to be determined in consultation with Ohio EPA based on the nature of the problem and the response actions taken to address the problem.

10 PUBLIC INVOLVEMENT PLAN

10.1 INTRODUCTION

The Public Involvement Plan (PIP) is intended to identify the mechanisms for the dissemination of information to the public regarding the selected corrective measures and implementation of those corrective measures.

10.2 PUBLIC INVOLVEMENT PROGRAM ACTIVITIES

10.2.1 Public Involvement Goals

The PIP provides a set of procedures for the dissemination of information to the public regarding Corrective Measures Implementation (CMI). The goal of the PIP is to:

- Keep the public informed as the CMI progresses, and
- Provide a mechanism for disseminating information on a routine, as well as, non-routine basis to the public.

Implementation of the PIP will ensure a regular flow of progress information from ESOI to the general public during the course of the CMI process. A summary of the public involvement activities potentially applicable to this CMI program is provided on Table 7.

10.2.2 Communications Provisions

To promote easy access to corrective measures progress, a Corrective Action Page has been created on the ESOI website (www.envirosafeservices.com). A description of the corrective measures documentation that will be included on the website is provided in Section 10.2.3. In addition, the distribution list specified by USEPA for this project is provided on Table 7.

10.2.3 PIP Implementation

10.2.3.1 RFI Report

The RFI Report will be included on the website.

10.2.3.2 CMS Report

The CMS Report will be included on the website.

10.2.3.3 Progress Reports

ESOI will prepare and submit to Ohio EPA reports on the progress of the CMI implementation. The monthly progress reports will be prepared to provide prompt and accurate information regarding the status of the project to interested parties. Progress reports will be posted on the website.

10.2.3.4 Unscheduled Communication

ESOI will, as necessary, respond to comments or concerns of individual members of the public in response to individual requests.

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T A B L E S

Table 1: Summary of Previously Implemented Corrective Measures ESOI Otter Creek Facility, Oregon, Ohio		
Unit	**Presumptive Corrective Measures Completed Prior to CMS**	**Additional Ongoing Actions**
SWMU 1 **Landfill Cell F**	• Landfill cap drainage improvements and repair of the leachate sump collar were made to minimize infiltration of liquids and promote positive drainage of precipitation. Regrading completed in late 2009. • Initiated enhanced inspection and survey program in 2010. Note: Ponding was still observed in one descrete location after regrading in 2009; landfill cap was regraded again in August 2010. Ponding no longer observed.	Revised Explosive Gas Monitoring Plan has been submitted to Ohio EPA. Continued contigency monitoring in place.
SWMU 5 **Millard Road Landfill**	• Leachate recovery system of two recovery wells were installed by June, 2007 and became fully operational in July, 2007. • Passive gas vents installed (vented recovery wells). • Expansion and enhancement of leachate recovery systems. • Landfill gas monitoring. Note: Recommendations from 24 month leachate recovery system performance assessment approved by Ohio EPA in August 2010 and implemented, including well testing, cleaning of wells to prevent pump fouling, updated target leachate levels and the conversion of a piezometer to a recovery well.	Evaluation of performance of the Leachate Extraction System to determine if any further enhancements are needed. Revised Explosive Gas Monitoring Plan has been submitted to Ohio EPA. Continued contigency monitoring in place.
SWMU 6 **Northern Sanitary Landfill**	• Leachate recovery system of five recovery wells were installed by June, 2007 and became fully operational in July, 2007. • Passive gas vents installed (vented recovery wells). • Landfill gas monitoring. • Expansion and enhancement of leachate recovery systems. • Cap repairs in the northeast corner to ensure proper drainage. Note: Recommendations from 24 month leachate recovery system performance assessment approved by Ohio EPA in August 2010 and implemented, including well testing, cleaning of wells to prevent pump fouling, updated target leachate levels and the conversion of a piezometer to a recovery well.	Evaluation of performance of the Leachate Extraction System to determine if any further enhancements are needed. Revised Explosive Gas Monitoring Plan has been submitted to Ohio EPA. Continued contigency monitoring in place.
SWMU 7 **Central Sanitary Landfill**	• Leachate recovery system of three recovery wells were installed by June, 2007 and became fully operational in July, 2007. • Passive gas vents installed (vented recovery wells). • Expansion and enhancement of leachate recovery systems. •Landfill gas monitoring Note: Recommendations from 24 month leachate recovery system performance assessment approved by Ohio EPA in August 2010 and implemented, including well testing, cleaning of wells to prevent pump fouling, updated target leachate levels, the conversion of a piezometer to a recovery well and a broken recovery wellto a piezometer.	Evaluation of performance of the Leachate Extraction System to determine if any further enhancements are needed. Revised Explosive Gas Monitoring Plan has been submitted to Ohio EPA. Continued contigency monitoring in place.
SWMU 8 **Old Oil Pond #1 (South Pond)**	None	

Table 1: Summary of Previously Implemented Corrective Measures
ESOI Otter Creek Facility, Oregon, Ohio

Unit	Presumptive Corrective Measures Completed Prior to CMS	Additional Ongoing Actions
SWMU 9 **New Oil Pond #2 (North Pond)**	• Cap excavated and recompacted in area of oily water seeps; and delineation of free liquids under the cap was conducted in 2009. Note: Visual inspection in June 2010 identified oily water seepage along the eastern portion of the unit and near certain vent pipes. Storm water ponding was occurring in the vicinity of the vent pipes.	ESOI has also been conducting routine inspections and periodically removes accumulated water from the cover area as needed.
AOC 1 **Toledo Water Lines**	• Installation and operation of water line monitoring trenches • Periodic accumulated liquid removal from trench collection sumps. • Any liquid collected in the sumps is analyzed by the City of Toledo quarterly for the indicator parameters.	Trench inspection program currently ongoing in accordance with the agreement with the City of Toledo and State RCRA Permit.
AOC 6 **Oily Waste Above Ground Storage Tanks**	• All Above ground storage tanks removed from AOC 6. Associated piping, sump, and drainage layer were removed. • Soil under the tanks was removed. • A new 12,250 gallon tank was installed in the leachate tank farm area between SWMU 7 and Cell H to manage oily waste from AOC 6.	Backfilling/capping the area with at least 3 feet of re-compacted clay is being currently performed. Area is being graded to promote positive drainage to the nearby perimeter ditch.
AOC 7 **Butz Crock—Concrete Utility Vault**	None	
AOC 12 **Building C Heating Oil Tank**	• Excavated fuel oil impacted soil and replaced with clean fill in April 2000. • Installed a protective outer sleeve of steel piping to prevent damage to the feedline in April 2000. • Storm water and ice machine drainage pipes removed/rerouted in 2006 and plugged.	None

Table 2: Summary of Corrective Measures Evaluated in CMS ESOI Otter Creek Facility, Oregon, Ohio			
Unit	**General Description and Background**	**RFI Conclusions**	**Corrective Measures Evaluated in CMS**
All SWMUs/AOCs			• Establish institutional controls on land use and groundwater use. • Amend the Facility's Health and Safety Plan to identify and address locations where potentially significant exposures could occur. • Amend or modify the Facility's RCRA groundwater monitoring program. • Upgrade engineering controls (i.e., fencing and/or security). • Install pretreatment facility for leachate recovered from landfills. • Restore areas disturbed during implementation of corrective measures.
SWMU 1 Landfill Cell F	• SWMU 1 is a closed permitted RCRA hazardous waste landfill of approximately three (3) acres. • Landfill was in operation from 1980 to 1983 for the disposal of both non-hazardous industrial waste and RCRA hazardous waste. The wastes disposed included bulk and containerized solids, primarily consisting of treated sludges, landfarm soil, ignitable solids, refinery solids, paint solids and contaminated soils, along with non-hazardous industrial waste solids. • The estimated waste thickness is 50 to 55 feet, with a total disposed volume of waste of approximately 146,000 tons. • There is an existing leachate collection sump and laterals installed in the unit for leachate recovery. • Evaluation of physical properties: - Bottom is clay. - Landfill cap is 9 to 10 feet thick of the clay soil cover; properties of clay cover are acceptable. - One area of the cap observed to accumulate storm water as a result of grading to accommodate the overhead electric transmission lines. - Explosive gas measurements did not exceed the screening level of 25% of the lower explosive limit.	• No unacceptable human health risks • No unacceptable ecological risks	• Maintain existing control systems (leachate recovery and landfill cap) • Modify the maintenance program for the existing leachate collection pipes to improved leachate recovery. • Upgrade landfill cap to composite cover (i.e., geomembrane/clay) • Install active landfill gas recovery system
SWMU 5 Millard Road Landfill	• SWMU 5 is a pre-RCRA unit of approximately eight (8) acres. • Landfill was operated from approximately 1976 to 1981 and was used primarily for disposal of construction and demolition material and solid waste, principally debris from the demolition of an oil refinery. • The approximate waste thickness is 24 to 50 ft and the volume is reported to be approximately 224,600 cubic yards. • Evaluation of physical properties: - Landfill cap ranges from 6.5 to 17 feet thick, provides adequate drainage. Properties of the clay soil cover are acceptable. - Explosive gas measurements from monitoring probe 13 near SWMU 5 exceeded the relevant screening level of 25% of the lower explosive limit. None of the sustained explosive gas readings exceeded the screening criteria. • Subsurface NAPL has been recovered from area adjacent (west) of this Landfill as part of recovery tests.	• No unacceptable human health risks except: - Outdoor routine facility workers to subsurface NAPL - Maintenance workers to shallow groundwater when considering unfiltered data • No unacceptable ecological risks	• Maintain existing control systems (leachate recovery, landfill cap, and gas vents) • Improve/expand the existing leachate collection system. • Upgrade the landfill cap to composite cover (i.e., geomembrane/clay). • Improve roadway areas serving as landfill cap. • Improve storm water drainage and/or mitigate infiltration of storm water. • Expand passive landfill gas vent system. • Install active landfill gas recovery system. • Install recovery system for NAPL detected in a subsurface peat layer outside the western edge of the landfill. • Install containment system (which could include a barrier cutoff wall) for the lacustrine/upper till groundwater.

