Five-Year Review Report

First Five-Year Review Report for Midway Landfill Site Kent, Washington

Final

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Date: 9-19-05

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# Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>AGI</td>
<td>AGI Technologies</td>
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<tr>
<td>CAP</td>
<td>Cleanup Action Plan</td>
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<tr>
<td>CERCLA</td>
<td>Comprehensive Environmental Response Compensation Liability Act</td>
</tr>
<tr>
<td>City</td>
<td>City of Seattle</td>
</tr>
<tr>
<td>COCs</td>
<td>contaminants of concern</td>
</tr>
<tr>
<td>DCA</td>
<td>Dichloroethane</td>
</tr>
<tr>
<td>DCE</td>
<td>Dichloroethene</td>
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<tr>
<td>EA</td>
<td>Endangerment Assessment</td>
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<tr>
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<td>EPA</td>
<td>Environmental Protection Agency</td>
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<tr>
<td>FS</td>
<td>Feasibility Study</td>
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<tr>
<td>HDPE</td>
<td>high-density polyethylene membrane</td>
</tr>
<tr>
<td>MCLs</td>
<td>Maximum Contaminant Levels</td>
</tr>
<tr>
<td>MTCA</td>
<td>Model Toxics Control Act</td>
</tr>
<tr>
<td>NCP</td>
<td>National Contingency Plan</td>
</tr>
<tr>
<td>NGA</td>
<td>Northern Gravel Aquifer</td>
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<tr>
<td>NPL</td>
<td>National Priorities List</td>
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<tr>
<td>O&amp;M</td>
<td>Operations and maintenance</td>
</tr>
<tr>
<td>PCE</td>
<td>Tetrachlorethene</td>
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<tr>
<td>PQL</td>
<td>Practical quantification limit</td>
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<tr>
<td>RCRA</td>
<td>Resource Conservation and Recovery Act</td>
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<tr>
<td>RCW</td>
<td>Revised Code of Washington</td>
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<tr>
<td>RI</td>
<td>Remedial investigation</td>
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<tr>
<td>ROD</td>
<td>Record of decision</td>
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<tr>
<td>ROW</td>
<td>Right of way</td>
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<tr>
<td>SA</td>
<td>Sand Aquifer</td>
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<tr>
<td>SG/SR</td>
<td>Shallow Groundwater/Saturated Refuse</td>
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<tr>
<td>SGA</td>
<td>Southern Gravel Aquifer</td>
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<td>Trichloroethene</td>
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<tr>
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<td>Trichloroethane</td>
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<tr>
<td>UGA</td>
<td>Upper Gravel Aquifer</td>
</tr>
<tr>
<td>USEPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>VOCs</td>
<td>Volatile organic compounds</td>
</tr>
<tr>
<td>WAC</td>
<td>Washington Administrative Code</td>
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<tr>
<td>WSDOT</td>
<td>Washington State Department of Transportation</td>
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Executive Summary

The purpose of this periodic review is to determine whether the cleanup remedy at the City of Seattle’s Midway Landfill Superfund site in Kent, Washington continues to be protective of human health and the environment. The review focuses on answering three questions. The answers to these questions are summarized below.

Question A: Is the remedy functioning as intended by the decision documents?

• The remedy has greatly reduced impacts, but it has not brought the landfill into compliance with respect to 1,2-dichloroethane and vinyl chloride in one upgradient well and four downgradient wells. Manganese exceeds the cleanup level in one downgradient well. The sources of these contaminants are the waste placed in the landfill and upgradient off site.

• Fluid levels in most of the SG/SR wells have continued to substantially decline over the past five years, demonstrating the continuing effectiveness of engineering controls.

• Concentrations of Record of Decision (ROD) contaminants of concern (COCs) in the SGA have generally remained stable or decreased over the past five years, although levels of some COCs remain above cleanup levels (1,2-dichloroethane and vinyl chloride in one upgradient well and four downgradient wells and manganese in one downgradient well).

• The SGA does not serve as a current source of drinking water and institutional controls prohibit future drinking water uses. Therefore, despite the existing levels of contaminants, the remedy continues to be protective of human health and the environment.

• Upgradient sources of VOCs in groundwater continue to be present and will limit the potential for the COCs in the SGA to decrease below the ROD cleanup levels. Vinyl chloride is a daughter product of the ethenes and ethanes detected in upgradient wells, and both vinyl chloride and 1,2-dichloroethane are also present upgradient of the landfill.
Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

The exposure assumptions, toxicity data, and remedial action objectives used at the time of the remedy selection are still valid. The cleanup levels established for the site in the ROD are still appropriate and protective considering the current and likely future use of the site. There have been no regulatory or statutory changes that would call into question the protectiveness of the remedy.

The cleanup levels selected in the ROD are also still valid. However, because of changes to the Model Toxics Control Act (MTCA) regulations, the vinyl chloride ground water cleanup level is updated to reflect revisions to the state cleanup levels. The cleanup level for vinyl chloride was established at the state MTCA level of 0.02 µg/L instead of the federal maximum contaminant level of 2 µg/L. The Record of Decision specified the state cleanup standard of 0.02 µg/L with the caveat that the practical quantification limit of 0.2 µg/L would be used as an alternative because the cleanup level was lower than the practical quantification limit.

Revisions to the MTCA implemented in 2001, changed the requirements for developing ground water cleanup standards (Washington State Department of Ecology, 2001a, b; respectively). The MTCA regulations require adjustment of concentrations based on applicable state and federal law to the $1E^{-5}$ risk level.

The revised state cleanup level for vinyl chloride is $0.29 \mu g/L$, using the MTCA adjusted cancer risk of $1E^{-5}$.

With the change of the vinyl chloride state cleanup standard from 0.02 to 0.29 µg/L, the use of the practical quantification limit of 0.2 µg/L as an alternative cleanup is no longer relevant.

The revisions to the vinyl chloride cleanup standard as described above are agreed upon by the City of Seattle and the Washington Department of Ecology. The City of Seattle will issue a revision to Midway Landfill Monitoring Plan (Parametrix 2000a) to document the history of changes to the cleanup.
standards for vinyl chloride. The new vinyl chloride standard will be utilized in future evaluations of ground-water conditions at the Midway Landfill.

**Question C:** Has any other information come to light that could call into question the protectiveness of the remedy?

The presence of low concentrations of 1,2-dichloroethane and vinyl chloride in one upgradient and four downgradient wells in the Southern Gravel Aquifer is of concern. In addition, other volatile organic compounds have also been detected upgradient of the landfill. The Washington Department of Ecology will be contacting the owners of properties in the vicinity of the upgradient sources to encourage the property owners to voluntarily investigate and cleanup any contamination that may affect the landfill.

At the request of the US EPA, 1, 4 dioxane testing, will be conducted during the next sampling event at upgradient monitoring wells 17B and 21B in the Sand Aquifer and a third well, MW-14, a downgradient well in the Southern Gravel Aquifer. Well 21B has shown a slight, but steady increase over time of volatile organic compounds. Well 17B has shown a decrease in concentration over time for volatile organic compounds. This is a precautionary step advised by the US EPA for all sites undergoing 5-year periodic review where certain other solvents are present.

The Washington Department of Transportation, in cooperation with the City of Seattle and the Washington Department of Ecology will be expanding Interstate 5 into the highway right-of-way on the eastern side of the landfill. Investigations of the refuse in the right-of-way show that this expansion will not adversely affect the landfill. Gas probes in this portion of the landfill have been devoid of any gases for the past several years. These gas probes will be abandoned prior to expansion of the interstate.
The City of Seattle will continue to operate and maintain remedial systems, including access controls, constructed under the consent decree. In addition, the monitoring programs will need to continue in compliance with the approved monitoring plan. This includes continuing the fluid elevation monitoring program, groundwater chemistry monitoring program, and landfill gas monitoring program in accordance with the Monitoring Plan, and evaluate the results on an ongoing basis.

Specific recommendations and follow-up actions include:

- Annually assess the results of the ongoing monitoring program to determine if additional work is needed.

- During the next schedule ground-water sampling round, test for 1,4-dioxane at monitoring wells 14B, 17B and 21B. If 1,4-dioxane is not detected, and then discontinue testing for this compound. If detected, however, the monitoring program will be adjusted to monitor the trend of this compound.

- Reassess the scope of monitoring on a 5-year interval depending on monitoring results.

