REVISED DRAFT
FOCUSED FEASIBILITY STUDY REPORT

Pasco Sanitary Landfill National Priorities List Site—MSW Disposal Areas

Prepared for: Pasco Landfill Group

Project No. 060255 • August 31, 2017 Ecology Review Draft

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Contents

List of Tables

List of Figures

List of Appendices

Acronyms

AIA	Additional Interim Action
AO	Agreed Order
ARAR	Applicable or Relevant and Appropriate Requirement
Aspect	Aspect Consulting, LLC
BCS	Bayer CropScience
BFDHD	Benton-Franklin District Health Department
CAP	Cleanup Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/s	centimeters per second
COC	chemical of concern
DCA	disproportionate cost analysis
Ecology	Washington Department of Ecology
EPA	U.S. Environmental Protection Agency
FFS	Focused Feasibility Study
FS	Feasibility Study
GCCS	gas collection and control system
gpm	gallons per minute
IA	Interim Action
IC	institutional control
ICP	Institutional Controls Program
IRM	Interim Remedial Measure
IWA	Industrial Waste Area
IWA/GW Agreed Order	Agreed Order DE-00TCPER-1324
IWAG	Industrial Waste Area Generator Group III
KPSC	Pasco Tri-Cities Airport Climate Station
Landfill Agreed Order	Agreed Order DE-00TCPER-1326
MSW	Municipal Solid Waste

MTCA	Model Toxics Control Act
NAPL	nonaqueous phase liquid
NPV	net present value
O&M	Operations and Maintenance
PCE	tetrachloroethylene
PLP	potentially liable party
PSLI	Pasco Sanitary Landfill, Inc.
NPL Site	Pasco Sanitary Landfill National Priorities List Site
RAO	remedial action objective
RCW	Revised Code of Washington
RI	Remedial Investigation
RRC	Resource Recovery Corporation
SEPA	State Environmental Policy Act
SVE	soil vapor extraction
VOC	volatile organic compound
WAC	Washington Administrative Code

Executive Summary

Members of the Landfill Group, designated as Potentially Liable Parties (PLPs) have prepared this revised draft Focused Feasibility Study (FFS) report for the Municipal Solid Waste (MSW) Disposal Areas at the Pasco Sanitary Landfill National Priorities List (NPL) Site. This revised draft FFS report is submitted pursuant to Agreed Order No. DE-09240 entered into between the PLPs and the Washington State Department of Ecology (Ecology), effective October 31, 2012. This revised draft FFS report addresses comments made by, and discussions with, Ecology on the draft FFS report submitted to Ecology in September 2014.

The Industrial Waste Area Generator Group III (IWAG) and Bayer CropScience (BCS) as PLPs prepared a separate revised draft FFS report for the NPL Site to address Industrial Waste Areas (IWAs). The ongoing cleanup process for the IWAs involves added complexity, which has resulted in differing perspectives on current environmental conditions, data interpretation, and remedial alternatives. The Landfill Group members could not endorse the IWAG's cleanup approach, and we were unable to agree upon a combined document notwithstanding dialogue and collaboration.

The closed Pasco Sanitary Landfill is located along the northeast limit of the City of Pasco in Franklin County, Washington. Waste disposal and closure activities were conducted at the landfill under permits issued by the Benton-Franklin District Health Department, the Franklin County Planning Department, and/or Ecology. MSW landfilling operations began in 1958 and ended in 1993. Industrial wastes were disposed from 1972 through 1975, and included 35,000 drums of mixed industrial waste (Zone A); 5,400 drums of herbicide manufacturing wastes, which have been removed as an Interim Action (Zone B); 3 million gallons of mixed industrial waste (Zone C/D); and 11,000 tons of chlor-alkali waste (Zone E). The regulatory history has been driven primarily by the releases of industrial wastes disposed of in the IWAs, and Interim Actions (IAs) to address releases from the Industrial Wastes Areas. The MSW Disposal Areas (MSW Landfill, Balefill and Inert Waste Disposal Area, and Burn Trenches) received approximately 2.5 million cubic yards of MSW. At the time of landfill closure in 1993, all MSW Disposal Areas were covered with soil consistent with regulatory requirements at the time.

In 2002, two IAs for the MSW Landfill were implemented, including design and installation of an engineered cover and a landfill gas control and collection system (GCCS) at the MSW Landfill. These IAs were consistent with the presumptive remedy for federally-listed municipal landfill sites, which is containment with engineering controls to prevent impacts to human health and the environment. The IAs implemented at the MSW Landfill have eliminated direct exposure to MSW or landfill gas, minimized potential groundwater impacts from landfill gas or leachate, and minimized potential air quality impacts from fugitive emissions of landfill gas.

The remedial action objectives (RAOs) for the MSW Disposal Areas include protecting human health and the environment from exposure to waste, landfill gas, and potentially contaminated groundwater. These RAOs have been met by the IAs at the MSW Landfill, based on routine monitoring data. Remedial alternatives proposed for the Balefill and Inert Waste Disposal Areas, and the Burn Trenches, should satisfy the RAOs and support demonstration of functional stability for these Disposal Areas.

Three alternatives were proposed for the MSW Landfill. Alternative MSW-1 includes leaving the MSW in place, and continued operation, maintenance, and monitoring of the engineered cover and landfill GCCS as the MSW Landfill continues to approach stabilization, in addition to Institutional Controls (ICs) pertinent to landfills and groundwater monitoring to confirm that cleanup levels continue to be met. Alternatives MSW-2 and MSW-3 include all of the elements of Alternative MSW-1, with the expansion of the landfill GCCS, then addition of a groundwater collection and treatment system, respectively. Alternative MSW-1 has been demonstrated to meet all MTCA requirements and is the preferred alternative for the MSW Landfill. Selection of Alternative MSW-1 is supported by the performance of the existing systems and the disproportionate cost analysis. Alternative MSW-1 includes a change in landfill gas treatment to accommodate decreasing landfill gas generation and transition from post-closure care to custodial care when landfill stability can be demonstrated (i.e., little to no settlement, gas production, or leachate generation). The total estimated cost of the preferred MSW Landfill alternative, MSW-1, is $1.475 million.

One alternative was proposed for the Balefill and Inert Waste Disposal Areas. Alternative BA-1 consists of leaving the MSW in place and restoring the existing soil cover to a minimum thickness of 30 inches, including a gravel layer to address terrestrial ecological exposure and wind erosion of the soil cover. Currently exposed MSW will be leveled to the extent practical before soil cover restoration. The total estimated cost of the preferred remedial alternative for the Balefill and Inert Waste Disposal Area is $468,000.

Three alternatives were proposed for the Burn Trenches. Alternative BT-A involves leaving the MSW in place, and conducting routine monitoring of the existing soil cover at Burn Trench BT-1 (Burn Trench BT-2 is beneath the Zone A cover system). Alternatives BT-B and BT-C include investigating the thickness of the BT-1 soil cover, and restoring the soil cover (if needed), respectively. The preferred remedial alternative for the Burn Trenches is Alternative BT-A, based on a well log indicating the soil cover thickness is 6 feet thick near the eastern end. The existing soil covers over the Burn Trenches adequately address the RAOs and have minimized transport of contaminants to soil and groundwater, based on available environmental monitoring results. The total estimated cost of Alternative BT-A is $14,000.

The Balefill and Inert Waste Disposal Areas and Burn Trench BT-2 are proximal to Zone A. Remedial alternatives for IWAs should be implemented in a way that ensures the safety and integrity of adjacent MSW Disposal Areas. If the existing soil cover system above MSW is disturbed or removed during remedial activities at the IWAs, then the soil cover should be restored to Ecology's satisfaction.

The overall preferred alternative is the combination of the preferred remedial alternatives for each of the individual MSW Disposal Areas, including: Alternative MSW-1, Alternative BA-1, and Alternative BT-A. After restoration of the soil cover across the Balefill and Inert Waste Disposal Areas (Alternative BA-1), the preferred remedial alternatives for the MSW Disposal Areas are the existing IAs, which have been demonstrated to meet all MTCA requirements. Routine monitoring will continue to support the demonstration of functional stability.

The overall preferred alternative recognizes that the MSW disposal areas will remain on the Pasco Sanitary Landfill, Inc. Property. The estimated restoration timeframe is 15 years, and functional stability of the MSW Disposal Areas should be demonstrated before 2032. As a closed landfill property, ICs will be maintained to control potential exposure pathways. All of the preferred alternatives are consistent with MTCA requirements and expectations for remedial actions as they protect human health and the environment, comply with cleanup standards, comply with applicable state and federal laws, provide for compliance monitoring, use permanent solutions to the extent practicable, provide for reasonable restoration timeframes, and consider public concerns.

1 Introduction

1.1 Purpose and Objectives

Members of the Landfill Group[1] designated as Potentially Liable Parties (PLPs) have prepared this revised draft Focused Feasibility Study (FFS) report for the Municipal Solid Waste (MSW) disposal areas at the Pasco Sanitary Landfill National Priorities List Site (NPL Site [2]) pursuant to Agreed Order No. DE-09240 (AO) entered into between the PLPs and the Washington State Department of Ecology (Ecology), effective October 31, 2012. Prepared by Aspect Consulting, LLC (Aspect) for the Landfill Group, this revised draft FFS report addresses comments made by, and discussions with, Ecology on the draft FFS report submitted to Ecology in September 2014. This revised draft FFS report develops and evaluates cleanup action alternatives to support selection of a final cleanup action in accordance with Model Toxics Control Act (MTCA) regulations and consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidelines. Procedures for conducting a feasibility study are provided by Washington Administrative Code (WAC) 173-340-350(8).

The Industrial Waste Area Generator Group III (IWAG) [3] and Bayer CropScience (BCS) as PLPs prepared a separate revised draft FFS report for the NPL Site to address Industrial Waste Areas. The ongoing cleanup process for the Industrial Waste Areas involves added complexity, which has resulted in differing perspectives on current environmental conditions, data interpretation, and remedial alternatives. In short, the Landfill Group members could not endorse the IWAG's cleanup approach, and we were unable to agree upon a combined document notwithstanding dialogue and collaboration.

The purpose of the FFS report is "to evaluate a focused set of remedial alternatives.[4]" It builds upon the 1999 Feasibility Study (FS) (PSC, 1999) that included comprehensive screening of remedial alternatives in accordance with then-applicable MTCA criteria. The remedial action objectives (RAOs) are consistent with, and build upon, those identified in the 1999 FS Report. For the MSW Disposal Areas, the known nature and extent of environmental impacts are similar to those presented in the FS Report. This

[1] The current members of the Landfill Group are Basin Disposal, Inc.; BNSF Railway Company; and Pasco Sanitary Landfill, Inc. (PLSI).

[2] The NPL Site encompasses the property currently owned by PSLI, including the areas in which wastes were managed between 1958 and 1993, as well as the downgradient off-site groundwater plume area (Figure 1.2-1). The NPL Site does not include the closed New Waste, Inc. Landfill, also on property currently owned by PSLI.

[3] The members of the IWAG are PPG-Architectural Coatings Canada Inc.; Blount, Inc.; The Boeing Company; Crown Beverage Packaging, LLC; Daimler Trucks North America LLC; Georgia-Pacific, LLC; Goodrich Corporation on behalf of Kalama Specialty Chemicals, Inc.; Intalco Aluminum; 3M Company; PACCAR Inc.; PCC Structurals, Inc.; Pharmacia Corporation; Simpson Timber Company; Union Oil of California; and Weyerhaeuser NR Company.

[4] Agreed Order No. DE 9240, Washington State Department of Ecology, 202, p.3.

revised draft FFS report has been updated with information developed during Interim Actions (IAs) since 1999, and to reflect changes in applicable MTCA cleanup standards.

1.2 NPL Site Description and Background

The closed Pasco Sanitary Landfill is located along the northeast limit of the City of Pasco in Franklin County, Washington. The location of the entire NPL Site, including the groundwater protection area, is shown on Figure 1.2-1. The industrial and municipal waste disposal areas are illustrated on Figure 1.2-2. Former waste disposal areas have been excavated and transferred to the existing areas. The existing areas include the following:

- Industrial Waste Areas:
    - Zone A received 35,000 drums of mixed industrial waste;
    - Zone B received approximately 5,400 drums of herbicide manufacturing wastes (removed as an Interim Action);
    - Zone C/D received approximately 3 million gallons of bulk plywood resin waste, wood treatment and preservative waste, lime sludge, cutting oils, paint and paint solvent waste, and other bulk liquid waste; and
    - Zone E received primarily approximately 11,000 tons of chlor-alkali waste.
- MSW Disposal Areas received approximately 2.5 million cubic yards, or 1.25 million tons, of MSW.

1.2.1 Operational History

Waste disposal and closure activities were conducted at the landfill under permits issued by the Benton-Franklin District Health Department (BFDHD), the Franklin County Planning Department, and/or Ecology. MSW landfilling operations began in 1958 and ended in 1993.

Industrial wastes were disposed from 1972 through 1975. The industrial wastes were received in bulk (tanker trucks) and in 55-gallon drums or other containers, and included solvent wastes, paint wastes, and herbicide wastes, for example. Industrial wastes were segregated and disposed of in separate zones collectively called the Industrial Waste Areas (IWAs). Franklin County halted industrial waste disposal in 1975. Interim closure of the IWAs began in 1975.

Additional description of the operational history is presented in Section 2.3 and in the Phase I and Phase II Remedial Investigation Reports (Burlington Environmental, 1994; Philip Environmental, 1998a).

1.2.2 Regulatory History

The regulatory history has been driven primarily by the releases of industrial wastes disposed of in the Industrial Waste Areas, and IAs to address releases from the Industrial Wastes Areas. The milestone events are described below.

In 1973, in response to concerns from the agricultural community and the BFDHD, Ecology undertook an independent investigation (BFDHD, 1972; Ecology, 1973). Ecology's final report, issued in December 1973, concluded that the Pasco Sanitary Landfill was "an excellent location for ground disposal of industrial solid wastes if the proper safeguards are observed" (Ecology, 1973).

In 1988, the U.S. Environmental Protection Agency (EPA) proposed that the Pasco Sanitary Landfill be placed on the National Priorities List for Superfund sites after volatile organic compounds (VOCs) were detected in on-property groundwater monitoring wells.

In 1990, EPA announced that the Pasco Sanitary Landfill was placed on the National Priorities List for Superfund sites, and Ecology was established as the lead agency. Ecology is overseeing the cleanup under the Washington MTCA, Revised Code of Washington (RCW) Chapter 70.105D.

In 1992, Ecology issued Agreed Order DE92TC-E105 designating various individuals and entities as PLPs under MTCA, and requiring completion of a Phase I Remedial Investigation (RI). In 1994, the PLPs completed and submitted the Phase I RI report (Burlington Environmental, 1994).

In 1994, Ecology issued Enforcement Order DE94TC-E103, requiring work, including a Phase II RI report, a risk assessment/cleanup levels analysis, and FS. The Enforcement Order was amended in 1996 to address impacts to off-property groundwater and an expanded off-property groundwater investigation and identification of potentially impacted residential wells. Interim Remedial Measures (IRMs) were implemented by the PLPs to further reduce potential risks to human health and the environment. In 1998, the PLPs presented delivered the *Interim Measures Completion Report* (Philip Environmental, 1998b) to Ecology. The following major documents were submitted under Enforcement Order DE94TC-E103:

- *Pasco Sanitary Landfill Closure Plan* (Woodward-Clyde, 1996);
- Phase II RI report (Philip Environmental, 1998);
- Ecological Evaluation (Philip Environmental, 1997), which described the potential impacts to plants and animals at the PSLI Property;
- *Risk Assessment/Cleanup Level Analysis* (Philip Environmental, 1998c), which described the potential impacts to human health and the environment; and
- FS Report (PSC, 1999), which described remedial alternatives to reduce potential risk at each individual contaminant source area.

In 2000, Ecology issued the following two AOs (and two companion Enforcement Orders) directing work at the NPL Site:

- Agreed Order DE-00TCPER-1324 for the Industrial Waste Area and the Groundwater Plume Area (IWA/GW Agreed Order); and

- Agreed Order DE-00TCPER-1326 for the Sanitary Landfill Area (Landfill Agreed Order).

Ecology approved the preferred remedies described in the 1999 FS Report as IAs, determining that a final Cleanup Action Plan (CAP) would be deferred until the IAs were in place and performance monitoring data had been generated and reported. The IWA/GW Agreed Order required certain PLPs to:

- Prepare an interim action work plan (Task 1);
- Provide industrial waste containment systems design documents (Task 2);
- Implement Zone B removal action (Task 3);
- Implement groundwater treatment and interim action systems monitoring plan (Task 4);
- Implement institutional controls (ICs) (Task 5); and
- Prepare a completion report documenting the containment, groundwater, and Zone B action (Task 6).

In addition, the IWA/GW Agreed Order required an IA performance monitoring report be prepared after 6 years. Based on the findings in the *Interim Action Performance Monitoring Report* (EPI, 2007a), Ecology required additional IAs for Zone A.

The 2000 Landfill Agreed Order required certain PLPs to:

- Prepare a Pre-Closure Site Investigation Work Plan;
- Design and install a Municipal Closure Cap System, including a landfill gas collection and control system (GCCS); and
- Prepare a Closure Completion Report and a Post-Closure Inspection and Maintenance and Operations Plan.

Ecology gave notice to the Landfill Group members in March 2013 that the provisions of the Landfill Agreed Order were satisfied.

The City of Pasco adopted its Groundwater Protection Ordinance, Ordinance No. 3469, effective May 7, 2001, codified in Pasco Municipal Code 16.06.040. Franklin County adopted Ordinance No. 2-99, Chapter 28 I-3 Heavy Industrial Zone, repealed in 2003, and replaced by Chapter 17.56, Franklin County Code.

In 2012, Ecology issued Agreed Order DE 9240 (and a companion Enforcement Order) directing the PLPs to:

- Continue with ongoing operation, maintenance, and reporting of the IAs (Task 1);
- Prepare of a focused feasibility study (FFS) work plan (Task 2);
- Conduct FFS analysis and reporting (Task 3); and

- Implement supplemental data collection and treatability evaluation (as contingency Task 4).

The revised FFS work plan (Anchor QEA, et al., 2013) was approved by Ecology on November 6, 2013. The draft FFS report was submitted to Ecology on September 3, 2014. Ecology provided comments on the draft FFS report on June 13, 2016.

In April 2014, Ecology issued Enforcement Order DE 10651 in response to a subsurface combustion event requiring recipients to:

- Prepare a Balefill Area fire suppression work plan (Task 1);
- Extinguish and monitor the Balefill Area subsurface fire (Task 2); and
- Prepare a Balefill Area Combustion Prevention Work Plan (Task 3).

Ecology gave notice to the PLPs in April 2017 that the Enforcement Order was satisfied.

In July 2015, Ecology issued Approval Order No. 14AQ-E571 to Thom Morin (representing the IWAG) providing conditional approval of the regenerative thermal oxidizer for use in treating contaminated soil vapors extracted from Zone A.

In April 2016, Ecology issued Notice of Violation Docket # 13240 to Thom Morin (representing the IWAG) for causing or permitting air pollution from the regenerative thermal oxidizer.

In November 2016, Ecology issued Administrative Order Docket #: 13922 to Thom Morin (representing the IWAG) allowing for the temporary installation and operation of a recuperative thermal oxidizer to control emissions from the Zone A SVE system until a new regenerative thermal oxidizer is installed and operational. In April 2017, Ecology provided an extension of deadline for installation and operation of the new regenerative thermal oxidizer.

In May 2017, Ecology issued Approval Order No. 16AQ-E031 to Mark Leece (representing the IWAG) providing conditional approval of the new regenerative thermal oxidizer for use in treating soil vapors extracted from Zone A.

1.3 Exposure Assessment Summary

Potential exposure to contaminants in MSW and environmental media potentially affected by MSW (including soil, soil vapor, ambient air, and groundwater) have been largely addressed through:

- Moving potentially contaminated soil from the Land Application Areas to the MSW Landfill;
- Installing soil covers at the time of landfill closure; and
- Installing the engineered cover and landfill GCCS as IAs at the MSW Landfill.

Remaining potential exposure pathways will be addressed through preferred remedial alternatives for the MSW Disposal Areas, as described below.

1.4 Remedial Goals and Objectives Summary

The RAOs for the MSW Disposal Areas include protecting human health and the environment from exposure to waste, landfill gas, and potentially contaminated groundwater. These RAOs have been met by the IAs at the MSW Landfill based on routine monitoring data. Remedial alternatives proposed for the Balefill and Inert Waste Disposal Areas, and the Burn Trenches, will satisfy the remedial action objectives and will support demonstration of functional stability.

1.5 Remedial Alternatives Summary

The remedial alternatives for the MSW Disposal Areas are based on regulatory requirements for MSW landfills, which include leaving the waste in place with an appropriate cover, a landfill GCCS, and a monitoring program to demonstrate protection of human health and the environment.

Three alternatives were proposed for the MSW Landfill. Alternative MSW-1 includes continued operation, maintenance, and monitoring of the engineered cover and landfill GCCS as the MSW Landfill continues to approach stabilization. Based on the environmental monitoring data collected to date, Alternative MSW-1 should be an appropriate remedy for the MSW Landfill.

Alternatives MSW-2 and MSW-3 include all of the elements of Alternative MSW-1, with the expansion of the landfill gas collection system, then addition of a groundwater treatment system, respectively. Implementing Alternatives MSW-2 or MSW-3 appear unnecessary at this time, but may be considered as potential corrective actions in the future, if necessary.

One alternative was proposed for the Balefill and Inert Waste Disposal Area. The soil cover in the Balefill and Inert Waste Disposal Areas will be restored to address limited areas where MSW has been exposed, and other potential exposure pathways.

Three alternatives were proposed for the Burn Trenches. Alternative BT-A involves routine monitoring the existing soil cover at Burn Trench BT-1 (Burn Trench BT-2 is beneath the Zone A cover system). Alternatives BT-B and BT-C include investigating the thickness of the BT-1 soil cover, and restoring the soil cover (if needed), respectively.

1.6 Summary Evaluation of Remedial Alternatives

The remedial alternatives presented for the MSW Disposal Areas address the MTCA requirements. Cost estimates were prepared for each alternative. The preferred remedial alternatives were selected based on past performance, and a comparison of benefits and costs for each of the MSW Disposal Areas.

- For the MSW Landfill, the preferred remedial alternative is Alternative MSW-1 for a total estimated cost of $1.475 million.
- For the Balefill and Inert Waste Disposal Areas, the preferred remedial alternative is Alternative BA-1 for a total estimated cost of $468,000.
- For the Burn Trenches, the preferred remedial alternative is Alternative BT-A for a total estimated cost of $15,000.

The recommended overall alternative is the combination of these preferred remedial alternatives. The restoration timeframe is assumed to be 15 years, based on when the MSW Disposal Areas are expected to reach functional stability, if they have not already done so.

2 Background

2.1 Property and Vicinity Description

The NPL Site boundaries, as defined by the Agreed Order DE 9240, encompass the Pasco Sanitary Landfill, Inc. (PSLI) Property and the Groundwater Plume area (see Figure 1.2-1). The PSLI Property is located along the northeast limit of the City of Pasco, in the southwest quarter of Section 15, the northeast quarter of Section 21, and the northwest quarter of Section 22, Township 9 North, Range 30 East, Willamette Meridian, in Franklin County, Washington.

The PSLI Property occupies a 200-acre area in an area of gently rolling hills and flat terrain. Prior to landfill operations, aerial photos show the property was open, unimproved grassland characterized by both stabilized and active sand dunes. The MSW Disposal Areas, Industrial Waste Areas, and the New Waste, Inc. Landfill are located within the PSLI Property (see Figure 1.2-2). The New Waste, Inc. Landfill is not part of the NPL Site[5].

2.2 Zoning, Local Demographics, and Land Use

The City of Pasco parcels west and south of the PSLI Property are zoned light industrial, based on the March 2017 City of Pasco Zoning map (https://www.pasco-wa.gov/DocumentCenter/View/51804, accessed August 22, 2017). The Franklin County parcels east and north of the PSLI Property are zoned agricultural production (https://www.pasco-wa.gov/DocumentCenter/View/51804, accessed August 22, 2017).

The U.S. Census Bureau reported 59,781 people living in the City of Pasco in the 2010 census. The city has more than doubled in size since the initiation of RI activities in 1988.

The land use, cultural features, and demography of the areas within 1-mile and 4-mile radii of the PSLI Property were investigated as part of the Phase I RI in 1993. Land use changes since the 1990s include expansion of residential areas to the south and west of State Route 12; expansion of the Basin Disposal, Inc. operations center, immediately south of the PSLI Property; installation of evaporation ponds by OXARC, Inc., along the southwest PSLI Property boundary; and installation of food processing and storage facilities along Dietrich Road.

2.3 Operational History

This section provides a synopsis of the landfill permitting and operations from the mid-1950s to the present. Originally, John and Marjorie Dietrich individually owned or leased the land where the landfill operated. Land ownership history is summarized by parcel on Figure 2.3-1. A timeline for each disposal area is provided on Figure 2.3-2, summarizing key dates for waste disposal, landfill closure, Interim Remedial Measures, and IAs.

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[5] The New Waste, Inc. Landfill is a modern and fully lined solid waste landfill, opened on May 31, 1993, and closed in 2002, that is located to the north of the MSW Landfill. The New Waste, Inc. Landfill has been regulated separately by BFDHD and Ecology's Waste 2 Resources program. Based on post-closure monitoring, the New Waste, Inc. Landfill has not caused any environmental impacts.

2.3.1 Permitting

Throughout the operating history of the landfill, waste disposal and closure activities were conducted under permits issued by the BFDHD, the Franklin County Planning Department, and/or Ecology. Permits allowed disposal of MSW, commercial waste, industrial waste, and agricultural waste. Table 3-6 in the Phase I RI lists the landfill operating permits (Burlington Environmental, 1994).

On May 6, 1958, the Franklin County Planning Commission authorized John Dietrich, d/b/a Pasco Garbage Service, to establish and operate a garbage disposal facility at this property. The landfill operated as a burning dump until 1971, when it converted to a sanitary landfill.

Resource Recovery, Corporation (RRC) was incorporated in Washington on August 8, 1972. Ecology issued Industrial Waste Discharge Permit No. 5301 to RRC for industrial waste disposal at the landfill on March 21, 1973, which was valid until March 21, 1978. The Board of Commissioners of Franklin County issued special permits for industrial waste disposal which were valid from February 1, 1974 through December 31, 1974.

The BFDHD or the Board of Commissioners of Franklin County issued permits to RRC to operate a sanitary landfill for disposal of municipal solid waste through December 31, 1980. PSLI operated under permits for a sanitary landfill from BFDHD through landfill closure in mid-1993.

2.3.2 Municipal Solid Waste Disposal Areas

MSW was landfilled from 1958 through 1993. During this period, MSW was placed in the Burn Trenches (1958 to 1965), the MSW Landfill (1958 to 1993), the Balefill Area and Inert Waste Disposal Area[6] (1976 to 1993). The landfill operated as a burning dump until 1971, when it converted to a sanitary landfill. Any MSW temporarily managed in the Septic Lagoon, Landspread, and Sludge Management Areas (1976 to 1992) was subsequently moved to the MSW Landfill for disposal and/or as daily cover as part of operations.

2.3.3 Industrial Waste Areas

RRC received industrial waste for disposal at the landfill from 1972 through early 1975. RRC segregated and deposited wastes into five primary zones including the following:

- Zone A received approximately 35,000 drums of mixed industrial waste, including paint waste, metal cleaning and finishing waste, wood preserving waste, metal etching waste, and pesticides waste;
- Zone B received approximately 5,400 drums of herbicide manufacturing wastes;
- Zones C and D received approximately 3 million gallons of bulk plywood resin waste, wood treatment and preservative waste, lime sludge, cutting oils, paint and paint solvent waste, and other bulk liquid waste; and

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[6] The Balefill Area and the Inert Waste Disposal Area have been treated separately in prior NPL Site documents. Due to proximity and similarity, Ecology requested these areas be combined for purposes of remedy development in this Focused Feasibility Study.

- Zone E received primarily approximately 11,000 tons of chlor-alkali waste.

Figure 1.2-2 shows the locations of the primary industrial waste zones, and other industrial waste management areas used on a temporary basis.

2.3.4 Regulatory History

The regulatory history summarized below is organized by timeframe or subject matter, and provides context for the regulatory focus on Industrial Waste Areas, especially Zone A.

2.3.4.1 Early Regulatory Oversight

In 1973, in response to concerns from the agricultural community and the Franklin County Board of Commissioners, Ecology undertook an independent investigation of the RRC operation (BFDHD, 1972; Ecology, 1973). The final report, issued in December 1973, concluded that the Pasco Sanitary Landfill was "an excellent location for ground disposal of industrial solid wastes if the proper safeguards are observed" (Ecology, 1973).

In 1975, the IWAs were initially closed with soil covers and plastic sheeting, before engineered covers were required by regulation. After initial closure, monitoring by Ecology revealed no air, soil, or groundwater impacted with herbicides 2,4-dichlorophenoxyacetic acid (2,4-D) or 2,4,5-trichlorophenoxyacetic acid (2,4,5-T).

In 1982, the first groundwater monitoring wells were installed by JUB Engineers for PSLI, at the direction of Ecology.

As part of the EPA's nationwide dioxin investigation, the Pasco Sanitary Landfill was investigated in 1984 because of known herbicide wastes buried there. No dioxins or other organic contaminants were identified in groundwater during that investigation. Ecology and Environment, Inc. (E&E), performed another investigation in 1985 for EPA. The report identified several VOCs present in the groundwater (E&E, 1986).

2.3.4.2 EPA Lists Superfund Site

In June 1988, EPA nominated the Pasco Sanitary Landfill to the National Priorities List for Superfund sites, and was formally listed in February 1990. Ecology was established as the lead agency for the cleanup investigations and remedial actions taken at the NPL Site.

2.3.4.3 Remedial Investigation and Feasibility Study

A group of PLPs for the NPL Site performed the RI, as required by the 1992 Agreed Order DE92TC-E105 and the 1994 Enforcement Order DE94TC-E103. Phase I of the RI began in 1992 and was completed with the submittal of the Final Phase I RI Report in 1994 (Burlington Environmental, 1994). Phase II RI activities began in 1995, and off-property groundwater was identified as impacted. Ecology amended the scope of the Phase II RI to include treatability testing of a soil vapor extraction (SVE) system at Zone A, an expanded off-property groundwater investigation and identification of potentially impacted residential wells. The Phase II RI Report was completed in 1998 (Philip Environmental Services Corp., 1998), and the final draft Feasibility Study (FS) Report was completed in 1999 (PSC, 1999).

2.3.4.4 Interim Remedial Measures and Interim Actions

In 1996 and 1997, several IRMs were implemented by a group of PLPs to further reduce potential risks to human health and the environment. Starting in March 1996, as part of the IRMs, the IWAG provided bottled drinking water to users of drinking water wells located in the area potentially impacted by the groundwater plume downgradient of Zone A, pending an assessment of actual groundwater impacts at those wells (Figure 25 in 2004 Annual Report; EPI, 2005). The IWAG also funded an extension of the City of Pasco municipal water supply system and the connections to the city water system for those properties that were found to be impacted and where the owners accepted the offer of a connection (Figure 26 in 2004 Annual Report; EPI, 2005). The initial short-term bottled drinking water program was terminated at the end of 1997 when it was confirmed that no additional drinking water wells were impacted.