Table 2: Summary of Corrective Measures Evaluated in CMS ESOI Otter Creek Facility, Oregon, Ohio			
Unit	**General Description and Background**	**RFI Conclusions**	**Corrective Measures Evaluated in CMS**
SWMU 6 Northern Sanitary Landfill	• SWMU 6 is a pre-RCRA solid waste unit area of about six and one-half (6.5) acres and was operated from 1976 through 1981. • Evaluation of physical properties: - Cap ranges from 2 to 7 feet thick, physical properties of the clay soil cover are acceptable, with the exception of the northeast corner where thickness was less than 2 feet and storm water/leachate was observed and landfill gas was noted bubbling through a crack in the cover soil. The northeast corner of the cap was repaired on March 23, 2007. Other than northeast corner, cap provides adequate drainage. - Waste thickness is at least 4 to 10 feet, solid waste was found to extend no more than 10 feet beyond the northern property line; off-facility waste layer was limited to 2 feet in thickness. - Initial explosive gas measurements exceeded the relevant screening level of 25% of the lower explosive limit. Sustained readings in March 2002 exceeded the screening level; however subsequent monthly sustained readings have not exceeded the screening level.	• No unacceptable human health risks except: - Outdoor routine facility workers to surface seeps - Maintenance workers to shallow groundwater when considering unfiltered data • No unacceptable ecological risks	• Maintain existing control systems (leachate recovery, landfill cap, and gas vents) • Improve/expand the existing leachate collection system. • Upgrade the landfill cap to composite cover (i.e., geomembrane/clay). • Improve roadway areas serving as landfill cap. • Improve storm water drainage and/or mitigate infiltration of storm water. • Expand passive landfill gas vent system. • Install active landfill gas recovery system. • Install recovery system for NAPL detected in a subsurface peat layer outside the western edge of the landfill. • Install containment system (which could include a barrier cutoff wall) for the lacustrine/upper till groundwater. • Manage off-site waste that has extended beyond the northern limits of the existing landfill cap.
SWMU 7 Central Sanitary Landfill	• SWMU 7 is a pre-RCRA solid waste unit with an area of approximately seven acres • Landfill was the first major cell to receive solid waste and operated from 1969 to 1983 • Evaluation of physical properties completed: - Cap ranges from 3.6 to 7.8 feet thick, physical properties of the clay soil cover and the roadway cover soils are acceptable, with the exception of the roadway cover sample collected from S7-202. Cap provides adequate drainage - Explosive gas measurements were all below 25 % LEL	• No unacceptable human health risks • Ecological exposures were not evaluated at this unit	• Maintain existing control systems (leachate recovery, landfill cap, and gas vents) • Improve/expand the existing leachate collection system. • Upgrade the landfill cap to composite cover (i.e., geomembrane/clay). • Improve roadway areas serving as landfill cap. • Improve storm water drainage and/or mitigate infiltration of storm water. • Expand passive landfill gas vent system. • Install passive active landfill gas recovery system. • Install recovery system for NAPL detected in a subsurface peat layer outside the western edge of the landfill. • Install containment system (which could include a barrier cutoff wall) for the lacustrine/upper till groundwater.
SWMU 8 Old Oil Pond #1 (South Pond)	• SWMU 8 is a closed pre-RCRA unit operated from the early 1960's through 1969 for recycling of oil with an area of approximately 6.7 acres. The remaining oil was pumped into a newly constructed oil pond (now SWMU 9) and the unit was backfilled with assorted sanitary and municipal waste and covered with a clay cap. At least part of the maintenance building (Building C) was constructed on top of SWMU 8. NAPL seepage has been observed but test pit activities did not identify a clear pathway. The seepage is likely related to seams between soil lifts in the cap or other weaknesses in the cover soil. In addition, LFG pressure was observed during drilling into this SWMU. • Evaluation of physical properties completed: - Cap ranged from 7 to 15 feet thick, clay soil cover is acceptable. - LFG pressure was observed during drilling. Elevated explosive gas levels were detected at several locations, including borings located immediately adjacent to Building C (Borings LFG-202 and -205). Peak concentration is below the hydrogen sulfide LEL, but above PEL and IDLH. Methane LEL levels ranged between 0 and 100 percent.	• No unacceptable human health risks except: - Routine facility and maintenance workers to NAPL seeps - Maintenance workers to shallow groundwater • Ecological exposures were not evaluated at this unit	• Install landfill gas recovery/venting system • Install leachate and NAPL recovery. • Excavate or stabilize NAPL, including restoration of excavated area. • Install and enhanced barrier system between the unit and the off-site utilities. • Install containment system for shallow groundwater. • Improve cap system. • Demolish Building C and construct a new building at an alternate location to house its operations. • Excavate waste and dispose in on-site corrective action management unit (CAMU), including restoration of excavated area.

Table 2: Summary of Corrective Measures Evaluated in CMS ESOI Otter Creek Facility, Oregon, Ohio			
Unit	**General Description and Background**	**RFI Conclusions**	**Corrective Measures Evaluated in CMS**
SWMU 9 New Oil Pond #2 (North Pond)	• SWMU 9 is a pre-RCRA unit with an area of approximately 1.6 acres • It was used for waste oil recovery after SWMU 8 was abandoned in the late 1960's. The unit operated through 1980. The oil was removed and the remaining sludge was solidified during placement. • Evaluation of physical properties completed: - Cover soils range from 6 to 9 feet thick, the physical properties of the clay soil cover are acceptable. NAPL/oily water seepage accumulates in a small area on the top of the unit. Outside of this area, observations indicate that the cap provides adequate drainage - Explosive gas readings from the physical property borings were below screening criteria. - Oily water mixture (water with an oily sheen) identified within the unit at the top of the solidified material.	• No unacceptable human health risk except: - Routine facility workers to NAPL seeps. • Ecological exposures were not evaluated at this unit.	• Install NAPL/oily water recovery system. • Remove free liquids observed at top of the solidified waste that may be contributing to surface outbreaks. • Upgrade landfill cap to composite cover (i.e., geomembrane/clay). • Improve cap drainage. • Restore area disturbed by corrective measures implementation. • Excavate waste from unit and dispose off-site.
AOC 1 Toledo Water Lines	• AOC 1 consists of two low-pressure raw water transmission lines that bisect the Facility in an east/west direction north of York Street. These lines, located north of SWMU 8 and south of SWMU 2 and SWMU 9, carry raw Lake Erie water to the city of Toledo Collins Park Water Treatment Plant. • One line is a 78 inch, steel pipe, constructed in 1939-1940 at a depth ranging from 11 to 21 ft bgs. Backfilling was accomplished with "selected clay", compacted to 24 inches above the top of the pipe. The second line, a 60-inch steel encased concrete pipe was installed north of the original line in 1967 at a depth ranging from 9 to 18 ft bgs. The easement in which these two lines are located ranges from 80 to 105 feet in width, leaving the outside edges of the lines 7 to 22 feet from the limits of the easement. • Monitoring trenches are located along both sides of the water lines midway between the adjacent waste areas and the water lines. Each trench was installed at least one foot below the depth of the adjacent water line and is approximately 2.5 feet wide. • Trenches are sloped at one percent grade with collection sumps at 200 foot intervals.	• No unacceptable human health risk except: - Maintenance workers to shallow groundwater. • Ecological exposures were not evaluated at this unit	. • Install barrier walls along shared border with SWMU 8 and SWMU 9 to reduce the lateral migration of groundwater into the trenches. • Improve surface water drainage along the AOC.
AOC 5 (Decontamination Bldg USTs)	• AOC 5 is located within the eastern portion SWMU 8 and it consists of a two out-of-service underground storage tanks..	• No issues identified with this AOC	• Remove underground storage tanks during corrective measures for SWMU 8.
AOC 6 Oily Waste Above Ground Storage Tanks	• AOC 6 is located southeast of SWMU 7 and north of SWMU 9. • The tanks were erected and placed into operation in approximately 1969 or 1970. • Runoff is prevented by a soil berm that surrounds the area; storm water from within the bermed area is removed and managed with the Facility's leachate.	• No unacceptable human health risks. • Ecological exposures were not evaluated at this unit.	• Above ground storage tank removal from AOC 6 • Relocate storage area and place new tank for containerizing the oily water from SWMU 9 as part of corrective action
AOC 7 (Butz Crock—Concrete Utility Vault)	• AOC 7 is located south of Building C which is within the western portion SWMU 8 and it consists of a concrete utility vault for access to a water line serving Building C and is an oval cement sewer pipe installed vertically, with the following inside dimensions: 60 inch length; 38 inch width; and 108 inches deep.	• No unacceptable human health risks except: - Routine facility and maintenance workers to NAPL seeps. • Ecological exposures were not evaluated at this unit.	• Remove waterline utility vaults and associated piping during demolition of Building C.

Table 2: Summary of Corrective Measures Evaluated in CMS ESOI Otter Creek Facility, Oregon, Ohio			
Unit	**General Description and Background**	**RFI Conclusions**	**Corrective Measures Evaluated in CMS**
AOC 12 (Building C Heating Oil Tank)	• AOC 12 is a 1,500 gallon oil tank, single walled steel UST for Number 2 fuel oil, located underneath the paved road. It was installed in 1978 and is still operational. A storm water drainage pipe from the building and an ice machine drainage pipe passed near the tank and drained out at the south side of the road until their removal/rerouting in November, 2006. April 13, 2000: Approximately 50 gallons of oil were released from the boiler feed line of copper construction. The feed line was damaged when the manhole providing access to the tank was replaced off-center, partially cutting it. Oil seeped from the feed line into the access hatch and then flowed down the drainage pipe by rainwater infiltration. Oi was released to the south side of the road, where sheen and petroleum odors were noticed. The contaminated soil was excavated and replaced with clean fill. Recommended in incident report: Install a steel outer sleeve protecting the feed line at the point of the manhole.	• Incident report concluded that human health or environment was not endangered. • Oily seepage from under roadway from prior release	• Remove tank and contaminated soil during demolition and relocation of Building C.