Change the cleanup level for vinyl chloride from 0.2 µg/L to 0.29 µg/L.
### Periodic Review Summary

#### SITE IDENTIFICATION

<table>
<thead>
<tr>
<th>Site Name (from WasteLAN):</th>
<th>Midway Landfill</th>
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<tr>
<td>EPA ID (from WasteLAN):</td>
<td>WAD WAD 980638910</td>
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<tr>
<td>Region:</td>
<td>10</td>
</tr>
<tr>
<td>State:</td>
<td>WA</td>
</tr>
<tr>
<td>City/County:</td>
<td>Kent/King</td>
</tr>
</tbody>
</table>

#### SITE STATUS

- **NPL status**: Final
- **Remediation status**: Under construction, Operating, Complete
- **Multiple OUs?**: no
- **Construction completion date**: 2000
- **Has site been put into reuse?**: yes

#### Review Status

- **Lead Agency**: EPA, State
- **Author Name**: Ching-Pi Wang
- **Author Affiliation**: WA State Dept. of Ecology
- **Review Period**: January 2005 to September 2005
- **Dates of site inspection**: May 2, 2005
- **Type of Review**: Post-SARA, Pre-SARA, NPL - Removal Only, Non-NPL Remedial Action Site
- **Regional Discretion**: NPL State/Tribe-lead
- **Review Number**: First
- **Triggering Action**: Actual RA on-site Construction at OU# ____, Actual RA Start at OU# ____, Construction Completion
- **Triggering action date (from WasteLAN)**: September 6, 2000
- **Due date (five years after triggering action date)**: September 6, 2005

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* ["OU" refers to operable unit.]
1.0 Introduction

The purpose of this periodic review is to determine whether the cleanup remedy at the City of Seattle's Midway Landfill Superfund Site continues to be protective of human health and the environment.

The Midway Landfill was placed on the National Priorities List (NPL) in May, 1986. It is a state-lead site. The Washington State Department of Ecology (Ecology) is responsible for the oversight management of the site as stipulated by an agreement with Region 10 of the Environmental Protection Agency (EPA). The cleanup is managed by Ecology under the authority of the Model Toxics Control Act [Chapter 70.105D RCW], the Water Pollution Control Act [Ch. 90.48 RCW], and all other applicable state and federal laws.

WAC 173-340-420 provides for periodic review of post-cleanup conditions at sites where institutional controls are required as part of the cleanup action. Institutional controls are required at the landfill because waste is contained on site.

Reviews must be conducted at least every five years after the initiation of the cleanup action. Because most of the cleanup action at this site occurred prior to the ROD, and thus the ROD did not require further construction, the ROD signature date is the trigger for the CERCLA five year review at this site. This review has been conducted by the Toxics Cleanup Program, Northwest Regional Office, Washington State Department of Ecology.
2.0 Site Chronology

September 2005  First 5-year review completed by Washington State Department of Ecology and the EPA.

September 2000  EPA completes a Record of Decision.

1991  Landfill cap and cover system construction completed

1990  Consent decree between Ecology and City of Seattle

1989  Landfill cap and cover system designed and construction started


May 1986  Landfill Placed on National Priorities List.

October 1984  Landfill nominated to the National Priorities List.

1985  Removal action begun to extract migrating landfill gases.

1984  Methane gas discovered in surrounding residential area.

Fall 1983  City of Seattle closed the landfill.

1966-1983  Site leased by City of Seattle for use as a landfill.

1945-1968  Site operated as a gravel pit.
3.0 Background

3.1 Location and Climate

The Midway Landfill is in King County, Washington, Between Interstate-5 (I-5) and Highway 99, and between South 252\textsuperscript{nd} Street and South 246\textsuperscript{th} Street in Kent, Washington 98032. Figure 1 shows the regional site location.

The location is in a geographic area known as the Puget Sound Lowland. The area has been glaciated several times and is underlain by a sequence of glacio-fluvial sediments. The area has a maritime climate characterized by cool, wet winters and drier, mild summers. Annual rainfall is about 40 inches per year, which falls mainly between November and June.

3.2 History and Regulatory Synopsis

The City of Seattle (City) operated the Midway Landfill from 1966 to 1983. When the City closed the Midway Landfill in 1983, extensive testing for landfill gas and analysis of groundwater in and around the landfill began. The presence of contaminants with a potential for off-site migration was indicated and the Washington State Department of Ecology (Ecology) began to investigate the site.

In 1986, the site was placed on the National Priorities List (NPL) by the Environmental Protection Agency (EPA) for groundwater conditions at the site. As required by the EPA, the City completed a remedial investigation (RI), an Endangerment Assessment (EA), and a Feasibility Study (FS).

In May 1990, prior to completion of the RI and FS studies, the City and Ecology entered into a consent decree pursuant to the State of Washington Model Toxics Control Act [MTCA], (Washington State Department of Ecology, 1996). This legal agreement set forth Ecology’s determination that undertaking certain remedial actions, prior to a Cleanup Action Plan (CAP), would provide immediate protection to human health and the environment. The remedial actions were completed by 1992.

Under MTCA, the decision document that selects the cleanup action and cleanup levels is called the CAP (similar to an EPA Record of Decision [ROD]).
Ecology and the City had been working on a CAP since 1992. In September 2000, the EPA completed a Comprehensive Environmental Response Compensation Liability Act (CERCLA) ROD for the landfill so that a determination of CERCLA construction completion could be made (USEPA 2000). Ecology then decided to utilize the ROD as a CAP for a final MTCA remedy, pursuant to WAC 173-340-360(13).

3.3 Physical and Geographical Characteristics

The Midway Landfill is located near the crest of a narrow north-south trending glacier feature known as the Des Moines Drift Plain. This area, referred to as "upland" because of its location above adjacent valleys and sea level, is bordered by Puget Sound on the west and the Green River valley on the east. Maximum elevations along the crest of the upland generally range from 400 to 450 feet above mean sea level. Puget Sound is at sea level, and the Green River valley floor typically averages about 30 feet above mean sea level.

The Midway Landfill occupies a shallow, bowl-shaped depression near the crest of the upland. The surface of the landfill generally ranges from 360 to 400 feet above mean sea level and slopes upward to the south and east. West of the landfill, the land surface is nearly flat across Highway 99 and then drops steeply downward approximately 100 feet to the Parkside Wetland.

The upland area is cut with a number of steep-sided stream valleys. Midway Creek is located northeast of the landfill, and two other streams, the north and south forks of McSorley Creek, are located to the west and southwest, respectively.

There is no major surface water body in the immediate vicinity of the Midway Landfill. The closest are Lake Fenwick, located approximately one mile to the southeast, and Star Lake, located approximately 1.5 miles to the south.
3.4 Land and Resource Use

3.4.1 Land Use

Currently the landfill is capped and fenced. No public access is allowed. Future land use has been the subject of an extensive but preliminary 1992 study by community representatives, the City of Kent, and the City of Seattle. Some possible uses considered desirable by the Midway Citizens Advisory Committee include open space uses such as a passive park, a sports complex with ball fields, or garden center. Less desirable but potentially possible future uses would be a golf driving range or a park and ride facility. All uses would be designed to protect the integrity of the cap and other containment systems.

Occasionally there are inquiries from buyers of properties adjacent to or near the Midway Landfill. The inquiries request information on any environmental impacts to the property that the buyer may be interested in purchasing. Whenever such inquiries are received, the City of Seattle reviews the current environmental data with respect to the location of the property of interest. An example information letter from the City of Seattle to prospective purchasers of adjacent or nearby properties is provided in Appendix A.

3.4.2 Ground-Water Use

To the best of Ecology’s and the City’s knowledge, no one is drinking the groundwater from any aquifer within almost a mile of the landfill, and there are no current plans to use the groundwater near the landfill for drinking water. The closest wells currently in use for drinking water are the Lake Fenwick wells almost 1 mile southeast of the Midway Landfill.

There are three public wells in the Midway Landfill area. Two are operated by the Highline Water District near the two intersections of South 209th Street and 31st Avenue South, and South 208th Street and 12th Avenue South, respectively. These two wells are screened in the second confined aquifer, at over 120 feet below sea level. Both are over two miles north and northwest from the landfill in an area that is up gradient of the landfill, and are completed in aquifers that are not connected to the affected aquifers.
The third well is operated by the Kent Water District at South 212th Street and Valley Freeway and is used to satisfy peak summer demands. None of these municipal wells draw water from affected aquifers, and all are more distant from the landfill than are the Lake Fenwick wells.

Neither water district has future plans to develop groundwater supplies from any aquifers within an one-mile radius of the Midway Landfill. The wellhead protection areas delineated by these utilities do not include the Midway Landfill site.

State regulations (WAC 173-160 -171) do not allow any new private drinking water wells within 1000 feet of a solid waste landfill or 100 feet of all other sources or potential sources of contamination, and notice is required to be given to Ecology prior to the construction of any well. However, the NCP is more stringent and requires EPA to consider all groundwater as drinking water except directly under a waste management area. The landfill area with refuse is a waste management area and thus is not considered a future drinking water source by EPA. All other areas downgradient of the landfill are considered to be potential future drinking water sources. However, it is likely that all future developments lie within water district service areas and, therefore, are not likely to rely on private wells for their potable water supply.