Other IRMs in 1997 included installation of a pilot-scale SVE system to remove contaminants in soils and soil vapor, and a pilot-scale NoVOCs system to remove contaminants in the groundwater. Contaminated soil vapor from the SVE and NoVOCs systems was sent through granular activated carbon. Contaminated condensate from the SVE system was discharged to the ground. A detailed discussion of the IRMs was presented to Ecology in the *Interim Measures Completion Report* (Philip Environmental, 1998b).

As part of the RI/FS process, the PLPs submitted the following reports:

- An Ecological Evaluation (Philip Environmental, 1997), which described the potential impacts to plants and animals at the PLSI Property;
- A Risk Assessment/Cleanup Level Analysis (Philip Environmental, 1998c), which described the potential impacts to human health and the environment; and
- An FS Report (PSC, 1999), which described remedial alternatives to reduce potential risk at each individual contaminant source area.

The recommended remedy for the IWAs in the 1999 FS Report included:

- Capping and long-term monitoring of the five IWA Zones;
- Zone A source control in the form of continued operation and expansion of the SVE system surrounding the 35,000 buried drums of industrial wastes, and treatment of contaminated soil vapor using granular activated carbon; and
- Continued operation and expansion of the Zone A groundwater treatment system using NoVOCs wells.

The recommended remedy for the MSW Landfill in the 1999 FS Report included the presumptive remedy of installing an engineered cover system and a landfill GCCS, including a flare for treating landfill gas.

Under IWA/GW Agreed Order, Ecology identified the preferred remedies described in the 1999 FS Report as IAs, determining that a final CAP would be deferred until performance monitoring data had been generated.

In 2002, the IWAG implemented the IAs required by the IWA/GW Agreed Order, including the following:

- Consolidation of contaminated soil and installation of engineered landfill caps at Zones A, C/D, and E;
- Expansion of the SVE and NoVOCs systems at Zone A;
- Drum removal and off-site treatment and disposal of drum contents (herbicide wastes) and contaminated soil from Zone B;
- Consolidation of contaminated soil and installation of an engineered landfill cap at Zone B; and
- Ongoing operation, maintenance, and monitoring activities.

The IWAG submitted the Operations and Maintenance Manual for SVE, NoVOCs, and Ground Water Monitoring (PSC, 2002c). As required by the IWA/GW Order, appropriate ICs were put in place. Contaminated soil vapor was sent from the SVE skid through a conveyance line to the flare at the north end of the MSW Landfill for treatment, with granular activated carbon used as backup treatment. Potentially contaminated condensate collected at the SVE skid was discharged to ground. Condensate collected at the flare compound was treated at the flare.

In 2002, the Landfill Group members implemented the IAs required by the Landfill Agreed Order, including installation of an engineered cover system and a GCCS. The 2000 Landfill Agreed Order required certain PLPs to:

- Prepare a Pre-Closure Site Investigation Work Plan;
- Design and install a Municipal Closure Cap System, including a landfill GCCS; and
- Prepare a Closure Completion Report and a Post-Closure Inspection and Maintenance and Operations Plan.

The Landfill Group submitted the *Operations and Maintenance Manual, Landfill Gas Collection Control and Flare* (PSC, 2002a). The PLPs collectively submitted the *Operations and Maintenance Manual for Landfill Caps* (PSC, 2002b). Ecology gave notice to the Landfill Group members in March 2013 that the provisions of the Landfill Agreed Order were satisfied.

2.3.4.5 Interim Action Performance Monitoring Report

In 2007, at the end of the performance monitoring period following 2002 expansion of the SVE and NoVOCs systems, the IWAG presented the Interim Action Performance Monitoring Report (EPI, 2007a) and an updated Operations and Maintenance Manual for SVE, NoVOCs and Ground Water Monitoring (EPI, 2007b), which were approved by Ecology in May 2007. Ecology identified issues regarding several aspects of the performance of the IAs, specifically related to Zone A. The IWAG responded to those issues through the preparation of technical memoranda presenting additional technical evaluation and negotiated a scope of work for the necessary additional actions to be performed under the IWA/GW Agreed Order. The IWAG stopped discharging contaminated condensate from the SVE skid to ground, and this condensate was sent to the flare for treatment.

2.3.4.6 Additional Interim Actions

In 2008, the IWAG prepared the *Revised Final Work Plan for Additional Interim Actions – Phase I* (EPI, 2008a), and *Addendum No. 1 – Operations and Maintenance Manual – SVE, NoVOCs and Ground Water Monitoring* (EPI, 2008b), which outlined the scope of work, and were subsequently approved by Ecology in May 2008. The Phase I Additional IAs included:

- Installation of additional groundwater monitoring wells to better characterize the vertical and spatial extent of the Zone A contaminant plume and groundwater flow;
- SVE system rehabilitation, testing, and optimization;
- Evaluation of the NoVOCs system;
- A geophysical survey of the Zone A area; and
- The development of an updated Conceptual Site Model for Zone A.

In 2009, the IWAG presented the findings of the Phase I Additional Interim Actions (AIAs) to Ecology in the combined *2008 Annual Report Ground Water Monitoring and Phase I Additional Interim Actions* report (EPI, 2009). The SVE wells required maintenance by vacuuming out debris from inside the wells. The SVE flow rates were optimized by adjusting from equal flows between wells to flows proportional to contaminant concentrations. The NoVOCs system was subsequently decommissioned after performance could not be demonstrated. The extent of groundwater impacts from Zone A was determined vertically across the aquifer thickness. The conceptual site model for Zone A was updated to include a continuous source of contaminants to soil vapor and groundwater. Upon completion of the Phase I AIAs, the IWAG and Ecology initiated discussions for additional work to assess source control for industrial waste leaking from buried drums at Zone A.

In 2010, the Landfill Group members tested the flare performance. Based on the findings in the *Revised Flare Performance Report* (Aspect, 2011), Ecology approved flare operations that would treat contaminated soil vapor from Zone A for a range of SVE system operations, and landfill gas from the MSW Landfill.

In 2010, the IWAG prepared the *Draft Final Phase II Additional Interim Actions Work Plan Volume 1 – Soil Vapor Extraction System Upgrades and Start-up Testing with Monitoring Well Installation* (Phase II AIA, Volume 1 Work Plan), dated May 14, 2010 (EPI, 2010a), which was approved by Ecology on May 27, 2010. The Phase II AIA, Volume I Work Plan included:

- Installing SVE wells inside Zone A;
- Installing a vacuum monitoring probe inside Zone A;

- Installing groundwater monitoring wells inside Zone A, and downgradient of Zone A;
- Testing procedures for the new SVE wells; and
- Specifying soil sampling during drilling.

The *Revised Final Phase II Additional Interim Actions Work Plan; Volume 2 – Sub-Zone A Investigation, Downgradient Well Installation and Cap Maintenance* (Phase II AIA, Volume II Work Plan) was submitted January 28, 2011, after it was conditionally approved by Ecology on December 6, 2010 (EPI, 2011a). The Phase II AIA, Volume II Work Plan included:

- Installing horizontal borings beneath the buried drums of industrial waste in Zone A;
- Repairing the Zone A engineered cover system to address differential settlement;
- Installing additional monitoring wells downgradient of Zone A; and
- Specifying soil sampling during drilling.

In 2011, the IWAG combined the findings and results of the Phase II AIA Work Plan, Volumes 1 and 2, that pertained to the environmental conditions beneath and downgradient of Zone A into one comprehensive report, the *Phase II Additional Interim Actions Sub-Zone A Investigation and Downgradient Well Installation Report, Volume 1 of 2*, dated September 30, 2011 (EPI, 2011b; EPI, 2012). The findings included:

- Presence of mixed soil and MSW beneath the buried drums of industrial waste in Zone A;
- SVE wells radius of influence that extended from Zone A to the surrounding MSW Disposal Areas; and
- Mobilization of contaminants through the soil column due to liquid-phase releases of industrial waste from buried drums in Zone A.

Also in 2011, the IWAG disconnected the granular activated carbon unit as backup to the flare, and relied solely on the flare at the MSW Landfill flare for treatment of contaminated soil vapor from the Zone A SVE system.

2.3.4.7 FFS Work Plan, Analysis, and Reporting

In 2012, Ecology issued Agreed Order DE 9240 (and a companion Enforcement Order) directing the PLPs to:

- Continue with on-going operation, maintenance, and reporting of the IAs (Task 1);
- Prepare of a FFS work plan (Task 2);
- Conduct FFS analysis and reporting (Task 3); and

- Implement supplemental data collection and treatability evaluation (as contingency Task 4).

The revised FFS work plan (Anchor QEA, et al., 2013) was approved by Ecology on November 6, 2013. The draft FFS report was submitted to Ecology on September 3, 2014. Ecology provided comments on the draft FFS report on June 13, 2016. This revised draft FFS is being submitted in partial satisfaction of Agreed Order DE 9240.

2.3.4.8 Zone A Heating Event, Balefill Subsurface Fire, and Zone A Combustion Investigation

In 2012, the IWAG started up the expanded SVE system. After two months of operation, Ecology required a Zone A Heating Evaluation when the SVE wellhead temperature at VEW-06I increased from 100 degrees Fahrenheit (°F) to 123 °F. On October 29, 2012, the IWAG submitted a memorandum described the findings of the heating evaluation (Anchor QEA, et al., 2012). SVE system upgrades, testing, and operations and maintenance (O&M) were presented in the *As-Built and Testing Reports with Operations and Maintenance Manual, Volumes 1-3,* dated February 25, 2013 (EPI 2013a). On September 23, 2013, Ecology approved Volumes 1 and 2 (SVE system upgrades and testing), and deferred review of Volume 3 (O&M manual) pending further demonstration of SVE flows and heating.

In December 2013, differential settlement was observed in the Balefill Area adjacent to the northeast border of Zone A. The IWAG immediately ceased shallow and intermediate SVE well operations; the deep SVE wells continued operating. Subsequent monitoring found elevated ground surface and shallow subsurface temperatures, and venting of smoke and water vapor. With these indicators of subsurface combustion, Ecology requested an immediate response. The Landfill Group members monitored and repaired the soil cover to address some differential settlement and soil cracks.

In January 2014, the IWAG installed thermocouples to measure subsurface temperatures, and maintained deep SVE well operation at relatively low rates of between 100 and 130 standard cubic feet per minute each. The results of the January 2014 groundwater sampling event showed high concentrations of VOCs in groundwater, indicating a potential liquid-phase contaminant source. In response, the IWAG restarted the shallow and intermediate SVE wells in February 2014, and subsurface temperatures in the Balefill Area increased to above 700 °F.

In March 2014, the IWAG installed vacuum monitoring probes to determine the SVE influence on combustible waste in the vicinity of the subsurface fire. Ecology issued Enforcement Order No. DE 10651, effective April 28, 2014, directing recipient PLPs to perform the following three tasks:

- Develop a work plan to promptly extinguish the Balefill Area subsurface fire, including monitoring activities to verify short- and long-term success of proposed actions, to be submitted by May 13, 2014.

- Implement the fire extinguishment activities approved by Ecology.

- Develop a work plan detailing an engineering and/or operational approach to minimize, to the extent practicable, the potential for future subsurface combustion events within waste materials located near the Zone A perimeter.

On May 13, 2014, both the IWAG and the Landfill Group members submitted separate work plans to Ecology with different approaches to extinguish the Balefill Area subsurface fire. Ecology selected the IWAG's work plan on May 23, 2014, and approved a revised work plan dated June 4, 2014, which included injecting liquid carbon dioxide four times over the course of up to 8 weeks (SCS Engineers, 2014). When the four initial carbon dioxide injections did not extinguish the fire, the IWAG subsequently implemented an additional 18 liquid carbon dioxide injections over the course of 36 weeks, while continuing to operate the SVE system. Because the carbon dioxide injections did not extinguish the subsurface fire, Ecology determined that an alternative fire extinguishment method was required.

In 2015, the IWAG submitted a Technical Execution Plan, which involved quenching the fire using a water /cement-bentonite slurry mixture. The Technical Execution Plan also provided for installing a slurry wall just outside the drummed waste in Zone A, and installing monitoring probes outside the slurry wall. The IWAG implemented the Technical Execution Plan by June 2016 (IWAG, 2015). A revised Enforcement Order Task 3 Work Plan was submitted by IWAG to Ecology on March 6, 2017. Ecology gave notice to the PLPs in April 2017 that the Enforcement Order was satisfied.

In 2016, Ecology requested that the IWAG conduct a Zone A combustion investigation based on sustained, elevated temperatures and carbon monoxide concentrations at intermediate-depth SVE wells, VEW-06i and VEW-07i. Elevated carbon monoxide was first measured in January 2016, and subsequent monitoring since July 2016 has found consistently elevated carbon monoxide concentrations. Ecology requested that the IWAG conduct a Zone A combustion investigation. The IWAG submitted a report on the Zone A combustion evaluation on April 24, 2017 (GSI & SCS, 2017). Ecology has stated that SVE wells may not be operated with temperatures higher than 140 °F. Ecology's formal comments on the Zone A Combustion Investigation Report (GSI & SCS, 2017) were pending at the time this revised draft FFS report was submitted.

2.3.4.9 Differential Settlement of the Zone A Cover System

The Zone A cover system was repaired in late 2011 to address differential settlement of up to 1.4 feet observed over 3 years of monitoring. Subsequent to the cover system repairs, some areas of Zone A have settled up to 5.3 feet over 5 years of monitoring, with most of the settlement occurring between 2012 and 2015. Sumps were installed in the areas with greatest settlement to observe any liquid accumulation. In April 2017, accumulated water was observed at the sump in the southern depression. The IWAG pumped approximately 600 gallons out of the sump. Ecology requested the IWAG conduct an investigation of the cover system performance, addressing the potential for leaks of water into the buried drummed waste. The IWAG's formal report addressing Zone A cover system performance was pending at the time this revised draft FFS Report was submitted.

2.3.4.10 Zone A Contaminated Soil Vapor Treatment System

The IWAG decided to treat contaminated soil vapor from the Zone A SVE system using an alternative technology to the existing MSW Landfill flare. The flare was designed, and had been operated, to treat approximately 600 standard cubic feet per minute of contaminated soil vapor from Zone A. The flare had been fueled exclusively by methane in landfill gas from the MSW Landfill, and the methane collection rate was decreasing over time. Between April and October 2015, the Landfill Group modified flare operations to use supplemental fuel to maintain flare temperatures and treat the contaminated soil vapor from Zone A.

The IWAG submitted a Notice of Construction for a regenerative thermal oxidation in July 2014, designed to treat up to 1,000 standard cubic feet per minute of SVE vapor from Zone A, as well as 12 gallons per hour of hazardous waste condensate. In July 2015, Ecology issued Approval Order No. 14AQ-E571 to Thom Morin (representing the IWAG) providing conditional approval of the regenerative thermal oxidizer for use in treating contaminated soil vapors and condensate from the SVE system at Zone A.

In January 2016, during source testing of the regenerative thermal oxidation unit, vapor samples were collected for laboratory analysis. Laboratory results showed emissions from the regenerative thermal oxidation unit exceeding permitted limits, as well as elevated carbon monoxide concentrations at intermediate SVE wells. Samples were not collected from the inlet, and a destruction efficiency for the regenerative thermal oxidizer could not be calculated. Additional investigations by the IWAG found potential causes for emissions exceeding permitted limits.

In April 2016, Ecology issued Notice of Violation Docket # 13240 to Thom Morin (representing the IWAG) for causing or permitting air pollution from the regenerative thermal oxidizer. The IWAG decided to replace the regenerative thermal oxidizer, rather than repair it. In October 2016, Ecology requested that the IWAG conduct an analysis of the health risk of regenerative thermal oxidation operation until April 2017 replacement. The results of this analysis limited the flow rate from the SVE system to no more than 500 standard cubic feet per minute.

In November 2016, Ecology issued Administrative Order Docket # 13922 to Thom Morin (representing the IWAG) allowing for the temporary installation and operation of a recuperative thermal oxidizer to control emissions from the Zone A SVE system until a new regenerative thermal oxidizer was to be installed and operational by June 1, 2017. The recuperative thermal oxidizer was installed and began operating in December 2016. In April 2017, Ecology provided an extension of deadline for installation and operation of the new regenerative thermal oxidizer. The recuperative thermal oxidizer was disconnected from the Zone A SVE system on July 9, 2017.

In May 2017, Ecology issued Approval Order No. 16AQ-E031 to Mark Leece (representing the IWAG) providing conditional approval of the new regenerative thermal oxidizer for use in treating up to 1,000 standard cubic feet per minute of soil vapors extracted from Zone A. The Approval Order does not allow condensate treatment at the new regenerative thermal oxidizer. Therefore, condensate from the SVE system must be properly disposed of at a permitted facility. The new regenerative thermal oxidizer was installed and began operating in July 2017. Source testing is scheduled for early September 2017.

2.3.4.11 Nonaqueous Phase Liquid beneath Zone A

In December 2016, saturated soil was observed near the base of the buried drums while drilling during of the Zone A combustion investigation. In January 2017, elevated groundwater concentrations were observed at monitoring well MW-52S, potentially indicating a liquid-phase release of industrial waste from drums buried at Zone A. In April 2017, nonaqueous phase liquid (NAPL) was observed at monitoring well MW-52S during groundwater monitoring, and Ecology requested that the IWAG conduct an investigation of the nature and extent of the NAPL. Starting in late June 2017, the IWAG began weekly thickness monitoring and recovery of NAPL. Samples were submitted to laboratories for analysis to support characterizing the composition of the NAPL. The IWAG's formal report on the NAPL was pending at the time this revised draft FFS was submitted.

2.3.4.12 SVE Well Inspection and Maintenance

The IWAG conducted video surveys of the SVE wells in Zone A in late June and early July 2017, based on an analysis of routine monitoring parameters indicating potential clogging (Aspect, 2017). The videos showed material had collected inside the well screens and, in some cases, prevented a full survey. The IWAG previously surveyed and vacuumed out SVE wells in 2009 (EPI, 2010b). The Ecology-approved O&M manual for the SVE system (EPI, 2013) included routine annual video surveys and maintenance if necessary.

2.4 Environmental Setting

2.4.1 Topography

The NPL Site is situated at approximately 400 feet above mean sea level, in an area of flat terrain and gently rolling hills. An aerial topographic survey of the PSLI Property was performed by the IWAG during the first quarter of 2013.

2.4.2 Geology and Hydrogeology

The NPL Site is located in the central portion of the Columbia Plateau, a broad plain situated between two mountain ranges—the Cascade Range to the west and the Rocky Mountains to the east. The Columbia Plateau occupies an area of about 64,500 square miles, mainly in eastern Washington and northeastern Oregon.

The dominant rocks of the Columbia Plateau are the Miocene basalts and sedimentary interbeds of the Columbia River Basalt Group, which range in thickness from 4,000 to 12,000 feet in the Pasco Basin. The Columbia River Basalt Group is overlain by the younger Pliocene rocks of the Ringold Formation deposited as mainstream and sidestream facies of the ancestral Columbia River, and the loess deposits of the Palouse Formation. The Ringold Formation is overlain by glaciofluvial sediments of the Hanford Formation, deposited as a result of the catastrophic flooding from glacial Lake Missoula during the Pleistocene. The Hanford Formation is subdivided into the coarse deposits of the Pasco Gravels and the fine-grained slack-water deposits of the Touchet Beds. A detailed description of the regional geology of the NPL Site and adjacent areas is provided in the Phase I RI Report (Burlington Environmental, 1994).

Regional aquifers in this part of the Columbia Basin are present in the Columbia River Basalt Group and the unconsolidated deposits of the Hanford Formation. The Columbia River Basalt Group is the principal aquifer of the Columbia Plateau, consisting of a thick sequence of flood basalts with associated interbedded sedimentary layers.

Stratified clay, silt, sand, and gravel of the Ringold Formation and glaciofluvial deposits of the Hanford Formation overlie the basalt over much of the region. Loess deposits may also overlie the basalt, but are usually thin when present. Where the saturated thickness of the glaciofluvial deposits is great, high yields of water can be expected. Well yields from 10 to 1,000 gallons per minute (gpm) are reported for the Ringold Formation, while well yields from 100 to 4,000 gpm have been reported for the glaciofluvial sands and gravels.

The hydraulic conductivity of the Ringold Formation has been reported to range from 0.007 to 0.21 centimeter per second (cm/s), and that of the glaciofluvial deposits has been reported to range from 0.18 to 7.0 cm/s (U.S. Department of Energy, 1979).

Regional groundwater east of the Columbia River flows to the southwest, following topography, and discharges along the Columbia and Snake rivers (Widness, 1986).

Infiltration from precipitation in the Pasco Basin is minimal. Results of water balance studies in the region indicate that infiltration of rainfall contributes between 0.06 and 0.5 inch annually for nonirrigated portions of the Pasco Basin (Fenn et al., 1975; Gephart et al., 1979; Bauer and Vaccaro, 1990). Irrigated farmland is located adjacent to the PSLI Property to the south and east and to the west of Dietrich Road. The U.S. Bureau of Reclamation (1971) estimated that 20 to 40 percent of irrigation water reaches the water table during periods of prolonged irrigation. Similarly, Bauer and Vaccaro (1990) calculated that, from an estimated 23.7 inches of irrigation water applied to agricultural areas in the Pasco Basin annually, approximately 12 inches reach the regional aquifer system through direct infiltration.

Additional details concerning the regional hydrogeology are provided in the Phase I RI Report (Burlington Environmental, 1994).

2.4.3 Surface Water Hydrology

There are no surface water hydrologic features in the vicinity of the PSLI Property. The closest surface waterbodies are the Snake River and the Columbia River located approximately 2.6 miles southeast and southwest, respectively, of the PSLI Property.

2.4.4 Meteorology

The NPL Site is located in an arid region of the Columbia Plateau that is surrounded on the west, north, and northeast by mountain ranges. The Cascade Mountains to the west shield the region from the moist and relatively mild air of the Pacific Ocean, and the northern stretches of the Rocky Mountains in Canada provide a barrier to the southward-moving arctic air. Annual precipitation in the Pasco Basin ranges from approximately 4 to 13 inches with mean precipitation of approximately 7.5 inches. Winter snowfall averages about 14 inches annually.

The Pasco Tri-Cities Airport climate station (KPSC) has been used for local, continuous weather data courtesy of the National Weather Service, and is located approximately 2.5

miles from the PLSI Property. Based on long-term data from KPSC, the following weather conditions have been observed:

- Monthly precipitation ranges from 0.24 inches in August to 1.42 inches in December.
- High temperatures range from 40 °F in December to 92 °F in July. Low temperatures range from 28 °F in December to 58 °F in July.
- Winds are typically out of the northwest or southwest. Average winds range from 5 miles per hour to 8 miles per hour. Maximum winds range from 11 to 16 miles per hour. Gusts of over 25 miles per hour have been observed with large storm events, and have resulted in wind erosion of the soil cover in limited areas of the MSW Landfill and the Balefill and Inert Waste Disposal Areas.
- Barometric pressure averages 30 inches mercury, and ranges from 29 to 31 inches mercury. Barometric pressure changes are greatest in November and December, coinciding with large storms, and affect landfill gas conditions at the MSW Landfill (such as static pressure and methane concentrations).

According to the Stormwater Management Manual for Eastern Washington (Ecology, 2004), the precipitation in Pasco during 24-hour rainfall events range from 0.95 inches for a 2-year mean recurrence interval to 2.28 inches for a 100-year mean recurrence interval, and typically occur during thunderstorms between April and October. According to the nearest Washington State University agricultural weather station (CBC Pasco), the potential evapotranspiration ranges from 0.55 inches in December to 7.75 inches in July.

2.4.5 Ecological Setting

An ecological assessment of the NPL Site was carried out in order to provide the most current ecological conditions of the area and to complete a terrestrial ecological evaluation under MTCA. This assessment was based on the review, search, and evaluation of available information from appropriate federal and state agency online tools and historical and 2013 aerial imagery from Google Earth for land, fish, and wildlife habitats in the region of Franklin County. Overall, the habitat within the PSLI Property and adjacent land appears to be degraded with little diversity in habitat types, and there are no contiguous habitats locally due to agriculture and transportation uses.

2.4.5.1 Soils

Soils were assessed for classification and physical properties using the 2012 Web Soil Survey (available from the U.S. Department of Agriculture, under the Natural Resources Conservation Service) for an area of interest of 2,700 acres, surrounding the PSLI Property. All mapped soils showed moderate to high infiltration rates and wind erodibilities; no hydric soils were identified within the area of interest.

2.4.5.2 Wetlands

Wetlands were assessed within and adjacent to the PSLI Property boundary using the 2011 Wetland Mapper, available at the U.S. Fish and Wildlife Service. While the National Wetland Inventory did not map any wetlands within the PSLI Property, two wetlands were identified approximately 0.2 miles from the southeast property boundary. The two wetlands are hydrologically connected and they appear to be excavated ponds, which hold agricultural effluent from irrigation. Irrigation return flows and holding ponds are not typically considered "wetlands" or waters of the United States under the Clean Water Act.

2.4.5.3 Flora

The 1997 Ecological Assessment (Philip Environmental, 1997) reported that the PSLI Property is almost entirely surrounded by agricultural fields—primarily irrigated alfalfa and potatoes—or residential and light industrial properties. Few native plants were found, and only included the species Sandberg bluegrass (*Poa secunda*) and Indian ricegrass (*Oryzopsis hymenoides*).

The only shrub identified was gray rabbit brush. The vegetation is primarily composed of annual grasses and weeds, including cheat grass, tumble mustard, Russian thistle, and species of knapweed.

In addition, the Washington Department of Natural Resources 2013 Natural Heritage Program website was reviewed for "Rare Plants" in the region of Franklin County. None of the state status species within Franklin County have current or known populations within 10 miles of the PSLI Property (WDNR, 2013).

2.4.5.4 Fauna

According to the 1997 Ecological Assessment (Philip Environmental, 1997), fauna in the vicinity of the PSLI Property included very small populations of burrowing owls, long-billed curlews, and ring-necked pheasants. Additional research for Priority Habitats and Species was conducted by Washington Department of Fish and Wildlife using the online 2013 maps. Within the PSLI Property boundary, only one priority species was identified in 2010: the greater sage-grouse (*Centrocercus urophasianus*). The burrowing owl (*Athene cunicularia*) was found in several breeding locations very close (within 0.2 miles) to the PSLI Property boundary; these mapped breeding areas range in time from 2001 to 2009. Finally, a waterfowl concentration area was mapped approximately 0.5 miles to the southeast of the PSLI Property boundary.

Additionally, the 1997 Ecological Assessment (Philip Environmental, 1997) reported that species that use the area occasionally or seasonally include rough-legged hawks, red-tailed hawks, northern harriers, ducks, geese, American kestrels, and rodents. According to the Washington Department of Fish and Wildlife, the PSLI Property will likely continue to provide habitat for this limited wildlife community, as long as some open space is provided.

2.4.6 Historical and Cultural Resources

A literature search of historical and cultural resources did not identify any known historical or cultural resources in the NPL Site area (DAHP, 2013).

2.4.7 Off-Property and On-Property Groundwater Use

Since 2006, the PSLI Property has been subject to a restrictive covenant that prohibits 1) the use of groundwater from existing groundwater wells for domestic and agricultural uses; 2) the installation of new groundwater wells for domestic and agricultural uses; and 3) the use of the PSLI Property for residential purposes. State regulations prohibit the installation of water supply wells within 1,000 feet of the boundary of previously permitted MSW landfills (WAC 173-160-171).

In 1995, as part of the NPL Site RIs, it was found that off-property groundwater contained Contaminants of Concern related to the Pasco Sanitary Landfill. Alternative water supply was provided, and drinking water wells were disconnected from households. The Institutional Controls Program (ICP) stipulates that no new wells for drinking water purposes may be installed within the Groundwater Protection Area. Irrigation wells were present before the Groundwater Protection Area was established, and continue to operate as nonpotable water supply. Sampling of former drinking water wells in the area has been performed as part of the IWAG's ongoing groundwater monitoring.

2.5 Overview of Waste Repositories and Waste Management Areas

2.5.1 Municipal Solid Waste Landfill, Burn Trenches, Balefill Area, and Inert Waste Disposal Area

2.5.1.1 Disposal History

For the purposes of this revised draft FFS report, the following synopsis provides a history leading up to the RI and the IAs for the MSW Disposal Areas, including the MSW Landfill, Burn Trenches, Balefill Area, and Inert Waste Disposal Area. Table 2.5.1-1 presents the MSW disposal operations chronology in more detail. Figure 2.5.1-1 shows the historical MSW Landfill area. A more comprehensive history is provided in the Phase I RI Report (Burlington Environmental, 1994), which was compiled based on aerial photos, permitting and operational records, and interviews.

- 1958–1993: Refuse disposal at MSW Landfill. Open burning ended in 1971.
- 1959–1965: Disposal and open burning take place in two east-west trenches (BT-1), and later in two north-south trenches (BT-2).
- 1976–1993: Baled MSW accepted at the PSL site and landfilled in area east of Zone A. MSW then considered inert placed in Inert Waste Disposal Area.

Because refuse was burned until 1971, there is a combination of burned and unburned MSW remaining in place in some areas. The composition of MSW received at this landfill was consistent with the definition of MSW at the time, and included tires (Burlington Environmental, Inc., 1992; Burlington Environmental, Inc., 1994) and shredded tires among the refuse. The composition of MSW varies within individual MSW Disposal Areas.

2.5.1.2 Key Remedial Investigation Findings

This section addresses key RI findings relative to the MSW Landfill. Figure 2.5.1-1 shows the locations of the MSW Landfill, Burn Trenches (BT-1 and BT-2), Balefill Area, and Inert Waste Disposal Area. Historical locations of the septic lagoons (SL-1, SL-2, and SL-3), Landspread Area, and Sludge Management Area are also shown on Figure 2.5.1-1. Figure 2.5.1-2 is a north-south cross section depicting the approximate vertical extent of MSW, and maximum observed groundwater levels.

2.5.1.3 Overview of Interim Actions

In 2002, under the Landfill Agreed Order, the MSW Landfill was capped with an engineered cover system, an active landfill GCCS was installed, and O&M Manuals were prepared (PSC, 2002a; PSC, 2002b). These IAs were implemented in agreement with the approved closure plan (Woodward-Clyde, 1996), and based on the "Presumptive Remedy for CERCLA Municipal Landfill Sites" (EPA 1991a). Between 2002 and 2012, the Landfill Group members completed the following tasks required by the Landfill Agreed Order:

- Balanced landfill gas collection to prevent potential groundwater impacts and address decreasing methane concentrations;
- Performed a stack test on the landfill flare to confirm treatment of approximately 232 pounds per day of VOCs from the Zone A SVE system, and approximately 1 pound per day from the MSW Landfill (Aspect, 2011);
- Operated and maintained the flare to manage landfill gas and optimize treatment of VOCs from the Zone A SVE system;
- Monitored subsurface landfill gas, and expanded the landfill gas monitoring probe network around the perimeter of the MSW Landfill, to prevent potential landfill gas migration;
- Conducted regular inspections of the landfill cover systems to ensure the cover was in good condition and preventing potential fugitive emissions, infiltration of precipitation, and direct contact by humans or terrestrial receptors; and
- Prepared routine quarterly and annual reports regarding the MSW Disposal Areas, and other interim action reports, for Ecology[7].

Ecology gave notice in March 2013 that the provisions of the Landfill Agreed Order were satisfied.