Table 3a Screening of Preliminary Corrective Measures Alternatives - Landfill Leachate
ESOI Otter Creek Facility, Oregon, Ohio

		Threshold Criteria				Balancing Criteria				
Unit	**Alternative**	**Protective of Human Health and the Environment**	**Attains Media Cleanup Standards**	**Controls the Source of Release**	**Complies with Applicable Standards for Waste Management**	**Long-term Reliability and Effectiveness**	**Reduction in Toxicity, Mobility or Volume of Wastes**	**Short-term Effectiveness**	**Implementability**	**Total Cost**
SWMU 1 Landfill Cell F	Alternative 1: Maintain Existing System	Yes. Per RFI, no unacceptable human health and ecological risks associated with leachate releases.	Yes. Reduction in potential outward migration of leachate will lead to compliance with GW standards.	Yes. Leachate collection system is fully operational.	Yes. Complies with approved post-closure plan.	Yes. Maintenance of cap and leachate collection may be necessary to maintain effectiveness.	Yes. Reduces leachate volume.	Yes. System is in operation.	Feasible.	No change from existing post-closure cost.
	Alternative 2: Expand/ Improve Leachate Recovery Program	Yes. Per RFI, no unacceptable human health and ecological risks associated with leachate releases.	Yes. Reduction in potential outward migration of leachate will lead to compliance with GW standards.	Yes. Improves existing system performance.	Yes. Complies with approved post-closure plan.	Yes.	Yes. Reduces leachate volume.	Yes. Provides immediate improvement. Requires limited exposure to waste.	Feasible.	Marginal increase from existing post-closure cost.
SWMU 5 Millard Road Landfill	Alternative 1: No Additional Action	Yes. Reduction in leachate migration is expected to improve potentially significant GW impacts identified in RFI.	Yes. Reduction in potential outward migration of leachate will lead to compliance with GW standards.	Yes. Inward gradients have been established as part of Presumptive measures.	No. RCRA Permit target leachate levels will not be reached by target date.					
	Alternative 2: Expand/ Improve Leachate Recovery	Yes. Reduction in leachate migration is expected to improve potentially significant GW impacts identified in RFI.	Yes. Reduction in potential outward migration of leachate will lead to compliance with GW standards.	Yes. Inward gradients have been established as part of Presumptive measures. Will be further improved with additional recovery well.	Yes. RCRA Permit target leachate levels should be reached by target date; levels should be monitored to ensure adequate progress to target levels.	Yes. Leachate levels monitored to evaluate need for additional wells.	Yes. Implementing this alternative will reduce leachate volume.	Yes. Improved leachate recovery. Requires limited exposure to waste.	Feasible	Marginal increase from existing post-closure cost.
SWMU 6 Northern Sanitary Landfill	Alternative 1: No Additional Action	Yes. Reduction in leachate migration is expected to improve potentially significant GW impacts identified in RFI.	Yes. Reduction in potential outward migration of leachate will lead to compliance with GW standards.	Yes. Inward gradients have been established as part of Presumptive measures.	No. RCRA Permit target leachate levels will not be reached by target date.					
	Alternative 2: Expand/ Improve Leachate Recovery	Yes. Reduction in leachate migration is expected to improve potentially significant GW impacts identified in RFI.	Yes. Reduction in potential outward migration of leachate will lead to compliance with GW standards.	Yes. Inward gradients have been established as part of Presumptive measures. Will be further improved with additional recovery well.	Yes. RCRA Permit target leachate levels should be reached by target date; levels should be monitored to ensure adequate progress to target levels.	Yes. Leachate levels monitored to evaluate need for additional wells.	Yes. Implementing this alternative will reduce leachate volume.	Yes. Improved leachate recovery. Requires limited exposure to waste.	Feasible	Marginal increase from existing post-closure cost.
SWMU 7 Central Sanitary Landfill	Alternative 1: No Additional Action	Yes. Per RFI, no human health and ecological risks associated due to leachate releases.	Yes. Reduction in potential outward migration of leachate will lead to compliance with GW standards.	Yes. Inward gradients have been established as part of Presumptive measures.	No. RCRA Permit target leachate levels will not be reached by target date.					
	Alternative 2: Expand/ Improve Leachate Recovery	Yes. Per RFI, no human health and ecological risks associated due to leachate releases.	Yes. Reduction in potential outward migration of leachate will lead to compliance with GW standards.	Yes. Inward gradients have been established as part of Presumptive measures. Will be further improved with additional recovery well.	Yes. RCRA Permit target leachate levels should be reached by target date; levels should be monitored to ensure adequate progress to target levels.	Yes. Leachate levels monitored to evaluate need for additional well.	Yes. Implementing this alternative will reduce leachate volume.	Yes. Improved leachate recovery. Requires limited exposure to waste.	Feasible	Marginal increase from existing post-closure cost.

Table 3b Screening of Preliminary Corrective Measures Alternatives - Landfill Caps ESOI Otter Creek Facility, Oregon, Ohio											
		Threshold Criteria				Balancing Criteria					
Unit	**Alternative**	**Protective of Human Health and the Environment**	**Attains Media Cleanup Standards**	**Controls the Source of Release**	**Complies with Applicable Standards for Waste Management**	**Long-term Reliability and Effectiveness**	**Reduction in Toxicity, Mobility or Volume of Wastes**	**Short-term Effectiveness**	**Implementability**	**Capital Cost**	**Total Net Present Cost (includes Capital and O&M Costs)**
SWMU 1 Landfill Cell F	Alternative 1: No Additional Action. Maintain Existing Cap.	Yes. Prevents exposure to waste.	Yes. Reduction in leachate generation will lead to compliance with GW standards.	Yes. Existing cap provides adequate postive drainage and reduces leachate generation.	Yes. Complies with approved post-closure plan.	Yes. Low permeability soil caps provide long-term containment of waste.	Yes. Limits infiltration thus reduces leachate volume in cell.	Yes. Relies on existing cap.	Feasible.	-	$ 62,000
	Alternative 2: Upgrade Cap to Composite Cover	Yes. Prevents exposure to waste.	Yes. Reduction in leachate generation will lead to compliance with GW standards.	Yes. Improves performance. Reduces leachate generation.	Yes. Complies with approved post-closure plan.	Yes. Composite caps provide long-term containment of waste.	Yes. Installation of composite cap further reduces infiltration and thus volume of leachate.	Yes. Can be implemented with spme disturbance to existing waste contamination.	Feasible.	$ 473,000	$ 478,000
SWMU 5 Millard Road Landfill	Alternative 1: Improve Stormwater Drainage. Maintain Existing Cap.	Yes. Prevents exposure to waste.	Yes. Reduction in leachate generation will lead to compliance with GW standards.	Yes. Existing cap adequately reduces infiltration that generates leachate. Drainage improvements will further reduce infiltration potential.	Yes. Complies with minimum solid waste landfill requirments.	Yes. Low permeability soil caps provide long-term containment of waste.	Yes. Limits infiltration thus reduces leachate volume in cell.	Yes. Relies on existing cap.	Feasible.	$ 28,000	$ 151,000
	Alternative 2: Upgrade Cap to Composite Cover	Yes. Prevents exposure to waste.	Yes. Reduction in leachate generation will lead to compliance with GW standards.	Yes. Improves performance. Reduces leachate generation.	Yes.	Yes. Composite caps provide long-term containment of waste.	Yes. Installation of composite cap further reduces infiltration and thus volume of leachate.	Yes. Can be implemented with spme disturbance to existing waste contamination.	Feasible.	$ 1,283,000	$ 1,286,000
SWMU 6 Northern Sanitary Landfill	Alternative 1: Improve Stormwater Drainage. Maintain existing cap. Excavate off-site waste outside of property line.	Yes. Prevents exposure to waste.	Yes. Reduction in leachate generation will lead to compliance with GW standards.	Yes. Existing cap adequately reduces infiltration that generates leachate. Drainage improvements will further reduce infiltration potential.	Yes. Complies with minimum solid waste landfill requirments.	Yes. Low permeability soil caps provide long-term containment of waste.	Yes. Limits infiltration thus reduces leachate volume in cell.	Yes. Relies on existing cap.	Feasible.	$ 138,000	$ 355,000
	Alternative 2: Upgrade Cap to Composite Cover. Excavate off-site waste outside of property line.	Yes. Prevents exposure to waste.	Yes. Reduction in leachate generation will lead to compliance with GW standards.	Yes. Improves performance. Reduces leachate generation.	Yes.	Yes. Composite caps provide long-term containment of waste.	Yes. Installation of composite cap further reduces infiltration and thus volume of leachate.	Yes. Can be implemented with spme disturbance to existing waste contamination.	Feasible.	$ 1,167,000	$ 1,182,000
SWMU 7 Central Sanitary Landfill	Alternative 1: Improve Stormwater Drainage. Maintain Existing Cap.	Yes. Prevents exposure to waste.	Yes. Reduction in leachate generation will lead to compliance with GW standards.	Yes. Existing cap adequately reduces infiltration that generates leachate. Drainage improvements will further reduce infiltration potential.	Yes. Complies with minimum solid waste landfill requirments.	Yes. Low permeability soil caps provide long-term containment of waste.	Yes. Limits infiltration thus reduces leachate volume in cell.	Yes. Relies on existing cap.	Feasible.	$ 56,000	$ 937,000
	Alternative 2: Upgrade Cap to Composite Cover	Yes. Prevents exposure to waste.	Yes. Reduction in leachate generation will lead to compliance with GW standards.	Yes. Improves performance. Reduces leachate generation.	Yes.	Yes. Composite caps provide long-term containment of waste.	Yes. Installation of composite cap further reduces infiltration and thus volume of leachate.	Yes. Can be implemented with spme disturbance to existing waste contamination.	Feasible.	$ 1,009,000	$ 1,014,000

Table 3c: Screening of Preliminary Corrective Measures Alternatives - Landfill Gas
ESOI Otter Creek Facility, Oregon, Ohio