3.5 History of Contamination

From 1945 to 1966, the site of the current Midway Landfill was operated as a gravel pit. Originally, the pit was adjacent to a natural drainage basin often used as a settling pond. This basin, known as Lake Meade, was located northeast from the center of the present landfill. As the pit was mined, water was drawn from Lake Meade to wash silt and clay from the gravel and sand, and then returned to the lake. This silt and clay settled on the lake bottom. Near the end of the gravel pit operation, the lake was drained into the southern end of the gravel pit, depositing a layer of clay and silt into the bottom of the pit. This layer of fine materials currently underlies much, but not all, of the present landfill.

In 1966, the City of Seattle leased the site and began using it as a landfill. From 1966 to 1983, approximately three million cubic yards of solid waste
were deposited there. The exact dimensions of the bottom of the landfill are not known. However, existing boreholes indicate that the solid waste extends as deep as 130 feet in some places.

The Midway Landfill was created primarily to accept demolition materials, wood waste and other slowly decomposing materials. However, some hazardous wastes and industrial wastes, including approximately two million gallons of bulk industrial liquids from a single source, were also placed in the landfill. In 1980, a state-mandated screening process administered by the Seattle-King County Department of Public Health was initiated to eliminate the disposal of any hazardous waste into Midway Landfill.

When the City closed the landfill in the fall of 1983, it began extensive testing of water and gas in the landfill and its vicinity. Samples of groundwater from monitoring wells in and around the landfill, and gas samples from gas probes, indicated the presence of organic and inorganic contaminants outside the landfill boundary. In 1985, Ecology also began investigating the site and found methane gas in nearby residences. Beginning in September 1985, the City of Seattle constructed gas migration control wells within the landfill property and gas extraction wells beyond the landfill property to control the subsurface migration of gas. Gas was found to have migrated up to 2600 feet beyond the landfill prior to installation of the gas extraction system.

### 3.6 Synopsis of Hydrogeology Setting

The ground water conditions beneath the landfill are very complex. A brief synopsis is provided to describe the important hydrogeologic features of the landfill.

Groundwater movement within and below the landfill has been characterized to an approximate depth of 300 to 350 ft below ground surface (50 to 100 ft above mean sea level. Several aquifers have been identified within this interval, including (from shallowest to deepest)

- Perched Aquifer (also referred to as Shallow Groundwater)
- Landfill Aquifer (also referred to as Saturated Refuse)
• Upper Gravel Aquifer (UGA)

• Sand Aquifer (SA)

• Southern Gravel Aquifer (SGA)

• Northern Gravel Aquifer (NGA)

The line of the generalized cross section of the monitored units is shown in Figure 2, and the cross section itself is shown in Figure 3.

The Perched Aquifer was named during the RI when it was believed to represent shallow, discontinuous lenses of groundwater perched on low permeability deposits above the UGA. Field work and data analysis since completion of the RI indicate that while this groundwater is shallow and discontinuous, it is not always perched. The majority of these shallow zones are found north of the landfill. The Perched Aquifer is referred to as Shallow Groundwater in the remainder of this report.

The Saturated Refuse consists of leachate within the landfill. Its occurrence and movement are largely functions of the former gravel pit topography. Flow in the Saturated Refuse is generally from the north and west toward the south central section of the landfill, where the pit excavations were deepest. Leachate likely discharges vertically throughout much of the landfill base, but the greatest volume of vertical flow is in the south central area. Leachate discharging from the landfill enters the underlying UGA.

A generalized potentiometric surface map of the UGA for March 2005 is presented as Figure 4. The UGA occurs immediately below the base of the landfill, is limited in lateral extent and is composed of silty and sandy gravel. The aquifer is typically semi-confined, although some parts are unconfined. Groundwater flow in the UGA is generally from both the north and south inward toward an area beneath the southern end of the landfill where the groundwater appears to discharge downward into the underlying SA.

The UGA and SA are separated by the Upper Silt Aquitard, a discontinuous layer of fine-grained silt, clayey silt, and silty fine sand. Vertical flow from the UGA into the SA is most pronounced in places where the aquitard is absent.
A generalized potentiometric surface map of the SA for March 2005 is presented as Figure 5. The SA occurs as a widespread deposit of interbedded sands and silts. Flow in this aquifer in the vicinity of the landfill is generally from the north and west to the southeast toward an apparent hydraulic sink. The sink occurs across a broad area beneath the southern part of the landfill and extends several hundred feet to the east. Groundwater south of this sink also flows towards the sink. Groundwater entering this sink appears to flow downward into the SGA. Some vertical flow outside the sink area also occurs from the SA downward into the SGA and NGA.

The SA and SGA are separated by the Lower Silt Aquitard. Like the Upper Silt Aquitard, the Lower Silt Aquitard is discontinuous and likely controls downward flow from the SA into the SGA.

The deepest stratigraphic units studied are the NGA and SGA; they occur at about the same elevation, but hydraulic heads in the NGA are typically 100 ft higher than heads in the SGA. A generalized potentiometric surface map of the SGA for March 2005 is presented in Figure 6.

The SGA is found beneath the southern half of the landfill and extends to the east, south, and west. It consists of permeable sands and gravel interbedded with silts and silty gravel. The SGA appears to be recharged by the SA and by lateral flow from the south. A groundwater mound in the SGA, below the hydraulic sink in the SA, is believed to be an expression of flow through the sink. Groundwater flow from the mound is to the east and west; flow to the north is blocked by higher potentiometric heads within the NGA. Groundwater in the SGA eventually discharges west to Puget Sound and east to the Green River Valley.

The NGA is found beneath the northern half of the landfill and extends to the north and northeast. Like the SGA, the NGA consists of permeable sands and gravel interbedded with silts and silty gravel. Flow from the NGA is generally from north to south toward the SGA. Like the SGA, the NGA eventually discharges to Puget Sound and the Green River Valley.

Flow rates within the aquifers and along critical flow paths are very difficult to estimate at Midway Landfill because of the complex stratigraphy and the
strong vertical gradients. Based on evidence from calculated hydraulic conductivities, estimated porosities, and measured hydraulic heads, flow rates in the aquifers beneath Midway Landfill range from less than 0.01 to 10 ft per day. Given that flow rates of 0.1 to 1 foot per day are most likely, actions affecting leachate discharge or quality would be detectable in the groundwater monitoring network between 3 months and 30 years after they occurred. Note that the groundwater monitoring wells were selected in representative upgradient and downgradient sampling locations based on flow directions within each aquifer. Monitoring has been conducted at the site for over 15 years. Over this period, flow rates have been sufficient to allow observation of substantial changes in fluid level and chemical monitoring data in response to remedial actions.

4.0 Pre-ROD Remedial Actions

4.1 Remedy Selection and Implementation

In May 1990, prior to completion of the remedial investigation and feasibility studies, the City and Ecology entered into a consent decree pursuant to State of Washington Model Toxics Control Act (MTCA.) This legal agreement set forth Ecology’s determination that undertaking certain remedial actions at Midway Landfill, prior to a Cleanup Action Plan (a MTCA decision document, similar to a Superfund ROD) would provide immediate protection to public health and the environment. In this consent decree, the City of Seattle agreed to finance and perform specific cleanup work. This cleanup work, or remedial action, consisted of the elements described in the following sections.

4.2 System Operations/Operation and Maintenance (O&M)

4.2.1 Gas Control

An active gas control system was installed at the Midway Landfill. It originally included 87 gas extraction wells, 31 of which were located off the landfill in native soil. The off-landfill wells have since been abandoned or capped. In addition, approximately 70 off-landfill gas monitoring probes were installed to provide information on gas concentrations; about half of these probes have since been abandoned. The gas is extracted through the control
wells at the landfill and routed to a permanent blower/flare system. Construction of the gas migration control system began in September 1985 and was completed in March 1991.

4.2.2 Landfill Surface Filling and Grading

The landfill surface was regraded which increased the soil cover over the landfill by 2 to 14 feet. The engineered grades improved surface water runoff and decreased infiltration. The fill was also compacted to reduce permeability and prepare the surface for the cover system. The work began in August 1988 and was competed in June 1989.

4.2.3 Storm Water Detention Pond

The storm water detention pond includes the landfill dewatering and discharge system. A lined detention pond was constructed to the north of the landfill. Re-grading of the landfill surface redirected surface water to the new detention pond. Previously, the surface water infiltrated into the landfill. The detention pond is a 3 acre structure, lined with a 60-millimeter high-density polyethylene membrane (HDPE) to eliminate infiltration. The bottom of the pond was constructed below localized groundwater; therefore, a permanent dewatering system was also installed. Construction of the storm water detention pond began in August 1988 and was completed in June 1989.

4.2.4 Landfill Cap Installation

Construction of the final landfill cover began in October 1989 and was completed in May 1991. It consists of the following layers from bottom to top: a 12-inch thick layer of low permeability (1 x 10^-7 cm/sec) soil/clay material; a 50 millimeter HDPE flexible membrane; drainage net; filter fabric; 12-inch-thick drainage layer; and a 12-inch-thick topsoil layer.