Since 2012, the Landfill Group members have completed required tasks under Agreed Order DE-9240 including the following examples:

- Continued operation, maintenance, monitoring and reporting of Interim Actions for the MSW Disposal Areas;
- Updated the O&M manual for the MSW Disposal Areas;
- Implemented initial response and soil cover repairs in the vicinity of a subsurface fire in the Balefill Area near Zone A;
- Installed a supplemental fuel system for the flare to continue treating contaminated soil vapor from Zone A while methane generation rates decreased

[7] A summary of reports produced by the Landfill Group members since 2005 is provided in Table 2.5.1-2.

(later decommissioned when the flare was used to treat only landfill gas from the MSW Landfill);

- Installed landfill gas probes in the Balefill Area and Inert Waste Disposal Area to investigate subsurface conditions; and
- Prepared a focused feasibility study for the MSW Disposal Areas.

The following subsections discuss an overview of Interim Actions to provide context for their selection as preferred remedial alternatives (discussed in Sections 5 and 6).

Soil Covers

In 1993 all of the MSW Disposal Areas were initially closed with soil covers, in accordance with permitting requirements at the time. The soil covers provided a physical barrier to MSW, an evapotranspiration cover (EPA, 2003), and a habitat for methane oxidizing bacteria (Spokas and Bogner 2011). Information on soil covers is provided for each MSW Disposal Area below.

- The interim MSW Landfill soil cover was reinforced with an engineered cover system in 2002.
- The Burn Trench BT-1 soil cover is approximately 6 feet thick at the east end, based on the monitoring well log for EE-7.
- The Burn Trench BT-2 soil cover was reinforced in 2002 with the engineered cover system for Zone A.
- The Balefill Area and Inert Waste Disposal Area soil covers were originally placed where MSW was leveled to the extent practicable (Burlington Environmental, 1992). Near Zone A, the soil cover was reinforced in 2002 with installation of the engineered cover system for Zone A.

In the Inert Waste Disposal Area, soil cover was placed across level areas, and was not placed on top of some bulky MSW. The soil covers for the Balefill Area and the Inert Waste Disposal Area have been subject to some wind erosion in some areas, and some soil cracking in some areas. A soil cover restoration was proposed in the draft O&M Manual (Aspect, 2012). Implementation of the soil cover restoration at the Balefill Area and Inert Waste Disposal Area, as described in the O&M Manual (Aspect, 2014a; Aspect, 2016), is planned following public review of the Cleanup Action Plan (per Ecology, 2013).

The Balefill Area cover was repaired in an area near Zone A associated with a subsurface fire to address differential settlement (Aspect, 2014b) and disturbances caused during fire investigation and extinguishment efforts (Anchor, et al., 2016).

The existing Balefill and Inert Waste Disposal Areas soil cover was observed to have a minimum thickness of 12 inches during installation of six gas probes in early 2017. However, the soil cover thickness will be determined more accurately and in more locations during pre-design of the proposed soil cover restoration.

Engineered Cover and Landfill Gas Collection and Control System

Pursuant to the Landfill Agreed Order, the two IAs for the MSW Landfill were implemented[8], including design and installation of an engineered cover and a GCCS at the MSW Landfill. These IAs were consistent with the presumptive remedy for CERCLA municipal landfill sites (EPA 1991a) which is containment with engineering controls to prevent impacts to human health and the environment.

The IAs implemented at the MSW Landfill have eliminated direct exposure to MSW or landfill gas, minimized groundwater impacts from landfill gas or leachate, and minimized air quality impacts due to potential fugitive emissions of landfill gas. Construction detail for the engineered cover and the GCCS is provided in the O&M Manual for MSW Disposal Areas (Aspect, 2014a).

The engineered cover system and the GCCS are in good operating condition. The MSW Landfill cover and associated infrastructure have been inspected and maintained following the Operations and Maintenance Manual for Landfill Caps (PSC, 2002b) and the O&M Manual: MSW Disposal Areas (Aspect, 2014a). Minor wind erosion of the topsoil layer of the cover has been occasionally observed and repaired. No visually observable differential subsidence or settling of the MSW cover system has been observed since 2002. The GCCS components and operations have been modified to handle decreasing landfill gas generation rates. The VOC loading rate during the First Quarter 2017 was approximately 0.4 pounds per day, and generally meet the air quality thresholds before treatment (Aspect, 2017).

Subsurface Fire Investigation and Extinguishment Effort

In 2013, a small area of differential settlement in the Balefill Area near the northeast corner of Zone A was observed, and was later associated with the subsurface fire discussed in Section 2.3.4. Initial responses by the Landfill Group members included repairing the soil cover, recommending reduced SVE system influence, and monitoring the soil cover for additional differential settlement, elevated temperatures, and emissions (Aspect, 2014b). Subsequent subsurface fire investigation and extinguishment efforts by the IWAG were conducted, including installation of subsurface thermocouples and vapor monitoring probes, injection of 128 tons of liquid carbon dioxide, and placing 4,200 cubic yards of slurry in Zone A and the Balefill Area (Anchor QEA, 2016).

Balefill and Inert Waste Disposal Areas Investigation

In early 2017, the Balefill and Inert Waste Disposal Areas were investigated by drilling to determine MSW thickness and install probes in MSW, and by monitoring landfill gas conditions, subsurface temperatures, and the extent of vacuum influence from the Zone A SVE system.

- The MSW thickness was approximately 20 to 25 feet thick, similar to previous estimates used to calculate landfill gas generation for the Balefill and Inert Waste Disposal Area, and presented in Appendix A.

[8] The Landfill Agreed Order did not specify IAs for the Burn Trenches, the Balefill Area, or the Inert Waste Disposal Area because there was no evidence of impacts from these MSW Disposal Areas in the RIs.

- Landfill gas composition observed contained less than 7 percent methane, less than 25 percent carbon dioxide, consistent with a landfill approaching functional stability.
- Subsurface temperatures were warmer near Zone A, and less than 120 °F. Vacuum influence from the Zone A SVE system was observed in probes near Zone A. The monitoring data, including carbon monoxide results, were below thresholds that indicate and confirm a subsurface fire, and monitoring is ongoing.

2.5.1.4 Current Environmental Conditions

The current environmental conditions for MSW Disposal Areas are summarized below:

- The IAs at the MSW Disposal Areas have achieved RAOs.
- VOC concentrations in groundwater at the MSW Landfill monitoring wells have historically been low, and for the most part have been less than draft cleanup levels for the last 10 years. Since 2014, all cleanup levels have been met at all MSW Landfill monitoring wells, based on results of routine groundwater monitoring.
- Recent vapor monitoring within the Balefill Area and Inert Waste Disposal Area confirms little to no landfill gas is being generated. No methane was detected above the soil cover in 2014.
- Landfill gas collection and treatment at the MSW Landfill has been protective of air quality, based on routine methane monitoring at perimeter gas probes and the MSW Landfill surface, and results of stack tests and analysis.
- Geochemically, groundwater quality at the MSW Landfill monitoring wells has remained similar to background water quality since 1995. Total chromium concentrations at monitoring well MW-22S have reflected background conditions, except for outliers, and hexavalent chromium has not been detected. There has been little to no indication of leachate impacts in groundwater.
- Groundwater levels increased between approximately 2000 and 2010, and have since decreased. Based on groundwater elevations and the bottom elevation of the MSW Landfill, the MSW has not been in contact with groundwater.
- There has been no indication of subsurface fire in the Balefill Area or the Inert Waste Area since 2016.

The MSW Disposal Areas are in compliance with requirements specified in Agreed Order DE 9240. As described above, groundwater and air quality have been, and continue to be, protected by closure activities and IAs at the MSW Disposal Areas. The post-closure operations and maintenance of the MSW Landfill are in compliance with applicable MSW regulations, including WAC 173-304 and WAC 173-351.

2.5.1.5 Updated Conceptual Site Model

The IAs implemented at the MSW Disposal Areas since the 1999 FS Report have improved the understanding of conditions. Over the years, additional effort has been made at the MSW Disposal Areas to fill data gaps previously identified, including:

- Installation of the engineered cover system and landfill gas collection system at the MSW Landfill have been meeting remedial action objectives within a reasonable restoration timeframe.
- Monitoring and analysis of landfill gas collection rates from the MSW Landfill have confirmed the limited and decreasing rates of landfill gas generation.
- Inspection of selected landfill gas extraction wells at the MSW Landfill helped confirm the lack of liquid collection in the wells, the total depth of the wells, and the physical condition of the wells. The observed MSW thickness confirmed previous estimates on the volume of mass in the MSW Landfill used for landfill gas generation analysis (Appendix A). The total depth of the extraction well addressed the proximity of the bottom of waste to the groundwater table (see Figure 2.5.1-2).
- Installation and monitoring of gas probes surrounding the MSW Landfill have helped confirm the minimization of potential landfill gas migration laterally beyond the edge of waste, or vertically downward to the water table.
- Monitoring the engineered cover system at the MSW Landfill and the soil cover at the Balefill and Inert Waste Disposal Areas has confirmed the prevention of potential fugitive emissions of landfill gas to the atmosphere.
- Sampling and analysis of landfill gas and condensate at the flare have helped confirm the limited and decreasing concentrations of VOCs from the MSW Landfill. Condensate from the GCCS has been consistently characterized as non-hazardous, non-dangerous waste.
- Source testing confirmed the performance of the flare treatment system, and demonstrated that emissions were below air quality thresholds.
- Installation, monitoring, and analysis of gas probes inside the Balefill and Inert Waste Disposal Areas have helped confirm the low levels of landfill gas, the influence of the Zone A SVE system, and the low subsurface temperatures.
- Analysis of water levels, geochemical parameters, and leachate indicator parameters in groundwater have helped confirm the level of groundwater protection offered by the IAs at the MSW Landfill.

The updated Conceptual Site Model for the MSW Disposal Areas provides additional confidence with conditions projected into the future. The following subsections address projected future conditions supporting the preferred remedial alternatives.

Projected Landfill Gas Generation

Landfill gas generation rates are projected to continue decreasing over time as shown on Figure 2.5.1-3. An assessment of landfill gas generation from the MSW Landfill was included in The Final Closure Plan (Woodward-Clyde, 1996), and has been updated and compared with actual landfill gas collection rates. Past and future landfill gas generation rates were calculated for the MSW Landfill, the Balefill Area, and the Burn Trenches using EPA’s LandGEM model (2005), and reports are provided in Appendix A. Model input included the estimated MSW mass and age, and model settings were selected based on default values for the arid conditions to best match observed landfill gas collection rates. In 2017, the calculated methane generation rates for the MSW Landfill, the Balefill Area, and the Burn Trenches were approximately 80, 5, and 0.5 cubic feet per minute, respectively. Methane collection at the MSW Landfill has been less than one-third of the calculated value, indicating that the LandGEM model results are biased high for the MSW Disposal Areas.

Projected Flare Replacement

Because the existing enclosed flare is no longer required to treat SVE off-gas, an alternative treatment technology for landfill gas may be implemented, subject to Ecology approval. An example is the Solar Spark CF-10 flare (http://solar-spark.com/), capable of treating across the range of projected landfill gas generation rates, and until the methane content drops below the flammability limit. This treatment technology would be plumbed into the existing infrastructure. The alternative treatment technology will be formally selected at the appropriate time.

Eventually, treatment of landfill gas will not be required because emissions will decrease to below air quality threshold levels, and the landfill gas may be directly discharged to atmosphere. It is common for older landfills to passively vent small amounts of landfill gas directly to the atmosphere.

Projected Groundwater Protection

The groundwater monitoring wells for the MSW Landfill include an up-gradient well (NW-1), on-property wells (MW-16S, 4R, and MW-17SR), and property-boundary wells (MW-22S and MW-23S). These monitoring wells have been used to monitor the effects of IAs at the MSW Landfill on groundwater quality. The groundwater monitoring well network for the MSW Landfill should be sufficient for future confirmational monitoring.

Groundwater levels at the NPL Site have fluctuated over time, likely due to agricultural irrigation practices in the region. Figure 2.5.1-4 shows observed groundwater levels at MSW Landfill monitoring wells are currently going down. The cause of groundwater level change at the NPL Site is not related to cleanup action activities. Projected groundwater levels are assumed to remain within the historical range, and the bottom of MSW in the MSW Landfill is assumed to remain above groundwater.

VOC concentrations in groundwater at the MSW Landfill monitoring wells have historically been low, and, for the most part, have been less than draft cleanup levels for the last 10 years, as shown on Figure 2.5.1-5. In 2014, groundwater in two monitoring wells immediately next to the MSW Landfill reached cleanup levels for tetrachloroethene (PCE). Based on decreasing trends, PCE concentrations are projected to remain below the draft cleanup level in the future. No statistically significant groundwater impacts for other contaminants have been observed, supporting the conceptual site model that there has been little to no liquid-phase transport from MSW to groundwater.

2.5.2 Land Application Areas

All MSW formerly present in the Land Application areas was excavated and transferred to the MSW Landfill prior to landfill closure. No further action was proposed for the Land Application Area in the Ecology-approved FFS Work Plan. No further action is proposed in this revised draft FFS report. A summary of disposal history and key remedial investigation findings is provided below as background information.

2.5.2.1 Disposal History

This section provides a synopsis of the Land Application disposal history for the MSW Landfill, which included the disposal of liquid and dried septic tank waste, sewage sludges, and animal fat emulsion coolants. A comprehensive history of Land Application disposal activities is provided in the Phase I RI Report (Burlington Environmental, 1994).

Throughout much of the MSW disposal period, the MSW Landfill was permitted for disposal of various nonhazardous bulk liquids such as septic tank waste, sewage sludges, and animal fat emulsion coolants. These materials were disposed at lagoons (approximately 1976 to 1989), applied to the ground in the Landspread Area and Sludge Management Area (approximately 1981 to 1989), and applied directly on the MSW Landfill (approximately 1981 to 1987). The residual nonhazardous waste and associated surface soils from the Landspread Areas were used as daily cover for the MSW Landfill or transferred to the MSW Landfill during installation of the interim soil cover by the end of 1993.

2.5.2.2 Key Remedial Investigation Findings

Soils from the Land Application areas were excavated and transferred to the MSW Landfill as daily cover during operations from the late 1970s through the early 1990s. The RI identified no contaminants in soil or groundwater for the Land Application areas. A complete summary of findings relative to the Land Application areas can be found in Section 3.10 of the Phase II RI Report (Philip Environmental, 1998a).

3 Exposure Assessment

This section evaluates potentially complete exposure pathways for contaminants associated with the MSW Disposal Areas.

3.1 Media of Concern and Transport Mechanisms

3.1.1 Surface Soil

Surface soils at MSW Disposal Areas meet appropriate industrial direct contact criteria. Surface soils within the Landspread Area and Sludge Management Area were moved to the MSW Landfill and are now safely located beneath the MSW Landfill cover. Limited exposed MSW in the Balefill Area and Inert Waste Area will be addressed by soil cover restoration and subsequent monitoring where wind has eroded some parts of the soil cover or where the MSW could not be covered initially.

3.1.2 Landfill Gas

Potential landfill gas migration from the MSW Landfill has been mitigated by the GCCS, confirmed by results from perimeter gas probe monitoring and cover monitoring for methane. Condensate has been collected from the GCCS and disposed of as nondangerous waste at the Pasco wastewater treatment plant. Landfill gas monitoring will continue at the MSW Landfill.

The Balefill and the Inert Waste Disposal Area do not generate sufficient landfill gas to result in potential landfill gas migration, confirmed by in-waste probe monitoring and soil cover monitoring for methane across the Balefill Area and Inert Waste Disposal Area. The Burn Trenches contain smaller and older volumes of MSW than the Balefill Area, and therefore have lower landfill gas generation potential than the Balefill Area.

3.1.3 Groundwater

VOC concentrations in groundwater at the MSW Landfill monitoring wells have historically been low, and for the most part have been less than draft cleanup levels for the last 10 years, as shown on Figure 2.5.1-5. Performance groundwater monitoring will continue during the future transition from active to passive landfill gas collection at the MSW Landfill. Confirmational groundwater monitoring will be conducted following active remediation.

3.1.4 Ambient Air

Air quality thresholds have been met during flare operation. Air quality analysis will be conducted to demonstrate protection of ambient air during the transition from active to passive landfill gas collection at the MSW landfill, and will be subject to Ecology approval. The Burn Trenches, the Balefill Area, and the Inert Waste Disposal Area do not generate sufficient landfill gas to affect ambient air. Landfill regulations for explosive gas control (WAC 173-351-200 (4)) address the need for developing ambient air cleanup levels for the MSW Landfill, and are incorporated in the draft O&M Manual Update for MSW Disposal Areas (Aspect, 2016).

3.2 Exposure Pathways and Receptors

Humans with access to the PSLI Property can be potentially exposed to MSW in MSW Disposal Areas.

- An industrial worker could potentially have contact with MSW or landfill gas during:
    - Monitoring or sampling activities;
    - Maintenance, repairs, or modifications to remediation equipment; and/or
    - Future cleanup activities.
- Trespassers could potentially have contact with MSW or landfill gas.

Potential exposure pathways for an industrial worker or a trespasser in the MSW Disposal Areas include:

- Inhalation of landfill gas—mitigated by GCCS operating under vacuum, and/or low and decreasing landfill gas generation rates;
- Ingestion or dermal absorption of nondangerous condensate—mitigated by storing condensate within a closed tank within a fenced flare compound; or
- Direct contact with exposed MSW—mitigated by existing or restored cover.

The MSW Landfill is exempt from assessment of terrestrial ecological evaluation consistent with WAC 173-340-7491(1)(b) because all contaminated soil will be below “physical barriers that will prevent plants or wildlife from being exposed to soil contamination.” To qualify for this exemption, an institutional control is required under WAC 173-340-440. This institutional control is already required as part of landfill closure.

Terrestrial ecological receptors such as burrowing animals could be exposed to MSW in the Balefill Area and Inert Waste Disposal Area, where the soil cover thickness is less than the biologically active zone. The soil cover thickness will be at least 30 inches following restoration described in the Ecology-approved O&M Manual for MSW Disposal Areas (Aspect, 2014a).

3.3 Potential Sources

3.3.1 MSW Landfill

Based on monitoring results and analysis, the MSW Landfill with an active GCCS has been protective of groundwater and ambient air. With continued diligent operation, the MSW Landfill will continue to be protective of groundwater and air. The MSW Landfill is approaching a functionally stable condition, meaning it “does not present a threat to human health or the environment at the point of exposure for humans or environmental receptors” (WAC 173-351-500). For the purposes of this revised draft FFS report, the MSW Landfill is projected to reach functional stability within a reasonable restoration timeframe (by approximately 2032). Within that timeframe, the active GCCS will transition first to passive landfill gas collection, then to custodial care.

3.3.2 Burn Trenches

The Burn Trenches are not sources of contaminants to groundwater or ambient air, based on observed and calculated environmental conditions. This is due to the nature of MSW in the Burn Trenches, and the soil covers. BT-1 is partially under the engineered cap of Zones C/D, or otherwise covered by soil cover. BT-2 is entirely within the Zone A engineered cap.

3.3.3 Balefill Area and Inert Waste Disposal Area

The Balefill Area and Inert Waste Disposal Area have not been sources of contaminants to groundwater or ambient air, based on environmental monitoring results. The Balefill Area received primarily baled MSW. The Inert Waste Disposal Area received MSW then considered to be inert. The Balefill and Inert Waste Disposal Area is a potential source of direct contact with non-hazardous MSW where it is not covered.

3.3.4 Land Application Areas

Materials in the Land Application areas were removed in 1993, and are not a potential source of contaminants to groundwater, based on data collected during the Phase I RI. Landspread wastes, temporarily disposed outside the footprint of the MSW Landfill, were excavated along with underlying surface soils and placed within the MSW Landfill.

4 Remedial Goals and Objectives

This section identifies the potentially affected media, the NPL Site-wide chemicals of concern (COCs), RAOs for the MSW Disposal Areas, the applicable laws and regulations, and the cleanup levels.

4.1 Media of Concern

The limited areas of exposed MSW in the Balefill Area and Inert Waste Disposal Area will be addressed by soil cover restoration and monitoring. The GCCS at the MSW Landfill will continue to be monitored to demonstrate control of potential landfill gas migration and protection of groundwater and ambient air. The potentially affected media include MSW, landfill gas, soil, and groundwater.

4.2 Chemicals of Concern (COCs)

COCs for groundwater for the entire NPL Site were identified following guidance provided by Ecology in 2013 as part of the comment on the FFS work plan. Potential COCs in groundwater are presented in Table 4.2-1. Constituents in MSW or soil under an adequately designed and permanently maintained cover do not need to be considered as COCs because they are not expected to reach groundwater. Therefore, no soil cleanup levels are proposed for the MSW Disposal Areas.

Constituents in landfill gas from the MSW Disposal Areas do not need to be considered as COCs for the purpose of developing air cleanup standards under MTCA. Landfill gas collection and treatment will be protective of human health and the environment, consistent with landfill regulations (WAC 173-304 and WAC 173-351).

4.3 Remedial Action Objectives (RAOs)

RAOs for the MSW Disposal Areas are based on minimizing the potential exposure of human and ecological receptors to MSW, landfill gas, impacted subsurface soils, or contaminated groundwater. RAOs are general descriptions of what the remedial action is expected to accomplish (EPA, 1991b). The RAOs presented in the 1999 FS Report for the MSW Landfill are appropriate for all MSW Disposal Areas. Table 4.3-1 lists the RAOs for the MSW Disposal Areas by media of concern, and summarizes the status of meeting the RAOs at the MSW Landfill, the Balefill and Inert Waste Disposal Areas, the Burn Trenches, and the Land Application areas. Consistent with landfill regulations, the RAOs will be fully met upon demonstration of functional stability when post-closure activities can end.

4.4 Applicable Laws and Regulations

Cleanup actions under MTCA must demonstrate compliance with applicable state and federal laws. Given the NPL Site status, the mutual goal of the PLPs and Ecology is to conduct a remedial action that meets CERCLA requirements, includes the identification of the nature and extent of contamination, and selects a final cleanup action. Applicable laws and regulations are presented in Table 4.4-1 for substantive requirements.

Applicable laws and regulations are presented in Table 4.4-2 for action-specific requirements.

4.5 Development of Cleanup Levels under Model Toxics Control Act

Cleanup levels under MTCA are defined as the concentration of hazardous substances that are protective of human health and the environment under specific exposure conditions. MTCA also requires that cleanup be at least as stringent as the concentrations established under applicable state and federal law.

4.5.1 Development of Groundwater Cleanup Levels

Draft groundwater cleanup levels for individual compounds, presented in Table 4.5.1-1, were developed by Ecology following the modified Method B analysis based on chemical-specific information, and the Landfill Group members have used these draft cleanup levels in routine reports since 2013. Since at least 2014, the groundwater concentrations have remained below the NPL Site-specific draft cleanup levels at all of the MSW Landfill wells, including 4R, MW-16S, MW-17SR, MW-22S, and MW-23S. Locations for MSW Landfill wells are shown on Figure 2.5.1-1, as well as other existing groundwater monitoring wells.

4.5.2 Development of Ambient Air Cleanup Levels

The flare for the MSW Landfill was used to treat contaminated soil vapor from Zone A between 2002 and October 2015. During this period, the flare was operated to destroy up to approximately 1,600 pounds per day of VOC from the Zone A SVE system. Flare emissions have been below regulatory thresholds, as reported in quarterly reports. Since October 2015, the flare has treated only landfill gas from the MSW Landfill with trace concentrations of VOCs.

Historical monitoring has demonstrated no fugitive emissions of landfill gas from the MSW Disposal Areas to the atmosphere. Landfill regulations for explosive gas control (WAC 173-351-200 (4)), incorporated in the O&M Manual for MSW Disposal Areas (Aspect, 2014a), address the need for developing ambient air cleanup levels for the MSW Landfill.

4.5.3 Points of Compliance

4.5.3.1 Points of Compliance for Groundwater

Groundwater cleanup levels shall be met at the points of compliance, which should be the MSW Landfill wells for the MSW Landfill. Other MSW Disposal Areas do not have groundwater monitoring wells that aren't already affected by releases from Industrial Waste Areas.

4.5.3.2 Points of Compliance for Surface Soil

Terrestrial ecological receptors such as burrowing animals could be exposed to MSW in the Balefill and Inert Waste Disposal Area, where the soil cover thickness is less than the biologically active zone. The soil cover thickness will be at least 30 inches following restoration described in the Ecology-approved O&M Manual Update for MSW Disposal Areas (Aspect, 2016). The points of compliance for soil covers should be 30 inches.

5 Description of Remedial Alternatives

Remedial alternatives have been developed for the MSW Disposal Areas consistent with the FFS Work Plan (Anchor QEA et al., 2013) and the RAOs described in Section 4. This section describes the remedial alternatives, and illustrates the range of approaches that can be used to conduct the final cleanup at the Site. These alternatives are carried forward into the detailed MTCA evaluation in Section 6.

5.1 Common Elements

This section describes common elements and details pertinent to several remedial alternatives. ICs and groundwater compliance monitoring would be needed as part of any cleanup action.

5.1.1 Institutional Controls (ICs)

ICs are measures to “limit or prohibit activities that may interfere with the integrity of an Interim Action or a cleanup action or result in exposure of humans to hazardous substances at the site” (WAC 173-340-200). ICs that can be implemented at cleanup sites are described in the MTCA regulations (WAC 173-340-440), and are required to assure both the continued protection of human health and the environment and the integrity of remedial actions. As stated in the Revised Institutional Control Program (Anchor QEA, 2013), ICs that have been established for the NPL Site are an integral part of the cleanup activities implemented as IAs to date. Similar ICs are anticipated to be an integral part of final cleanup actions as well.

Proprietary controls, in the form of easements and covenants, have been used at the PSLI Property to protect current and future owners of property, tenants, licensees, and guests, from exposure to contamination and are enforceable by Ecology. Deed restrictions on the PSLI Property are currently in place to prevent groundwater usage for domestic and agricultural uses, and damage to cover systems. In addition, warning notices and signage have been placed at gates and along fencing to inform the public of potential risks of contamination remaining at the PSLI Property.

5.1.2 Groundwater Compliance Monitoring

Groundwater compliance monitoring is expected to be the key element of an overall compliance monitoring program. The MTCA cleanup regulations describe three types of compliance monitoring (WAC 173-340-410):

1. Protection monitoring, to confirm that human health and the environment are adequately protected during construction and the operation and maintenance of the cleanup action;
2. Performance monitoring, to confirm that the cleanup action has attained the cleanup levels and other performance standards; and
3. Confirmational monitoring, to confirm the long-term effectiveness of the cleanup action.

Based on a long history of protection and performance monitoring, draft cleanup levels have been achieved at the MSW Landfill monitoring wells. The groundwater compliance monitoring plan will be developed after the CAP is finalized, and will confirm the long-term effectiveness of the cleanup action. Assumptions for future groundwater monitoring costs are described in Section 5.2.1. The compliance monitoring plan will address specific reporting requirements, as described by WAC 173-340-410 and WAC 173-340-420.

5.2 Municipal Solid Waste Landfill

Three remedial alternatives for the MSW Landfill were proposed for evaluation in the Ecology-approved FFS Work Plan (Anchor QEA et al., 2013). Alternative MSW-1 involves continued operation and maintenance of the existing IAs, and is the preferred alternative. Alternatives MSW-2 and MSW-3 involve additional corrective actions, which should be unnecessary at this time based on current environmental conditions.

Alternatives MSW-1, MSW-2, and MSW-3, discussed in detail below, are all permanent to the maximum extent practicable, and were retained in the FFS Work Plan. The RAOs for, and current status of, the MSW Landfill are presented in Table 4.3-1. In the 1999 FS Report, the no-action alternative was not carried forward for the MSW Landfill, and would not meet the MTCA requirements for addressing state landfill regulations, for example. During the technology screening in the FFS Work Plan, a permanent solution (excavation and disposal of the MSW Landfill at a Subtitle D landfill) was not retained for further evaluation because it is impractical.

5.2.1 Alternative MSW-1

Alternative MSW-1 consists of leaving the MSW Landfill in place with existing ICs and including the following:

- Existing engineered cover system and monitoring for potential landfill gas migration;
- Existing GCCS (landfill gas collection system and enclosed flare system);
- Existing MSW Landfill groundwater monitoring wells; and
- Post-closure care as required under WAC 173-351, and detailed in the draft O&M manual update (Aspect, 2016).

Alternative MSW-1 has historically addressed the RAOs by controlling potential landfill gas migration and treating collected landfill gas with the existing GCCS. As landfill gas generation at the MSW Landfill decreases over time, changes in how landfill gas is collected and treated are anticipated as described below.

Within 5 years, the existing GCCS may be oversized to meet the objectives of maintaining combustible methane concentrations and controlling potential landfill gas migration. Therefore, MSW Landfill alternatives assumes a change in landfill gas treatment technology and O&M specifications as conditions warrant, and with Ecology approval.

Within 15 years, the MSW Landfill will transition from post-closure care to custodial care when landfill stability can be demonstrated (i.e., little to no settlement, gas production, or leachate generation) to Ecology's satisfaction.

The anticipated life cycle for the landfill cover system is greater than 100 years, based on the design of the cover system and the temperatures observed at the wellheads (Koerner et al., 2011). Therefore, MSW Landfill alternatives assume that the cover system does not need to be replaced.

Table 5.2-1 provides the estimated annual costs over time for Alternative MSW-1, a total cost of $1.475 million, and the total net present value (NPV) cost of $1.359 million. A detailed cost estimate for Alternative MSW-1 is included in Table 5.2-2. These costs include:

- Continued monitoring, operations, maintenance, and reporting as described in Section 2.5.1.4.
- Replacement of existing flare with alternative treatment system (estimated in 2022).
- Transition from post-closure care to custodial care (estimated in 2031).

The cost estimate for Alternative MSW-1 includes groundwater monitoring assuming two wells are sampled quarterly, and six wells are sampled semiannually. The expected design life for monitoring wells was assumed to be longer than the anticipated restoration timeframe. The cost estimate for Alternative MSW-1 does not include a contingency to install new or replacement monitoring wells.

5.2.2 Alternative MSW-2

Alternative MSW-2 consists of all elements of Alternative MSW-1, and expanding the GCCS, if necessary. Alternative MSW-2 should be the next step in the unlikely case that alternative MSW-1 does not meet the RAOs. Alternative MSW-2 addresses the RAOs by installing additional landfill gas extraction wells. However, flows from the GCCS would be increased to improve landfill gas collection under Alternative MSW-1 before any new wells would be installed under Alternative MSW-2.

If necessary, new extraction wells would be located in the MSW to replace or supplement existing wells, such as "Example EW" shown between EW-20 and EW-21 on Figure 2.5.1-2. Or, new SVE wells would be located just beyond the edge of MSW to prevent potential lateral landfill gas migration, such as the "Example SVE" well shown just north of EW-19 on Figure 2.5.1-2. These example completions would be located on the north end of the MSW Landfill, which has the greatest thickness of MSW, and the thinnest vadose zone.

Table 5.2-1 provides the estimated annual costs over time for Alternative MSW-2, the total cost of $1.730 million, and the total NPV cost of $1.608 million. A detailed cost estimate for Alternative MSW-2 is included in Table 5.2-3. These costs include:

- Continued monitoring, operations, maintenance, and reporting as described in Section 2.5.1.4.

- Installation and startup of four new landfill gas extraction wells to address potential future landfill gas transport beyond the influence of the existing GCCS.
- Replacement of existing flare with alternative treatment system (estimated in 2022).
- Transition from post-closure care to custodial care (estimated in 2031).