		Threshold Criteria				Balancing Criteria				
Unit	**Alternative**	**Protective of Human Health and the Environment**	**Attains Media Cleanup Standards**	**Controls the Source of Release**	**Complies with Applicable Standards for Waste Management**	**Long-term Reliability and Effectiveness**	**Reduction in Toxicity, Mobility or Volume of Wastes**	**Short-term Effectiveness**	**Implementability**	**Cost**
SWMU 1 Landfill Cell F	Alternative 1: Maintain Current Program	Yes. Per RFI, no unacceptable human health and ecological risks associated with LFG.	N/A	Off-site migration of landfill gas is highly unlikely.	Current EGMP approved by Ohio EPA.	Yes. Continue monitoring.	Yes	Yes	Existing.	Included in ESOI's post-closure cost
	Alternative 2: Install a Passive Landfill Gas Venting System.	Yes. Per RFI, no unacceptable human health and ecological risks associated with LFG.	N/A	Off-site migration of landfill gas is highly unlikely.	Yes.					
	Alternative 3: Install Active Landfill Gas Recovery System.	Yes. Per RFI, no unacceptable human health and ecological risks associatedwith LFG.	N/A	Yes. Landfill gas generation decreases.	Yes.					
SWMU 5 Millard Road Landfill	Alternative 1: Maintain Current Program	Yes. Per RFI, no unacceptable human health and ecological risks associated with LFG.	N/A	Off-site migration of landfill gas is highly unlikely.	Current EGMP approved by Ohio EPA.	Yes. Continue monitoring.	Yes	Yes	Existing.	Included in ESOI's post-closure cost
	Alternative 2: Expand Passive Landfill Gas Venting System.	Yes. Per RFI, no unacceptable human health and ecological risks associated with LFG.	N/A	Off-site migration of landfill gas is highly unlikely.	Yes.					
	Alternative 3: Install Active Landfill Gas Recovery System.	Yes. Per RFI, no unacceptable human health and ecological risks associated with LFG.	N/A	Yes. Landfill gas generation decreases.	Yes.					
SWMU 6 Northern Sanitary Landfill	Alternative 1: Maintain Existing System	Yes. Per RFI, no unacceptable human health and ecological risks associated with LFG.	N/A	Off-site migration of landfill gas is highly unlikely.	Current EGMP approved by Ohio EPA.	Yes. Continue monitoring.	Yes	Yes	Existing.	Included in ESOI's post-closure cost
	Alternative 2: Install a Passive Landfill Gas Recovery System.	Yes. Per RFI, no unacceptable human health and ecological risks associated with LFG.	N/A	Off-site migration of landfill gas is highly unlikely.	Yes.					
	Alternative 3: Install Active Landfill Gas Recovery System.	Yes. Per RFI, no unacceptable human health and ecological risks associated with LFG.	N/A	Yes. Landfill gas generation decreases.	Yes.					
SWMU 7 Central Sanitary Landfill	Alternative 1: Install Monitoring Points and Implement Landfill Gas Monitoring Program	Yes. Per RFI, no unacceptable human health and ecological risks associated with LFG.	N/A	Off-site migration of landfill gas is highly unlikely.	Current EGMP approved by Ohio EPA.	Yes. Continue monitoring.	Yes	Yes	Existing.	Included in ESOI's post-closure cost
	Alternative 2: Install a Passive Landfill Gas Recovery System.	Yes. Per RFI, no unacceptable human health and ecological risks associated with LFG.	N/A	Off-site migration of landfill gas is highly unlikely.	Yes.					
	Alternative 3: Install Active Landfill Gas Recovery System.	Yes. Per RFI, no unacceptable human health and ecological risks associated with LFG.	N/A	Off-site migration of landfill gas is highly unlikely.	Yes.					

Table 3d Screening of Preliminary Corrective Measures Alternatives - SWMU 5 LNAPL ESOI Otter Creek Facility, Oregon, Ohio											
		Threshold Criteria				Balancing Criteria					
Unit	**Alternative**	**Protective of Human Health and the Environment**	**Attains Media Cleanup Standards**	**Controls the Source of Release**	**Complies with Applicable Standards for Waste Management**	**Long-term Reliability and Effectiveness**	**Reduction in Toxicity, Mobility or Volume of Wastes**	**Short-term Effectiveness**	**Implementability**	**Capital Cost**	**Total Net Present Cost (includes Capital and O&M Costs)**
SWMU 5 Millard Road Landfill	Alternative 1: Passive NAPL recovery	Yes. Will reduce the potential for surface releases where exposure may occur.	Yes. Will achieve risk reduction goal.	Yes. Will reduce mobile NAPL fraction.	Yes. Recovered NAPL will be properly managed for disposal.	Maybe. Although NAPL recovery maybe hindered by physical characterization and hydrogeology.	Yes. Reduces the volume of NAPL present	Slower than active	Feasible	$ 31,000	$ 183,000
	Alternative 2: Active NAPL recovery	Yes. Will reduce the potential for surface releases where exposure may occur.	Yes. Will achieve risk reduction goal.	Yes. Will reduce mobile NAPL fraction.	Yes. Recovered NAPL will be properly managed for disposal.	Maybe. Although NAPL recovery maybe hindered by physical characterization and hydrogeology.	Yes. Reduces the volume of NAPL present	Faster than passive	Feasible	$ 36,000	$ 54,000

Table 3e Screening of Corrective Measures Alternatives - SWMU 8
ESOI Otter Creek Facility, Oregon, Ohio

		Threshold Criteria				Balancing Criteria					
Unit	**Alternative**	**Protective of Human Health and the Environment**	**Attains Media Cleanup Standards**	**Controls the Source of Release**	**Complies with Applicable Standards for Waste Management**	**Long-term Reliability and Effectiveness**	**Reduction in Toxicity, Mobility or Volume of Wastes**	**Short-term Effectiveness**	**Implementability**	**Capital Cost**	**Total Net Present Cost (includes Capital and O&M Costs)**
SWMU 8 Old Oil Pond #1 (South Pond)	Alternative 1: Manage Waste In-Place • Demolish existing Bldg.(AOC 3); and remove AOC 12, AOC 5 and AOC 7. • Excavate and repair cap in the observed NAPL seepage areas. • Repair and regrade cover. • Install leachate recovery wells. • Install passive landfill gas vents around perimeter. • Install barrier wall on North and South perimeter of Unit. • Construct new maintenance bldg.	Yes. Prevents exposure to routine facility and maintenance workers as cap controls leachate seepage to surface. Leachate controls and barrier walls reduce lateral migration to AOCs 1 and 7.	Yes. Reduces impacts to surrounding shallow groundwater.	Yes- leacahte Yes - landfill gas Yes - surface releases Yes - Shallow groundwater (limited potential for vertical migration)	Yes. Cover is consistent with minimum solid waste regulatory requirements. Consistent with presumptive remedy guidance.	Standard practices for effective long-term waste management.	Yes. Reduces leachate, NAPL and landfill gas volume and thus mobility (limited potential for vertical migration of leachate).	Limited potential for workers exposure to waste, leachate, NAPL during construction due to health and safety policies in place at facility.	Feasible	$ 6,440,000	$ 7,004,000
	Alternative 2: Construction of Corrective Action Management Unit (CAMU) • Demolish existing Bldg. C (AOC 3); and remove AOC 12, AOC 5, and AOC 7. • Sequential excavation and backfill of entire unit: excavate and store waste, dewater and dispose leachate and LNAPL and place liner at the bottom of subcell, and backfill waste to the unit. • Install composite (sequentially) cover with landfill gas vent layer over entire unit. • Construct new maintenance bldg.	Yes. Prevents exposure to routine facility and maintenance workers as cap controls leachate seepage to surface and groundwater including AOC 7 and AOC 1.	Yes. Leachate collection system.	Yes- leacahte Yes - landfill gas Yes - surface releases Yes - Shallow groundwater	Yes-. Waste management consistent with CAMU rules.	Standard practices for effective long-term waste management.	Yes. Installation of liner, gas vents, and composite cap will reduce mobility and toxicity.	Limited potential for workers exposure to waste, leachate, NAPL during construction due to health and safety policies in place at facility.	Feasible. But sequential excavation of the entire unit is time consuming. Need for stabilization will need to be determined during design. Existing leachate will need to be controlled during excavation.	$ 8,271,000	$ 8,835,000

Notes:
AOC 12:Maintenance/ Storage Building C.
AOC 5: Two USTs associated with this AOC.
AOC 7: Butz Crock - Concrete Utility Vault

Table 3f Screening of Corrective Measures Alternatives - SWMU 9
ESOI Otter Creek Facility, Oregon, Ohio

		Threshold Criteria				Balancing Criteria					
Unit	**Alternatives**	**Protective of Human Health and the Environment**	**Attains Media Cleanup Standards**	**Controls the Source of Release**	**Complies with Applicable Standards for Waste Management**	**Long-term Reliability and Effectiveness**	**Reduction in Toxicity, Mobility or Volume of Wastes**	**Short-term Effectiveness**	**Implementability**	**Capital Cost**	**Total Net Present Cost (includes Capital and O&M Costs)**
SWMU 9 New Oil Pond #2 (North Pond)	Alternative 1: Cap Repair and Storm Water Drainage Improvements • Recontour landfill cover to provide positive drainage and minimize infiltration. • Clean and improve drainage system. • Install additional dewatering wells within the delineated NAPL area. • Repair of existing soil cover in the areas of seeps.	Yes. Prevents exposure to routine facility workers as regraded cap and improved drainage reduces potential oily water seepage to ground surface.	Yes. Reduces potential for impacts to surface soils	Yes. Reduces infiltration and potential surface releases.	Yes. Cover improvements are consistent with presumptive remedy guidance.	Standard practices for effective long-term waste management.	Yes. Reduces free liquid in cell.	Limited potential for workers exposure to waste, leachate, NAPL during construction due to health and safety policies in place at facility.	Feasible	$ 365,000	$ 407,000
	Alternative 2: Upgrade Cap to a Composite Cover • Install recovery wells. • Excavate current cap to remove top zone of stabilized waste. • Install composite cover in excavated zone.	Yes. Prevents exposure to routine facility workers as regraded cap and improved drainage reduces potential oily water seepage to ground surface.	Yes. Prevents impacts to surface soils	Yes. Reduces infiltration and potential oily water releases.	Yes. Upgrading cover consistent with current RCRA standards and consistent with presumptive remedy guidance.	Standard practices for effective long-term waste management.	Yes. Reduces free liquid in cell.	Limited potential for workers exposure to waste, leachate, NAPL during construction due to health and safety policies in place at facility.	Feasible.	$ 703,000	$ 745,000
	Alternative 3: Excavate Unit and Disposal Excavation of Waste from Unit and Off-site Disposal.	Yes. Eliminates unit thus no exposure to workers.	Yes. Eliminates source of impacts to surface soils	Yes. Eliminates source	Not consistent with presumptive remedy guidance. Waste removal not warranted based on site-specific risk assessment.						