4.2.5 Linda Heights Park Storm Water Diversion

The Linda Heights Park drain, a 30-inch culvert that drained directly into the landfill, was blocked. Storm water is now routed through a pump station and a pipeline to the detention pond. The old discharge line to the landfill is still in place and functions as an overflow in the event of a pump station failure. The construction of this rerouting began in August 1989 and was completed in

4.2.6 Operations and Maintenance (O&M) Plan

A comprehensive operation and maintenance manual for both short-term and long-term operation and maintenance for the systems constructed under the consent decree was prepared by the City of Seattle, and was approved by Ecology in April 1992.

The 1990 consent decree also required the City to place a notice in the records of real property kept by the county auditor stating that the landfill was on the NPL, and serve a copy of the consent decree upon any prospective purchaser, lessee, transferee, assignee, or other successor in interest to the property prior to the transfer of any legal or equitable interest in all or any portion of the landfill.

4.3 Record of Decision Remedy

A final remedy for Midway Landfill was selected by EPA with Ecology’s concurrence in September 2000. The selected remedy consisted of:

1. Monitoring to:
   
   (a) Determine if the remedial systems are working as designed,

   (b) Determine the progress towards meeting the groundwater cleanup standards,

   (c) Determine if adequate containment is maintained when and if major changes are approved by the Department of Ecology in the operation of the site, such as turning off or scaling down the gas collection system, and

   (d) Demonstrate that the cleanup levels have been achieved.

   The monitoring will be done by the City of Seattle, while Ecology will continue to be the lead cleanup regulatory agency at the site. The details of the monitoring requirements have been set out by the City of Seattle in an Ecology-approved compliance monitoring plan.
Monitoring, including installation of new monitoring wells, is among the
activities EPA expects at sites even after EPA determines that
correction has been “completed” at a site. Through the procedures
outlined in the agreements between Ecology and the City of Seattle,
Ecology may require the City of Seattle to install and monitor new
monitoring wells if needed.

If necessary, the monitoring program may also address the issue of the
source of turbidity in North McSorley Creek raised by the City of Des
Moines in their comment letter on the proposed plan. The City of Des
Moines requested that the City of Seattle continue to monitor the S.
250th Street outfall for turbidity during storm events (on a periodic
basis) and provide the results to the City of Des Moines Engineering
Department.

2. Continuing to operate and maintain all remedial elements required in the
1990 consent decree. Ecology will continue to oversee the City’s operation
and maintenance activities. Operational changes can be approved by
Ecology when such changes ensure that the site and remedy will remain
protective. The Seattle King County Public Health Department should be
given the opportunity to review requested operational changes.

3. Implementing institutional controls. Institutional controls are legal or
administrative actions that help ensure the long-term protectiveness of
the remedy. At this site, the selected remedy consists of three types of
institutional controls. Variations of the first two types of institutional
controls are already required in the 1990 consent decree.

(a) First, the City of Seattle will place a notice in the records of real
property kept by the King County auditor, alerting any future purchaser
of the landfill property, in perpetuity, that this property had been used
as a landfill and was on EPA’s National Priorities List, and that future
use of the property is restricted. The use restriction shall comply with
the post-closure use restrictions under the State of Washington’s
Criteria for Municipal Solid Waste Landfills (WAC 173-351-500(1)(I)
and (2)(c)(iii). The City has recorded this note with King County on July
13, 2005.
(b) Second, the City needs to ensure continued operation and maintenance of the containment and monitoring systems if any portion of the property is sold, leased, transferred or otherwise conveyed. This requirement is an element of the 1990 consent decree.

(c) Third, notices are needed so that no water supply wells are constructed and used in areas with groundwater contamination emanating from the landfill. These notices shall include at a minimum the following:

- The City will annually notify the Seattle-King County Department of Public Health, Ecology, the local water districts (currently, the Kent and Highline Water Districts) and locally active well drillers in writing of groundwater conditions in the affected areas downgradient of the landfill. This notice will include a map showing the location of the affected areas and indicate which aquifers are affected and their elevations. This information shall be updated annually and can be part of an annual groundwater monitoring report. Locally active well drillers are all well drillers that have drilled wells within King County in the year prior to the notice. Ecology will provide the list of locally active well drillers to the City. This requirement for annual notices can be removed or modified by Ecology after groundwater cleanup standards have been met in the groundwater monitoring wells downgradient from the landfill. A copy of the 2005 notice to local drillers is provided in Appendix D.

- The City of Seattle will also annually notify owner of Well #37 in writing of groundwater conditions in the area of the well. Alternatively, the City of Seattle can provide to Ecology adequate assurances that this well has been properly abandoned.

As an additional protection, state regulations forbid any private drinking water wells within 1,000 feet of a municipal landfill or 100 feet from all other sources or potential sources of contamination (WAC 173-160-171). State regulations (WAC 173-160-151) also require a property owner, agent of that owner, or a water well operator to notify Ecology of their intent to begin well construction prior to beginning work. This notification can provide notice to Ecology if anyone plans to build a new water well too near Midway Landfill.
Ecology will continue to be the lead regulatory agency overseeing the performance of the selected remedial action by the City of Seattle. However, if necessary, EPA could use its statutory authority to ensure that actions selected by this ROD are implemented.

The groundwater cleanup standards for the current contaminants of concern can be found in Table 1. If other contaminants resulting from releases from the landfill are found in any down gradient monitoring well, cleanup levels, if necessary, will be established for these additional contaminants using the federal drinking water standards and MTCA.

The point of compliance for the groundwater will be at the edge of the landfill waste as specified in a Compliance Monitoring Plan approved by Ecology. Under MTCA, this location is considered a “conditional point of compliance.” All groundwater downgradient of this point of compliance will need to meet these cleanup levels for contaminants resulting from releases from the landfill before the Midway Landfill is removed from the Superfund National Priorities List.

One of the City of Seattle’s concerns is that contaminated groundwater is coming into the landfill from up gradient sources, and that this in-coming contaminated groundwater will never allow the groundwater leaving the landfill to meet the groundwater cleanup standards. Because of the major improvements in downgradient water quality in the last ten years, EPA believes it is possible that the groundwater leaving the landfill will eventually meet the groundwater cleanup standards. However, if in the future the City wants to demonstrate that it is technically impracticable for them to meet the cleanup standards at every downgradient well because of the up gradient sources, EPA and Ecology will work together with the City to determine what information is needed to support such a demonstration.

Because the selected remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted under CERCLA within five years of this Record of Decision to ensure that the remedy continues to be protective of human health and the environment. Because Ecology is expected to continue
to be the lead regulatory agency for this cleanup, EPA would expect Ecology to perform the five year review at this site.

The City of Seattle estimates that the closure costs of Midway Landfill amounted to about $56.5 million as of 1995. This does not include the ancillary costs associated with the landfill such as the “Good Neighbor Policy”. In recent years, the budgeted and actual operation and maintenance costs have ranged from $432,000 to $535,600 annually. This amount includes monitoring costs.

**Groundwater Cleanup Standards**

**Table 1. List of Contaminants of Concern and Cleanup Standards**

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Cleanup Level</th>
<th>Basis of the Cleanup Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manganese</td>
<td>2.2 mg/L</td>
<td>MTCA Method B</td>
</tr>
<tr>
<td>1,2-dichloroethane</td>
<td>5 µg/L</td>
<td>Federal Drinking Water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Standard (MCL)</td>
</tr>
<tr>
<td>vinyl chloride</td>
<td>.02 µg/L*</td>
<td>MTCA Method B.</td>
</tr>
</tbody>
</table>

**NOTES:**

(*) Pursuant to WAC 173-340-707(2), Ecology will utilize the practical quantification limit (PQL) of 0.2 µg/L to determine compliance with this cleanup standard because the cleanup standard is lower than the PQL.

(1) 1,2-Dichloroethane and vinyl chloride are solvents. Vinyl chloride can also be formed in groundwater during the natural breakdown of other solvents. Manganese is a natural mineral in soil that dissolves into the groundwater because of the chemistry of the water leaving the landfill.

(2) If other contaminants resulting from releases from the landfill are found in any downgradient monitoring well, cleanup levels, if necessary, will be established for these additional contaminants using the federal drinking water standards and MTCA.

(3) The point of compliance for the groundwater will be at the edge of the landfill waste as specified in a Compliance Monitoring Plan to be approved by Ecology. Under MTCA, this location is considered a “conditional point of compliance.” All groundwater downgradient
of this point of compliance will need to meet these cleanup levels for contaminants resulting from releases from the landfill before the Midway Landfill is removed from the Superfund National Priorities List.

### 5.0 Ongoing Environmental Monitoring Programs and O&M Requirements

To evaluate the effectiveness of the remediation measures described above, the City has conducted performance and compliance monitoring programs at the Midway Landfill since 1989. These include fluid level monitoring, groundwater chemistry monitoring, and landfill gas monitoring that are performed on an ongoing basis. The current monitoring program is described in the Midway Landfill Monitoring Plan (Parametrix 2000a).