5.2.3 Alternative MSW-3

Alternative MSW-3 includes all elements of Alternative MSW-2, and an active groundwater collection and treatment system. Alternative MSW-3 provides a next step in the unlikely case that Alternative MSW-2 does not meet the RAOs, groundwater concentrations at the MSW Landfill monitoring wells exceed cleanup levels due to concentrations not mitigated by the GCCS (expanded under Alternative MSW-2), and potential exposure to impacted groundwater cannot be prevented by ICs. The existing NPL Site ICs adequately address the RAO of preventing ingestion, inhalation, or dermal absorption of impacted groundwater.

If necessary, a groundwater “pump-and-treat” system would be designed and installed on the property and downgradient of the likely source of groundwater impacts. The groundwater pumping well(s) would operate with a combined flow of approximately 20 gpm to collect shallow contaminated groundwater. Pumped water would be treated to reduce concentrations, then re-infiltrated at a location beyond the influence of the groundwater collection system. The pump-and-treat system would be monitored for proper operation and effectiveness.

Table 5.2-1 provides the estimated annual costs over time for Alternative MSW-3, the total cost of $3.585 million, and the total NPV cost of $3.329 million. A detailed cost estimate for Alternative MSW-3 is included as Table 5.2-4. These costs include:

- Continued monitoring, operations, maintenance, and reporting as described in Section 2.5.1.4.
- Installation and startup of four new landfill gas extraction wells to address potential future landfill gas transport beyond the influence of the existing GCCS.
- Construction and operation of an assumed groundwater pump-and-treat system with a design flow rate of 20 gpm to address potential future on-property impacts at the water table.
- Replacement of existing flare with alternative treatment system (estimated in 2022).
- Transition from post-closure care to custodial care (estimated in 2031).

5.3 Balefill and Inert Waste Disposal Areas, and Burn Trenches

Remedial alternatives for the Balefill and Inert Waste Disposal Areas and the Burn Trenches are presented below.

5.3.1 Balefill and Inert Waste Disposal Areas

For the purpose of remedial alternative selection, the Balefill Area and the Inert Waste Disposal Area were combined based on the alternatives (BA-1 and IWDA-1, respectively) in the Ecology-approved FFS Work Plan (Anchor QEA et al., 2013). During the technology screening in the FFS Work Plan, a permanent solution (excavation and disposal of the Inert Waste Disposal Area at a Subtitle D landfill) was not retained for further evaluation due to impracticality.

RAOs were not specified in the 1999 FS Report for the Balefill and Inert Waste Disposal Areas, and IAs have not been previously required by Ecology (PSC, 1999). The Balefill and Inert Waste Disposal Areas are approaching or have reached functionally stable conditions, meaning little to no landfill gas generation, leachate production, or settlement. However, a no-action alternative is not appropriate for the Balefill and Inert Waste Disposal Areas because it does not meet the MTCA requirements for addressing landfill regulations.

The RAOs for, and current status of, the Balefill and Inert Waste Disposal Areas are presented in Table 4.3-1. The remedial alternative for the Balefill and Inert Waste Disposal Areas is described below, based on the soil cover restoration described in the Draft O&M Manual Update for MSW Disposal Areas (Aspect, 2016).

5.3.1.1 Alternative BA-1

Alternative BA-1 consists of leaving the Balefill and Inert Waste Disposal Areas in place and restoring the existing soil cover to a minimum thickness of 30 inches, including a gravel layer to eliminate terrestrial ecological exposure and wind erosion of the soil cover. Any currently exposed MSW will be leveled to the extent practical before soil cover restoration. As with other soil covers, the restored soil cover will store and evaporate precipitation preventing potential liquid-phase transport to subsurface soil and groundwater. The draft O&M manual update (Aspect, 2016) describes the soil cover restoration and O&M requirements to demonstrate landfill stability. Existing gas probes and thermocouple arrays completed within the MSW will be decommissioned, as needed. This alternative adequately addresses the RAOs for preventing direct exposure to MSW and soil, and minimizing potential transport of contaminants to subsurface soils and groundwater. In addition, a soil cover will maximize protection from potential surface fires.

Table 5.3-1 provides the estimated annual costs for Alternative BA-1, the total cost of $468,000, and the total NPV cost of $450,000. A detailed cost estimate for Alternative BA-1 is included in Table 5.3-2. These costs include:

- Restoring the soil cover over approximately 25 percent of the total Balefill and Inert Waste Disposal Areas (estimated in 2017);
- Monitoring, maintenance, and reporting; and
- Transitioning to custodial care (estimated in 2031).

5.3.2 Burn Trenches

Two alternatives for Burn Trenches were proposed for evaluation in the Ecology-approved FFS Work Plan (Anchor QEA et al., 2013). A third alternative is included in the unlikely event that the existing soil cover system over a portion of BT-1 is determined to be inadequate and requires restoration. The RAOs for, and current status of, the Burn Trenches are presented in Table 4.3-1. The three remedial alternatives for the Burn Trenches are described below.

5.3.2.1 Alternative BT-A

This alternative consists of leaving the Burn Trenches in place, and implementing monitoring, maintenance, and reporting before transitioning to custodial care with ICs. The existing covers over the Burn Trenches adequately address the RAOs. Based on historical groundwater sampling results, the Burn Trench covers have minimized transport of any contaminants to soil and groundwater.

Table 5.3-3 provides the estimated annual costs over time for Alternative BT-A, the total cost of $15,000, and the total NPV cost of $14,000. A detailed cost estimate for Alternative BT-A is included in Table 5.3-4. These costs include:

- Monitoring, maintenance, and reporting; and
- Transitioning to custodial care (est. in 2031).

5.3.2.2 Alternative BT-B

This alternative includes all elements of Alternative BT-A, and adds confirmation of the soil cover thickness over Burn Trench BT-1 not already beneath the engineered cover system at Zones C/D. Alternative BT-B adequately addresses the RAOs, and the benefit of empirically demonstrating soil cover thickness is balanced by short-term risks in field activities.

Table 5.3-3 provides the estimated annual costs over time for Alternative BT-B, the total cost of $54,000, and the total NPV cost of $51,000. A detailed cost estimate for Alternative BT-B is included in Table 5.3-5. These costs include:

- Confirming the soil cover thickness;
- Monitoring, maintenance, and reporting; and
- Transitioning to custodial care (est. in 2032).

5.3.2.3 Alternative BT-C

This alternative includes all elements of Alternative BT-B, in addition to restoring the cover system for Burn Trench BT-1 to a thickness of at least 30 inches, if necessary. For purposes of this revised draft FFS report, it was assumed that approximately 25 percent of the area of Burn Trench BT-1 would be restored. Alternative BT-C adequately addresses the RAOs, and the benefits of restoring the soil cover thickness are balanced by the short-term risks of construction.

Table 5.3-3 provides the estimated annual costs over time for Alternative BT-C, the total cost of $145,000, and the total NPV cost of $141,000. A detailed cost estimate for Alternative BT-C is included in Table 5.3-6. These costs include:

- Confirming the soil cover thickness;
- Soil cover thickness restoration, if needed;
- Monitoring, maintenance, and reporting; and
- Transitioning to custodial care (est. in 2031).

5.3.3 Influence of Industrial Waste Area Remedial Alternatives on Adjacent MSW Disposal Areas

The Balefill and Inert Waste Disposal Area is adjacent to the IWA Zone A, and in close proximity to Zones C/D and E. The Burn Trenches are in close proximity or partially covered by caps installed at Zone A or Zone C/D.

Remedial alternatives for industrial waste areas should be implemented in a way that ensures the safety and integrity of adjacent MSW Disposal Areas. If the existing soil cover system above MSW is disturbed or removed during remedial activities at the IWAs, then the soil cover should be restored to Ecology’s satisfaction.

6 Evaluation of Remedial Alternatives

This section performs the comparative evaluation of the remedial alternatives for the cleanup of the MSW Disposal Areas, based on MTCA evaluation criteria presented below.

6.1 MTCA Minimum Requirements

Under MTCA, remedial alternatives are evaluated within the framework of minimum requirements, including threshold requirements, other requirements, and additional minimum requirements, as specified in WAC 173-340-360.

6.1.1 MTCA Threshold Requirements

The four threshold requirements (WAC 173-340-360(2)(a)) for all cleanup actions are:

- Protect human health and the environment.
- Comply with cleanup standards.
- Comply with applicable state and federal laws.
- Provide for compliance monitoring.

All of the remedial alternatives are designed to meet the threshold requirements. Several alternatives are provided as next steps in the unlikely event that the preferred remedial alternative does not meet the RAOs in the future.

6.1.2 MTCA Other Requirements

After meeting the threshold requirements, MTCA requires that a cleanup action alternative meet three other requirements:

- **Use permanent solutions to the maximum extent practicable** (WAC 173-340-360(3)): MTCA specifies that when selecting a cleanup action, preference is given to permanent solutions to the maximum extent practicable. To determine whether a cleanup action uses permanent solutions to the maximum extent practicable, MTCA requires that costs and benefits of each of the remedial alternatives be balanced using a "Disproportionate Cost Analysis (DCA)". The criteria for conducting this analysis are described in Section 6.2.
- **Provide for a reasonable restoration time frame** (WAC 173-340-360(4)): MTCA places a preference on those alternatives that, while equivalent in other respects, can be implemented in a shorter period of time. Determining reasonable time to achieve cleanup standards based upon requirements and procedures in MTCA provides no specific reasonable restoration time requirement, but allows for a comparison of restoration time frames among the remedial alternatives.
- **Consider public concerns** (WAC 173-340-600): Public concerns will be addressed following the public comment period for the CAP.

6.1.3 MTCA Additional Requirements

Additional requirements are considered under MTCA for the evaluation of alternatives:

- Require permanent groundwater cleanup actions.
- Not rely primarily on ICs.
- Prevent or minimize present and future site releases and migration of hazardous substances.
- Not rely primarily on dilution and/or dispersion.

6.2 MTCA Disproportionate Cost Analysis

MTCA requires that remedial alternatives use permanent solutions to the maximum extent practicable. To evaluate practicality, MTCA considers cost effectiveness. Costs are disproportionate to benefits if the incremental costs of a more permanent remedial alternative are greater than the incremental degree of environmental benefits achieved by that alternative over that of lower cost remedial alternatives (WAC 173-340(3)(e)(i)). Where the qualitative and quantitative benefits of two remedial alternatives are equivalent, MTCA specifies that Ecology will select the less costly alternative (WAC 173-340-360(e)(ii)(c)).

6.2.1 DCA Evaluation Criteria

The following criteria are used in completing a DCA under MTCA:

- **Protectiveness:** Overall protectiveness of human health and the environment includes the degree of overall risk reduction, the time required to reduce risk and attain cleanup levels, on-site and off-site risks resulting from implementing the alternatives, and the improved overall quality of the environment at a site.
- **Permanence:** The long-term success of an alternative can be measured by the degree to which an alternative permanently reduces the toxicity, mobility or volume of hazardous substances.
- **Cost:** Cost considerations include design, construction, and installation costs; the net present value of long-term costs; and agency oversight costs. Long-term costs include operation and maintenance, monitoring, equipment replacement, and maintaining ICs.
- **Long-term Effectiveness:** An alternative's long-term effectiveness is based on the reliability of treatment technologies to meet and maintain cleanup levels and, if using engineering or ICs, on their reliability to manage residual risks. Long-term reliability is also influenced by uncertainties associated with potential long-term risk management.
- **Short-term Risk Management:** Short-term risk management evaluates the potential risk posed by the cleanup action during its implementation (including construction and operation), based on potential impacts to the community,

workers, and the environment, and the effectiveness and reliability of protective or mitigative measures.

- **Implementability:** An alternative's implementability is evaluated on the basis of whether it is easy or difficult to implement depending on practical, technical, or legal difficulties that may be associated with construction and implementation. The implementability also depends upon the ability to measure the remedy's effectiveness and its consistency with MTCA and other regulatory requirements.
- **Consideration of Public Concerns:** Potential public concerns about a proposed cleanup alternative are addressed by means of MTCA's public involvement process during Ecology's remedy selection process.

The remedial alternatives are ranked for each DCA criterion, with the highest rank given to the most favorable alternative. Equal ranking was assigned to remedial alternative with equivalent benefit. For each remedial alternative, these rankings were summed for an overall score of the benefits achieved, along with the total costs (as net present value).

6.3 Comparative Evaluation of Alternatives

This section presents the comparative evaluation of the remedial alternatives for each MSW disposal area (described in Section 5) against the MTCA minimum requirements and DCA criteria, and a preferred remedial alternative is identified.

6.3.1 Municipal Solid Waste Landfill

Alternative MSW-1 has been demonstrated to meet all MTCA requirements, and is the preferred alternative. Alternatives MSW-2 and MSW-3 should be unnecessary at this time, and will likely remain so in the future, because the MSW Landfill is becoming more stable over time. Alternatives MSW-2 and MSW-3 are provided as potential available corrective actions in the unlikely event that Alternative MSW-1 does not address the RAOs at some time in the future. Table 6.3.1-1 summarizes the evaluation criteria for MSW Landfill alternatives by the threshold, other, and additional requirements under MTCA.

Comparison to MTCA Requirements

As described in Section 2.5.1, Alternative MSW-1 has been demonstrated to meet MTCA Threshold Requirements. Based on historical performance of the IAs at the MSW Landfill, Alternative MSW-1 has been demonstrated to meet Other Requirements and Additional Requirements stipulated in MTCA.

Alternative MSW-1 has been, and is expected to remain, protective of human health and the environment through engineering controls already implemented as IAs, including the engineered cover system and the GCCS. Historical environmental monitoring has demonstrated that Alternative MSW-1 has been effective at complying with cleanup standards for groundwater and air quality without relying on dilution or dispersion. Groundwater cleanup actions at the MSW landfill have been unnecessary, and will likely remain unnecessary in the future, because groundwater at MSW landfill monitoring wells has met all draft cleanup levels since 2014.

All of the MSW Landfill alternatives will contain the MSW in place, and are equally permanent. Based on continuing downward trends in landfill gas generation and collection, a restoration timeframe of 15 years is assumed for all of the MSW Landfill alternatives, incorporating a downsized landfill gas treatment technology in approximately 5 years, and a transition from active to passive landfill gas collection in approximately 5 to 15 years. None of the alternatives can alter the restoration timeframe, because the rate of decomposition at the MSW Landfill is dictated by the age, volume, and methane-generating capacity of the MSW.

All alternatives for the MSW Landfill comply with applicable state and federal laws, and include compliance monitoring to ensure RAOs are addressed. All of the MSW Landfill alternatives will include ICs consistent with landfill regulations. In the unlikely event that MTCA requirements are not met by Alternative MSW-1 in the future, then Alternatives MSW-2 and/or MSW-3 would be implemented, consistent with landfill regulations.

MTCA Disproportionate Cost Analysis

Benefit evaluations and cost summaries for Alternatives MSW-1, MSW-2, and MSW-3 are presented in Table 6.3.1-2 as the DCA. Figure 6.3.1-1 provides a graphical comparison of the benefits, costs, and benefit-to-cost ratios for each of the three alternatives. The benefits of the MSW Landfill alternatives were ranked from 3 (most beneficial) to 1 (least beneficial) for each of the MTCA-established criteria, as shown in Table 6.3.1-2. The benefits for Alternative MSW-1 rank highest because the IAs have been successfully demonstrated, and it is the most straight-forward alternative to implement and operate in the long term.

Both Alternatives MSW-2 and MSW-3 are more complex than Alternative MSW-1. The benefits for Alternative MSW-2 rank lower than MSW-1 because expanding the landfill gas collection system potentially involves greater risks than simply increasing the flow rate using the existing GCCS. The benefits for Alternative MSW-3 rank lower than MSW-2 because installing and operating a groundwater treatment system potentially involves greater risks and less long-term effectiveness than expanding the landfill gas collection system.

The detailed cost estimates for Alternatives MSW-1, MSW-2, and MSW-3 are provided in Table 5.2-1. Alternative MSW-1 includes replacement of the existing flare with an alternative landfill gas treatment system at a capital cost of $30,000. Alternative MSW-2 includes Alternative MSW-1 elements, and installation, hookup, and operation of four additional landfill gas extraction wells with an estimated capital cost of $140,000. Alternative MSW-3 includes Alternative MSW-2 elements, and design, installation, and operation of a groundwater treatment system with an estimated capital cost of $500,000.

Long-term costs were estimated for a 15-year timeframe and categorized as O&M costs or equipment replacement costs. O&M costs in Table 5.2-1 also include costs for monitoring, maintaining ICs, and Agency oversight. Annual O&M costs are forecasted to decline in 2020 when the existing flare will be replaced with an alternative landfill gas treatment system that is easier to operate. All assumptions for long-term cost estimates are provided in Table 5.2-1.

Preferred MSW Landfill Alternative

The preferred remedial alternative for the MSW Landfill is Alternative MSW-1. Selection of Alternative MSW-1 is supported by the performance of the existing systems and the results of the disproportionate cost analysis. There is no technical rationale to implement Alternative MSW-2 or Alternative MSW-3.

6.3.2 Balefill and Inert Waste Disposal Areas, and Burn Trenches

6.3.2.1 Balefill and Inert Waste Disposal Areas

For the purpose of remedial alternative selection, the Balefill and Inert Waste Disposal Areas were combined based on the alternatives (BA-1 and IWDA-1, respectively) in the Ecology-approved FFS Work Plan (Anchor QEA et al., 2013). Alternative BA-1 is the preferred remedy, and will adequately meet the RAOs and MTCA requirements (see Table 6.3.1-1).

Comparison to MTCA Requirements

Alternative BA-1 adequately addresses the RAOs for preventing potential direct exposure to MSW and soil, minimizing potential transport of contaminants to subsurface soils and groundwater. In addition, Alternative BA-1 will minimize the risk of a surface fire. Alternative BA-1 is a solution that is permanent to the maximum extent practicable. Based on the need to observe and demonstrate the adequacy of the soil cover, a restoration timeframe of 15 years is assumed for Alternative BA-1. This would provide observation of soil cover erosion and maintenance requirements for three consecutive 5-year review periods.

Alternative BA-1 will include ICs consistent with landfill regulations.

Terrestrial ecological receptors could potentially be exposed to MSW below the soil cover or in areas where the MSW is exposed. As described in the Ecology-approved O&M manual (Aspect, 2014a) and in Alternative BA-1, the Balefill and Inert Waste Disposal Areas soil cover will be restored and maintained at a minimum of 30 inches thick.

The detailed cost estimates for Alternative BA-1 is provided in Table 5.3-1. Alternative BA-1 has an estimated capital cost of $310,000. No DCA was necessary.

Preferred Balefill and Inert Waste Disposal Area Alternative

The preferred remedial alternative for the Balefill Area is Alternative BA-1. Alternative BA-1 consists of leaving the Balefill and Inert Waste Disposal Areas in place and restoring the existing soil cover to a minimum thickness of 30 inches, including a gravel layer to address terrestrial ecological exposure and wind erosion of the soil cover. Currently exposed MSW will be leveled to the extent practical before soil cover restoration. As described in Section 2.5.1, restoration of the existing soil cover across the Balefill and Inert Waste Disposal Areas was first proposed in 2012. The draft O&M manual update (Aspect, 2016) describes the soil cover restoration and O&M requirements to demonstrate landfill stability.

6.3.2.2 Burn Trenches

Alternative BT-A meets all MTCA requirements, and is the preferred alternative. Alternatives BT-B and BT-C should be unnecessary at this time, and will likely remain so in the future because the Burn Trenches are protective of human health and the environment, are stable, and are becoming more stable over time. Alternatives BT-B and BT-C are provided as next steps in the unlikely event that Alternative BT-A does not address the RAOs at some time in the future. The evaluation criteria for remedial alternatives for the Burn Trenches by the threshold, other and additional requirements under MTCA are listed in Table 6.3.1-1.

Comparison to MTCA Requirements

As described in Section 2.5.1, Alternative BT-A has been demonstrated to meet MTCA requirements. Alternative BT-A has been, and is expected to remain, protective of human health and the environment through engineering controls implemented at the time the Burn Trenches were initially covered with soil. Because the MSW in the Burn Trenches is generating little if any landfill gas or leachate, Alternative BT-A is effective at complying with cleanup standards for groundwater and air quality without relying on dilution or dispersion. All alternatives for the Burn Trenches comply with applicable state and federal laws, and include compliance monitoring to ensure RAOs are addressed.

All of the Burn Trench alternatives will contain the MSW in place, and are equally permanent. Based on the need to observe and demonstrate the adequacy of the soil cover, a restoration timeframe of 15 years is assumed for all of the Burn Trench alternatives. This would provide observation of soil cover erosion and maintenance requirements for three consecutive 5-year review periods.

All of the Burn Trench alternatives will include ICs consistent with landfill regulations.

Terrestrial ecological receptors could potentially be exposed to MSW in the Burn Trenches below the soil covers. With Alternative BT-A, the MSW over a portion of Burn Trench BT-1 remains covered by soil. In the unlikely event that the RAOs are not met with Alternative BT-A, the soil cover thickness would be confirmed to be a minimum of 30 inches thick with Alternative BT-B. Under Alternative BT-C, it was assumed that 25 percent of the Burn Trench area would have less than 30 inches of soil cover, and the soil cover over that area would be restored to a minimum thickness of 30 inches across.

MTCA Disproportionate Cost Analysis

Benefit evaluations and cost summaries for Alternatives BT-A, BT-B, and BT-C are presented in Table 6.3.2-1 for the DCA. Figure 6.3.2-1 provides a graphical comparison of the benefits, costs, and Benefit-to-Cost Ratios for both alternatives. The benefits of the Burn Trench alternatives were ranked from 3 (most beneficial) to 1 (least beneficial) for each of the established criteria, as shown in Table 6.3.2-1. Overall, the alternatives for the Burn Trenches were judged to provide approximately equal benefit since there has been no demonstrated impact.

The detailed cost estimates for Burn Trench Alternatives are provided in Table 5.3-4 through Table 5.3-6. Alternative BT-A has no capital cost, whereas Alternative BT-B includes assessment of the soil cover, with an estimated capital cost of $24,000. Alternative BT-C includes capital effort to rehabilitate the soil cover at an estimated capital cost of $108,000.

Preferred Burn Trench Alternative

The preferred remedial alternative for the Burn Trenches is Alternative BT-A. Selection of Alternative BT-A is supported by the results of the DCA and the limited potential for exposure. As shown in Table 6.3.2-1 and on Figure 6.3.2-1, Alternative BT-A had the highest benefit-to-cost ratio compared to Alternatives BT-2 and BT-3.

The cover system of the Burn Trenches is comprised partially of the Zone A cover system, and the range of alternatives considered for Zone A include drum and impacted material removal. The MSW unimpacted by industrial waste remaining in the Burn Trenches may require a restored soil cover if drums and impacted material from Zone A is removed.

7 Summary of Preferred Alternatives

The overall preferred alternative is the combination of the preferred remedial alternatives for each of the individual MSW Disposal Areas, including: Alternative MSW-1, Alternative BA-1, and Alternative BT-A. After restoring the soil cover across the Balefill and Inert Waste Disposal Areas, the preferred remedial alternatives for the MSW Disposal Areas are consistent with historical activities, with the addition of routine monitoring to support the demonstration of functional stability.

The overall preferred alternative recognizes that the PSLI Property was an active landfill from 1953 to 1993, and it will remain a closed landfill. The MSW Disposal Areas should reach functional stability by approximately 2032, if they are not already stable. As a closed landfill property, ICs will be maintained to control potential exposure pathways. All of the preferred alternatives are consistent with MTCA requirements and expectations for remedial actions as they protect human health and the environment, comply with cleanup standards, comply with applicable state and federal laws, provide for compliance monitoring, use permanent solutions to the extent practicable, provide for reasonable restoration timeframes, and consider public concerns.

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9 Limitations

Work for this project was performed for the Pasco Landfill Group (Client), and this report was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting’s original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

TABLES

TABLES

Table 2.5.1-1. Chronology of MSW Disposal Operations

Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

Time Period	Description of MSW Disposal Operations (based on description in Phasr I RI)
1958	In May 1958, John Dietrich, doing business as Pasco Garbage Service, commenced refuse disposal at the facility under a disposal permit issued by the FCPD. No MSW management activities took place at the facility prior to 1958. Disposal of MSW started at the south end of the MSW Landfill area, shown on Figure 2.5.1-1. The MSW Landfill progressively expanded to the north and east. MSW consolidation practices included open burning on the MSW Landfill between 1958 and 1971. By 1972, the MSW Landfill area covered the southwest quadrant of the final MSW Landfill area. By 1979, the MSW Landfill area covered the southern half of the final MSW Landfill area. Starting in 1958, disposal and open burning of MSW also took place in two east-west trending burn trenches to the south of the MSW Landfill area. These burn trenches are denoted as BT-1 in Figure 2.5.1-1. Burning MSW was reportedly cooled using water from the facility's water supply well. By May 1963, BT-1 was nearly full. All disposal in the BT-1 area appears to have ceased before May 1965. BT-1 was covered with soil to the current grade.
1961–1965	Beginning in 1961, disposal and open burning of MSW also began in a north-south trending burn trench along Dietrich Road. This is denoted as BT-2 in Figure 2.5.1-1. Disposal and burning of MSW in BT-2 may have continued until 1965. Unburned MSW had reportedly been placed over the BT-2 trench by this time. Based on data from vertical borings installed in Zone A, it is possible that MSW in BT-2 was re-graded prior to accepting industrial waste at Zone A. BT-2 is beneath the western edge of the engineered cap system installed at Zone A.
Circa 1969–1973	In 1969, the MSW Landfill was approved for disposal of pesticides and empty pesticide containers by the BFDHD. Available photographs and interviews with Mr. Larry Dietrich indicate that disposal of empty pesticide containers continued through at least mid-1973 (pers. comm. 2011).
1976–1989	As part of the landfill operations, PSL Inc. was permitted for disposal of various non-hazardous bulk liquids. These bulk liquids included septic tank waste, sewage sludges, and animal fat emulsion coolants, and were accepted for disposal at lagoons (approximately 1976 to 1989), applied to the ground in the Landspread Area and Sludge Management Area (approximately 1981 to 1989), and applied directly on the MSW Landfill (approximately 1981 to 1987). The waste and surface soils from lagoons, landspread, and sludge managment areas outside the MSW Landfill area, depicted in Figure 2.5.1-1, were subsequently moved to the MSW Landfill for use as daily cover and/or the interim soil cover.
1976–1993	Beginning some time in 1976, baled MSW was accepted at the facility, and was landfilled in the area east of Zone A called the Balefill Area. Until 1990, the Balefill Area received primarily baled MSW, but also received tires and other loose MSW. The final extent of the Balefill Area is shown in Figure 2.5.1-1. From 1986 until the facility closed in mid-1993, MSW considered inert was segregated and disposed in an area south of the Balefill Area and southeast of Zone A called the Inert Waste Disposal Area. By the end of 1993, a soil cover was placed across the Balefill Area and the leveled portion of the Inert Waste Disposal Area.
1993	In fall 1992, Ecology and BFDHD authorized PSL Inc. to continue municipal landfill activity until June 1, 1993. The MSW Landfill operated through May 1993 under a 10-year conditional use permit from the FCPD in accordance with the Minimum Functional Standard (MFS) requirements specified by Ecology, and allowed acceptance of domestic waste, and light commercial, non-hazardous industrial, and non-toxic agricultural wastes. Pesticide containers rinsed in accordance with USDA standards were included in the non-toxic agricultural waste designation. On May 31, 1993, PSL Inc. commenced closure with placement of an interim cover consisting of a minimum of 3 feet of native soil on the MSW Landfill.