Table 3g Screening of Corrective Measures Alternatives - AOC 1
ESOI Otter Creek Facility, Oregon, Ohio

		Threshold Criteria				Balancing Criteria					
Unit	**Alternatives**	**Protective of Human Health and the Environment**	**Attains Media Cleanup Standards**	**Controls the Source of Release**	**Complies with Applicable Standards for Waste Management**	**Long-term Reliability and Effectiveness**	**Reduction in Toxicity, Mobility or Volume of Wastes**	**Short-term Effectiveness**	**Implementability**	**Capital Cost**	**Total Net Present Cost (includes Capital and O&M Costs)**
AOC 1 Toledo Water Lines	Alternative 1: Maintain Existing Program	Yes. Prevents groundwater migration into the waterline area.	Yes.	Yes. Collection trenches are designed to prevent migration of contaminated groundwater into waterline right-of-way.	N/A	Yes. Relies on existing system.	Yes. Reduces volume of contaminated groundwater present in the waterline trenches.	Yes.	Feasible	-	-
	Alternative 2: Recap Waterline Right-of-Way	Yes. Prevents groundwater migration into the waterline area.	Yes.	Yes. Collection trenches are designed to prevent migration of contaminated groundwater into waterline right-of-way.	N/A	Yes. Relies on existing system.	Yes. Reduces volume of contaminated groundwater present in the waterline trenches. Reduces volume of storm water in trench collection system.	Yes.	Feasible.	$ 115,000	$ 115,000
	Alternative 3: Installment of Barrier Walls	Yes. Prevents groundwater migration into the waterline area.	Yes.	Yes. Collection trenches are designed to prevent migration of contaminated groundwater into waterline right-of-way.	N/A	Yes. Relies on existing system.	Yes. Prevents lateral migration of contaminated shallow groundwater.	Yes.	Feasible	$ 1,064,000	$ 1,064,000

Table 4: Summary of Recommended Alternatives
ESOI Otter Creek Facility, Oregon, Ohio

Unit	Media/ Activity	Recommended Alternative	Alternative Description	Capital Cost	O&M Cost, 30 years	Net Present Cost O&M 30 years, 2.7% ROR	Total Cost for Proposed Alternative 30 years	Net Present Cost for Proposed Alternative 30 years, 2.7% ROR
Site Wide	Site-wide corrective measures that will be implemented: • Establish institutional controls on land use and groundwater use. • Maintain engineering controls (i.e., fencing and/or security). • Amend the Facility's procedures to prevent hazards (Section F of ESOI's Part B Permit). • Amend the Facility's RCRA groundwater monitoring program. • Install direct sewer connection for leachate recovered from nonhazardous waste landfills. • Restore areas disturbed during implementation of corrective measures							
Leachate Management (nonhazardous)	Alternative 1: Leachate Disposal Via Direct Connection to Sewer System		This alternative involves construction of discharge sewer line to convey nonhazardous landfill leachate from directly from the Facility to an existing sanitary sewer manhole.	$ 180,000	$ 1,410,000	$ 957,995	$ 1,590,000	$ 1,138,000
SWMU 1 Landfill Cell F	Landfill Leachate	Alternative 2: Expand/ Improve Leachate Recovery Program	This alternative involves minor modification of ESOI's existing maintenance program for cleaning/jetting the existing 6-inch perforated lateral leachate collection pipes.	Marginal increase from current post-closure cost for the unit.	$ 90,000	$ 61,149	$ 90,000	$ 62,000
	Landfill Cap	Alternative 1: No Additional Action	Cap improvements performed as part of presumptive corrective measures continue to provide sufficient drainage for Cell F. This alternative includes maintenance of the existing cap with additional settlement monitoring of the cell.					
	Landfill Gas	Alternative 1: Maintain Current Program	This alternative involves continuation of existing landfill gas venting and monitoring program as specified in Explosive Gas Monitoring Plan (EGMP).					
SWMU 5 Millard Road Landfill	Landfill Leachate	Alternative 2: Expand/ Improve Leachate Recovery	This alternative involves modifications to the existing system layout and operation based on the recommendations from post 2-year evaluation report as approved by OEPA. Improvements include the following: • Convert piezometer PZ-8 to a recovery well • Install three new piezometers • Incorporate three additional exterior monitroing wells • Drill vent holes in the piezometers and modify water level measurement procedures	$ 28,000	$ 180,000	$ 122,297	$ 208,000	$ 151,000
	Landfill Cap	Alternative 1: Improve Stormwater Drainage	This alternative involves regrading and lining perimeter storm water drainage ditches to prevent potential for storm water ponding and infiltration into landfill.					
	Landfill Gas	Alternative 1: Maintain Current Program	This alternative involves continued implementation of the current monitoring of the recovery well/gas vents as specified in current leachate recovery program Operations, Maintenance, and Performance Monitoring (OMPM) Plan and the EGMP.					
SWMU 5 LNAPL	LNAPL	Alternative 2: Active Recovery	This alternative involves NAPL recovery using vaccum enhanced skimmer system in the area of T-20S(2) and T-20S(5).Two recovery wells would be installed for the skimmer system.	$ 36,000	$ 18,000	$ 17,070	$ 54,000	$ 54,000
SWMU 6 Northern Sanitary Landfill	Landfill Leachate	Alternative 2: Expand/ Improve Leachate Recovery	This alternative involves modifications to the existing system layout and operation based on the recommendations from post 2-year evaluation report as approved by OEPA. Improvements include the following: • Discontinue use of RW-6, RW-7, and RW-5 • Drill vent holes in the piezometers and modify water level measurement procedures	$ 138,000	$ 318,000	$ 216,058	$ 456,000	$ 355,000
	Landfill Cap	Alternative 1: Improve Stormwater Drainage	This alternative involves the following: • Regrading and lining perimeter storm water drainage ditches to prevent storm water ponding and infiltration. • Installation of intermediate drainage swales on north and south slopes of the unit • Installation of lined retention basin in southwest corner (between SWMU 6 and 7) of the unit • Installation of lined retention area northeastern corner of the facility and relocation of the outfall to the western end of this new basin. • Excavation and transportation of off-site waste to ESOI's active landfill for disposal.					
	Landfill Gas	Alternative 1: Maintain Current Program	This alternative involves continued implementation of the current monitoring of the recovery well/gas vents as specified in current leachate recovery program OMPM Plan and the EGMP.					

Table 4: Summary of Recommended Alternatives ESOI Otter Creek Facility, Oregon, Ohio								
Unit	**Media/ Activity**	**Recommended Alternative**	**Alternative Description**	**Capital Cost**	**O&M Cost, 30 years**	**Net Present Cost O&M 30 years, 2.7% ROR**	**Total Cost for Proposed Alternative 30 years**	**Net Present Cost for Proposed Alternative 30 years, 2.7% ROR**
SWMU 7 Central Sanitary Landfill	Landfill Leachate	Alternative 2: Expand/ Improve Leachate Recovery	This alternative involves modifications to the existing system layout and operation based on the recommendations from post 2-year evaluation report as approved by OEPA. Improvements include the following: • Convert piezometer PZ-12 to a recovery well, RW-10 to piezometer • Install 2-3 new piezometers • Drill vent holes in the piezometers and modify water level measurement procedures	$ 56,000	$ 1,296,000	$ 881,000	$ 1,352,000	$ 937,000
	Landfill Cap	Alternative 1: Improve Stormwater Drainage	This alternative involves the following: • Regrading and lining perimeter storm water drainage ditches to prevent storm water ponding and infiltration. • Installation of intermediate drainage ditches on north and west slopes of the landfill.					
	Landfill Gas	Alternative 1: Maintain Current Program	This alternative involves continued implementation of the current monitoring of the recovery well/gas vents as specified in current leachate recovery program OMPM Plan and the EGMP.					
SWMU 8 Old Oil Pond #1 (South Pond)	Alternative 1: Contain Waste In-Place		This alternative involves management of wastes within the existing SWMU 8 cell. As part of this alternative, the existing cap would be repaired at locations where NAPL tar seeps have been observed. In place managment requires several components to achieve containment: • Installation of leachate/NAPL recovery wells. • Installation of passive landfill gas recovery/vents. • Installation of barrier wall surrounding the limits of the waste. In addition, this alternative also involves removal of Building C (including floor slab) and removal of AOC 12, AOC 7, and AOC 5.	$ 6,444,000	$ 815,500	$ 563,591	$ 7,256,000	$ 7,004,000
SWMU 9 New Oil Pond #2 (North Pond)	Alternative 1: Cap Repair and Storm Water Drainage Improvements		This alternative involves recontouring of the landfill cover to provide positive drainage, and minimize accumulation and infiltration of storm water. Prior to cap regrading the following activities are performed: • Installation of additional dewatering wells within the delineated NAPL area in order to remove free liquids to the extent practicable. • Repair of existing soil cover in the areas of seeps. • Placement of additional fill and recompaction to improve slopes at the top of the cell. • Settlement tests will be performed as part of design.	$ 365,000	$ 61,659	$ 42,000	$ 427,000	$ 407,000
AOC 1 Toledo Water Lines	Alternative 2: Improve Cover Along Waterline Right-of-Way		In order to reduce the management of infiltrating storm water and improve efficiency of the existing collection system operations (e.g., reducing the volume of water to be managed), this alternative includes removing vegetation from drainage ditches along this AOC and regrading and recapping the areas to improve runoff and reduce infiltration.	$ 115,000	-	-	$ 115,000	-
AOC 5 Decontamination Building USTs	The corrective measures alternatives evaluated for SWMU 8 also address this AOC.			-				
AOC 7 Butz Crock—Concrete Utility Vault	The corrective measures alternatives evaluated for SWMU 8 also address this AOC.			-				
AOC 12 Building C Heating Oil Tank	The corrective measures alternatives evaluated for SWMU 8 also address this AOC.			-				

Table 5: Summary of Distances Between Bedrock Wells
ESOI Otter Creek Facility, Oregon, Ohio

Well ID	Distance from Prior Well (ft)
R-2	
R-23	708
R-4	336
R-14	386.4
R-9	446.4
R-16	192
R-3	432
R-24	300
R-8	144
R-1	324
R-10	422.4
R-15	168
R-5	336
R-21	1116
R-22	408
R-11	794.4
R-7	460.8
R-13	520.8
R-6	660
R-12	316.8
R-17	549.6
R-18*	436.8
R-19*	388.8
R-20*	288
R-21	556.8
Note:	

* Indicates wells along York Street (between Cell M and SWMU 8).

Table 6a: Proposed Groundwater Monitoring Program
ESOI Otter Creek Facility, Oregon, Ohio

Bedrock (Upper-most Aquifer) Monitoring

Detection Monitoring		Compliance Monitoring[1]		Corrective Action[2]	
Parameters	Frequency	Parameters	Frequency	Parameters	Frequency
1. K list constituents	Semiannual	1. K list constituents; 2. Constituents from Appendix 98 analysis with concentrations that exceed background or PQL	Semiannual	Depends on the corrective action, but likely to include parameters from compliance monitoring	To be determined; if MCL or background (if higher than MCL) is exceeded
Appendix 98 (or subset)	If a K list constituent exceeds PQL or background	Appendix 98 (or subset)	Annual		

Notes

1. Compliance monitoring is triggered by a confirmed exceedance of a comparision standard specified in Tables K-1 and K-2.

2. Corrective action is triggered by a confirmed exceedance of the cumulative cancer risk limit of 1E-5 or hazard index of 1.