The O&M requirements for Midway Landfill are described in Midway Landfill Operation and Maintenance Manual completed in 1992, (Parametrix). This document is a comprehensive operation and maintenance manual for both short-term and long-term operation and maintenance for the systems constructed under the consent decree was prepared by the City of Seattle, and was approved by Ecology in April 1992. The manual addresses operation and maintenance of all components of the remedy including; gas system, surface water systems, pump stations, landfill cover system, roadway and site control.

#### 5.1 Fluid Level Monitoring

An extensive formal fluid level monitoring program began in October 1989 and has been conducted monthly, quarterly, or semi-annually through sampling Round 47, March 2005. In 1993 the monitoring frequency was reduced to a semi-annual schedule. Fluid level monitoring was previously referred to as “Performance Monitoring” and is intended to track response of landfill leachate levels and shallow groundwater levels to remedial actions required by the consent decree. It includes collection of groundwater level and oil thickness measurements within the saturated portion of Midway Landfill (termed Saturated Refuse) and groundwater levels in the shallow groundwater surrounding the landfill (Shallow Groundwater). The fluid level monitoring network for the Shallow Groundwater and Saturated Refuse is shown in
Figure 7. Fluid level monitoring is currently being conducted on a biannual basis and the current program (Parametrix 2002) consists of:

- Monitoring seven wells from the key hydraulic areas (south end, hydraulic sink, west side, central mound, Linda Heights, north end, north end shallow) of the landfill twice a year beginning in 2002 during Round 41. These wells monitor the Shallow Groundwater/Saturated Refuse (SG/SR). The measurements from these wells are being compared to historical data to evaluate continued effectiveness of the closure measures.

- Monitoring 61 additional wells from the SG/SR once every other year beginning in 2003 (Round 43). Measurements from these wells are being compared to historical data as described above, and used to evaluate groundwater flow within the SG/SR and oil thickness trends.

5.2 Groundwater Chemistry Monitoring

Groundwater chemistry monitoring was initiated in February 1990 with Round 1 (QM-1) and has been conducted on a quarterly or semi-annual basis through sampling Round 46 in 2004. Groundwater chemistry monitoring has also been referred to as “Compliance Monitoring” in previous documents and is intended to track the presence, concentrations, and migration of groundwater contaminants, both upgradient and downgradient of the landfill, to assess the effectiveness of the remedial actions.

The first semi-annual groundwater chemistry event was Round 34 (QM-34). The current groundwater chemistry monitoring program includes collection and qualitative analysis of groundwater samples collected from monitoring wells located upgradient and downgradient of the landfill and groundwater flow determination. The well locations currently used for groundwater level measurements are shown in Figure 8. The well locations currently used for groundwater chemistry monitoring are shown in Figure 9.
5.3 Landfill Gas Monitoring

Gas monitoring is conducted on a biweekly, weekly, monthly, or quarterly basis; it consists of checks for concentration, composition, temperature, flow, and velocity of gases.

Monitoring and a monitoring plan are not specifically identified as required activities in the 1990 consent decree. An amendment to the consent decree will specify a requirement to implement a compliance monitoring plan approved by Ecology, as well as to implement an operations and maintenance plan. The City of Seattle and Ecology agreed upon a long-term monitoring plan in April 2005 and amended the consent decree to include the monitoring plan.

6.0 Monitoring Results

6.1 Groundwater Flow Determination

Potentiometric contour maps have been generated regularly with each monitoring round for the Upper Gravel Aquifer, the Sand Aquifer, and the Southern Gravel Aquifer. The monitoring well locations are shown in Figure 8. The most current results are shown in the 2004 Annual Groundwater Monitoring Report and the 2005 Groundwater Remediation Status Report 5-Year Review. (Parametrix 2005a, 2005b).

Flow patterns in the Upper Gravel Aquifer and Sand Aquifer have remained relatively stable during the period of record. Flow patterns in the Southern Gravel Aquifer have also remained relatively stable, although recent data in the vicinity of well MW-30C indicate that the flow direction in that area is more northeast/northwest instead of east/west as measured during the remedial investigation. This change has not affected the upgradient and downgradient relationships within the SGA, except that well MW-30C appears to be in a cross-gradient direction relative to the influence of the landfill.

In general, the fluid levels in the shallow groundwater and saturated refuse have declined over time and the overall shape of the potentiometric surface has undergone little change over the last 15 years. The overall flow patterns within and directly under the landfill have generally remained constant over time.
6.2 Water Quality Monitoring

The most recent groundwater quality results are published in the 2004 Annual Groundwater Monitoring Report (Parametrix, 2005a). Summary tables of groundwater quality data and trend plots of key downgradient and upgradient wells are attached in Appendix C.

The cleanup levels were exceeded for 1,2-dichloroethane and vinyl chloride in samples collected from one upgradient well in the Sand Aquifer (MW-17B) and in samples collected from all five downgradient wells in the Southern Gravel Aquifer (MW-14B, MW-20B, MW-23B, MW-29B, and MW-30C) during the 2004 sampling rounds.

Three additional volatile organic compounds (1,1-DCE; tetrachloroethene [PCE]; and Trichloroethene [TCE]) have shown steadily increasing trends in well MW-21B. Concentrations of these VOCs are above applicable standards (federal Maximum Contaminant Levels (MCLs) for drinking water, and Model Toxics Control Act (MTCA) Method B groundwater cleanup levels), and have shown increases over time.

Manganese has exceeded the cleanup level in one downgradient well (MW-20B) during the 2004 sampling rounds.

Examples of time-series plots illustrating the levels of volatile organic compounds and trends over time in monitoring wells are attached in Appendix C.

The source(s) of upgradient contamination of the Midway Landfill in the Sand Aquifer is still present as indicated by data from upgradient monitoring well MW-21B. The results from these two wells show two different time-concentration trends. The concentrations of several volatile organic compounds detected in MW-17B are decreasing while the concentrations of several volatile organic compounds in MW-21B are increasing. Downgradient groundwater concentrations of volatile organic compounds in the Sand Aquifer and the Southern Gravel Aquifer continue to be affected by this undetermined contamination source.
Upgradient sources of VOCs in groundwater will continue to limit the potential for the chemicals of concern in the Southern Gravel Aquifer to decrease below the ROD cleanup levels, especially because the concentrations of volatile organic compounds in upgradient Sand Aquifer well MW-21B are increasing over time. Vinyl chloride is a daughter product of the ethenes and ethanes detected in upgradient wells, and both vinyl chloride and 1,2-DCA are also present upgradient of the landfill.

The chemical 1,4-dioxane will be added to the next sampling round at monitoring wells 14B, 17B, and 21B; both wells are upgradient wells with concentrations of volatile organic compounds in the Sand Aquifer at those locations.

6.3 Nature and Extent of Gas Migration

The Upper Gravel Aquifer beneath the landfill is under vacuum from the landfill gas collection system. In 1984, following the initial detection of widespread gas migration outside of the landfill boundary, numerous actions were initiated to extract and control gas migration. Currently 136 offsite gas probes and 139 on-site gas extraction wells are monitored regularly for landfill gas. In the past 6 years (1999-2004), there have been no exceedances of the regulatory value for methane concentrations outside of the landfill.

As of 1997, none of the off-landfill property gas extraction wells were still in use because of the significant decreases in off-property methane gas concentrations. All gas probes and gas monitoring locations surrounding the landfill are under the state’s landfill gas regulatory limits and all such monitoring locations where the limit may be approached are under the influence of the gas collection system. During the remedial investigation, numerous hazardous substances were found in the extracted landfill gas including vinyl chloride, xylenes, toluene, benzene and other solvents.

6.4 Surface Water, Seeps, and Soil Contamination

Surface water, seeps and soils in areas around the landfill were sampled in the late 1980’s as part of the RI and no contamination from the Midway
Landfill was found. Sampling was discontinued for the lack of detection of contaminants.

Whenever there is sufficient flow, the storm water discharged from the stormwater detention pond is monitored for turbidity, dissolved oxygen, PH, temperature and conductivity five day a week during conditions of flow.

6.5 Non-Aqueous Phase Fluid Monitoring

Oil thicknesses in the Shallow Groundwater and Saturated Refuse have generally decreased over the history of monitoring. Only three wells (31, 39D, and 43D) continue to show oil thicknesses of approximately one foot or more. Rapid declines in the measured oil thickness in these wells were observed during the RI period in 1988 and 1989, followed by slight increases through the early 1990s. Since that time, oil thicknesses at 31 and 39D have declined from highs of approximately 8 feet, to approximately 3 feet, and 1 foot, respectively. The oil thickness is regularly measured.

7.0 Measured Effectiveness of Remediation on Fluid Levels

The remediation measures at the Midway Landfill have had a substantial measured effect on fluid elevations, as represented in the potentiometric surface maps, fluid level change maps, and hydrographs in the periodic monitoring reports. The landfill fluid levels have substantially declined from 1989 to 2005 due to the remedial actions. The effectiveness of the remedial actions on fluid levels in the landfill is summarized below.