Table 2.5.1-2. Summary of Reports - MSW Disposal Areas

Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

Date:	Title:	Author:
5/03/2004	Pasco Municipal Solid Waste Landfill – 2003 Fourth Quarter and Annual Report	Craig S. Trueblood
7/03/2005	Pasco Municipal Solid Waste Landfill – 2004 Fourth Quarter and Annual Report	Craig S. Trueblood
3/15/2006	Pasco Municipal Solid Waste Landfill – 2005 Fourth Quarter and Annual Report	Craig S. Trueblood
9/15/2006	Pasco Municipal Solid Waste Landfill – 2006 Second Quarter Report	Craig S. Trueblood
3/14/2007	Pasco Municipal Solid Waste Landfill – 2006 Fourth Quarter and Annual Report	Craig S. Trueblood
6/15/2007	Pasco Municipal Solid Waste Landfill – 2007 First Quarter Report	Craig S. Trueblood
9/14/2007	Pasco Municipal Solid Waste Landfill – 2007 Second Quarter Report	Craig S. Trueblood
12/17/2007	Pasco Municipal Solid Waste Landfill – 2007 Third Quarter Report	Aspect Consulting, LLC
3/14/2008	Pasco Municipal Solid Waste Landfill – 2007 Fourth Quarter and Annual Report	Shasta Environmental Services and Aspect Consulting, LLC
6/13/2008	Pasco Municipal Solid Waste Landfill – 2008 First Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
9/15/2008	Pasco Municipal Solid Waste Landfill – 2008 Second Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
12/15/2008	Pasco Municipal Solid Waste Landfill – 2008 Third Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
12/03/2009	Supplemental Technical Memorandum - Soil Vapor Extraction System Testing	Aspect Consulting, LLC
1/04/2009	Pasco Municipal Solid Waste Landfill – 2008 Fourth Quarter and Annual Report	Shasta Environmental Services and Aspect Consulting, LLC
4/17/2009	Draft Memorandum re: Addendum to Pasco Municipal Solid Waste Landfill Operations and Maintenance Manual	Aspect Consulting, LLC
5/15/2009	Pasco Municipal Solid Waste Landfill Flare Rehabilitation	Aspect Consulting, LLC
6/15/2009	Pasco Municipal Solid Waste Landfill – 2009 First Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
9/15/2009	Pasco Municipal Solid Waste Landfill – 2009 Second Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
12/15/2009	Pasco Municipal Solid Waste Landfill – 2009 Third Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
12/15/2009	Work Plan for Installation of Supplemental Landfill Gas Probes	Aspect Consulting, LLC
7/22/2010	Pasco Municipal Solid Waste Landfill – 2009 Fourth Quarter and Annual Report	Shasta Environmental Services and Aspect Consulting, LLC
9/22/2010	Pasco Municipal Solid Waste Landfill – 2010 First Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
9/22/2010	Proposal for Flare Stack Tests at the Pasco Landfill Site	Aspect Consulting, LLC
4/11/2010	Pasco Municipal Solid Waste Landfill – 2010 Second Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
1/14/2011	Pasco Municipal Solid Waste Landfill – 2010 Third Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
4/21/2011	Modified Louver Design for the Flare at the Pasco Landfill Site	Aspect Consulting, LLC
4/25/2011	Pasco Municipal Solid Waste Landfill – 2010 Fourth Quarter and Annual Report	Shasta Environmental Services and Aspect Consulting, LLC
6/29/2011	Revised Flare Performance Report	Aspect Consulting, LLC
6/29/2011	Modified Louver Assembly Installation	Aspect Consulting, LLC
9/19/2011	Pasco Municipal Solid Waste Landfill – 2011 First Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
10/11/2011	Pasco Municipal Solid Waste Landfill – 2011 Second Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
1/12/2011	Additional Documentation Related to Untreated SVE Vapor Discharge at the Landfill Flare - Pasco Landfill Site	Aspect Consulting, LLC
10/02/2012	Pasco Municipal Solid Waste Landfill – 2011 Third Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
7/16/2012	Pasco Municipal Solid Waste Landfill – 2012 First Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC

Table 2.5.1-2. Summary of Reports - MSW Disposal Areas
Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

Date:	Title:	Author:
1/25/2013	Pasco Municipal Solid Waste Landfill – 2012 Second Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
3/12/2013	Pasco Municipal Solid Waste Landfill – 2012 Third Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
8/12/2013	Pasco Municipal Solid Waste Landfill – 2012 Fourth Quarter and Annual Report	Shasta Environmental Services and Aspect Consulting, LLC
9/27/2013	Pasco Municipal Solid Waste Landfill – 2013 First Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
11/11/2013	Pasco Municipal Solid Waste Landfill – 2013 Second Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
2/07/2014	Pasco Municipal Solid Waste Landfill – 2013 Third Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
2/19/2014	Operations and Maintenance Manual : MSW Disposal Areas	Shasta Environmental Services and Aspect Consulting, LLC
5/13/2014	Balefill Area Fire Suppression/Extinguishment Work Plan	Aspect Consulting, LLC
8/21/2014	Work Plan to Monitor Carbon Dioxide at Zone A SVE Wellheads on Daily Basis	Aspect Consulting, LLC
11/11/2014	Pasco Municipal Solid Waste Landfill – 2013 Fourth Quarter and Annual Report	Shasta Environmental Services and Aspect Consulting, LLC
11/26/2014	Memorandum re: Influence of the Modified SVE System on the Balefill Area	Aspect Consulting, LLC
1/06/2015	Memorandum re: Supplemental Fuel System Work Plan	Aspect Consulting, LLC
2/18/2015	Pasco Municipal Solid Waste Landfill – 2014 First Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
4/20/2015	Pasco Municipal Solid Waste Landfill – 2014 Second Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
12/04/2015	Pasco Municipal Solid Waste Landfill – 2014 Third Quarter Report	Shasta Environmental Services and Aspect Consulting, LLC
3/22/2016	Pasco Municipal Solid Waste Landfill – 2014 Fourth Quarter and Annual Report	Shasta Environmental Services and Aspect Consulting, LLC
4/15/2015	Addendum to O&M Manual, Supplemental Fuel System	Aspect Consulting, LLC
6/12/2015	Pasco Municipal Solid Waste Landfill – 2015 First Quarter Report, Draft	Shasta Environmental Services and Aspect Consulting, LLC
9/15/2015	Pasco Municipal Solid Waste Landfill – 2015 Second Quarter Report, Draft	Shasta Environmental Services and Aspect Consulting, LLC
12/22/2015	Pasco Municipal Solid Waste Landfill – 2015 Third Quarter Report, Draft	Shasta Environmental Services and Aspect Consulting, LLC
3/29/2016	Pasco Municipal Solid Waste Landfill – 2015 Fourth Quarter and Annual Report, Draft	Shasta Environmental Services and Aspect Consulting, LLC
4/14/2016	Addendum to O&M Manual for MSW Disposal Areas, Supplemental Fuel System and SVE Conveyance Line Decommissioning	Aspect Consulting, LLC
4/15/2016	Memorandum re: Zone A SVE Effluent Carbon Monoxide and Temperature Data	Aspect Consulting, LLC
4/29/2016	Operations and Maintenance Manual Update: MSW Disposal Areas, Draft	Shasta Environmental Services and Aspect Consulting, LLC
6/15/2016	Pasco Municipal Solid Waste Landfill – 2016 First Quarter Report, Draft	Shasta Environmental Services and Aspect Consulting, LLC
6/28/2016	Pasco Landfill Group Concerns Regarding HOVs for SVE Wells and Implications for SVE-Only Remedy	Aspect Consulting, LLC
7/06/2016	Memorandum re: Landfill Group Comments on Regenerative Thermal Oxidation (RTO) System	Aspect Consulting, LLC
9/15/2016	Pasco Municipal Solid Waste Landfill – 2016 Second Quarter Report, Draft	Shasta Environmental Services and Aspect Consulting, LLC
12/15/2016	Pasco Municipal Solid Waste Landfill – 2016 Third Quarter Report, Draft	Shasta Environmental Services and Aspect Consulting, LLC
1/23/2017	Addendum to O&M Manual for MSW Disposal Areas, Balefill Area Subsurface Monitoring	Aspect Consulting, LLC
3/15/2017	Pasco Municipal Solid Waste Landfill – 2016 Fourth Quarter and Annual Report, Draft	Shasta Environmental Services and Aspect Consulting, LLC

Table 2.5.1-2. Summary of Reports - MSW Disposal Areas
Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

Date:	Title:	Author:
3/31/2017	Balefill Area Subsurface Monitoring Technical Memorandum	Aspect Consulting, LLC
6/15/2017	Pasco Municipal Solid Waste Landfill – 2017 First Quarter Report, Draft	Shasta Environmental Services and Aspect Consulting, LLC
6/30/2017	Addendum to O&M Manual for MSW Disposal Areas, Balefill Area Supplemental Subsurface Monitoring	Aspect Consulting, LLC

Table 4.2.1-1 - Potential Chemicals of Concern in Groundwater

Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

Compound	CAS Number	Frequency of Detection (%)	Number of Exceedances	Indicator	Comments
1,1,1-Trichloroethane	71-55-6	14	25	Yes	Based on Maximum Concentration Level as screening level
1,1,2-Trichloroethane[1]	79-00-5	3	41	No	Low frequency of detection, low number of exceedances, and not considered a chemical of concern by Ecology in the 2007 screening
1,1-Dichloroethene	75-35-4	17	845	Yes	Suspected carcinogen
1,2-Dichloroethane	107-06-2	28	1,220	Yes	Suspected carcinogen
cis-1,2-Dichloroethene	156-59-2	42	648	Yes	Non-carcinogen; exceedance based on hazard index
Acetone	67-64-1	2	1	No	Only one exceedance on record (1998); current CLARC Method B value higher than value used in Ecology 2007a analysis
Benzene	71-43-2	5	86	Yes	Suspected carcinogen
Chloroform	67-66-3	9	1	No	Only one exceedance on record (1997)
Ethylbenzene	100-41-4	3	1	No	Low frequency of detection and only one exceedance on record
Methylene chloride	75-09-2	5	103	Yes	Suspected carcinogen
Tetrachloroethene	127-18-4	31	969	Yes	Suspected carcinogen
Toluene	108-88-3	5	38	Yes	Non-carcinogen; exceedance based on hazard index
Trichloroethene	79-01-6	43	937	Yes	Suspected carcinogen
Vinyl chloride	75-01-4	11	209	Yes	Suspected carcinogen
Chromium (Total)	7440-47-3	80	17	Yes	Chromium not affected by interim actions except for capping; screening based on 2007 to 2012 data

Notes:

1 = The screening level for 1,1,2-Trichloroethane is 5 µg/L based on the Maximum Concentration Level. Three of four exceedances were at 6 µg/L and two of those results were from monthly monitoring, which did not use selective ion measurement or as extensive data validation as in quarterly sampling and analysis.

CLARC = Cleanup Levels and Risk Calculation

Table courtesy of Revised Focused Feasibility Study, Anchor QEA, LLC, et al., September 2014.

Table 4.3-1 - Summary of Remedial Action Objectives

Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

MSW Disposal Area	Potentially Affected Media	Remedial Action Objectives	Status at MSW Disposal Areas
MSW Landfill	Municipal Solid Waste/Landfill Gas	Prevent direct exposure to MSW.	Direct exposure to MSW and landfill gas is being prevented by capping, fencing, and institutional controls preventing excavation within footprint.
		Prevent contaminant releases to the atmosphere.	Contaminant release of landfill gas from the MSW Landfill to the atmosphere is being prevented by capping and ongoing operation of GCCS, as verified by ongoing landfill gas migration monitoring.
		Minimize transport of contaminants from MSW to subsurface soils and ground water.	Contaminant transport from MSW/landfill gas to subsurface soils and groundwater is being minimized by capping and ongoing operation of the GCCS, as verified by ongoing landfill gas migration monitoring and groundwater monitoring.
	Soil	Prevent direct exposure to soil.	Direct exposure to potentially impacted soil beneath the MSW Landfill is being prevented by institutional controls preventing excavation within footprint.
		Minimize transport of contaminants from soil to groundwater.	Contaminant transport from potentially impacted soil to groundwater is being minimized by capping and ongoing operation of the GCCS, and verified by landfill gas migration monitoring and groundwater monitoring.
	Groundwater	Prevent ingestion, inhalation, or dermal absorption of impacted groundwater.	Groundwater impacts minimized by capping and ongoing operation of the GCCS, and verified by groundwater monitoring. Institutional controls prevent exposure to potentially impacted groundwater.
Balefill and Inert Waste Disposal Areas	Municipal Solid Waste/Landfill Gas	Prevent direct exposure to MSW.	Direct exposure to MSW and landfill gas is being prevented by capping, fencing, and institutional control preventing excavation within footprint. Remedial alternatives address soil cover restoration in limited locations where the soil cover is thin or missing.
		Prevent contaminant releases to the atmosphere.	Contaminant release to the atmosphere is being prevented by low landfill gas generation due to the volume, age, and composition of the MSW, as verified by ongoing landfill gas composition monitoring.
		Minimize transport of contaminants from MSW to subsurface soils and ground water.	Potential contaminant transport from MSW to groundwater has been minimized by capping. COCs in groundwater have not been associated with the Balefill and Inert Waste Disposal Areas.
	Soil	Prevent direct exposure to soil.	Direct exposure to potentially impacted soil beneath MSW is being prevented by fencing and institutional controls preventing excavation within footprint.
		Minimize transport of contaminants from soil to groundwater.	Potential contaminant transport from potentially impacted soil to groundwater has been minimized by capping. COCs in groundwater have not been associated with the Balefill and Inert Waste Disposal Areas.
	Groundwater	Prevent ingestion, inhalation, or dermal absorption of impacted groundwater.	The Balefill and Inert Waste Disposal Areas should not be a source of groundwater impacts. COCs in groundwater have not been associated with the Balefill and Inert Waste Disposal Areas. Institutional controls prevent exposure to potentially impacted groundwater.
Burn Trenches	Municipal Solid Waste/Landfill Gas	Prevent direct exposure to MSW.	Direct exposure to MSW and landfill gas is being prevented by capping, fencing, and Institutional Controls preventing excavation in footprint.
		Prevent contaminant releases to the atmosphere.	Contaminant release to the atmosphere is being prevented by low landfill gas generation due to the volume, age, and composition of the MSW.
		Minimize transport of contaminants from MSW to subsurface soils and ground water.	Potential contaminant transport from MSW to groundwater has been minimized by capping. COCs in groundwater have not been associated with the Burn Trenches.
	Soil	Prevent direct exposure to impacted soil.	Direct exposure to potentially impacted soil beneath MSW is being prevented by fencing and institutional controls preventing excavation within footprint.
		Minimize transport of contaminants from soil to groundwater.	Potential contaminant transport from potentially impacted soil to groundwater has been minimized by capping. COCs in groundwater have not been associated with the Burn Trenches.
	Groundwater	Prevent ingestion, inhalation, or dermal absorption of impacted groundwater.	The Burn Trenches should not be a source of groundwater impacts. COCs in groundwater have not been associated with the Burn Trenches. Institutional controls prevent exposure to potentially impacted groundwater.
Land Application Areas	Municipal Solid Waste/Landfill Gas	Prevent direct exposure to MSW.	The MSW from the former Land Application Areas was moved to the MSW Landfill to prevent direct exposure.
		Prevent contaminant releases to the atmosphere.	The MSW from the former Land Application Areas was moved to the MSW Landfill to prevent contaminant releases to the atmosphere.
		Minimize transport of contaminants from MSW to subsurface soils and ground water.	The MSW from the former Land Application Areas was moved to the MSW Landfill to minimize contaminant transport from MSW to groundwater.
	Soil	Prevent direct exposure to impacted soil.	The potentially impacted soil from the former Land Application Areas was moved to the MSW Landfill to prevent direct exposure.
		Minimize transport of contaminants from soil to groundwater.	The potentially impacted soil from the former Land Application Areas was moved to the MSW Landfill to minimize contaminant transport from soil to groundwater, as verified by confirmation samples.
	Groundwater	Prevent ingestion, inhalation, or dermal absorption of impacted groundwater.	Land Application Areas should not be a source of groundwater impacts. Institutional controls prevent exposure to potentially impacted groundwater.

Table 4.4-1 - Potentially Applicable Requirements Substantive Requirements
Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

Authorizing Statute	Implementing Regulation	Rationale
Safe Drinking Water Act 42 USC 300	Primary Drinking Water Standards 40 CFR 141 Secondary Drinking Water Standards 40 CFR 143	Ground water is a potential source of drinking water
Clean Water Act 33 USC 1251	Water Quality Standards 40 CFR 131	Ground water discharge to surface water, which supports aquatic life and potentially a source of drinking water
Resource Conservation and Recovery Act 42 USC 6901	Criteria for Classification of Solid Waste Disposal Facilities and Practices 40 CFR 257 Air Emission Standards for Process Vents, Air Emission Standards for Equipment Leaks, and Air Emission Standards for Tanks, Surface Impoundments, and Containers 40 CFR 265AA, 265BB, and 265CC	Excavated wastes and soils may contain listed wastes Applies to vapor treatment systems
Clean Air Act 42 USC 7401	National Ambient Air Quality Standards 40 CFR 50 Ambient Air Quality Monitoring 40 CFR 58 Standards of Performance for New Stationary Sources 40 CFR 60 National Emission Standards for Hazardous Air Pollutants 40 CFR 61 National Emission Standards for Hazardous Air Pollutants for Source Categories 40 CFR 63	Applies to vapor treatment systems
Hazardous Materials Transportation Act 49 USC 1801	Hazardous Materials Regulation 49 CFR 171 Hazardous Materials Tables, Communications Requirements, and Emergency Response Information Requirements 49 CFR 172	May apply to excavated wastes and soils
Clean Air Act RCW 70.94 and 43.21A	General Regulations for Air Pollution Sources WAC 173-400 Controls for New Sources for Toxic Air Pollutants WAC 173-460 Ambient Air Quality Standards for Particulate Matter WAC 173-470 Emission Standards and Controls for Sources Emitting Volatile Organic Compounds (VOCs) WAC 173-490	Applies to vapor treatment systems
Solid Waste Management Act RCW 70.95	Criteria for Municipal Solid Waste Landfills WAC 173-351 Minimum Functional Standards for Solid Waste Handling WAC 173-304	WAC 173-351 applies to the MSW Landfill post-closure activities WAC 173-304 applies to the Balefill cover design criteria
Model Toxics Control Act RCW 70.105D	Model Toxics Control Act Cleanup Regulation WAC 173-340	Establishes cleanup standards for soil, ground water, surface water and air
Comprehensive Environmental Response, Compensation, and Liability Act	Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA	Meets CERCLA requirements
Water Pollution Control/Water Resource Act RCW 90.48 and 90.54	Surface Water Quality Standards WAC 173-201A Protection of Upper Aquifer Zones WAC 173-154 State Waste Discharge Program WAC 173-216	Establishes narrative and numeric standards for waters of the state No water discharge permits are anticipated for the Site
Water Pollution Control Act RCW 90.48	Ground Water Quality Standards for the State of Washington WAC 173-200	Cleanup actions under MTCA are exempt from State ground water standards
Public Water Supplies RCW 90.48	Maximum Contaminant Levels WAC 246-290	Ground water potential source of drinking water
State Environmental Policy Act RCW 43.21C	SEPA Rules WAC 197-11	Cleanup actions under MTCA are exempt from SEPA

Table courtesy of Draft Focused Feasibility Study, Anchor QEA, LLC, et al., September 2014.

Table 4.4-2 - Potentially Applicable Requirements, Action-specific Requirements

Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

Authorizing Statute	Implementing Regulation	Rationale
Hazardous Waste Management Act RCW 70.105	Dangerous Waste Regulations WAC 173-303	Generation, storage and treatment requirements may apply to condensate
Model Toxics Control Act RCW 70.105D	Model Toxics Control Act Cleanup Regulation WAC 173-340	Sets minimum requirements for cleanup actions
Resource Conservation and Recovery Act Subtitle C 42 USC 6901	Identification and Listing of Wastes 40 CFR 261 Closure and Post-Closure 40 CFR 265	Excavated wastes and soils may contain listed wastes May apply to cleanup actions
Water Well Construction RCW 18.104	Minimum Standards for Construction and Maintenance of Wells WAC 173-160 Rules and Regulations Governing the Licensing of Well Contractors and Operators WAC 173-162	Minimum standards for design and installation of wells
Washington Industrial Safety and Health RCW 49.17	General Occupational Health Standards WAC 296-62	Applies to on-site workers involved in cleanup implementation
Franklin County Code Chapter 17.56	Heavy Industrial Zone I-3	Zoning applies to Future Site use
City of Pasco Municipal Code Chapter 16.06	Utility Service Requirements for Building Permits	Applies to future construction
Federal Insecticide, Fungicide, and Rodenticide Act 40 CFR 150	FIFRA Rules 40 CFR 150	May apply if rodent control and/or application of insecticide is required for Site maintenance
Occupational Safety and Health Act 29 USC 651	Safety and Health Rules 29 CFR 1910	Applies to on-site workers involved in cleanup implementation

Table courtesy of Draft Focused Feasibility Study, Anchor QEA, LLC, et al., September 2014.

Table 4.5.1-1 - Groundwater Cleanup Levels

Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

Compound	Cleanup Level (µg/L)	Basis for Cleanup Level
1,1,1-Trichloroethane	200	Federal maximum concentration limit (MCL)
1,1-Dichloroethene	0.057	Surface Water Applicable or Relevant and Appropriate Requirement – Human Health – Fresh Water – National Toxics Rule, 40 CFR 131
1,2-Dichloroethane	0.38	Surface Water Applicable or Relevant and Appropriate Requirement – Human Health – Fresh Water – Clean Water Act §304
cis-1,2-Dichloroethene	16	Ground Water, Method B, Non-carcinogen, Standard Formula Value
Benzene	0.79	Ground Water, Method B, Carcinogen, Standard Formula Value adjusted total cancer risk
Methylene chloride	5	Ground Water, Method B, Carcinogen, Standard Formula Value adjusted total cancer risk
Tetrachloroethene	0.69	Surface Water Applicable or Relevant and Appropriate Requirement – Human Health – Fresh Water – Clean Water Act §304
Toluene	615	Ground Water, Method B, Non-carcinogen, Standard Formula Value adjusted for a hazard quotient of 1.
Trichloroethene	2.5	Surface Water Applicable or Relevant and Appropriate Requirement – Human Health – Fresh Water – Clean Water Act §304
Vinyl chloride	0.069	Ground Water, Method B, Carcinogen, Standard Formula Value adjusted for the MCL and total cancer risk
Total Chromium	100	Federal MCL

Table courtesy of Draft Focused Feasibility Study, Anchor QEA, LLC, et al., September 2014.

Table 5.2-1 - MSW Landfill - Alternative Cost Comparison

Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

Alternative MSW-1: Continued operation of the existing landfill gas collection and flare system.

Alternative MSW-2: Expanded operation of landfill gas collection with addition of four new landfill gas extraction wells.

Alternative MSW-3: Expanded operation of landfill gas collection with addition of four new landfill gas extraction wells. Construction and operation of a groundwater extraction and treatment system.

	Alternative MSW-1			Alternative MSW-2			Alternative MSW-3		
	Capital	O&M	Total Annual Costs	Capital	O&M	Total Annual Costs	Capital	O&M	Total Annual Costs
2017	$ -	$ 135,000	$ 135,000	$ 140,000	$ 156,000	$ 296,000	$ 640,000	$ 233,000	$ 873,000
2018	$ -	$ 135,000	$ 135,000	$ -	$ 156,000	$ 156,000	$ -	$ 233,000	$ 233,000
2019	$ -	$ 135,000	$ 135,000	$ -	$ 156,000	$ 156,000	$ -	$ 233,000	$ 233,000
2020	$ -	$ 135,000	$ 135,000	$ -	$ 156,000	$ 156,000	$ -	$ 233,000	$ 233,000
2021	$ -	$ 135,000	$ 135,000	$ -	$ 156,000	$ 156,000	$ -	$ 233,000	$ 233,000
2022	$ 30,000	$ 77,000	$ 107,000	$ 30,000	$ 78,000	$ 108,000	$ 30,000	$ 175,000	$ 205,000
2023	$ -	$ 77,000	$ 77,000	$ -	$ 78,000	$ 78,000	$ -	$ 175,000	$ 175,000
2024	$ -	$ 77,000	$ 77,000	$ -	$ 78,000	$ 78,000	$ -	$ 175,000	$ 175,000
2025	$ -	$ 77,000	$ 77,000	$ -	$ 78,000	$ 78,000	$ -	$ 175,000	$ 175,000
2026	$ -	$ 77,000	$ 77,000	$ -	$ 78,000	$ 78,000	$ -	$ 175,000	$ 175,000
2027	$ -	$ 77,000	$ 77,000	$ -	$ 78,000	$ 78,000	$ -	$ 175,000	$ 175,000
2028	$ -	$ 77,000	$ 77,000	$ -	$ 78,000	$ 78,000	$ -	$ 175,000	$ 175,000
2029	$ -	$ 77,000	$ 77,000	$ -	$ 78,000	$ 78,000	$ -	$ 175,000	$ 175,000
2030	$ -	$ 77,000	$ 77,000	$ -	$ 78,000	$ 78,000	$ -	$ 175,000	$ 175,000
2031	$ -	$ 77,000	$ 77,000	$ -	$ 78,000	$ 78,000	$ -	$ 175,000	$ 175,000
		Total MSW-1 Cost:	**$ 1,475,000**		**Total MSW-2 Cost:**	**$ 1,730,000**		**Total MSW-3 Cost:**	**$ 3,585,000**
		Total MSW-1 Cost (NPV):	**$ 1,359,000**		**Total MSW-2 Cost (NPV):**	**$ 1,608,000**		**Total MSW-3 Cost (NPV):**	**$ 3,329,000**

Notes:

1. Capital costs include design, installation, hookup, and initial testing costs and includes a 20-percent contingency to account for uncertainity in the final design and construction.
2. Long-term costs provided annually for 15-year period.
3. O&M costs also include costs for landfill gas operations and monitoring, compliance groundwater monitoring, maintaining Institutional Controls, and Agency oversight.
4. All alternatives assume replacement of the existing landfill gas flare with a utility flare in year 5 and corresponding reduction in O&M costs in subsequent years.
5. Net Present Value (NPV) calculated using a real discount rate of 1.2 percent according to the Federal Office of Management and Budget (https://www.whitehouse.gov/omb/circulars_a094/a94_appx-c).
6. These cost estimates are approximately +50/-30 percent of actual costs.

Table 5.2-2 - Alternative MSW-1 - Detailed Cost Estimate

Project No. 060255, MSW Landfill, Pasco Landill, Pasco, WA

TOTAL CAPITAL INVESTMENT (TCI) [DC + IC+ Contingency]:	**$0**

Direct Annual Operating Costs (Years 0-5)	Quantity	Units	Unit Cost	Extension	Description
Landfill Gas Collection and Flare System					
Maintenance and Replacement Parts	1	LS	$10,000	$10,000	
Sampling/Operator & Maintenance Labor (OL)	624	Man Hours	$75	$46,800	12 hours per week, 52 weeks per year
Field Supplies	12	Month	$1,000	$12,000	
Quarterly Reporting	4	Each	$10,000	$40,000	
Condensate Disposal	1	LS	$2,500	$2,500	
Laboratory Analytical	1	LS	$12,000	$12,000	
Electricity	12,000	kwh	$0.10	$1,200	
Groundwater Monitoring					
Compliance GW Monitoring	1	LS	$10,000	$10,000	Two wells quarterly; Six wells semi-annually
			TOTAL ANNUAL COST (Years 0-5):	**$135,000**	

Landfill Gas Flare Replacement (Year 5)	Quantity	Units	Unit Cost	Extension	Description
Utility Flare	1	LS	$10,000	$10,000	Quote from Parnel Biogas
Taxes (9% of EQ)	1	Lump	$900	$900	
Freight (5% of EQ)	1	Lump	$500	$500	
Miscellaneous Process and Mechanical	1	Lump	$5,000	$5,000	
Engineering Design & Startup	1	LS	$7,500	$7,500	
			Flare Replacement (Subtotal):	$23,900	
			Contingency (20% Subtotal):	$4,780	
			TOTAL Flare Replacement (Year 5):	**$30,000**	

Direct Annual Operating Costs (Years >5)	Quantity	Units	Unit Cost	Extension	Description
Landfill Gas Collection and Flare System					
Maintenance and Replacement Parts	1	Lump	$5,000	$5,000	
Sampling/Operator & Maintenance Labor (OL)	416	Man Hours	$75	$31,200	8 hours per week, 52 weeks per year
Field Supplies	1	LS	$1,500	$1,500	
Quarterly Reporting	2	Each	$10,000	$20,000	Assume reduction to semi-annual reporting
Condensate Disposal	1	LS	$1,500	$1,500	
Laboratory Analytical	1	LS	$6,000	$6,000	
Electricity (100 kVA assumed)	1	LS	$1,500	$1,500	
Groundwater Monitoring					
Compliance GW Monitoring	1	LS	$10,000	$10,000	Two wells quarterly; Six wells semi-annually
			TOTAL ANNUAL COST (Years >5):	**$77,000**	

Notes:

1. The costs presented are preliminary estimates based on existing information and are estimated to be within +50/-30 percent of actual costs
2. The Landfill Gas Collection and Flare system would continue current operations for 5 years; After 5 years it is asumed that the existing flare would be decommisioned and transitioned to a utility flare to adapt the flare treatment consistent with changes in Landfill Gas collection and loading to the flare.

Revision Date: July 2017.

Table 5.2-3 - Alternative MSW-2 - Detailed Cost Estimate

Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

Landfill Gas Collection System - Purchased Equipment	Quantity	Units	Unit Cost	Extension	Description
Landfill Gas Extraction Well Mechanical	4	Each	$500	$2,000	
Valves, and appurtenances	4	Each	$250	$1,000	
Instrumentation and Controls	1	LS	$7,500	$7,500	
			Equipment Subtotal (EQ):	***$11,000***	
Taxes (9% of EQ)	1	Lump	$990	$990	
Freight (2% of EQ)	1	Lump	$220	$220	
			Total Purchased Equipment Cost (PEC):	***$12,000***	

Landfill Gas Collection System - Direct Installation Costs	Quantity	Units	Unit Cost	Extension	Description
Install Landfill Gas Extraction Wells	4	Each	$10,500	$42,000	
1" HDPE Extraction System Piping	1,000	LF	$10	$10,000	
Process and Mechanical Installation	1	Lump	$20,000	$20,000	
			Total Direct Installation Cost (DI):	***$72,000***	
			TOTAL DIRECT COST (DC) [PEC + DI]:	**$80,000**	

Landfill Gas Collection System - Indirect Costs	Quantity	Units	Unit Cost	Extension	Description
Engineering Design	1	LS	$15,000	$15,000	
Start Up and Influence Testing	1	LS	$25,000	$25,000	
			Total Indirect Cost (IC):	***$40,000***	
			Total Capital Investment (Subtotal):	$120,000	
			Contingency (20% Subtotal):	$24,000	
			TOTAL CAPITAL INVESTMENT (TCI) [DC + IC+ Contingency]:	**$140,000**	

Direct Annual Operating Costs (Years 0-5)	Quantity	Units	Unit Cost	Extension	Description
Landfill Gas Collection and Flare System					
Maintenance and Replacement Parts	1	Lump	$10,000	$10,000	
Sampling/Operator & Maintenance Labor (OL)	1,000	Man Hours	$75	$75,000	~20 hours per week, 52 weeks per year
Field Supplies	1	LS	$3,000	$3,000	
Quarterly Reporting	4	Each	$10,000	$40,000	
Condensate Disposal	1	LS	$4,000	$4,000	
Laboratory Analytical	1	LS	$12,000	$12,000	
Electricity	15,000	kwh	$0.10	$1,500	
Groundwater Monitoring					
Compliance GW Monitoring	1	LS	$10,000	$10,000	Two wells quarterly; Six wells semi-annually
			TOTAL ANNUAL COST (Years 0-5):	**$156,000**	

Landfill Gas Flare Replacement (Year 5)	Quantity	Units	Unit Cost	Extension	Description
Utility Flare	1	LS	$10,000	$10,000	Quote from EPG
Taxes (9% of EQ)	1	Lump	$900	$900	
Freight (5% of EQ)	1	Lump	$500	$500	
Miscellaneous Process and Mechanical	1	Lump	$5,000	$5,000	
Engineering Design & Startup	1	LS	$7,500	$7,500	
			Flare Replacement (Subtotal):	$23,900	
			Contingency (20% Subtotal):	$4,780	
			TOTAL Flare Replacement (Year 5):	**$30,000**	

Direct Annual Operating Costs (Years >5)	Quantity	Units	Unit Cost	Extension	Description
Landfill Gas Collection and Flare System					
Maintenance and Replacement Parts	1	Lump	$5,000	$5,000	
Sampling/Operator & Maintenance Labor (OL)	416	Man Hours	$75	$31,200	16 hours per week, 52 weeks per year
Field Supplies	1	LS	$1,500	$1,500	
Quarterly Reporting	2	Each	$10,000	$20,000	Reporting to include required reporting of GW Treatment System
Condensate Disposal	1	LS	$2,500	$2,500	
Laboratory Analytical	1	LS	$6,000	$6,000	
Electricity (100 kVA assumed)	1	LS	$3,000	$1,500	
Groundwater Monitoring					
Compliance GW Monitoring	1	LS	$10,000	$10,000	Two wells quarterly; Six wells semi-annually
			TOTAL ANNUAL COST (Years >5):	**$78,000**	

Notes:

1. The costs presented are preliminary estimates based on existing information and are estimated to be within +50/-30% of actual costs
2. Four new Landfill Gas collection wells would be installed and tied into the existing collection system
3. Startup and Influence Testing would include two weeks of field activities for influence testing and flow adjustments and summary memorandum describing results
4. The Landfill Gas Collection and Flare system would continue current operations for 5 years; After 5 years it is asumed that the existing flare would be decommisioned and transitioned to a utility flare to adapt the flare treatment consistent with changes in Landfill Gas collection and loading to the flare

Revision Date: July 2017.