Table 6b: Proposed Groundwater Monitoring Program
ESOI Otter Creek Facility, Oregon, Ohio
Deep Till Contact Zone Monitoring

Unaffected Wells Not Next to Unlined Unit	
If action leakage rate (ALR) is not exceeded:	Monitor ALR in accordance with Response Action Plan, and monitor water levels annually.
If an ALR is exceeded, and analysis of secondary leachate indicates increase monitoring per permit condition D6.2 is necessary:	Monitor as an unaffected well next to unlined unit.

Unaffected Wells Next to Unlined Unit	
Monitor K-list parameters every 5 years (groundwater migration to bedrock takes > 100 years).	
If concentration of organic compound > PQL:	Designate parameter as an elevated constituent and monitor as an Affected Well
If concentration of metal > background:	

Adjacent Wells	
Monitor for new elevated constituent and Appendix 98 parameters in same analyte group.	
If concentration of organic compound > PQL:	Designate parameter as an elevated constituent and monitor as an Affected Well
If concentration of metal > background:	

Current Affected Wells	
Monitor K-list parameters semiannually and Appendix 98 parameters every 5 years (groundwater migration to bedrock takes > 100 years).	
If cancer risk > 1E-5 or HI > 1:	Evaluate need for additional corrective measures or modification of existing corrrective measures

Table 6c: Proposed Groundwater Monitoring Program
ESOI Otter Creek Facility, Oregon, Ohio
Shallow Till Contact Zone Monitoring

Unaffected Wells		
If leachate < shallow till contact	Monitor water levels annually	
If leachate > shallow till contact	Monitor K-list parameters semiannually.	
	If concentration > PQL or background:	Designate parameter as an elevated constituent and monitor as an Affected Well

Adjacent Wells	
Monitor for new elevated constituent and Appendix 98 parameters in same analyte group.	
If concentration > PQL or background:	Designate parameter as an elevated constituent and monitor as an Affected Well

Affected Wells		
If leachate < shallow till contact	Monitor elevated constituents biennually and water levels annually.	
	If cancer risk > 1E-5 or HI > 1:	Evaluate need for additional corrective measures or modification of existing corrrective
If leachate > shallow till contact	Monitor semiannually K-list and chemicals > screening criteria; annually App. 98.	
	If cancer risk > 1E-5 or HI > 1:	Evaluate need for additional corrective measures or modification of existing corrrective measures

Note:
Leachate level is the average interior leachate head and shallow till contact zone level is the average exterior shallow till groundwater head.

TABLE 7

SUMMARY OF POTENTIAL COMMUNITY RELATIONS ACTIVITIES

Establish Information Webpage

Objective: To provide the community with access to information about the corrective action activities at the Site.

Action: An information webpage will be established on the ESOI website.

Discussion: The webpage will include all substantive documents submitted to Ohio EPA as part of the corrective action activities including items such as the approved RFI Report, CMS Report, progress reports, and any revisions to these documents.

Designate a Point of Contact

Objective: To provide the public with an individual who can provide accurate information on the corrective measures activities.

Action: Contacts include:

Ohio EPA – Lynn Ackerson

Phone – 1-419-373-4113

ESOI: Stephen DeLussa

Phone – 1-215-659-2001

Discussion: The contact people will coordinate and direct responses to inquiries regarding the corrective measures activities. When necessary, technical personnel will assist in providing responses to public inquiries.

Prepare and Post Fact Sheets

Objective: To provide the public with information regarding corrective measures activities.

Action: Fact sheets will be used on an as-warranted basis.

Discussion: Fact sheets can be an effective method of providing information to the public.

Prepare Press Releases

Objective: To provide an additional means of releasing accurate information regarding corrective measures activities.

Action: Press releases will be used on as-warranted basis.

Discussion: Press releases can be an effective method of providing information to the public and would be sent to the appropriate local media.

Public Notices

Objective: To formally notify the public of the information webpage.

TABLE 7

SUMMARY OF POTENTIAL COMMUNITY RELATIONS ACTIVITIES

Action: Public notices will be mailed to the facility mailing list.

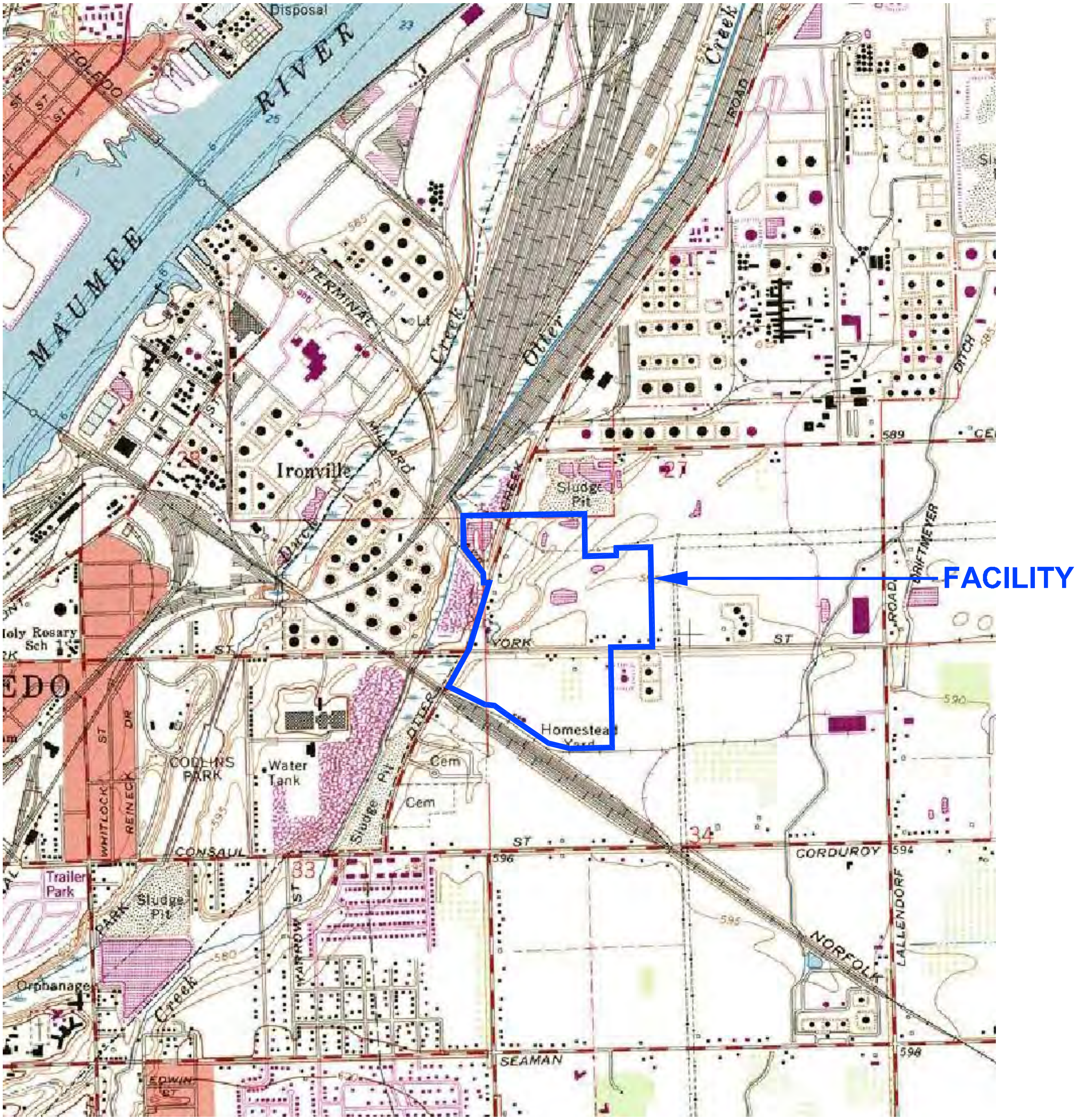
Conduct Briefings

Objective: To keep interested parties informed of the status of corrective measures activities.

Action: Briefings will be conducted on an as-warranted basis in accordance with state or federal regulations or guidance.

Discussion: Briefings will be accomplished through informal meetings.

F I G U R E S



0 1/2 1

Scale in Miles

2000 0 2000 4000

Scale in Feet

SOURCE: TOPO! MAP PRINTED ON 1/15/08 FROM "OHIO.TPO" USGS 7.5 OREGON, OHIO, TOPOGRAPHIC QUADRANGLE. MAP VERSION 1977. MAP CURRENT AS OF 1995.

BKLEIN 12/21/10 [6174M14BJ01]

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DRAFTED BY: BJK

DATE: 12/21/2010

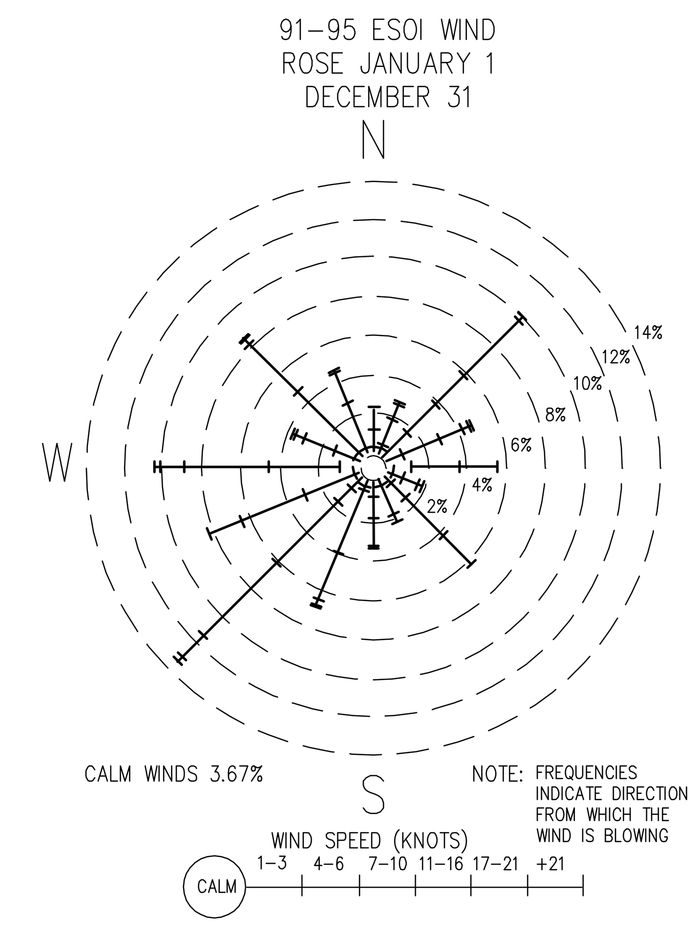
FACILITY LOCATION MAP

ENVIROSAFE SERVICES OF OHIO
OREGON, OHIO

FIGURE

1

026174M14B



LEGEND

- PROPERTY BOUNDARY
- ADJACENT PROPERTY LINES
- BUILDING OUTLINE
- PAVED ROAD
- GRAVEL ROAD
- FENCE LINE
- 10 FOOT TOPOGRAPHIC CONTOUR
- 2 FOOT TOPOGRAPHIC CONTOUR
- DITCH
- ABOVEGROUND TANK
- BASIN
- STREAM/WATER
- PROPERTY OWNER
- 1,000 FOOT LIMIT FROM PROPERTY LINE
- 100 YEAR FLOOD PLAIN AREA
- SOLID WASTE MANAGEMENT UNITS
- REVISED LIMIT OF SOLID WASTE MANAGEMENT UNIT BASED ON RFI PHASE I