7.1 Landfill Surface Filling and Detention Pond Construction

Infiltration to the Saturated Refuse from the former surface ponds is estimated to have been 30 to 45 million gallons per year (AGI 1988). Filling of the ponds and complete construction of the lined detention pond in June 1989 has reduced recharge from the surface in the northern and western areas of the landfill. Hydrographs for the west side wells and the fluid elevation change maps show a steady reduction in fluid levels since this time.
and are evidence of this reduced recharge. Hydrographs for the northern area reflect stable conditions.

### 7.2 Landfill Cap Installation

Pre-remediation recharge to the Saturated Refuse due to precipitation has been estimated to be approximately 50 to 70 million gallons per year (AGI, 1988). Completion of the cap has reduced recharge significantly. The downward trends seen in the hydrographs and the declines in fluid levels in the west side, south side, and central mound areas demonstrate cover effectiveness.

### 7.3 Linda Heights Park Storm Water Diversion

The estimated discharge from the Linda Heights Park drain to the landfill ranged from 14 to 55 million gallons per year (AGI, 1990). Analysis of the hydrographs for the Linda Heights Park and central mound areas and the fluid level change maps are evidence that the cut-off of this source of recharge has been very successful in reducing fluid levels in the landfill. Specifically, the hydrographs in the Linda Heights Park area no longer show large peaks during the rainy season, and hydrographs from the central mound area show a continued decrease in fluid levels.

### 8.0 Updated Review of Upgradient Sources

The ROD acknowledged that contaminated groundwater is flowing toward and under the landfill from upgradient sources, and that some contaminant levels exceed federal and state drinking water standards and MTCA cleanup levels. The upgradient contamination may impact the ability of current and future groundwater leaving the landfill to meet groundwater cleanup standards.

#### 8.1 Background and Summary of Previous Investigations

A hazard assessment was conducted by Ecology in 1990 (SAIC 1991) to identify potential sources of groundwater contamination detected upgradient of the Midway Landfill during the RI. This study identified several potential
sources for the chlorinated ethenes and ethanes northwest and upgradient of the landfill, in the vicinity of Pacific Highway South and South 248th Street.

In October 1998, Parametrix conducted a database search to identify sites upgradient of the landfill where historical contaminant releases have occurred (Parametrix 1998). In March 2000, Ecology files were reviewed for 16 of these sites that had confirmed releases to the environment or were properties of potential environmental concern (Parametrix 2000b). The results of the report confirmed the potential for area groundwater contamination from numerous sources upgradient of the Midway Landfill.

8.2 Findings of Updated Study

As part of this five-year review, a database search by EDR Environmental was conducted to assess the status of the properties previously identified, and to determine whether additional contaminated sites have been identified during the past five years (Parametrix, 2005b).

The 2005 EDR report continues to document the presence of many sites upgradient from the Midway Landfill where hazardous substances are present. These include sites without known releases such as RCRA small quantity generators and underground storage tanks sites with existing or former underground storage tanks, as well as sites where documented chemical releases have occurred.

In 2000, the 16 sites that were researched continued to be cited in the databases, and no change in status for any of these sites could be discerned from the available information.

In the 2005, the EDR report identified three additional sites with suspected or documented releases of organic solvents. Three sites (two of the additional sites and one of the previous 16 sites) with solvent releases are in the general vicinity of upgradient well MW-21B. This well has shown increasing concentrations of volatile organic compounds.

The Washington Department of Ecology will contact the owners of the sites identified as possible contaminant sources. The owners will be encouraged to
work cooperatively with the Department of Ecology to voluntarily investigate and remediate contamination.

9.0 Institutional Controls

Institutional controls are legal or administrative actions that help ensure the long-term protectiveness of the remedy. At this site, the selected remedy in the ROD consists of three types of institutional controls.

(a) First, the City of Seattle placed a notice in the records of real property kept by the King County auditor, alerting any future purchaser of the landfill property, in perpetuity, that this property had been used as a landfill and was on EPA’s National Priorities List, and that future use of the property is restricted. The use restriction shall comply with the post-closure use restrictions under the State of Washington’s Criteria for Municipal Solid Waste Landfills (WAC 173-351-500(1)(I) and (2)(c)(iii)). The deed notice was recorded in the King County records on July 13, 2005.

(b) Second, the City needs to ensure continued operation and maintenance of the containment and monitoring systems if any portion of the property is sold, leased, transferred or otherwise conveyed. This requirement is an element of the 1988 Response Order on Consent.

(c) Third, notices are needed so that no water supply wells are constructed and used in areas with groundwater contamination emanating from the landfill. These notices shall include at a minimum the following:

- The City will annually notify the Seattle-King County Department of Public Health, Ecology, the local water districts (currently, the Kent and Highline Water Districts) and locally active well drillers in writing of groundwater conditions in the affected areas downgradient of the landfill. This notice will include a map showing the location of the affected areas and indicate which aquifers are affected and their elevations. This information shall be updated annually and can be part of an annual groundwater monitoring report. Locally active well drillers are all well drillers that have drilled wells
within King County in the year prior to the notice. Ecology will provide the list of locally active well drillers to the City. This requirement for annual notices can be removed or modified by Ecology after groundwater cleanup standards have been met in the groundwater monitoring wells downgradient from the landfill.

- As an additional protection, state regulations forbid any private drinking water wells within 1,000 feet of a municipal landfill or 100 feet from all other sources or potential sources of contamination (WAC 173-160-171). State regulations (WAC 173-160-151) also require a property owner, agent of that owner, or a water well operator to notify Ecology of their intent to begin well construction prior to beginning work.

- The first annual notice was sent by the City of Seattle on July 22, 2005, to drilling companies holding active drilling licenses for operations in King County. See Appendix D for a copy of the annual notice statement.

### 9.1 Garbage Removal from Right of Way for State Route 509

Part of the Midway Landfill (waste and closure improvements) is within the Washington State Department of Transportation Right of Way (WSDOT ROW) under various franchise permits. Under the franchise permits, all of the City’s improvements must be removed from the ROW in the event WSDOT requires the use of the area.

WSDOT will implement a State Route 509 (SR-509) project that will connect to Interstate Highway 5 (I-5) near Midway. WSDOT has informed the City of Seattle that additional ROW is needed for highway construction. WSDOT has been actively working on this project for over five years. The Environmental Impact Statement has been completed. ROW acquisition, construction of environmental controls, and design work is underway. Full construction is estimated at 95% probable by 2008.
The Washington State Departments of Transportation and Ecology have discussed this project with the City of Seattle. The discussions have useful in identifying impacts to the landfill due to widening of the highway.

This project will add two southbound lanes and one northbound lane to I-5 at Midway. All City facilities and waste within the limits of the new highway construction will need to be removed from the I-5 ROW.

The project elements that have been specifically identified to date are:

- Removal and disposal of approximately 25,000 cubic yards of waste that is in the ROW.
- Retention or re-sloping of the remaining waste to stabilize the eastern margin of the landfill.
- Modifications to the landfill cover system (to allow waste excavation from the ROW and possible disposal in the landfill), including related modifications to the surface water system and the landfill gas system.
- Removal of 11 landfill gas extraction wells that are in the ROW.
- Relocation/reconfiguration of City force main on the east side of I-5.
- Relocation of existing City storm drain lines on the west side of I-5.
- Evaluation of the capacity of the Midway storm water detention pond to accept additional runoff from the highway.
- Backfill required when the waste is removed.

Since 2002, the eleven landfill gas extraction wells have not been needed nor used for gas extraction. The valves to the wells have been closed. In addition, these eleven wells are part of the fluid level monitoring program. Since 2002, these wells have been dry and not useful for the fluid level monitoring program. These wells do not need to be replaced.
9.1.1 Evaluation of Remedy Performance

Site remediation at the Midway Landfill has focused on source control, with control measures installed between September of 1985 and January 1992.

Remediation activities have included landfill gas control, landfill surface filling and grading, storm water detention pond construction and associated permanent dewatering, landfill cap installation, Linda Heights Park storm water diversion, and ongoing environmental monitoring.

Environmental monitoring data collected in 2004 and 2005 continued to demonstrate that the source controls completed in 1992 have been effective in reducing the saturated thickness of the leachate in the landfill, resulting in overall improvements in groundwater chemistry.

Specific conclusions based on the five-year review are as follows:

- Substantial declines in fluid levels were noted between 1989 and 2005. In the past five years, the overall fluid levels in the landfill remained fairly stable, and in many cases continued to decline. Declining water levels within the landfill waste was a goal of the remedy.

- Groundwater flow directions in the Upper Gravel Aquifer and Sand Aquifer have not changed significantly compared to previous data. Groundwater flow directions have changed slightly in the Southern Gravel Aquifer compared to previous data, with MW-30C in a more cross-gradient position with respect to the landfill’s influence.