Table 5.2-4 - Alternative MSW-3 - Detailed Cost Estimate

Project No. 060255, MSW Landfill, Pasco Landfil, Pasco, WA

GW Treatment System - Purchased Equipment	Quantity	Units	Unit Cost	Extension	Description
GW Extraction Pumps and Appurtenances	5	Each	$2,250	$11,250	Grundfos 25E6 4" Submersible (1HP, 110 TDH)
Valve Vaults w/ Hinged Locking Covers	5	Each	$1,000	$5,000	
Extraction System Instrumentation (flow and level)	5	Each	$1,000	$5,000	
10,000 Gal Aeration/Sedimentation Basin	1	Each	$12,000	$12,000	For oxidation of reduced, dissolved metals forms
Blower and Diffuser Equipment	1	LS	$5,000	$5,000	
1.5HP Porgressive Cavity Transfer Pump	1	Each	$2,500	$2,500	
30 GPM Ion Exchange Skid	2	Each	$25,000	$50,000	
Control Panel	1	Each	$10,000	$10,000	
Power Drop	1	Each	$15,000	$15,000	
Piping, valves, and appurtenances (4% EQ)	1	Lump	$35,000	$35,000	
Instrumentation, Controls and SCADA	1	LS	$20,000	$20,000	Instrumentation for fully-automated operated
			Equipment Subtotal (EQ):	***$171,000***	
Taxes (9% of EQ)	1	Lump	$15,390	$15,390	
Freight (3% of EQ)	1	Lump	$5,130	$5,130	
			Total Purchased Equipment Cost (PEC):	***$192,000***	

GW Treatmetn System - Direct Installation Costs	Quantity	Units	Unit Cost	Extension	Description
Permitting	1	LS	$10,000	$10,000	
10'x20' Treatment System Control/Storage Building	200	SF	$150	$30,000	
Install GW Extraction Wells (50' deep x 6" dia.)	5	Each	$12,000	$60,000	
1" HDPE Extraction System Piping on Surface w heat trace	1,800	LF	$30	$54,000	
2" HDPE Discharge Piping	300	LF	$28	$8,400	Estimated. Unknown discharge point
Extraction System Conduit and Wiring	1,800	LF	$25	$45,000	
Set Process Equipment (4% of EQ)	1	Lump	$6,840	$6,840	
Process Piping (3% of EQ)	1	Lump	$5,130	$5,130	
Heating and Lighting (1% of EQ)	1	Lump	$1,710	$1,710	
Electrical (4% of EQ)	1	Lump	$6,840	$6,840	
			Total Direct Installation Cost (DI):	***$227,920***	
			TOTAL DIRECT COST (DC) [PEC + DI]:	**$420,000**	

GW Treatment System - Indirect Costs	Quantity	Units	Unit Cost	Extension	Description
Engineering (12% of EQ)	1	LS	$20,520	$20,520	
Treatment - Bench Scale Testing	1	LS	$50,000	$50,000	
NPDES Permitting	1	LS	$7,500	$7,500	
Construction Oversight (3.5% of DC)	1	LS	$14,700	$14,700	
Start Up (3% of DC)	1	LS	$12,600	$12,600	
			Total Indirect Cost (IC):	***$105,320***	
			Total Capital Investment (Subtotal):	$530,000	
			Contingency (20% Subtotal):	$106,000	
			TOTAL CAPITAL INVESTMENT (TCI) [DC + IC+ Contingency]:	**$640,000**	

GW Treatment System - Direct Annual Operating Costs (All years)	Quantity	Units	Unit Cost	Extension	Description
Maintenance and Replacement Parts (2.5% EQ)	1	Lump	$4,275	$4,275	
Sampling/Operator & Maintenance Labor (OL)	624	Man Hours	$75	$46,800	12 hours per week, 52 weeks per year
Field Supplies	12	Month	$1,000	$12,000	
Reporting	0	LS	$20,000	$0	Assumes reporting within routine reporting
Laboratory Analytical	1	LS	$6,000	$6,000	Anticipated compliance and operational sampling at approx. $500/month
Electricity	25,000	kwh	$0.10	$2,500	Estimated based on components described above
NPDES Reporting	12	Month	$500	$6,000	
Sedimentation Basin - Solids Removal and Disposal	1	LS	$10,000	$10,000	
Ion Exchange Resin Replacement and Disposal	1	LS	$10,000	$10,000	
			GW Treatment System - Total Direct Annual Operating Cost (DAC1):	***$97,575***	

Direct Annual Operating Costs (Years 0-5)	Quantity	Units	Unit Cost	Extension	Description
Landfill Gas Collection and Flare System					
Maintenance and Replacement Parts	1	Lump	$10,000	$10,000	
Sampling/Operator & Maintenance Labor (OL)	624	Man Hours	$75	$46,800	12 hours per week, 52 weeks per year
Field Supplies	12	LS	$1,000	$12,000	
Quarterly Reporting	4	Each	$10,000	$40,000	Reporting to include required reporting of GW Treatment System
Condensate Disposal	1	LS	$2,500	$2,500	
Laboratory Analytical	1	LS	$12,000	$12,000	
Electricity	12,000	kwh	$0.10	$1,200	
Groundwater Monitoring					
Compliance GW Monitoring	1	LS	$10,000	$10,000	Two wells quarterly; Six wells semi-annually
			Total Direct Annual Operating Cost, Years 0-5 (DAC2):	***$135,000***	
			TOTAL ANNUAL COST (DAC1 + DAC2; Years 0-5):	**$233,000**	

Landfill Gas Flare Replacement (Year 5)	Quantity	Units	Unit Cost	Extension	Description
Utility Flare	1	LS	$10,000	$10,000	Quote from Parnel Biogas
Taxes (9% of EQ)	1	Lump	$900	$900	
Freight (5% of EQ)	1	Lump	$500	$500	
Miscellaneous Process and Mechanical	1	Lump	$5,000	$5,000	
Engineering Design & Startup	1	LS	$7,500	$7,500	
			Flare Replacement (Subtotal):	$23,900	
			Contingency (20% Subtotal):	$4,780	
			TOTAL Flare Replacement (Year 5):	**$30,000**	

Direct Annual Operating Costs (Years >5)	Quantity	Units	Unit Cost	Extension	Description
Landfill Gas Collection and Flare System					
Maintenance and Replacement Parts	1	Lump	$5,000	$5,000	
Sampling/Operator & Maintenance Labor (OL)	416	Man Hours	$75	$31,200	8 hours per week, 52 weeks per year
Field Supplies	1	LS	$1,500	$1,500	
Quarterly Reporting	2	Each	$10,000	$20,000	Assume reduction to semi-annual reporting
Condensate Disposal	1	LS	$1,500	$1,500	
Laboratory Analytical	1	LS	$6,000	$6,000	
Electricity (100 kVA assumed)	1	kwH	$1,500	$1,500	
Groundwater Monitoring					
Compliance GW Monitoring	1	LS	$10,000	$10,000	Two wells quarterly; Six wells semi-annually
			Total Direct Annual Operating Cost (DAC4; Years >5):	***$77,000***	
			TOTAL ANNUAL COST (DAC1 + DAC4; Years >5):	**$175,000**	

Notes:

1. The costs presented are preliminary estimates based on existing information and are estimated to be within +50/-30 percent of actual costs
2. Cost estimate assumes construction of a new building to house the treatment system. Building would be sited next Landfill Gas Flare
3. Miscellaneous electrical costs include costs associated with distributing power as required for the extraction and treatment system components, and electrical installation of lighting, ventilation, and treatment equipment
4. The groundwater extraction system includes 5 extraction wells equipped with centrifugal submersible pumps, level control systems, and flow meters
5. Treated groundwater will be discharged under an NPDES permit
6. Total groundwater extraction flow rate is assumed to be approximately 20 gallons per minute (gpm).
7. Pricing and treatment technologies are subject to change based on further site investigations
8. Electrical conduit will be installed in trench according to NFPA code.
9. The treatment system will be capable of treating at flow rates up to 30 gpm
10. System startup includes a two week operation/troubleshooting period and preparation of an O&M Manual
11. The Landfill Gas Collection and Flare system would continue current operations for 5 years; After 5 years it is asumed that the existing flare would be decommisioned and transitioned to a utility flare to adapt the flare treatment consistent with changes in Landfill Gas collection and loading to the flare

Revision Date: July 2017.

Table 5.3-1 - Balefill Area Cost Summary

Project No. 060255, Balefill Area, Pasco Landfill, Pasco, WA

Alternative BA-1

	Capital	O&M	Total Annual Costs
2017	$ 310,000	$ 10,500	$ 320,500
2018	$ -	$ 10,500	$ 10,500
2019	$ -	$ 10,500	$ 10,500
2020	$ -	$ 10,500	$ 10,500
2021	$ -	$ 10,500	$ 10,500
2022	$ -	$ 10,500	$ 10,500
2023	$ -	$ 10,500	$ 10,500
2024	$ -	$ 10,500	$ 10,500
2025	$ -	$ 10,500	$ 10,500
2026	$ -	$ 10,500	$ 10,500
2027	$ -	$ 10,500	$ 10,500
2028	$ -	$ 10,500	$ 10,500
2029	$ -	$ 10,500	$ 10,500
2030	$ -	$ 10,500	$ 10,500
2031	$ -	$ 10,500	$ 10,500
		Total BA-1 Cost:	**$ 467,500**
		Total BA-1 Cost (NPV):	**$ 450,000**

Notes:

1. Alternative assumes a cover rehabilitation of approximately 25% of the total Balefill and IWDA areas.
2. The cover consists of 30 inches of 10-6 cm/s soil, geotextile seperation barrier, and a crushed rock surface layer to inhibit vegetation.
3. Long-term costs provided annually for 15-year period.
4. O&M costs include inspections and maintenance of existing cover system.
5. Capital costs include design, installation, hookup, and initial testing costs and includes a 20-percent contingency to account for uncertainity in the final design and construction.
6. Net Present Value (NPV) calculated using a real discount rate of 1.2% according to the Federal Office of Management and Budget (https://www.whitehouse.gov/omb/circulars_a094/a94_appx-c).
7. These cost estimates are approximately +50/-30 percent of actual costs.

Table 5.3-2 - Balefill and Inert Waste Area - Detailed Cost Estimate

Project No. 060255, Balefill and Inert Waste Area, Pasco Landfill, Pasco, WA

Landfill Soil Cover - Direct Installation Costs	Quantity	Units	Unit Cost	Extension	Description
Consolidate and cover waste & Site prep	5,000	CY	$8	$40,000	
Import, place and compact cover soils (30" soil cover)	4,000	CY	$33	$132,000	
Crushed rock (6" cover)	1,000	tons	$25	$25,000	
Geotextile (Seperation Barrier)	5,000	SY	$6	$30,000	
TOTAL DIRECT COST (DC):				**$230,000**	

Landfill Soil Cover - Indirect Costs	Quantity	Units	Unit Cost	Extension	Description
Engineering	1	LS	$12,000	$12,000	
Construction Oversight (3.5% of DC)	1	LS	$8,050	$8,050	
Bidding and Contractor Management (2.5% of DC)	1	LS	$5,750	$5,750	
Probe and thermocouple decommissioning	1	LS	$2,500	$2,500	
Total Indirect Cost (IC):				***$28,300***	
Total Capital Investment (Subtotal):				$260,000	
Contingency (20% Subtotal):				$52,000	
TOTAL CAPITAL INVESTMENT (TCI) [DC + IC+ Contingency]:				**$310,000**	

Landfill Soil Cover - Direct Annual Operating Costs	Quantity	Units	Unit Cost	Extension	Description
Cover Inspection and Maintenance	1	LS	$2,500	$2,500	
Probe and thermocouple monitoring, download, reporting	1	LS	$8,000	$8,000	
TOTAL ANNUAL COST (DAC1 + DAC2; Years 0-5):				**$10,500**	

Notes:
1. The costs presented are preliminary estimates based on existing information and are estimated to be within +50/-30 percent of actual costs.
2. Landfill Soil Cover would consists of a 30-inch soil cover with maximum permeability of $1x10^{-5}$ cm/sec, 6 inches of crushed rock and a geotextile between soil and rock as seperation barrier.
3. The quantities assume that approximately 25 percent of the total Balefill Area and Inert Waste Disposal Areas will require the engineered cover system.

Revision Date: July 2017.

Table 5.3-3 - Burn Trenches - Alternative Cost Comparison

Project No. 060255, Burn Trenches, Pasco Landfill, Pasco, WA

	Alternative BT-A			Alternative BT-B			Alternative BT-C		
	Capital	O&M	Total Annual Costs	Capital	O&M	Total Annual Costs	Capital	O&M	Total Annual Costs
2017	$ -	$ 1,000	$ 1,000	$ 24,000	$ 2,000	$ 26,000	$ 108,000	$ 2,500	$ 110,500
2018	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2019	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2020	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2021	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2022	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2023	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2024	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2025	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2026	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2027	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2028	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2029	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2030	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
2031	$ -	$ 1,000	$ 1,000	$ -	$ 2,000	$ 2,000	$ -	$ 2,500	$ 2,500
		Total BT-A Cost:	**$ 15,000**		**Total BT-B Cost:**	**$ 54,000**		**Total BT-C Cost:**	**$ 145,500**
		Total BT-A Cost (NPV):	**$ 14,000**		**Total BT-B Cost (NPV):**	**$ 51,000**		**Total BT-C Cost (NPV):**	**$ 141,000**

Notes:
1. Alternative BT-B assumes a cover investigation to verify the integrity and thickensss of the existing cover system.
2. Alternative 3 assumes a cover investigation, and cover rehabilitation of approximately 25 percent of the total Burn Trench Areas.
3. Long-term costs provided annually for 15-year period.
4. O&M costs include inspections and maintenance of existing cover system.
5. Capital costs include design, installation, hookup, and initial testing costs and includes a 20-percent contingency to account for uncertainity in the final design and construction.

6. Net Present Value (NPV) calculated using a real discount rate of 1.2 percent according to the Federal Office of Management and Budget (https://www.whitehouse.gov/omb/circulars_a094/a94_appx-c).
7. These cost estimates are approximately +50/-30 percent of actual costs.

Table 5.3-4 - Burn Trench Alternative BT-A - Detailed Cost Estimate

Project No. 060255, Burn Trenches, Pasco Landfill, Pasco, WA

			TOTAL CAPITAL INVESTMENT:	**$0**	

Landfill Soil Cover - Direct Annual Operating Costs	**Quantity**	**Units**	**Unit Cost**	**Extension**	**Description**
Cover Inspection and Maintenance	1	LS	$1,000	$1,000	
			TOTAL ANNUAL COST:	**$1,000**	

Notes:

1. The costs presented are preliminary estimates based on existing information and are estimated to be within +50/-30 percent of actual costs.
   Revision Date: July 2017.

Table 5.3-5 - Burn Trench Alternative BT-B - Detailed Cost Estimate

Project No. 060255, Burn Trenches, Pasco Landfill, Pasco, WA

Landfill Soil Cover - Indirect Costs	Quantity	Units	Unit Cost	Extension	Description
Cover Soil Investigation	3	day	$2,500	$7,500	
Investigation Oversight	1	LS	$7,500	$7,500	
Investigation Summary Report	1	LS	$5,000	$5,000	
			Total Indirect Cost (IC):	***$20,000***	
			Contingency (20% Subtotal):	$4,000	
			TOTAL CAPITAL INVESTMENT (TCI) [DC + IC+ Contingency]:	**$24,000**	

Landfill Soil Cover - Direct Annual Operating Costs	Quantity	Units	Unit Cost	Extension	Description
Cover Inspection and Maintenance	1	LS	$2,000	$2,000	
			TOTAL ANNUAL COST:	**$2,000**	

Notes:

1. The costs presented are preliminary estimates based on existing information and are estimated to be within +50/-30 percent of actual costs.
2. Cover Soil Investigation would involve installation of direct-push borings across the BT area to verify thickness and integrity of existing soil cover.
3. Costs assume that no required improvements would be identified by investigation.

Revision Date: July 2017.

Table 5.3-6 - Burn Trench Alternative BT-C - Detailed Cost Estimate

Project No. 060255, Burn Trenches, Pasco Landfill, Pasco. WA

Landfill Soil Cover - Direct Installation Costs	**Quantity**	**Units**	**Unit Cost**	**Extension**	**Description**
Consolidate and cover waste & Site prep	1,000	CY	$8	$8,000	
Import, place and compact cover soils (30" soil cover)	1,210	CY	$33	$39,940	
Crushed rock (6" cover)	315	tons	$25	$7,867	
Geotextile (Seperation Barrier)	1,452	SY	$6	$8,714	
			TOTAL DIRECT COST (DC):	**$60,000**	

Landfill Soil Cover - Indirect Costs	**Quantity**	**Units**	**Unit Cost**	**Extension**	**Description**
Cover Soil Investigation	3	day	$2,500	$7,500	
Investigation Oversight	1	LS	$7,500	$7,500	
Engineering	1	LS	$6,000	$6,000	
Construction Oversight (5% of DC)	1	LS	$2,100	$2,100	
Bidding and Contractor Management (5% of DC)	1	LS	$1,500	$1,500	
Investigation Summary Report	1	LS	$5,000	$5,000	
			Total Indirect Cost (IC):	***$29,600***	
			Total Capital Investment (Subtotal):	$90,000	
			Contingency (20% Subtotal):	$18,000	
			TOTAL CAPITAL INVESTMENT (TCI) [DC + IC+ Contingency]:	**$108,000**	

Landfill Soil Cover - Direct Annual Operating Costs	**Quantity**	**Units**	**Unit Cost**	**Extension**	**Description**
Cover Inspection and Maintenance	1	LS	$2,500	$2,500	
			TOTAL ANNUAL COST:	**$2,500**	

Notes:

1. The costs presented are preliminary estimates based on existing information and are estimated to be within +50/-30 percent of actual costs.
2. Cover Soil Investigation would involve installation of direct-push borings across the BT area to verify thickness and integrity of existing soil cover.
3. The quantities assume that approximately 25 percent of the BT-1 area will require an engineering cover system.
4. Landfill Soil Cover would consists of a 30-inch soil cover with maximum permeability of $1x10^{-5}$ cm/sec, 6 inches of crushed rock and a geotextile between soil and rock as seperation barrier.

Revision Date: July 2017.

Table 6.3.1-1 - MTCA Requirements - Alternatives for MSW Disposal Areas

Project No. 060255, Pasco Landfill, Pasco, WA

Remedial Alternative MTCA Requirements	MSW Landfill			Balefill and Inert Waste Disposal Area	Burn Trenches		
	MSW-1	MSW-2	MSW-3	BA-1	BT-A	BT-B	BT-C
	Existing Systems	MSW-1 With Expanded LFG Collection System	MSW-2 With Contingent Ground Water Treatment System	Existing Soil Cover With Restoration	Existing Soil Cover	BT-A With Investigation to Confirm Cover Thickness	BT-B With Restoration of Soil Cover
Threshold Requirements							
Protects Human Health and the Environment	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Complies with Cleanup Standards	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Complies with Applicable State and Federal Laws	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provides for Compliance Monitoring	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Requirements							
Permanent to Maximum Extent Practicable	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provides Reasonable Restoration Timeframe	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Considers Public Concerns	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional Requirements							
Requires Ground Water Cleanup Actions	No	No	Yes	No	No	No	No
Does Not Rely Primarily on Institutional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Minimizes Present and Future Site Releases and Migration	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does Not Rely Primarily on Dilution and/or Dispersion	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6.3.1-2 - Disproportionate Cost Analysis - MSW Landfill

Project No. 060255, MSW Landfill, Pasco Landfill, Pasco, WA

Alternative MSW-1: Existing landfill gas collection network; Existing engineered cover system and monitoring for potential Landfill Gas migration; Existing enclosed flare system with future replacement.
Contingent Alternative MSW-2: Alternative MSW-1 with expanded landfill gas collection system.
Contingent Alternative MSW-3: Alternative MSW-2 with contingent groundwater treatment system.

Evaluation Criteria	Alternative MSW-1	Alternative MSW-2	Alternative MSW-3	Comments
Protectiveness	3	3	3	Alternatives are equally protective based on meeting the remedial action objectives.
Permanence	3	3	3	Waste will remain in place. Landfill gas is permanently destroyed.
Effectiveness Over the Long Term	3	2	1	Effectiveness based on historical effectiveness of the existing engineered systems, and complexity of Alternatives MSW-2 and MSW-3.
Management of Short-term Risks	3	2	1	Alternatives MSW-2 and MSW-3 require drilling and/or excavation, which may result in short-term risk.
Technical and Administrative Implementability	3	2	1	Implementability based on performance of existing systems, and complexity of Alternatives MSW-2 and MSW-3.
Consideration of Public Concerns	3	3	3	Concerns addressed based on previous public comment.
Total Benefit Score	18	15	12	
Capital Costs (millions)	$0.03	$0.17	$0.67	
O&M Costs (millions)	$1.45	$1.56	$2.92	
Total Costs (millions)	$1.48	$1.73	$3.59	
Total NPV Costs (millions)	$1.36	$1.61	$3.33	
Benefit-to-Cost Ratio (Benefit Score/NPV Costs)	**12.2**	**8.7**	**3.3**	

Note:
Alternatives are ranked with 1 being the least favorable rating and 3 being the most favorable rating.

Table 6.3.2-1 - Disproportionate Cost Analysis - Alternatives for Burn Trenches

Project No. 060255, Burn Trenches, Pasco Landfill, Pasco, WA

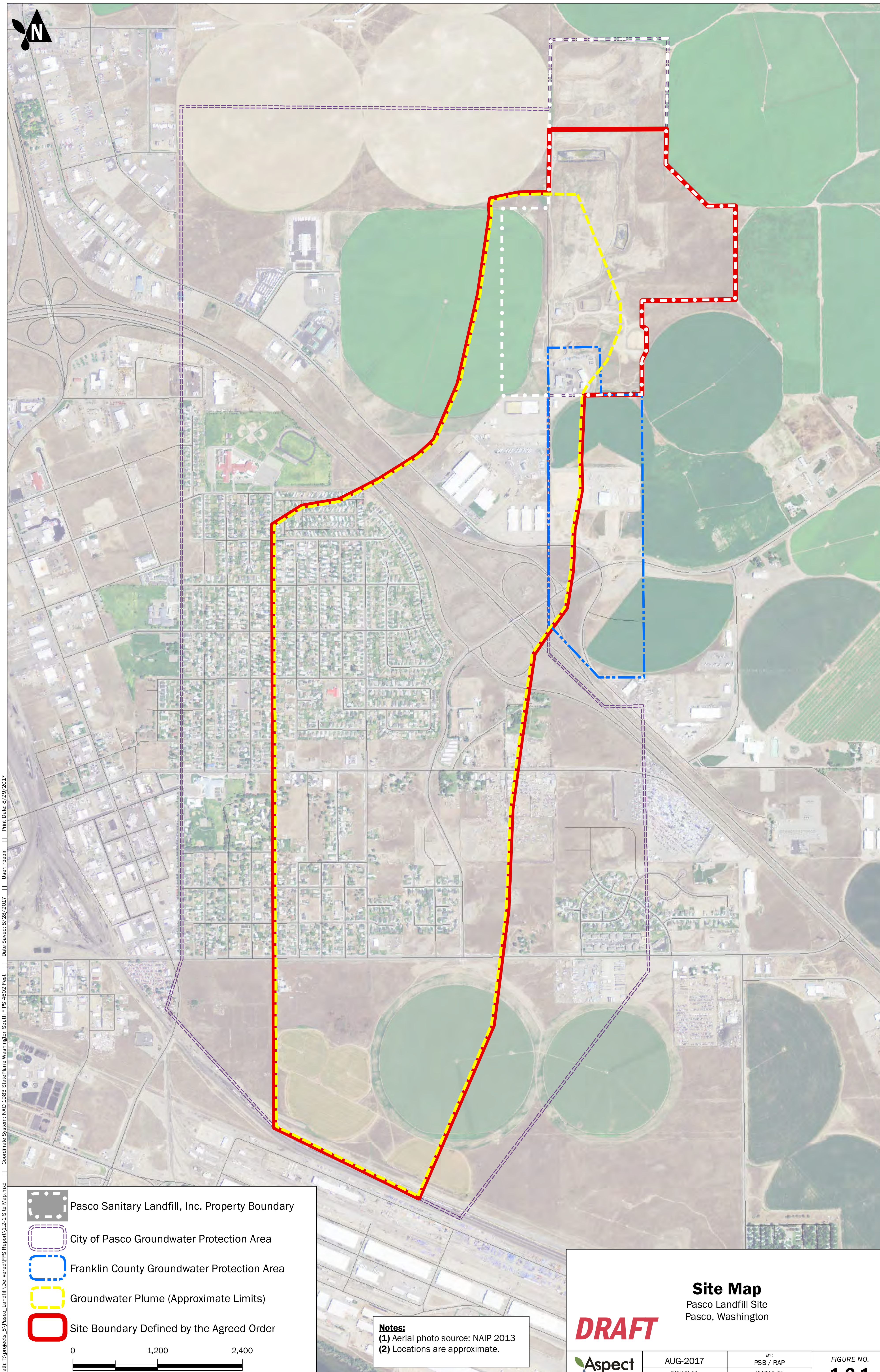
Alternative BT-A: Existing BT with inspection, maintenance, and reporting.
Contingent AlternativeBT-B: Alternative BT-A and assess BT soil cover thickness.
Contingent Alternative BT-C: Alternative BT-B and implement soil cover restoration.

Evaluation Criteria	Alternative BT-A	Alternative BT-B	Alternative BT-C	Comments
Protectiveness	1	2	3	Alternatives are protective based on historical observations of the existing engineered systems.
Permanence	3	3	3	Municipal solid waste will remain in place.
Effectiveness Over the Long Term	3	3	3	Alternatives are effective based on historical observations of the existing engineered systems.
Management of Short-term Risks	3	2	1	Alternatives BT-B and BT-C require excavation and construction, which may result in short-term risk.
Technical and Administrative Implementability	3	3	3	All alternatives are implementable.
Consideration of Public Concerns	3	3	3	Additional community/public input during review of this FFS may be factored into this analysis. For now, alternatives are equally ranked.
Total Benefit Score	16	16	16	
Capital Costs (millions)	$0.00	$0.02	$0.11	
O&M Costs (millions)	$0.02	$0.03	$0.04	
Total Costs (millions)	$0.02	$0.05	$0.15	
Total NPV Costs (millions)	$0.01	$0.05	$0.14	
Benefit-to-Cost Ratio (Benefit Score/NPV Costs)	**1143**	**314**	**113**	

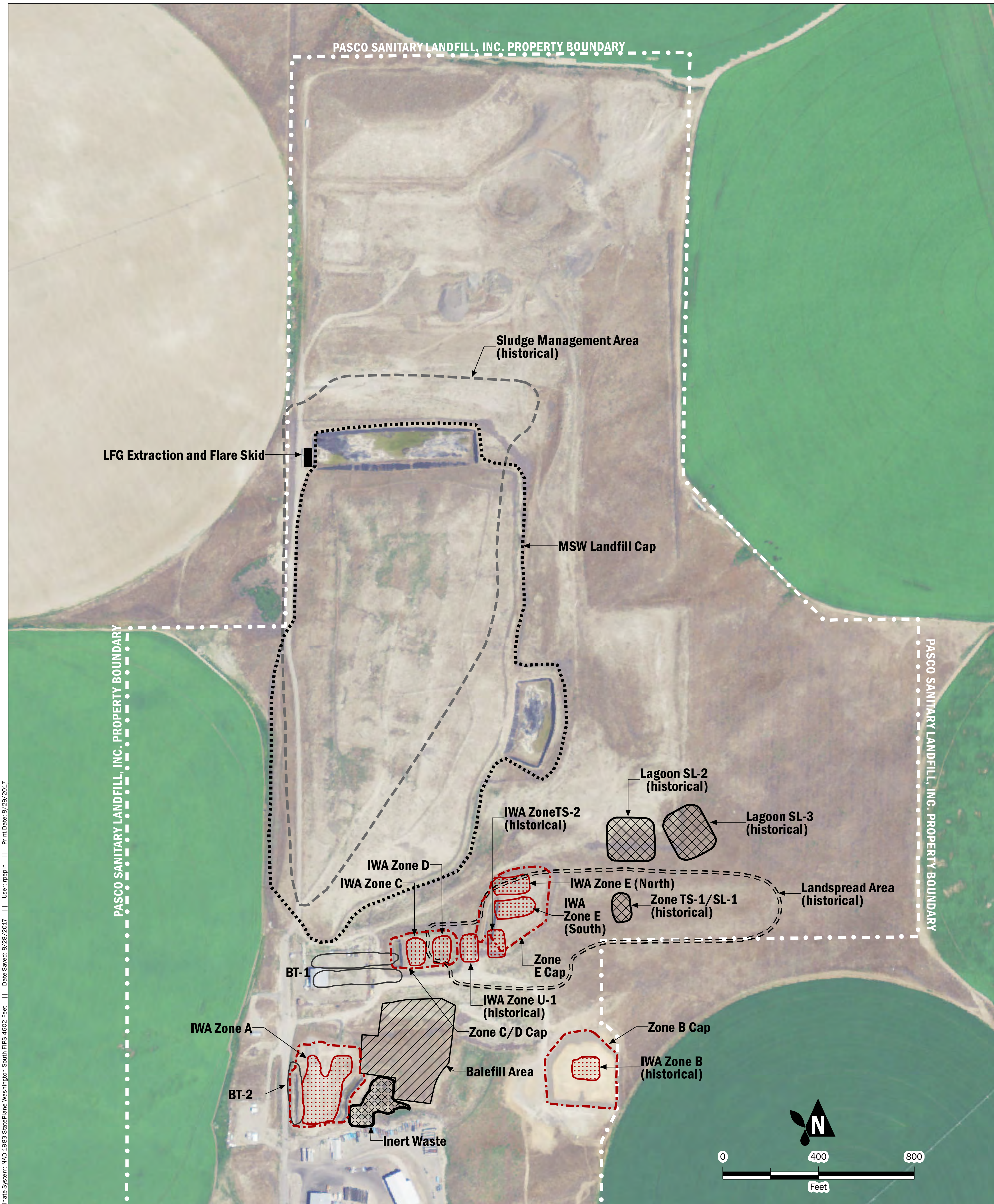
Note:
Alternatives are ranked with 1 being the least favorable rating and 3 being the most favorable rating.

FIGURES

FIGURES



GIS Path: T:\projects_8\Pasco_Landfill\Delivered\FFS Report\1.2-1 Site Map.mxd || Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet || Date Saved: 8/28/2017 || User: rpepin || Print Date: 8/29/2017



Notes:
(1) Aerial photo source: NAIP 2013
(2) Locations are approximate.
(3) Waste area boundaries based on Figure 2-5 in Phase I RI (Burlington Environmental, 1993), as-built construction drawings (IT Corp, 2002), and information recently presented (Pasco IWAG III Technical Committee, 2014).
(4) Burned municipal waste materials may be present beneath the Zone A industrial wastes, as indicated by borings logs from the 2011 Zone A investigation.
(5) Historical waste areas were generally consolidated within closure areas, as detailed in the text, and do not reflect current waste placement.
(6) Installation of a RCRA C cap at Zone B was completed in 2013.

Industrial Waste Areas
IWA Caps
Sludge Lagoons
Sludge Management Area
MSW Landfill Cap
Landspread Area
Balefill Area
Burn Trenches
Inert Waste Disposal Area

Property Boundary and Location of Waste Disposal Areas

Pasco Landfill Site
Pasco, Washington

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AUG-2017	BY: PSB / RAP	FIGURE NO.
PROJECT NO. 060255	REVISED BY: ACG / RAP	**1.2-2**

GIS Path: T:\projects_8\Pasco_Landfill\Delivered\FFS Report\1.2-2 Pasco Sanitary Landfill Property Boundary.mxd || Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet || Date Saved: 8/28/2017 || User: rpepin || Print Date: 8/29/2017

Parcel	Type	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Parcel 1	Deed	Franklin County Irrigation District								Dietrich, John and Marjorie (J&M Dietrich)																						Pasco Sanitary Landfill, Inc. (PSLI)																																	
Parcel 1	Lease	J&M Dietrich																		Resource Recovery Corporation (RRC)																																															
Parcel 2	Deed	Sanislo, A. N.																							J&M Dietrich							PSLI																																	
Parcel 2	Lease						J&M Dietrich (Treasurer Deed)									J&M Dietrich				RRC																	Dietrich, Leonard (Real Estate Contract)																												
Parcel 3	Deed	Sanislo, A. N.																							J&M Dietrich																																										
Parcel 3	Lease						J&M Dietrich									J&M Dietrich (Treasurer Deed)				RRC												PSLI																																	
Parcel 4	Deed	Northern Pacific Railway Company																			Burlington Northern Railroad Company															GPC	PSLI																														
Parcel 4	Lease					J&M Dietrich															RRC								PSLI		PSLI							(GPC = Glacier Park Company)																											
Parcel 5	Deed	US. Department of the Interior																													PSLI																																		
Parcel 5	Lease																				RRC								J&M Dietrich																																				
Parcel 6	Deed	Tomlinson Dairy																																																														
Parcel 6	Lease																				RRC																																													
Parcel 7	Deed	Columbia East Development																																		PSLI																														

Excerpt from Phase I Remedial Investigation:
"The lease and ownership history of all the parcels of the [facility] is presented in Table 3-5. Figure 3-13 indicates the geographic location of the parcels referenced in Table 3-5. The information presented in Table 3-5 and Figure 3-13 was gathered from a search of all available Burlington Environmental, Chempro, PSL and RRC files. One of the documents encountered was a title search of all the parcels comprising the [facility] conducted in 1991 by McCluskey, Sells, Ryan, Olbertz & Haberty, Attorneys at Law. However, the information included in the title search appears to have some discrepancies in the parcel descriptions and owners. Therefore, the lease and ownership history was developed using original documents where available, and supplemented as needed with information from the title search. Due to discrepancies in the title search and lack of sufficient original documents, the accurate ownership history of the parcels in the west half of the northwest quarter of Section 22 could not be fully resolved."