ZONING

- SUE – SPECIAL USE EXCEPTION, OREGON (SEE NOTE 5)
- R–3 – TWO-FAMILY RESIDENCE DISTRICT, TOLEDO DISTRICT
- R–2 – RESIDENCE DISTRICT, OREGON
- R–3 – RESIDENCE DISTRICT, OREGON
- M–2 – GENERAL INDUSTRY DISTRICT, OREGON

NOTES

1. NO PORTION OF THE SITE IS LOCATED WITHIN THE 100 YEAR FLOOD PLAIN FOR OTTER CREEK, THE APPROXIMATE FLOOD PLAIN ELEVATION IS 579 FEET ABOVE MEAN SEA LEVEL.
2. EXISTING LAND USES HAVE BEEN DETERMINED FROM RESEARCH WITHIN THE CITY OF OREGON AND THE CITY OF TOLEDO.
3. ZONING AREAS HAVE BEEN DERIVED AS PER MUNICIPAL CODES OF THE CITY OF OREGON AND THE CITY OF TOLEDO. AREAS ARE SHOWN FROM RESEARCH OBTAINED THROUGH THE LUCAS COUNTY PLAN COMMISSION AND THE CITY OF OREGON.
4. THE AREA WITHIN THE ESOI FACILITY PROPERTY LINE IS DESIGNATED SPECIAL USE EXCEPTION (SUE) AS SHOWN. THIS ZONING DESIGNATION ALSO APPLIES TO THE PAST WESTOVER SANITARY LANDFILL AREAS. SPECIAL USE EXCEPTION (SUE) SHOWN IS DEFINED FROM THE OREGON MUNICIPAL CODE AS MAINTENANCE AND OPERATION OF FACILITIES FOR DUMPING, STORING AND KINDS, AND FOR SANITARY LANDFILL OR INCINERATION OPERATIONS IN CONNECTION THEREWITH, SUBJECT TO APPLICABLE HEALTH AND SANITARY REGULATIONS. THE DURATION OF THIS EXCEPTION IS UNLIMITED.
5. INFORMATION ON ADJACENT LAND OWNERS WAS OBTAINED FROM THE LUCAS COUNTY AUDITOR'S OFFICE AND REPRESENTS CURRENT LAND OWNERS AS OF MARCH 1996.

200 0 200 400 600
Scale in Feet

SITE LAYOUT

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ENVIROSAFE SERVICES OF OHIO, INC.
OTTER CREEK FACILITY
OREGON, OHIO

PREPARED BY: FR	DATE: 2/14/08
DRAFTED BY: KPM	SCALE: AS SHOWN
APPROVED BY: MN	PROJECT: 026174M14B

FIGURE
2

LAYOUT OF CORRECTIVE MEASURES ASSESSMENT AREAS

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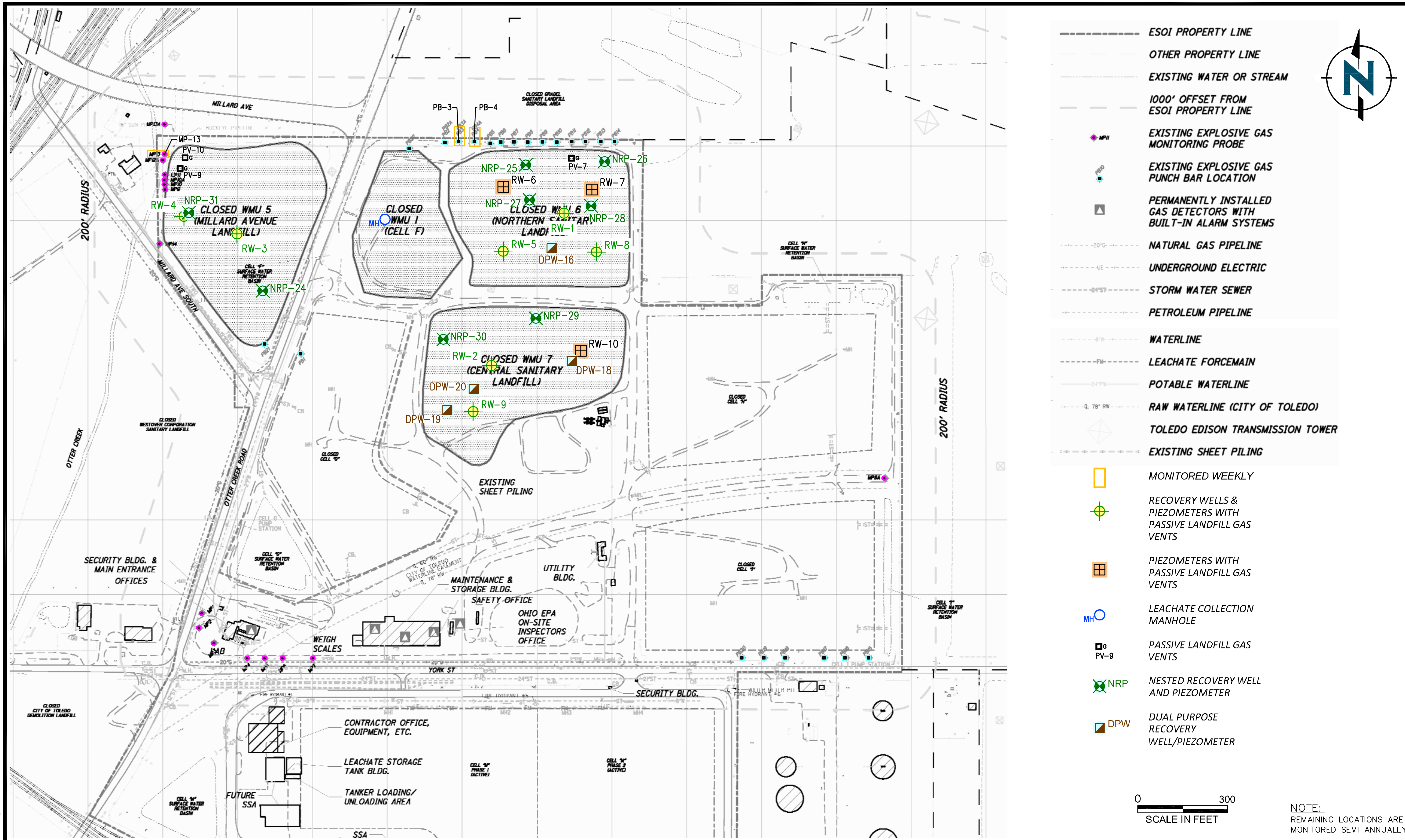
ENVIROSAFE SERVICES OF OHIO, INC.
OTTER CREEK ROAD FACILITY
OREGON, OHIO

PREPARED BY: FR	DATE: 11/02/2011
DRAFTED BY: PRM/BJK	SCALE: AS SHOWN
APPROVED BY: MN	PROJECT: 026174M4B

FIGURE
3



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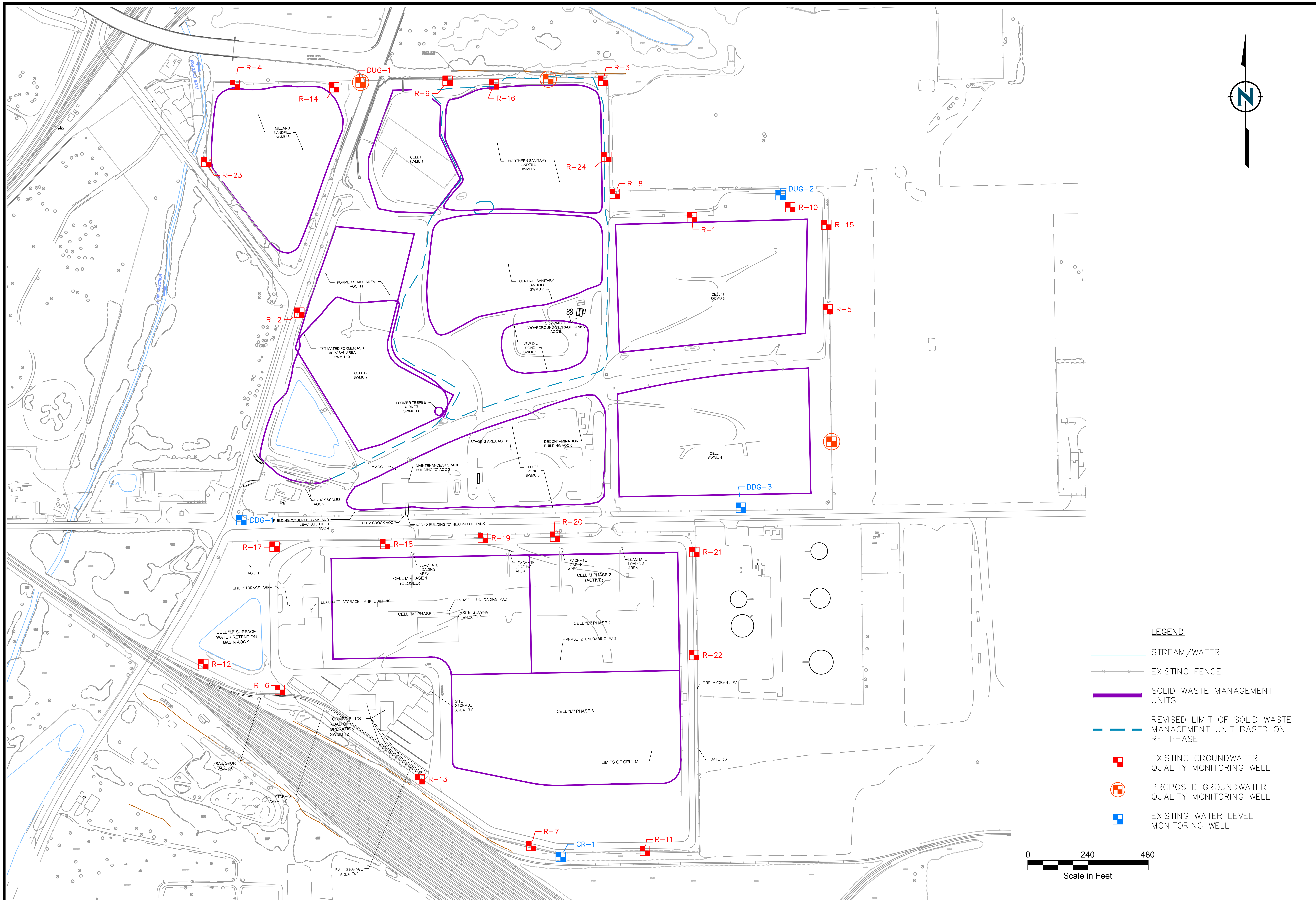
DRAFTED BY: BJK/KPM | DATE: 4/27/2012