- The overall groundwater chemistry monitoring network is still adequate for monitoring groundwater flow associated with the landfill. MW-30C was originally installed as a sentinel well between the landfill and the Lake Fenwick water supply wells. Over time the flow in this portion of the SGA has migrated slightly to the northeast, away from MW-30C and the Lake Fenwick wells.

- The fluid levels in the seven key hydraulic wells showed decreasing or stable trends. Historic low fluid level measurements were
recorded for 2 of the 7 wells (Well 5 and Well 47D) during monitoring round R-46.

- Due to engineering controls, decreased water levels in monitoring wells in the Upper Gravel Aquifer and Sand Aquifer continued to be observed in 2005. This is a benefit to overall water quality at the Midway Landfill, although individual water samples can no longer be evaluated from some of these wells.

Record of Decision cleanup levels were exceeded for one or more groundwater contaminants of concern in groundwater samples from one upgradient well in the Sand Aquifer (MW-17B) and the four downgradient wells in the Southern Gravel Aquifer (MW-14B, MW-20B, MW-23B, and MW-29B) during one or both of the 2004 sampling events. The Record of Decision cleanup level for vinyl chloride was exceeded one time in Southern Gravel Aquifer well MW-30C, which is located in a cross-gradient position relative to the landfill. A summary of exceedances are tabulated in Table 2. Time-series plots for ROD COCs for downgradient monitoring wells in the Southern Gravel Aquifer wells are attached in Appendix C to illustrate trends over time and the magnitude of concentrations compared to ROD cleanup levels.

- The time-series plot graphs show that most of the tested parameters are stable or decreasing in concentration over time, except for the volatile organic compounds that are steadily increasing in Sand Aquifer upgradient well MW-21B. The volatile organic compounds detected in well MW-21B that are increasing are 1,1-DCE; tetrachloroethene [PCE]; and trichloroethene [TCE]. The source or sources of contamination upgradient of the Midway Landfill in the Sand Aquifer are still present as indicated by the data from MW-17B and MW-21B. The results from these two wells are showing two different trends over time. The concentrations of several VOCs detected in MW-17B are decreasing while the concentrations of several VOCs in MW-21B are increasing. Downgradient groundwater concentrations of volatile organic compounds in the Sand Aquifer and the Southern Gravel Aquifer continue to be affected by this contamination source.
### Table 2. Comparison of 2004 Contaminants of Concern in Groundwater to ROD Cleanup Levels

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Units</th>
<th>Cleanup Levela</th>
<th>Round ID</th>
<th>Upper Gravel Aquifer</th>
<th>Sand Aquifer</th>
<th>Southern Gravel Aquifer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MW-16</td>
<td>MW-21A</td>
<td>MW-8B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MW-8B (DUP)</td>
<td>MW-17B (DUP)</td>
<td>MW-21B (DUP)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MW-14B (DUP)</td>
<td>MW-14B</td>
<td>MW-14B</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MW-14B</td>
<td>MW-20B</td>
<td>MW-23B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MW-29B</td>
<td>MW-30C</td>
<td></td>
</tr>
<tr>
<td>Manganese (mg/L)</td>
<td>2.2</td>
<td>R-45</td>
<td></td>
<td>0.082</td>
<td>0.082</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.176</td>
<td>0.175</td>
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<td>0.149</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-Dichloroethane (µg/L)</td>
<td>5</td>
<td>R-45</td>
<td></td>
<td>0.144</td>
<td>0.437</td>
<td>0.432</td>
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<td></td>
<td></td>
<td></td>
<td>1.08</td>
<td>1.09</td>
<td>5.07</td>
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<td></td>
<td></td>
<td></td>
<td>0.192</td>
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</tr>
<tr>
<td>Vinyl Chloride (µg/L)</td>
<td>0.2*</td>
<td>R-45</td>
<td></td>
<td>0.2</td>
<td>0.2</td>
<td></td>
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<td></td>
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<td>0.2</td>
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<td>0.24</td>
<td>0.62</td>
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<td>0.2</td>
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<td></td>
<td></td>
<td>0.5</td>
<td>0.54</td>
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<td>0.73</td>
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<td>1.2</td>
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<td></td>
<td></td>
<td>0.22</td>
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<td></td>
</tr>
</tbody>
</table>

**ROD** = Record of decision  
**R-45** = Round 45, May 2004  
**R-46** = Round 46, November 2004  
**a** = Cleanup level established in the Final EPA Record of Decision for the Midway Landfill Site, September 6, 2000.  
**U** = Indicates the compound was undetected at the reported concentration  
**DUP** = Duplicate.  
**R-46** = Round 46, November 2004  
**b** = The actual cleanup level in the ROD (USEPA 2000) is 0.02 µg/L. However, pursuant to WAC 173-340-707(2), Ecology utilizes the practical quantification limit (PQL) of 0.2 µg/L to determine compliance with this cleanup standard because the cleanup standard is lower than the PQL. 
**Note:** Up or Down in column title denotes whether the well is located upgradient or downgradient of the landfill’s influence. 
**b** = MW-30C is a downgradient well in the SGA, but is cross-gradient from the landfill’s influence.
• The detected concentrations of vinyl chloride in downgradient Southern Gravel Aquifer wells are likely related to the chlorinated ethenes (PCE, TCE, 1,1-DCE, and cis-1,1-DCE), and ethanes (1,1,1-TCA) detected in upgradient Sand Aquifer wells MW-17B and MW-21B. These compounds are parent compounds that break down to the daughter product vinyl chloride through biological or chemical processes.

• An updated review of regulatory databases indicated four sites located within approximately one-half mile of the Midway Landfill that have confirmed or suspected releases of solvents to groundwater and/or soil. Three of these upgradient sources are in the vicinity of wells MW-17B and MW-21 where volatile organic compounds have been detected in the Sand Aquifer.

The groundwater quality in the Southern Gravel Aquifer appears to be generally stable or improving, except as noted. Increasing concentrations of some volatile organic compounds and inorganic parameters were observed in wells MW-20B and MW-29B until the 2001 to 2003 timeframe, respectively. Since that time, concentrations have slightly decreased. This may be a reflection of the predicted delay between the initiation of source control and improvements in downgradient groundwater quality.

10.0 Conclusions

• Fluid levels in most of the Shallow Groundwater/Saturated Refuse wells have continued to substantially decline over the past five years, demonstrating the continuing effectiveness of engineering controls.

• Concentrations of Record of Decision contaminants of concern in the Southern Gravel Aquifer have generally remained stable or decreased over the past five years, although levels of some contaminants of concern remain above cleanup levels.

• The Southern Gravel Aquifer does not serve as a current source of drinking water and institutional controls prohibit future drinking
water uses. Therefore, despite the existing levels of contaminants, the remedy continues to be protective of human health and the environment.

- Upgradient sources of volatile organic compounds in groundwater continue to be present and will limit the potential for the contaminants of concern in the Southern Gravel Aquifer to decrease below the Record of Decision cleanup levels. Vinyl chloride is a daughter product of the ethenes and ethanes detected in upgradient wells, and both vinyl chloride and 1,2-dichloroethane are also present upgradient of the landfill.

11.0 Progress since Last Review

This is the first five-year periodic review.

The main activities at this site since the ROD have been monitoring of landfill gases, groundwater, and surface water. The final revisions to the consent decree and restrictions to the deed of the landfill property were agreed upon between the City of Seattle and the Washington Department of Ecology.

The fluid level monitoring program was modified in 2002, with agreement by the Department of Ecology, to cease monitoring of ground water wells that have either gone dry or were not producing useful data.

12.0 Five-Year Review Process

This period review was performed by Ching-Pi Wang, Washington State Department of Ecology site manager for the Midway Landfill. Documents reviewed in preparation of this five year review included: recent annual ground water and landfill gas monitoring reports, the Record of Decision, and remediation status report for the landfill.

The five-year review was not reviewed by the Public Health Seattle & King County per their letter dated March 15, 2005 (see Appendix B). A copy of the final version of this review will be sent to the health district for their records.
The local community in the vicinity of the landfill was notified of the upcoming five year review by a notice in Ecology's Site Register in March 2005. No inquiries of Ecology received.

A 30-day public comment period will be held in September, 2005. The comment period will include mailing a fact sheet to the interested public, placing the draft periodic review in public repositories for review, and placing the draft periodic review on the web.

13.0 Site Inspection

The site was visited on May 2, 2005, by Ching-Pi Wang and Sarah Good of the Washington Department of Ecology. Both the landfill cover and fence were in good repair and all systems appeared to be functioning normally. Conversations with Min Soon Yim, the Midway Landfill Closure Site Supervisor, and Jeff Neuner, the Midway Landfill Closure Program Manager of the City of Seattle, indicate landfill operations have been routine.

14.0 Technical Assessment

Question A: Is the remedy functioning as intended by the decision documents?

- The remedy has greatly reduced impacts, but it has not brought the landfill into compliance with respect to 1,2-dichloroethane and vinyl chloride in one upgradient well and four downgradient wells. Manganese exceeds the cleanup level in one downgradient well. The sources of these contaminants are the waste placed in the landfill and upgradient off site.