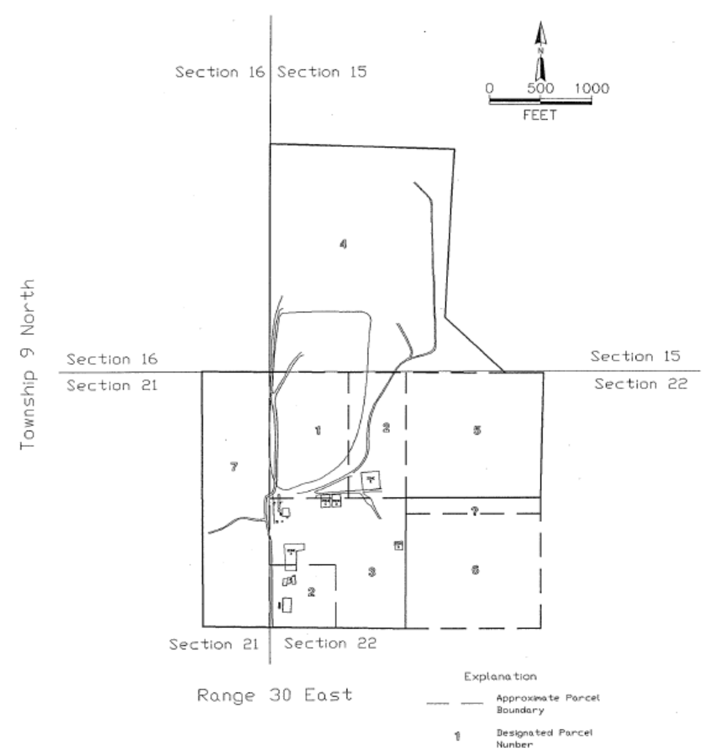
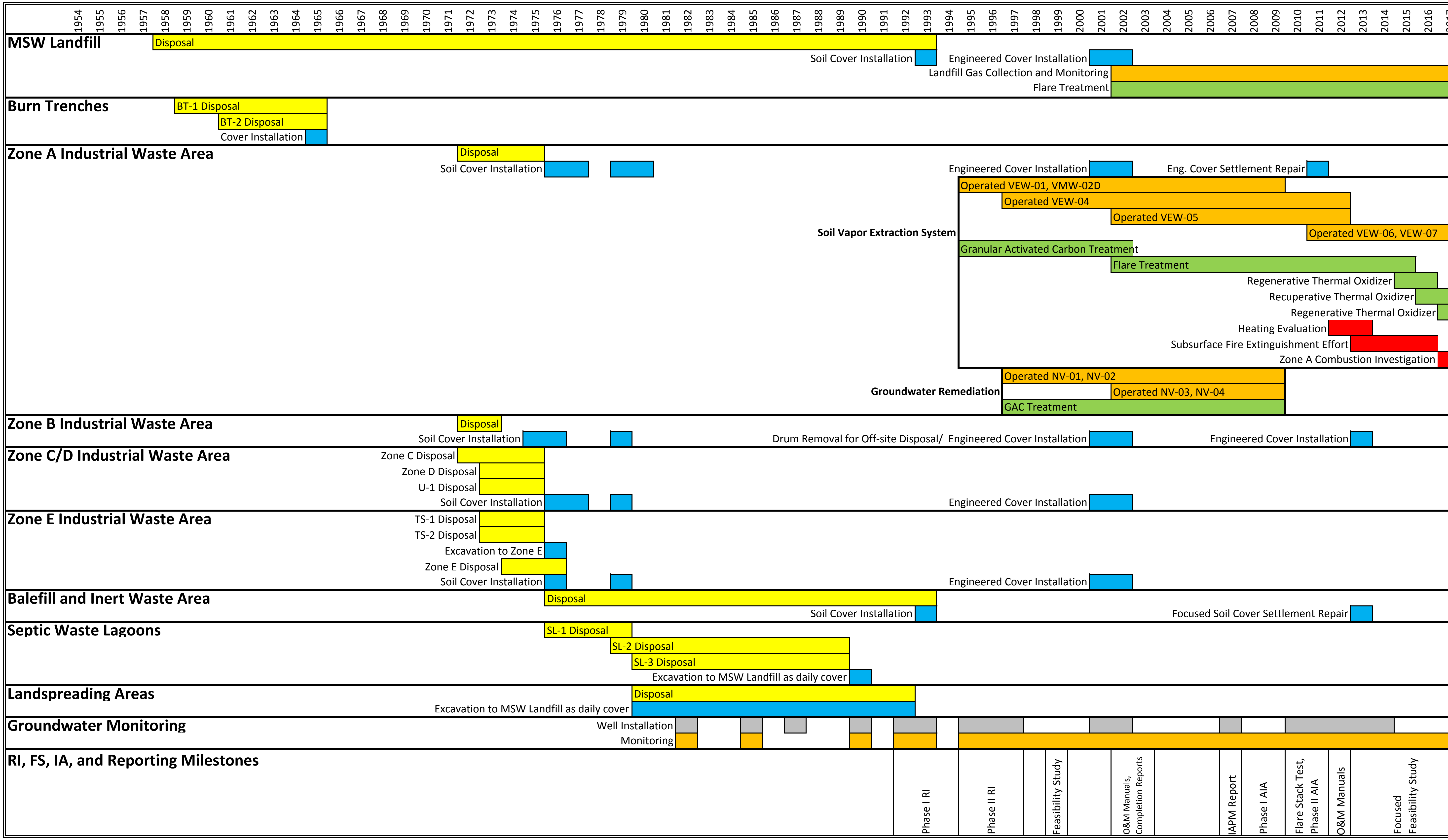


Figure 3-13 from Phase I Remedial Investigation



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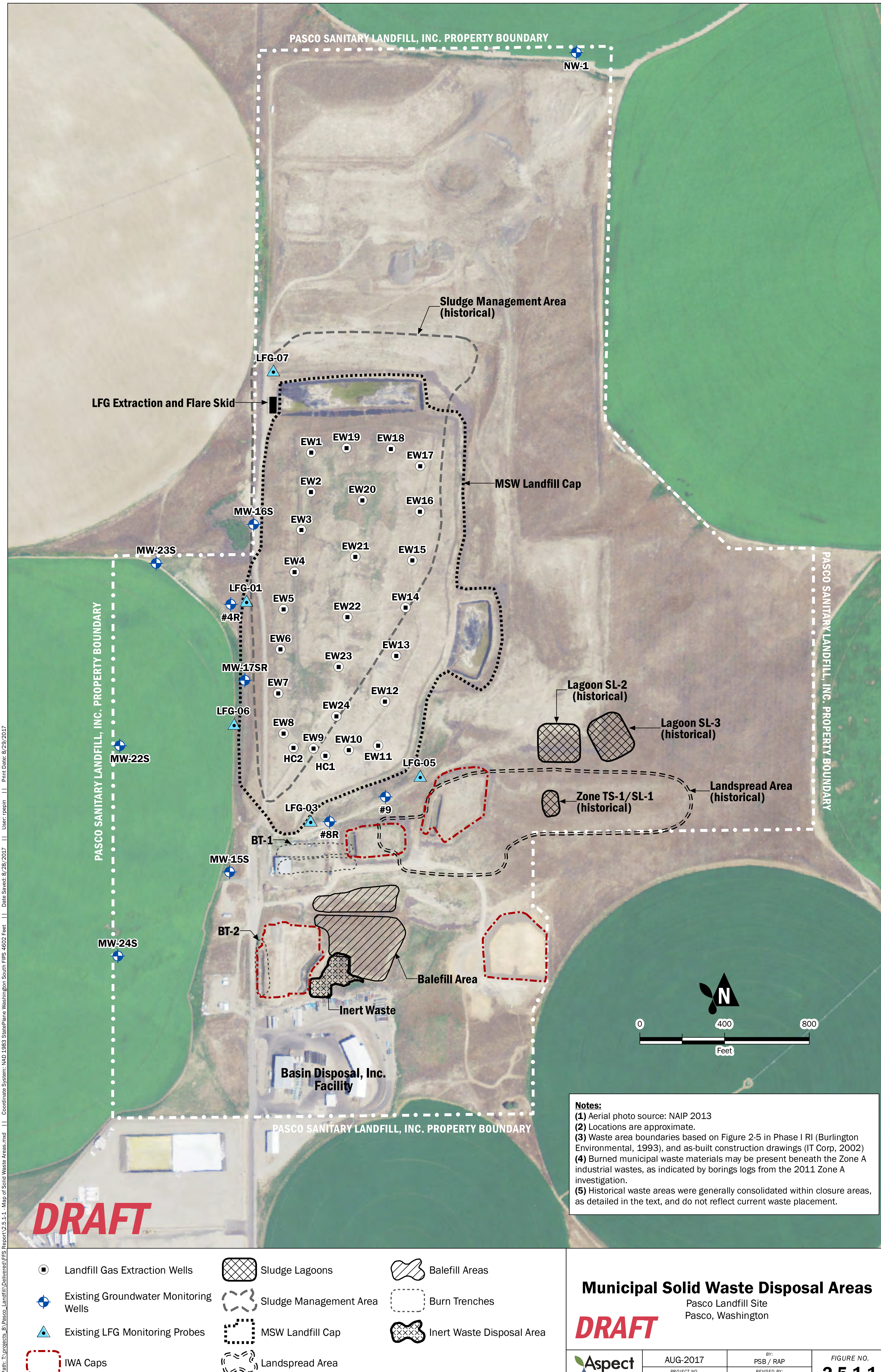
V:\060255 Pasco Landfill Group\Deliverables\FFS Report\Revised FFS\Tables and Figures\ActivitySummary_20170726.xlsx

Figure 2.3-2
Timeline of Operations, Closure, Cover, Remediation, and Monitoring
MSW Landfill, Pasco, WA



Municipal Solid Waste Disposal Areas

Pasco Landfill Site
Pasco, Washington

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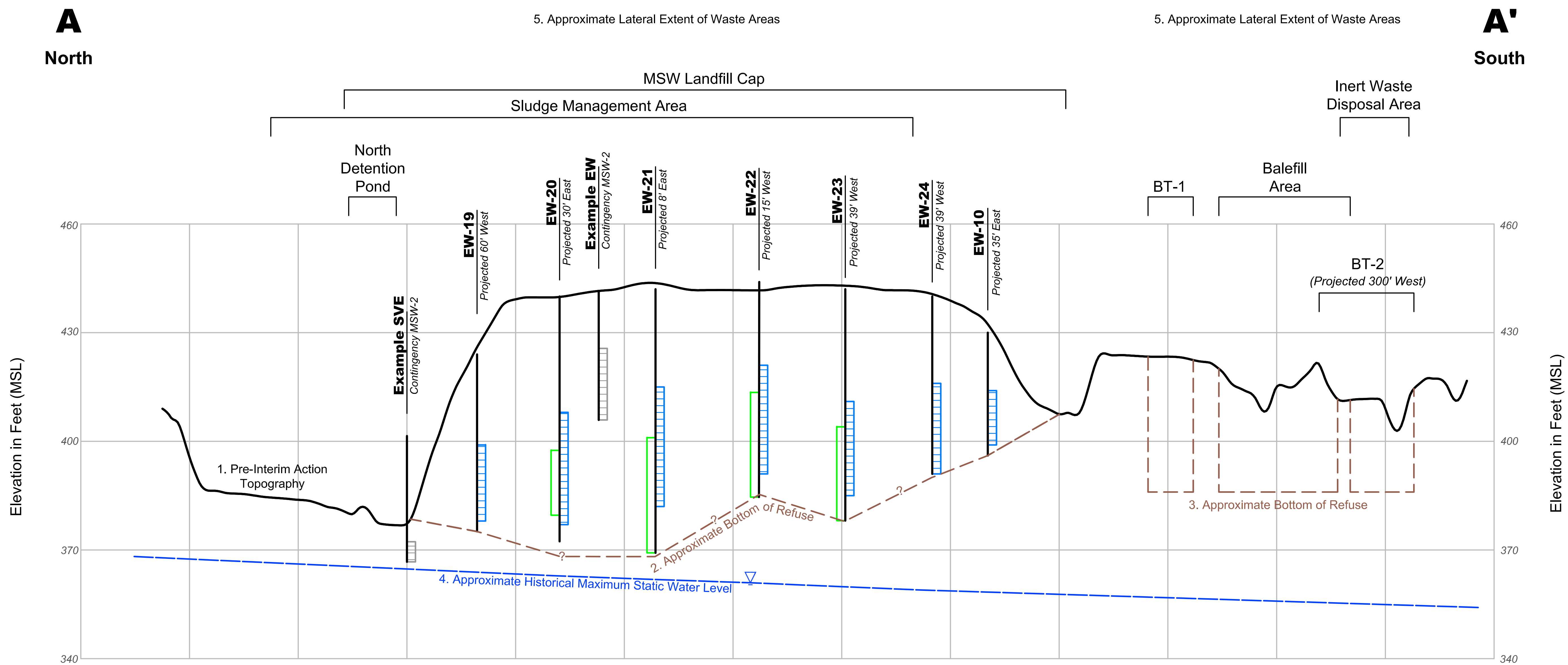
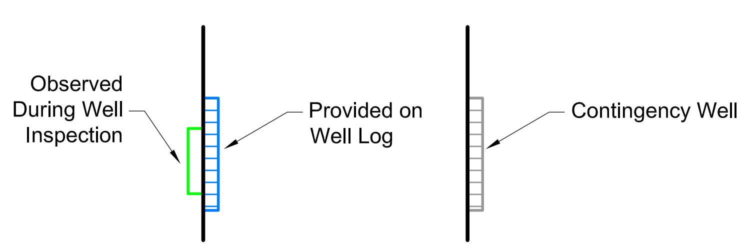
AUG-2017	BY: PSB / RAP	FIGURE NO.	
PROJECT NO. 060255	REVISED BY: ACG / RAP	**2.5.1-1**	



Well Perforation Interval:



0 300 600
Feet

1" = 30' Vertical
Scale: 1" = 300' Horizontal

Notes:
1. Pre-Interim Action Topography - based on photogrammetric methods using aerial photo from March 11, 2000 (IT Corp., 2002).
2. Approximate Bottom of Refuse estimated from drillers logs and well inspections in 2014.
3. Approximate Bottom of Refuse estimated from sub-Zone A investigation (EPI, 2012) and minimum topographic elevations in the vicinity.
4. Approximate Groundwater Level - estimated from historical maximum water levels observed during 2nd Quarter 2011.
5. Approximate lateral extent for waste areas consistent with boundaries illustrated in Figure 2.5.1-1.

Cross Section A-A'
of Municipal Solid Waste Areas

Pasco Landfill Site
Pasco, Washington

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Aug-2016	BY: PSB/SCC	FIGURE NO.	
PROJECT NO. 060255	REV BY: SCC	**2.5.1-2**	

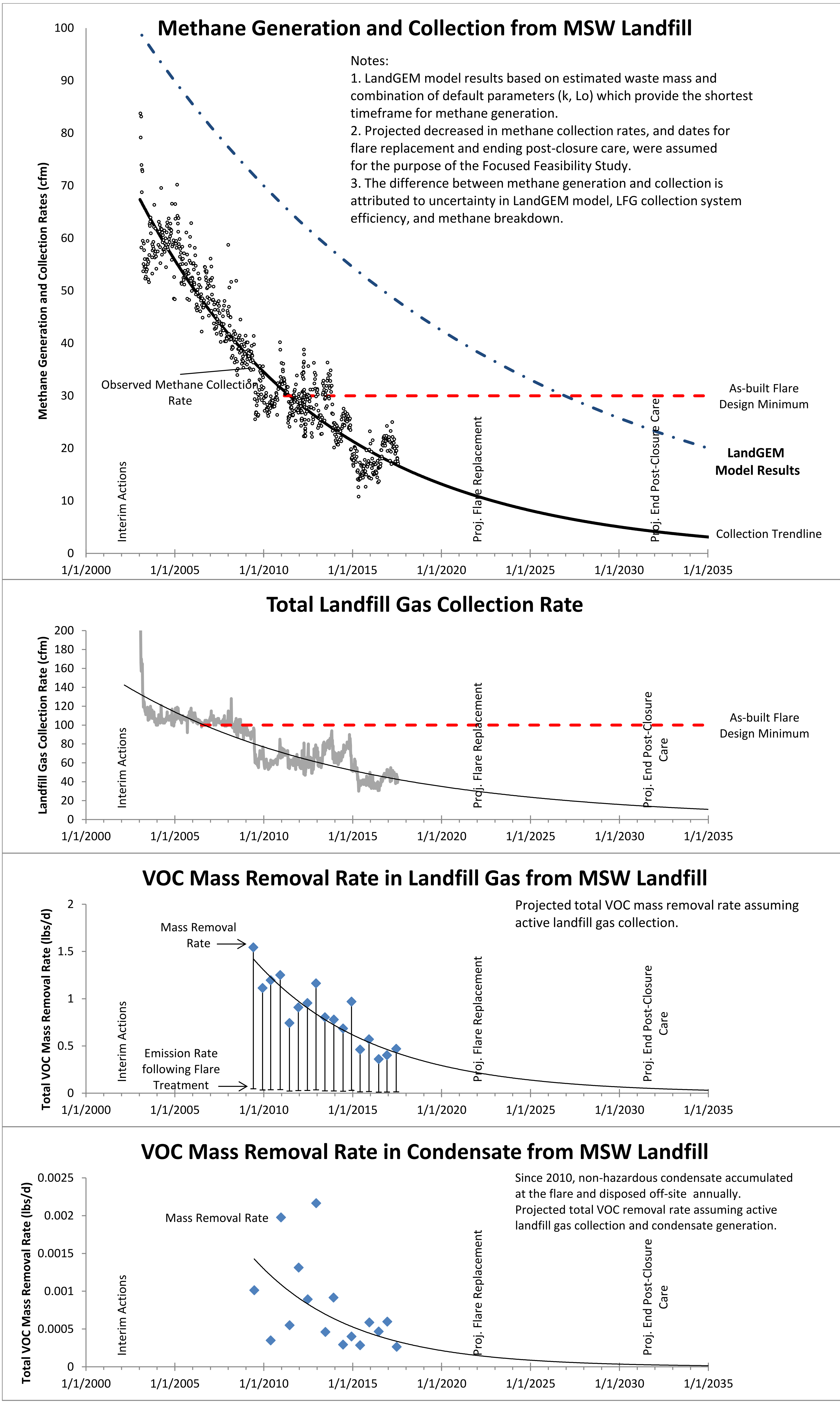

Figure 2.5.1-3
Decreasing Methane Generation and Collection Rates from the MSW Landfill
Pasco Sanitary Landfill NPL Site

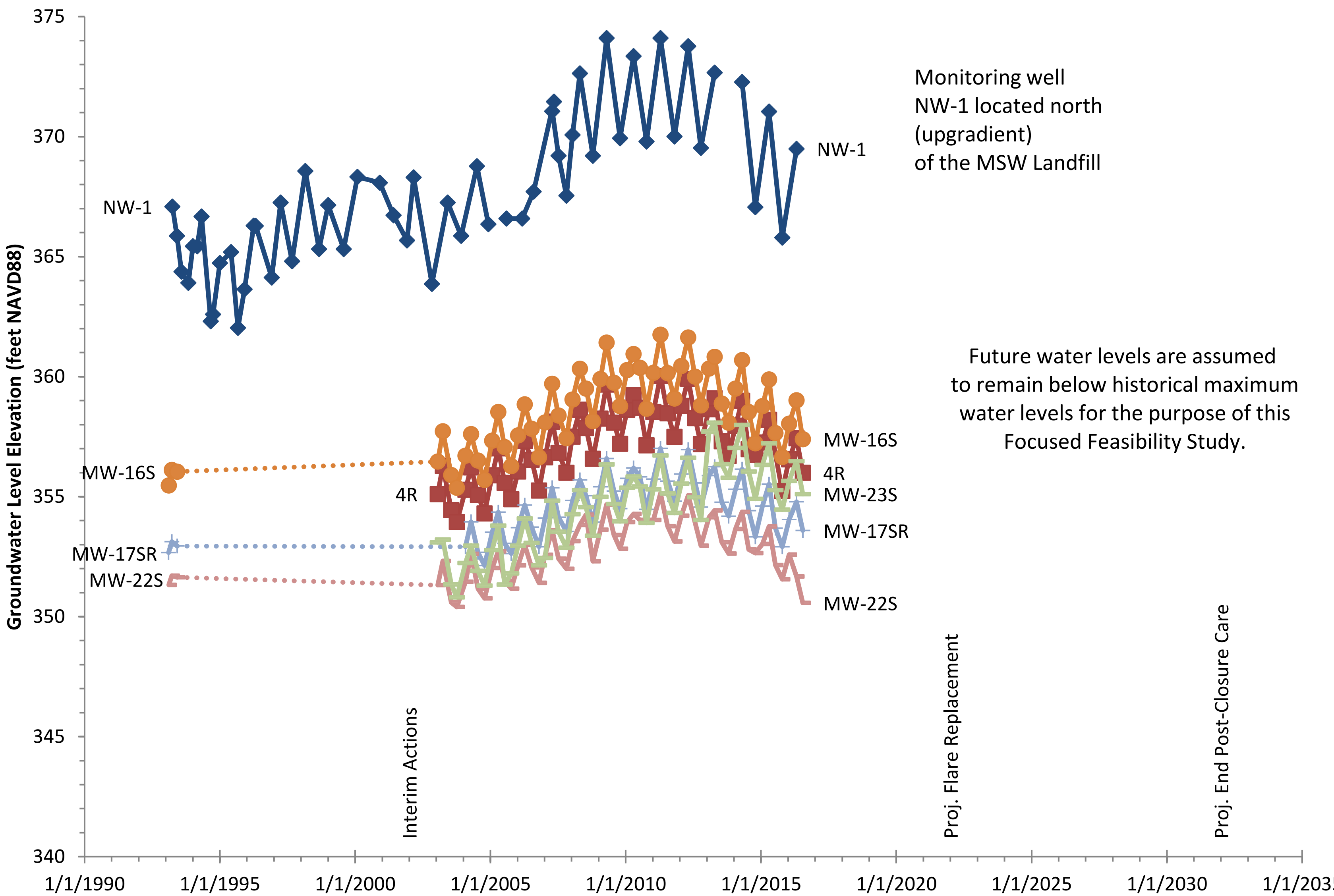

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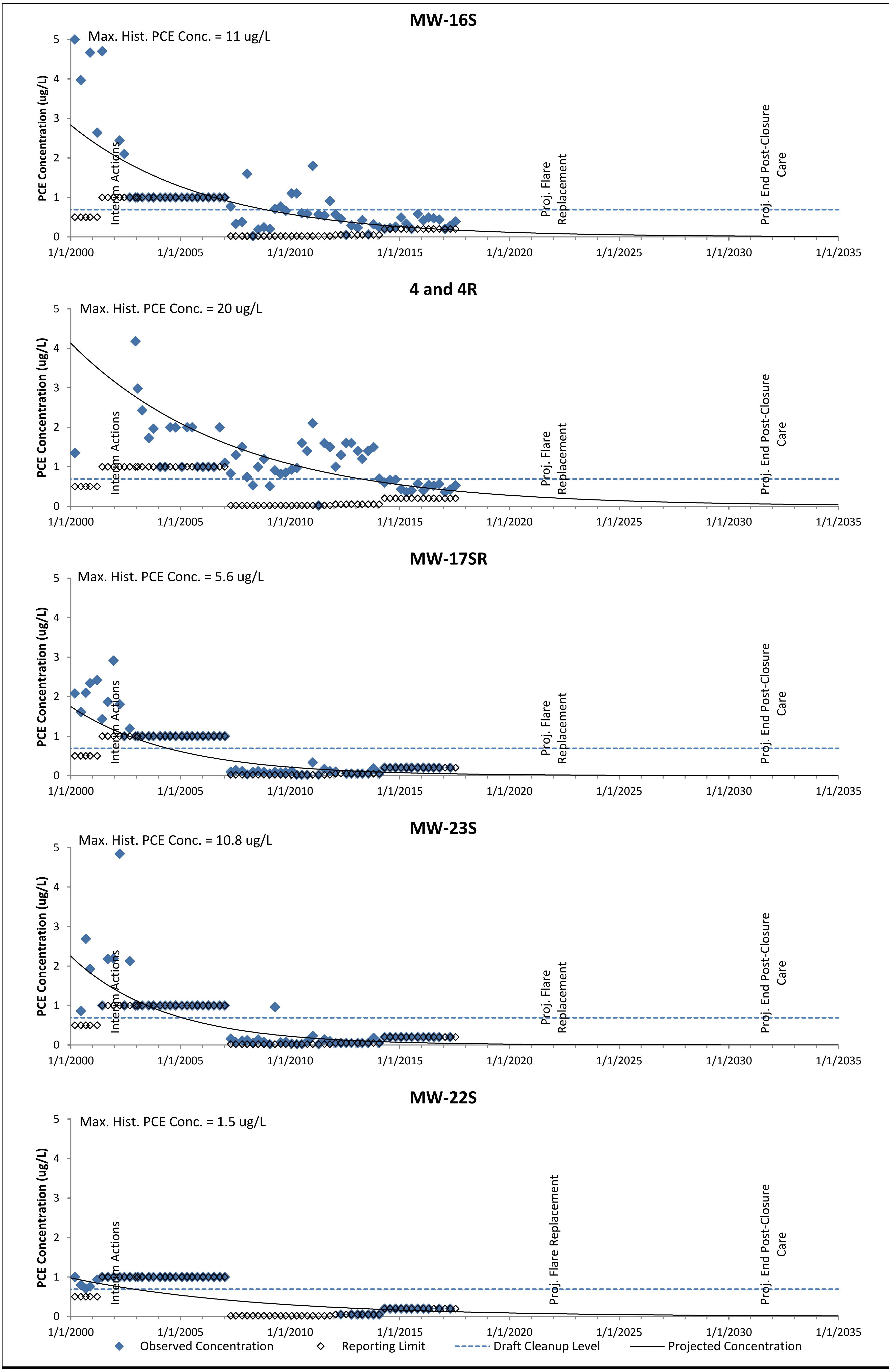
Figure 2.5.1-4
Changes in Groundwater Levels at MSW Landfill Monitoring Wells
Pasco Sanitary Landfill NPL Site



Projected concentrations based on trendline through all observed concentrations, including non-detects at reporting limit.