LANDFILL GAS MONITORING LOCATIONS
ENVIROSAFE SERVICES OF OHIO, INC.
OTTER CREEK ROAD FACILITY
OREGON, OHIO

FIGURE
4

026174M14B

KPM 4/27/12 [026174M14BB01A]



PROPOSED GROUNDWATER MONITORING NETWORK BEDROCK (UPPER-MOST AQUIFER)

ENVIRON
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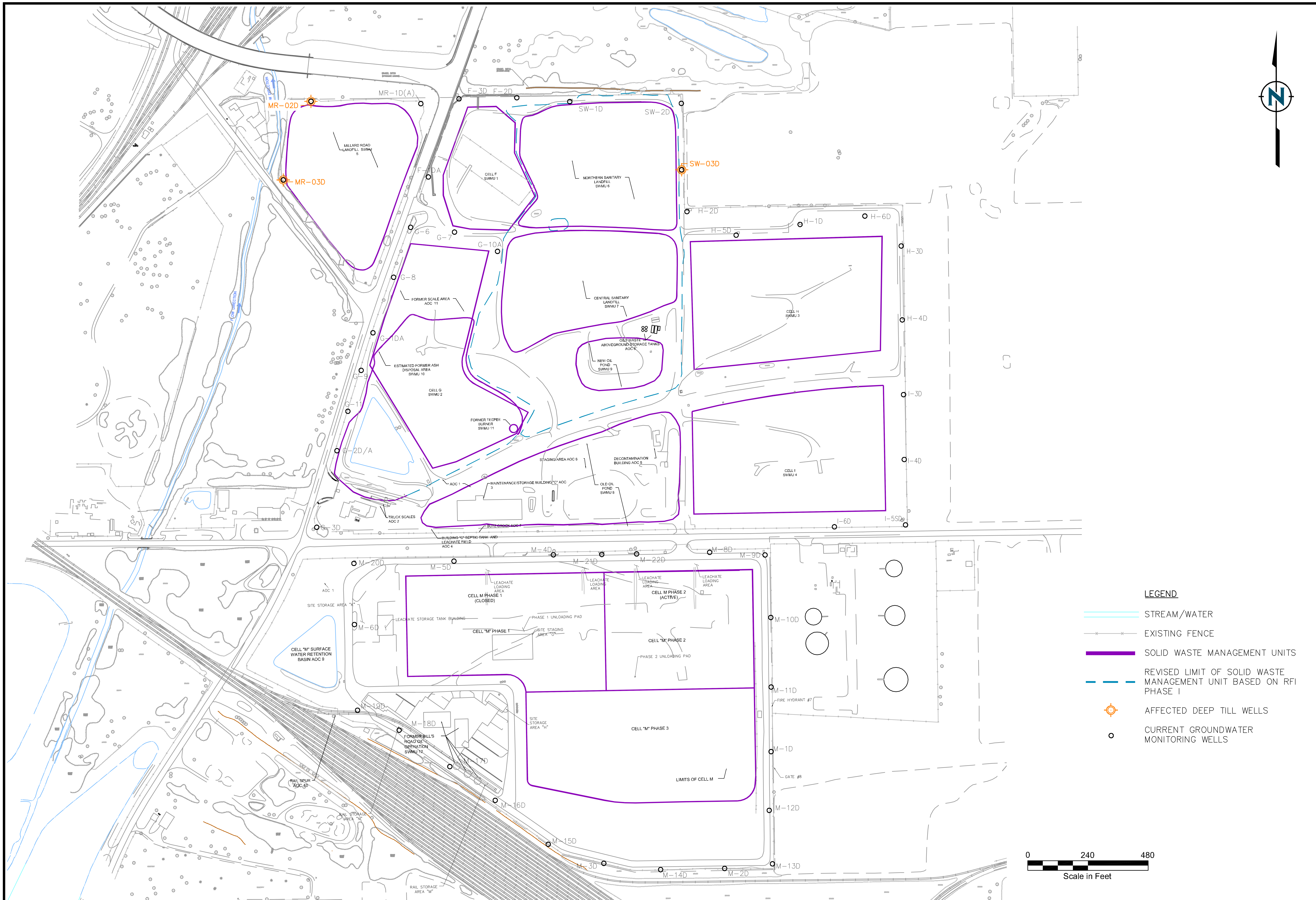
ENVIROSAFE SERVICES OF OHIO, INC.
OTTER CREEK ROAD FACILITY
OREGON, OHIO

PREPARED BY: KG	DATE: 04/30/2012	FIGURE
DRAFTED BY: BJK/PRM	SCALE: AS SHOWN	5a
APPROVED BY: SS	PROJECT: 026174M14B	

PMASCARO 4/30/12 [026174M13_S01]



PROPOSED GROUNDWATER MONITORING NETWORK DEEP TILL

ENVIROSAFE SERVICES OF OHIO, INC.
OTTER CREEK ROAD FACILITY
OREGON, OHIO

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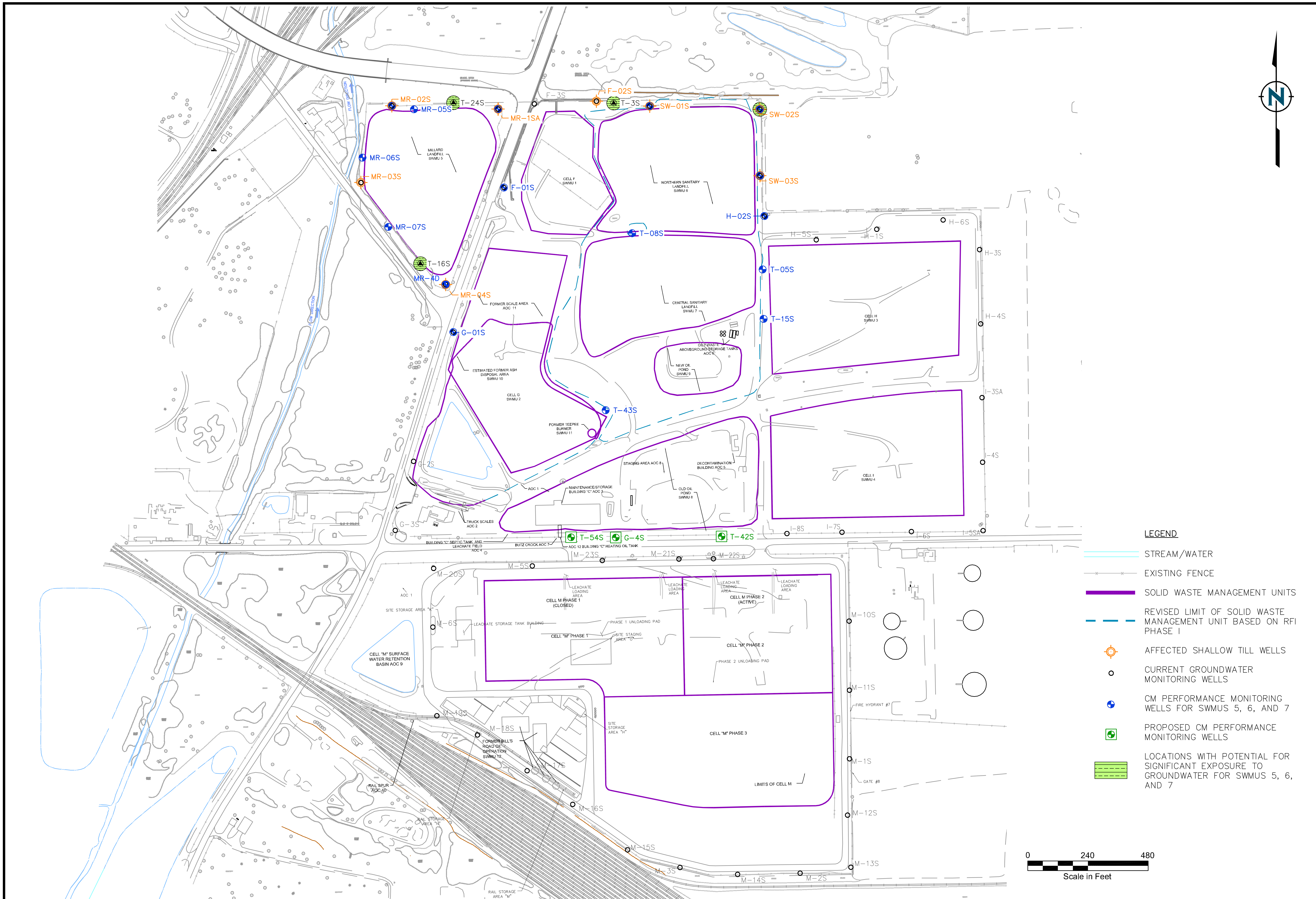
PREPARED BY: KG	DATE: 10/14/2010
DRAFTED BY: BJK/PRM	SCALE: AS SHOWN
APPROVED BY: SS	PROJECT: 026174M14B

FIGURE 5b

PMASCARO 1/6/11 [026174M13_5D]



PROPOSED GROUNDWATER MONITORING NETWORK SHALLOW TILL

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OTTER CREEK ROAD FACILITY
OREGON, OHIO

PREPARED BY: KG	DATE: 10/14/2010	FIGURE 5c
DRAFTED BY: BJK/PRM	SCALE: AS SHOWN	
APPROVED BY: SS	PROJECT: 026174M14C	