- Fluid levels in most of the SG/SR wells have continued to substantially decline over the past five years, demonstrating the continuing effectiveness of engineering controls.

- Concentrations of Record of Decision (ROD) contaminants of concern (COCs) in the SGA have generally remained stable or decreased over
the past five years, although levels of some COCs remain above cleanup levels (1,2-dichloroethane and vinyl chloride in one upgradient well and four downgradient wells and manganese in one downgradient well).

- The SGA does not serve as a current source of drinking water and institutional controls prohibit future drinking water uses. Therefore, despite the existing levels of contaminants, the remedy continues to be protective of human health and the environment.

- Upgradient sources of VOCs in groundwater continue to be present and will limit the potential for the COCs in the SGA to decrease below the ROD cleanup levels. Vinyl chloride is a daughter product of the ethenes and ethanes detected in upgradient wells, and both vinyl chloride and 1,2-dichloroethane are also present upgradient of the landfill.

**Question B:** Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

The exposure assumptions, toxicity data, and remedial action objectives used at the time of the remedy selection are still valid. The cleanup levels established for the site in the ROD are still appropriate and protective considering the current and likely future use of the site. There have been no regulatory or statutory changes that would call into question the protectiveness of the remedy.

The clean up levels selected in the ROD are also still valid. However, because of changes to the Model Toxics Control Act (MTCA) regulations, the vinyl chloride cleanup level is updated to reflect revisions to the state cleanup levels. The cleanup level for vinyl chloride was establish at the state MTCA level of 0.02 µg/L instead of the federal maximum contaminant level of 2 µg/L. The Record of Decision specified the state cleanup standard of 0.02 µg/L with the caveat that the practical quantification limit of 0.2 µg/L would be used as an alternative because the cleanup level was lower than the practical quantification limit.

Revisions to the MTCA implemented in 2001, changed the requirements for developing ground water cleanup standards (Washington State Department of
The revised state cleanup level for vinyl chloride is 0.29 µg/L, using the MTCA adjusted cancer risk of 1E⁻⁵.

With the change of the vinyl chloride state cleanup standard from 0.02 to 0.29 µg/L, the use of the practical quantification limit of 0.2 µg/L as an alternative cleanup is no longer relevant.

The revisions to the vinyl chloride cleanup standard as described above are agreed upon by the City of Seattle and the Washington Department of Ecology. The City of Seattle will issue a revision to Midway Landfill Monitoring Plan (Parametrix 2000a) to document the history of changes to the cleanup standards for vinyl chloride. The new vinyl chloride standard will be utilized in future evaluations of ground-water conditions at the Midway Landfill.

**Question C:** Has any other information come to light that could call into question the protectiveness of the remedy?

The presence of low concentrations of 1,2-dichloroethane and vinyl chloride in one upgradient and four downgradient wells in the Southern Gravel Aquifer is of concern. In addition, other volatile organic compounds have also been detected upgradient of the landfill. The Washington Department of Ecology will be contacting the owners of properties in the vicinity of the upgradient sources to encourage the property owners to voluntarily investigate and cleanup any contamination that may affect the landfill.

At the request of the US EPA, 1, 4 dioxane testing, will be conducted during the next sampling event at upgradient monitoring wells 17B and 21B in the Sand Aquifer and a third well, MW-14, a downgradient well in the Southern Gravel Aquifer. Well 21B has shown a slight, but steady increase over time of volatile organic compounds. Well 17B has shown a decrease in concentration over time for volatile organic compounds. This is a precautionary step advised by the US EPA for all sites undergoing 5-year periodic review.

The Washington Department of Transportation, in cooperation with the City of Seattle and the Washington Department of Ecology will be expanding
Interstate 5 into the highway right-of-way on the eastern side of the landfill. Investigations of the refuse in the right-of-way show that this expansion will not adversely affect the landfill. Gas probes in this portion of the landfill have been devoid of any gases for the past several years. These gas probes will be abandoned prior to expansion of the interstate.

15.0 Issues

The presence of low concentrations of 1,2-dichloroethane and vinyl chloride in one upgradient and four downgradient wells in the Southern Gravel Aquifer is of concern. The Washington Department of Ecology will be contacting the owners of properties in the vicinity of the upgradient sources to encourage the property owners to voluntarily investigate and cleanup any contamination that may affect the landfill.

16.0 Recommendations

The City of Seattle will continue to operate and maintain remedial systems, including access controls, constructed under the consent decree. In addition, the monitoring programs will need to continue in compliance with the approved monitoring plan. This includes continuing the fluid elevation monitoring program, groundwater chemistry monitoring program, and landfill gas monitoring program in accordance with the Monitoring Plan, and evaluate the results on an ongoing basis.

Specific recommendations and follow-up actions include the following:

- Annually assess the results of the ongoing monitoring program to determine if additional work is needed.
- During the next scheduled ground-water sampling round, test for 1,4-dioxane at monitoring wells 14B, 17B and 21B. If 1,4-dioxane is not detected, and then discontinue testing for this compound. If detected, however, the monitoring program will be adjusted to monitor the trend of this compound.
• Reassess the scope of monitoring on a 5-year interval depending on monitoring results.

• Change the cleanup level for vinyl chloride from 0.2 µg/L to 0.29 µg/L.

• Investigate and cleanup upgradient sources of VOC contamination. Encourage upgradient property owners to voluntarily cleanup contamination. Ecology will send letters to the property owners in the upgradient area to alert them to the groundwater contamination problem and to encourage them to voluntarily investigate sources and cleanup the contamination. September 2006 is the planned milestone date for notification and consultation with the property owners. September 2007 or 2008 is the target milestone date for substantive action on the upgradient source areas.

The recommendations and follow-up actions are summarized in Table 3.
<table>
<thead>
<tr>
<th>Recommendations/Follow-up Actions</th>
<th>Party Responsible</th>
<th>Oversight Agency</th>
<th>Milestone Date</th>
<th>Follow-up Actions Affects Protectiveness (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual notice of groundwater contamination is sent to local licensed well drillers.</td>
<td>City of Seattle</td>
<td>Ecology</td>
<td>7/06/05</td>
<td>Y Y</td>
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<tr>
<td>Assess the results of the ongoing monitoring program to determine if additional work is needed.</td>
<td>City of Seattle</td>
<td>Ecology</td>
<td>annual</td>
<td>N N</td>
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<tr>
<td>Reassess the scope of monitoring on a 5-year interval depending on monitoring results.</td>
<td>City of Seattle</td>
<td>Ecology</td>
<td>annual</td>
<td>N N</td>
</tr>
<tr>
<td>Change the cleanup level for vinyl chloride from 0.02 µg/L to 0.29 µg/L.</td>
<td>Ecology</td>
<td>EPA</td>
<td>October 2005</td>
<td>N N</td>
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<tr>
<td>Test monitoring wells 14b, 17B and 21B to ensure 1,4 dioxane is not present</td>
<td>City of Seattle</td>
<td>Ecology</td>
<td>November 2005</td>
<td>N N</td>
</tr>
<tr>
<td>Investigate and cleanup upgradient sources of VOC contamination. Encourage upgradient property owners to voluntarily cleanup contamination.</td>
<td>Ecology</td>
<td>Ecology</td>
<td>2010</td>
<td>Y Y</td>
</tr>
<tr>
<td>Ecology will notify property owners by September 2006. Ecology will advise the property owners on cleanup requirements. September 2007 or 2008 is the planned time period for property owners to take substantive action on the upgradient source.</td>
<td>Ecology</td>
<td>Ecology</td>
<td>September 2006, 2007, 2008</td>
<td>Y Y</td>
</tr>
</tbody>
</table>
17.0 Protectiveness Determination Summary

Based on the information reviewed and the site inspection, the remedial actions are protective of human health and the environment. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedial actions. Most of the cleanup levels for the contaminants of concern have been achieved. There is no other information that calls into question the protectiveness of the remedy.

The presence of low concentrations of 1,2-dichloroethane and vinyl chloride in one upgradient and four downgradient wells in the Southern Gravel Aquifer is of concern, do not affect the protectiveness of the remedial actions. The Washington Department of Ecology will be contacting the owners of properties in the vicinity of the upgradient sources to encourage the property owners to voluntarily investigate and cleanup any contamination that may affect the landfill.

18.0 Next Review

The next five-year periodic review is due in 2010. The US Environmental Protection Agency will continue to track these reviews on their tracking system.
References


AGI, 1990. Supplemental Hydrogeologic and Hydrochemical Investigation, Midway Landfill feasibility study.


Figures
Appendix A

Example letter to inquiries about environmental conditions of the landfill for real estate transactions.
Appendix B

March 15, 2005 letter from Public Health - Seattle & King County regarding review and oversight activities at the Midway Landfill.
Appendix C

Annual letter from the City of Seattle to local well drillers.
Appendix D

Concentration versus time plots for ground-water parameters.