Figure 2.5.1-5
Decreasing PCE Concentrations to Below Cleanup Levels in MSW Landfill Wells
Pasco Sanitary Landfill NPL Site

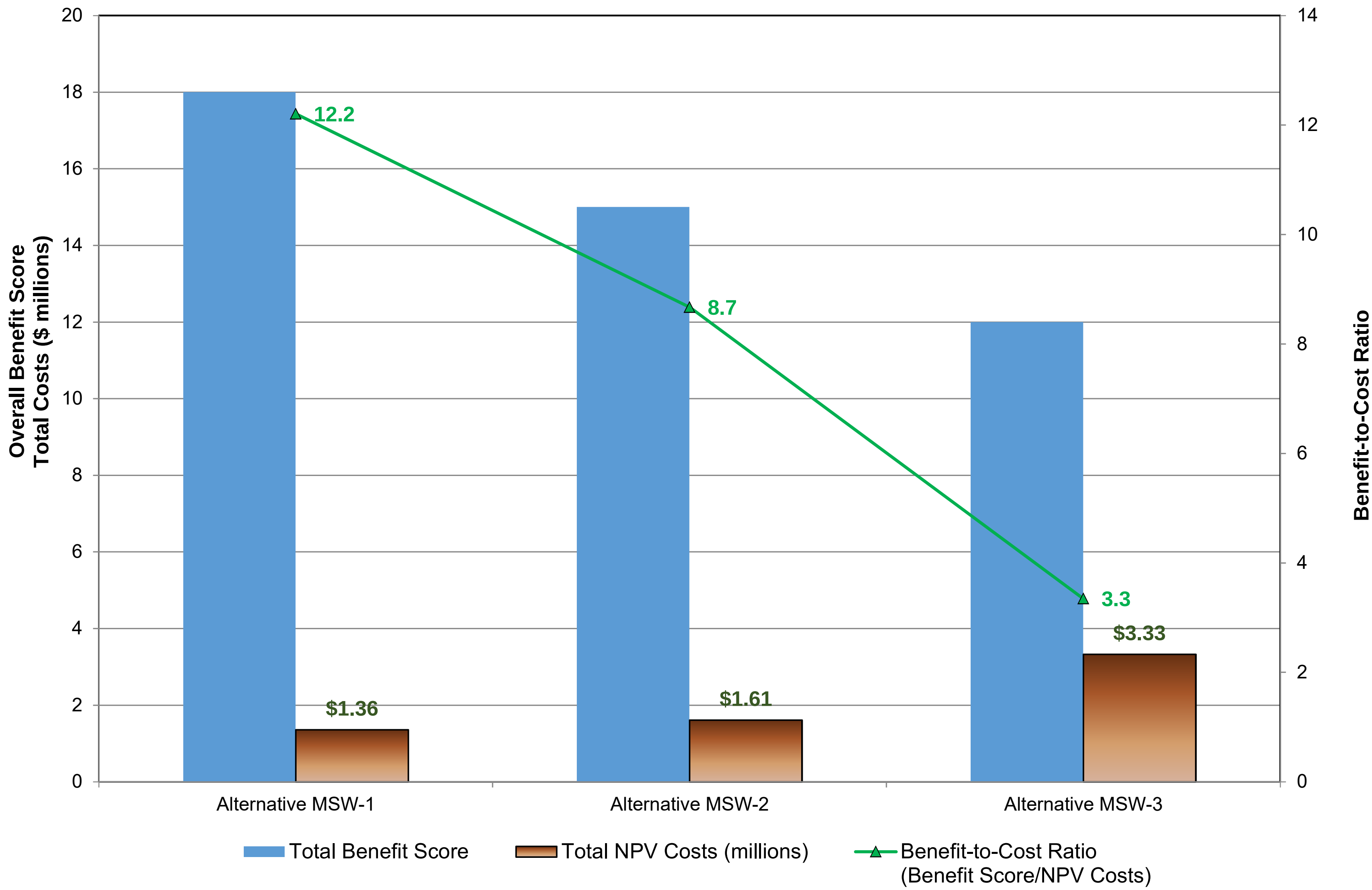


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Figure 6.3.1-1
MSW Landfill Disproportionate Cost Analysis
Focused Feasibility Study
Pasco Landfill, Pasco, WA

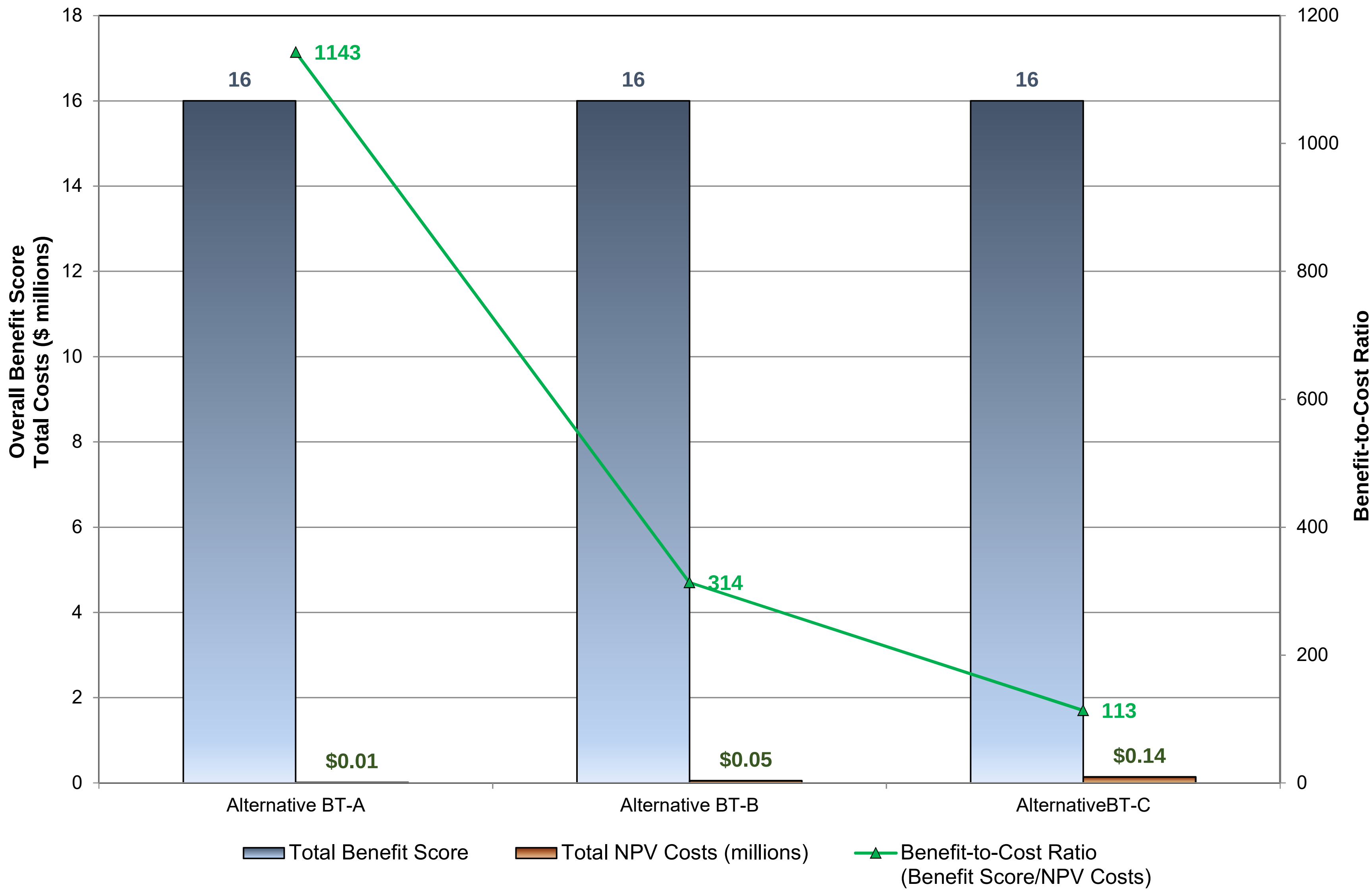

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Figure 6.3.2-1
Burn Trenches Disproportionate Cost Analysis

Focused Feasibility Study
Pasco Landfill, Pasco, WA

APPENDIX A

MSW Disposal Areas Landfill Gas Generation Rates

A. Introduction

This appendix provides estimates of methane generation using the U.S. Environmental Protection Agency (EPA) model LandGEM (EPA, 2005), and a brief comparison of potential methane generation to observed conditions, supporting the summary provided in Section 2.5.1. Methane generation projections for all MSW Disposal Areas are relatively low compared to historical conditions, and trending downward. LandGEM results provide estimated methane generation in 2017 of approximately:

- 50 standard cubic feet per minute (scfm) at the MSW Landfill;
- 5 scfm at the Balefill and Inert Waste Disposal Areas; and
- 0.5 scfm at the Burn Trenches.

The LandGEM results likely provide estimated methane generation rates greater than actual. The factors resulting in this difference are introduced below.

A.1. Factors Affecting Methane Generation Estimates and Collection Rates

Both methane generation and collection are complex processes. Methane generation is due to decomposition of MSW under anaerobic conditions; methane collection is achieved by applying a vacuum to vertical wells completed within the MSW. The accuracy of methane generation estimates is affected by multiple factors, including waste volume, density, age, moisture content, and potential methane generating capacity, among others. Actual methane collection efficiency is affected by the landfill gas collection system design and mode of operation. Figure 2.5.1-3 compares estimated methane generation with observed methane collection rates.

A.2. LandGEM Assumptions

The LandGEM software was used to estimate potential landfill gas generation rates for the MSW Landfill, the Balefill and Inert Waste Areas, and the Burn Trenches. The LandGEM reports include assumptions and results, and are provided as Attachment A-1. The LandGEM assumptions for the MSW Disposal Areas included:

- The mass of potential methane-generating waste was calculated from the estimated volume of waste and an estimated density of waste.
  - The volumes were estimated in the Ecology-approved FFS Work Plan (Anchor, QEA et al., 2013). Since then, observations on waste thickness confirmed the original volumes estimates, as discussed in Section 2.5.1.

  - The average density of Balefill MSW was assume to be 1,500 pounds per cubic yard. The density of MSW elsewhere was assumed to be of 1,000 pounds per cubic yard.

- The waste placement history was assumed to be uniform during the years of operation.
- The methane generation potential was estimated to be 100 cubic meters per megagram of waste, the lower of two default values (compared to 170 cubic meters per megagram).
- The decay in methane generation rate was estimated to be 0.05 per year, the greater of two default values (compared to 0.02 per year).
- Methane generation was assumed to account for 50% of total landfill gas generation.

The combination of the lower methane generation potential and greater decay for methane generation rates yields a low amount of contemporary landfill gas generation, compared to results using alternative assumptions.

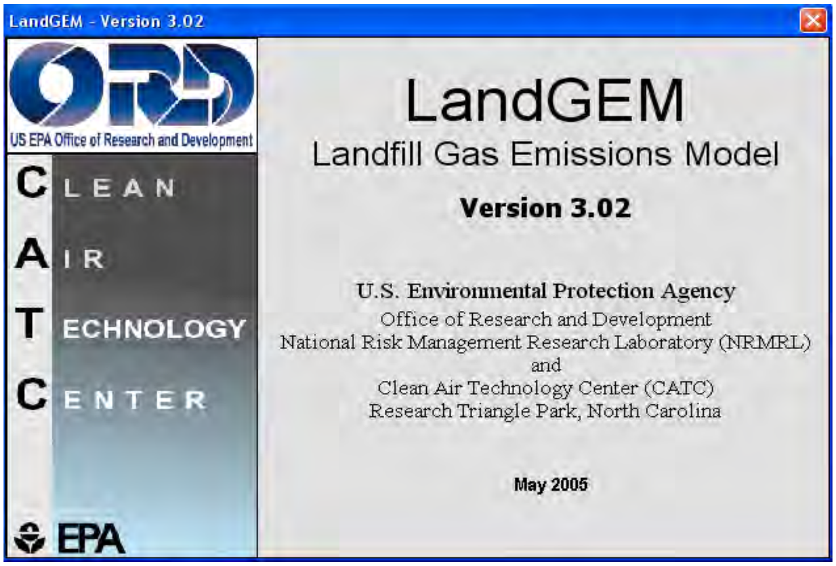
A.3. LandGEM Results Compared to Observed Conditions

For 2017, the LandGEM results estimate a methane generation rate of approximately 50 scfm for the MSW Landfill, whereas the observed methane collection rate has been 20 scfm, on average. Historically, the actual methane collection rate has been approximately 50 percent of the LandGEM-estimated methane generation rate, on average. Figure 2.5.1-3 shows that methane collection rates have been less than the flare design minimum. Flare modifications (such as improved louver control, automated temperature control, removing unnecessary burner arms) have allowed reliable operation below the design minimum. The observed minimum operational limit for the existing flare is related to the flammability limit of the landfill gas being collected, which is approximately 25 to 30 percent methane. For the purposes of this revised draft FFS report, an alternative landfill gas treatment system will replace the existing flare in 5 years (in 2022).

For 2017, the LandGEM results provide an estimated methane generation rate of approximately 5 scfm for the Balefill and Inert Waste Disposal Areas. Observed subsurface conditions suggest that both aerobic and anaerobic decomposition in the Balefill and Inert Waste Disposal Areas are currently occurring, based on the presence of oxygen in many of the gas probes. Landfill gas generation under aerobic conditions produces primarily carbon dioxide and little, if any, methane. Therefore, actual methane generation in the Balefill and Inert Waste Disposal Areas is likely less than the value estimated by the LandGEM model.

For 2017, the LandGEM results provide an estimated methane generation rate of approximately 0.5 scfm for the Burn Trenches. Based on the composition of MSW, primarily burned MSW, the actual methane generation in the Burn Trenches is likely is less than the value provided by the LandGEM model.

Similar to the methane generation rates, the risks of potential exposure associated with landfill gas transport from MSW Disposal Areas are low and trending downward. In conclusion, the LandGEM model results show the MSW Disposal Areas are approaching, or have reached, functional stability with respect to landfill gas generation.



Summary Report

Landfill Name or Identifier: Pasco Sanitary Landfill - MSW Landfill

Date: Wednesday, August 27, 2014

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n}\sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10}\right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation (*m^3/year*)
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate (*$year^{-1}$*)
L_o = potential methane generation capacity (*m^3/Mg*)

M_i = mass of waste accepted in the i^{th} year (*Mg*)
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1958**	
Landfill Closure Year (with 80-year limit)	**1993**	
Actual Closure Year (without limit)	***1993***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity	**1,030,000**	*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.050**	*year* $^{-1}$
Potential Methane Generation Capacity, L_o	**100**	*m* ^{3} */Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1958	29,429	32,371	0	0
1959	29,429	32,371	29,429	32,371
1960	29,429	32,371	58,857	64,743
1961	29,429	32,371	88,286	97,114
1962	29,429	32,371	117,714	129,486
1963	29,429	32,371	147,143	161,857
1964	29,429	32,371	176,571	194,229
1965	29,429	32,371	206,000	226,600
1966	29,429	32,371	235,429	258,971
1967	29,429	32,371	264,857	291,343
1968	29,429	32,371	294,286	323,714
1969	29,429	32,371	323,714	356,086
1970	29,429	32,371	353,143	388,457
1971	29,429	32,371	382,571	420,829
1972	29,429	32,371	412,000	453,200
1973	29,429	32,371	441,429	485,571
1974	29,429	32,371	470,857	517,943
1975	29,429	32,371	500,286	550,314
1976	29,429	32,371	529,714	582,686
1977	29,429	32,371	559,143	615,057
1978	29,429	32,371	588,571	647,429
1979	29,429	32,371	618,000	679,800
1980	29,429	32,371	647,429	712,171
1981	29,429	32,371	676,857	744,543
1982	29,429	32,371	706,286	776,914
1983	29,429	32,371	735,714	809,286
1984	29,429	32,371	765,143	841,657
1985	29,429	32,371	794,571	874,029
1986	29,429	32,371	824,000	906,400
1987	29,429	32,371	853,429	938,771
1988	29,429	32,371	882,857	971,143
1989	29,429	32,371	912,286	1,003,514
1990	29,429	32,371	941,714	1,035,886
1991	29,429	32,371	971,143	1,068,257
1992	29,429	32,371	1,000,571	1,100,629
1993	0	0	1,030,000	1,133,000
1994	0	0	1,030,000	1,133,000
1995	0	0	1,030,000	1,133,000
1996	0	0	1,030,000	1,133,000
1997	0	0	1,030,000	1,133,000

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1998	0	0	1,030,000	1,133,000
1999	0	0	1,030,000	1,133,000
2000	0	0	1,030,000	1,133,000
2001	0	0	1,030,000	1,133,000
2002	0	0	1,030,000	1,133,000
2003	0	0	1,030,000	1,133,000
2004	0	0	1,030,000	1,133,000
2005	0	0	1,030,000	1,133,000
2006	0	0	1,030,000	1,133,000
2007	0	0	1,030,000	1,133,000
2008	0	0	1,030,000	1,133,000
2009	0	0	1,030,000	1,133,000
2010	0	0	1,030,000	1,133,000
2011	0	0	1,030,000	1,133,000
2012	0	0	1,030,000	1,133,000
2013	0	0	1,030,000	1,133,000
2014	0	0	1,030,000	1,133,000
2015	0	0	1,030,000	1,133,000
2016	0	0	1,030,000	1,133,000
2017	0	0	1,030,000	1,133,000
2018	0	0	1,030,000	1,133,000
2019	0	0	1,030,000	1,133,000
2020	0	0	1,030,000	1,133,000
2021	0	0	1,030,000	1,133,000
2022	0	0	1,030,000	1,133,000
2023	0	0	1,030,000	1,133,000
2024	0	0	1,030,000	1,133,000
2025	0	0	1,030,000	1,133,000
2026	0	0	1,030,000	1,133,000
2027	0	0	1,030,000	1,133,000
2028	0	0	1,030,000	1,133,000
2029	0	0	1,030,000	1,133,000
2030	0	0	1,030,000	1,133,000
2031	0	0	1,030,000	1,133,000
2032	0	0	1,030,000	1,133,000
2033	0	0	1,030,000	1,133,000
2034	0	0	1,030,000	1,133,000
2035	0	0	1,030,000	1,133,000
2036	0	0	1,030,000	1,133,000
2037	0	0	1,030,000	1,133,000

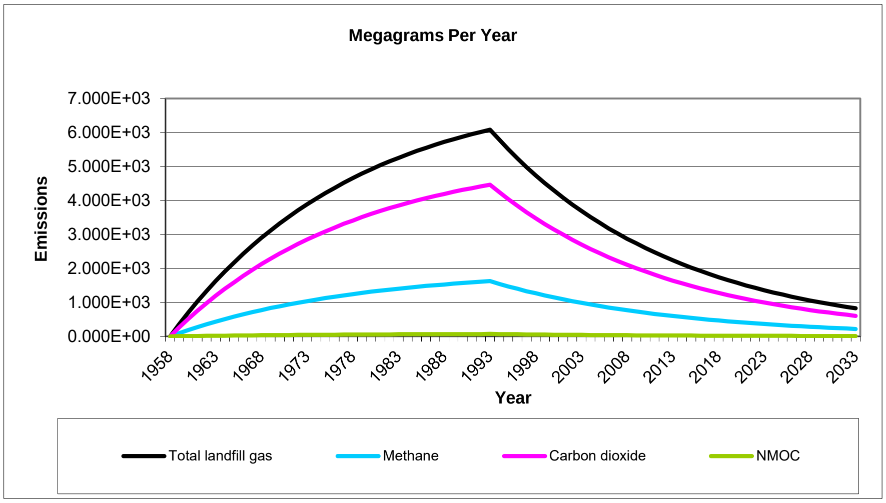
Pollutant Parameters

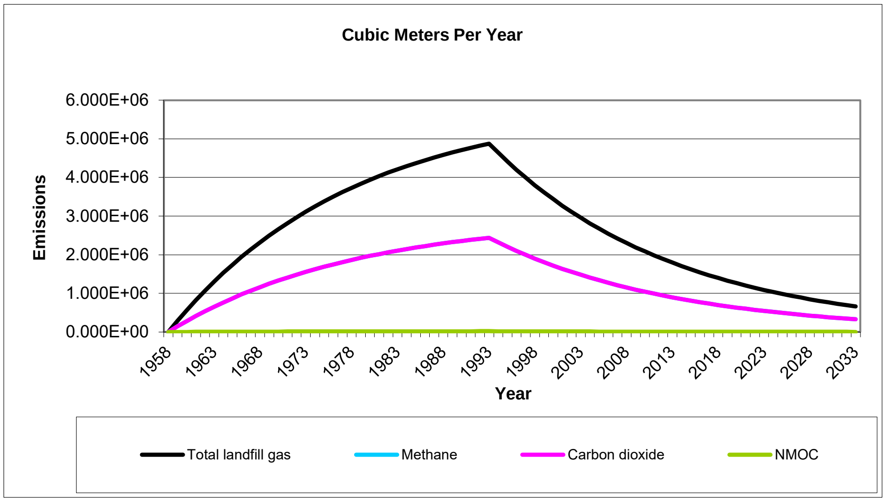
	Compound	Gas / Pollutant Default Parameters: Concentration (*ppmv*)	Molecular Weight	User-specified Pollutant Parameters: Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

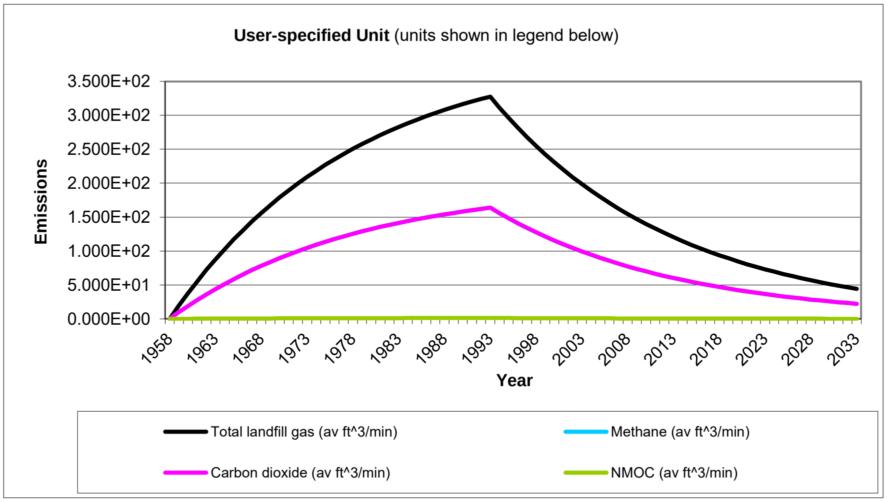
Pollutant Parameters (Continued)

	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
1958	0	0	0	0	0	0
1959	3.594E+02	2.878E+05	1.934E+01	9.599E+01	1.439E+05	9.668E+00
1960	7.012E+02	5.615E+05	3.773E+01	1.873E+02	2.808E+05	1.886E+01
1961	1.026E+03	8.219E+05	5.522E+01	2.742E+02	4.109E+05	2.761E+01
1962	1.336E+03	1.070E+06	7.186E+01	3.568E+02	5.348E+05	3.593E+01
1963	1.630E+03	1.305E+06	8.769E+01	4.354E+02	6.526E+05	4.385E+01
1964	1.910E+03	1.529E+06	1.028E+02	5.101E+02	7.646E+05	5.138E+01
1965	2.176E+03	1.742E+06	1.171E+02	5.812E+02	8.712E+05	5.854E+01
1966	2.429E+03	1.945E+06	1.307E+02	6.489E+02	9.726E+05	6.535E+01
1967	2.670E+03	2.138E+06	1.437E+02	7.132E+02	1.069E+06	7.183E+01
1968	2.899E+03	2.322E+06	1.560E+02	7.744E+02	1.161E+06	7.800E+01
1969	3.117E+03	2.496E+06	1.677E+02	8.327E+02	1.248E+06	8.386E+01
1970	3.325E+03	2.662E+06	1.789E+02	8.880E+02	1.331E+06	8.944E+01
1971	3.522E+03	2.820E+06	1.895E+02	9.407E+02	1.410E+06	9.474E+01
1972	3.709E+03	2.970E+06	1.996E+02	9.908E+02	1.485E+06	9.979E+01
1973	3.888E+03	3.113E+06	2.092E+02	1.039E+03	1.557E+06	1.046E+02
1974	4.058E+03	3.249E+06	2.183E+02	1.084E+03	1.625E+06	1.092E+02
1975	4.219E+03	3.379E+06	2.270E+02	1.127E+03	1.689E+06	1.135E+02
1976	4.373E+03	3.502E+06	2.353E+02	1.168E+03	1.751E+06	1.176E+02
1977	4.519E+03	3.618E+06	2.431E+02	1.207E+03	1.809E+06	1.216E+02
1978	4.658E+03	3.730E+06	2.506E+02	1.244E+03	1.865E+06	1.253E+02
1979	4.790E+03	3.836E+06	2.577E+02	1.279E+03	1.918E+06	1.289E+02
1980	4.916E+03	3.936E+06	2.645E+02	1.313E+03	1.968E+06	1.322E+02
1981	5.035E+03	4.032E+06	2.709E+02	1.345E+03	2.016E+06	1.355E+02
1982	5.149E+03	4.123E+06	2.770E+02	1.375E+03	2.062E+06	1.385E+02
1983	5.257E+03	4.210E+06	2.829E+02	1.404E+03	2.105E+06	1.414E+02
1984	5.360E+03	4.292E+06	2.884E+02	1.432E+03	2.146E+06	1.442E+02
1985	5.458E+03	4.371E+06	2.937E+02	1.458E+03	2.185E+06	1.468E+02
1986	5.552E+03	4.445E+06	2.987E+02	1.483E+03	2.223E+06	1.493E+02
1987	5.640E+03	4.516E+06	3.035E+02	1.507E+03	2.258E+06	1.517E+02
1988	5.724E+03	4.584E+06	3.080E+02	1.529E+03	2.292E+06	1.540E+02
1989	5.805E+03	4.648E+06	3.123E+02	1.550E+03	2.324E+06	1.562E+02
1990	5.881E+03	4.709E+06	3.164E+02	1.571E+03	2.355E+06	1.582E+02
1991	5.953E+03	4.767E+06	3.203E+02	1.590E+03	2.384E+06	1.602E+02
1992	6.022E+03	4.823E+06	3.240E+02	1.609E+03	2.411E+06	1.620E+02
1993	6.088E+03	4.875E+06	3.276E+02	1.626E+03	2.438E+06	1.638E+02
1994	5.791E+03	4.637E+06	3.116E+02	1.547E+03	2.319E+06	1.558E+02
1995	5.509E+03	4.411E+06	2.964E+02	1.471E+03	2.206E+06	1.482E+02
1996	5.240E+03	4.196E+06	2.819E+02	1.400E+03	2.098E+06	1.410E+02
1997	4.985E+03	3.991E+06	2.682E+02	1.331E+03	1.996E+06	1.341E+02
1998	4.741E+03	3.797E+06	2.551E+02	1.266E+03	1.898E+06	1.276E+02
1999	4.510E+03	3.612E+06	2.427E+02	1.205E+03	1.806E+06	1.213E+02
2000	4.290E+03	3.435E+06	2.308E+02	1.146E+03	1.718E+06	1.154E+02
2001	4.081E+03	3.268E+06	2.196E+02	1.090E+03	1.634E+06	1.098E+02
2002	3.882E+03	3.108E+06	2.089E+02	1.037E+03	1.554E+06	1.044E+02
2003	3.693E+03	2.957E+06	1.987E+02	9.863E+02	1.478E+06	9.934E+01
2004	3.513E+03	2.813E+06	1.890E+02	9.382E+02	1.406E+06	9.449E+01
2005	3.341E+03	2.676E+06	1.798E+02	8.925E+02	1.338E+06	8.988E+01
2006	3.178E+03	2.545E+06	1.710E+02	8.490E+02	1.273E+06	8.550E+01
2007	3.023E+03	2.421E+06	1.627E+02	8.076E+02	1.210E+06	8.133E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2008	2.876E+03	2.303E+06	1.547E+02	7.682E+02	1.151E+06	7.736E+01
2009	2.736E+03	2.191E+06	1.472E+02	7.307E+02	1.095E+06	7.359E+01
2010	2.602E+03	2.084E+06	1.400E+02	6.951E+02	1.042E+06	7.000E+01
2011	2.475E+03	1.982E+06	1.332E+02	6.612E+02	9.910E+05	6.659E+01
2012	2.355E+03	1.885E+06	1.267E+02	6.289E+02	9.427E+05	6.334E+01
2013	2.240E+03	1.793E+06	1.205E+02	5.982E+02	8.967E+05	6.025E+01
2014	2.130E+03	1.706E+06	1.146E+02	5.691E+02	8.530E+05	5.731E+01
2015	2.027E+03	1.623E+06	1.090E+02	5.413E+02	8.114E+05	5.452E+01
2016	1.928E+03	1.544E+06	1.037E+02	5.149E+02	7.718E+05	5.186E+01
2017	1.834E+03	1.468E+06	9.866E+01	4.898E+02	7.342E+05	4.933E+01
2018	1.744E+03	1.397E+06	9.385E+01	4.659E+02	6.984E+05	4.692E+01
2019	1.659E+03	1.329E+06	8.927E+01	4.432E+02	6.643E+05	4.463E+01
2020	1.578E+03	1.264E+06	8.492E+01	4.216E+02	6.319E+05	4.246E+01
2021	1.501E+03	1.202E+06	8.077E+01	4.010E+02	6.011E+05	4.039E+01
2022	1.428E+03	1.144E+06	7.684E+01	3.815E+02	5.718E+05	3.842E+01
2023	1.358E+03	1.088E+06	7.309E+01	3.629E+02	5.439E+05	3.654E+01
2024	1.292E+03	1.035E+06	6.952E+01	3.452E+02	5.174E+05	3.476E+01
2025	1.229E+03	9.843E+05	6.613E+01	3.283E+02	4.921E+05	3.307E+01
2026	1.169E+03	9.363E+05	6.291E+01	3.123E+02	4.681E+05	3.145E+01
2027	1.112E+03	8.906E+05	5.984E+01	2.971E+02	4.453E+05	2.992E+01
2028	1.058E+03	8.472E+05	5.692E+01	2.826E+02	4.236E+05	2.846E+01
2029	1.006E+03	8.058E+05	5.414E+01	2.688E+02	4.029E+05	2.707E+01
2030	9.573E+02	7.665E+05	5.150E+01	2.557E+02	3.833E+05	2.575E+01
2031	9.106E+02	7.292E+05	4.899E+01	2.432E+02	3.646E+05	2.450E+01
2032	8.662E+02	6.936E+05	4.660E+01	2.314E+02	3.468E+05	2.330E+01
2033	8.239E+02	6.598E+05	4.433E+01	2.201E+02	3.299E+05	2.217E+01
2034	7.838E+02	6.276E+05	4.217E+01	2.093E+02	3.138E+05	2.108E+01
2035	7.455E+02	5.970E+05	4.011E+01	1.991E+02	2.985E+05	2.006E+01
2036	7.092E+02	5.679E+05	3.816E+01	1.894E+02	2.839E+05	1.908E+01
2037	6.746E+02	5.402E+05	3.629E+01	1.802E+02	2.701E+05	1.815E+01
2038	6.417E+02	5.138E+05	3.452E+01	1.714E+02	2.569E+05	1.726E+01
2039	6.104E+02	4.888E+05	3.284E+01	1.630E+02	2.444E+05	1.642E+01
2040	5.806E+02	4.649E+05	3.124E+01	1.551E+02	2.325E+05	1.562E+01
2041	5.523E+02	4.423E+05	2.972E+01	1.475E+02	2.211E+05	1.486E+01
2042	5.254E+02	4.207E+05	2.827E+01	1.403E+02	2.103E+05	1.413E+01
2043	4.997E+02	4.002E+05	2.689E+01	1.335E+02	2.001E+05	1.344E+01
2044	4.754E+02	3.807E+05	2.558E+01	1.270E+02	1.903E+05	1.279E+01
2045	4.522E+02	3.621E+05	2.433E+01	1.208E+02	1.810E+05	1.216E+01
2046	4.301E+02	3.444E+05	2.314E+01	1.149E+02	1.722E+05	1.157E+01
2047	4.092E+02	3.276E+05	2.201E+01	1.093E+02	1.638E+05	1.101E+01
2048	3.892E+02	3.117E+05	2.094E+01	1.040E+02	1.558E+05	1.047E+01
2049	3.702E+02	2.965E+05	1.992E+01	9.889E+01	1.482E+05	9.959E+00
2050	3.522E+02	2.820E+05	1.895E+01	9.407E+01	1.410E+05	9.474E+00
2051	3.350E+02	2.682E+05	1.802E+01	8.948E+01	1.341E+05	9.012E+00
2052	3.187E+02	2.552E+05	1.714E+01	8.512E+01	1.276E+05	8.572E+00
2053	3.031E+02	2.427E+05	1.631E+01	8.096E+01	1.214E+05	8.154E+00
2054	2.883E+02	2.309E+05	1.551E+01	7.702E+01	1.154E+05	7.756E+00
2055	2.743E+02	2.196E+05	1.476E+01	7.326E+01	1.098E+05	7.378E+00
2056	2.609E+02	2.089E+05	1.404E+01	6.969E+01	1.045E+05	7.018E+00
2057	2.482E+02	1.987E+05	1.335E+01	6.629E+01	9.936E+04	6.676E+00
2058	2.361E+02	1.890E+05	1.270E+01	6.305E+01	9.451E+04	6.350E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2059	2.245E+02	1.798E+05	1.208E+01	5.998E+01	8.990E+04	6.041E+00
2060	2.136E+02	1.710E+05	1.149E+01	5.705E+01	8.552E+04	5.746E+00
2061	2.032E+02	1.627E+05	1.093E+01	5.427E+01	8.135E+04	5.466E+00
2062	1.933E+02	1.548E+05	1.040E+01	5.162E+01	7.738E+04	5.199E+00
2063	1.838E+02	1.472E+05	9.891E+00	4.911E+01	7.361E+04	4.946E+00
2064	1.749E+02	1.400E+05	9.409E+00	4.671E+01	7.002E+04	4.704E+00
2065	1.664E+02	1.332E+05	8.950E+00	4.443E+01	6.660E+04	4.475E+00
2066	1.582E+02	1.267E+05	8.514E+00	4.227E+01	6.335E+04	4.257E+00
2067	1.505E+02	1.205E+05	8.098E+00	4.021E+01	6.026E+04	4.049E+00
2068	1.432E+02	1.147E+05	7.703E+00	3.824E+01	5.733E+04	3.852E+00
2069	1.362E+02	1.091E+05	7.328E+00	3.638E+01	5.453E+04	3.664E+00
2070	1.296E+02	1.037E+05	6.970E+00	3.461E+01	5.187E+04	3.485E+00
2071	1.232E+02	9.868E+04	6.630E+00	3.292E+01	4.934E+04	3.315E+00
2072	1.172E+02	9.387E+04	6.307E+00	3.131E+01	4.693E+04	3.154E+00
2073	1.115E+02	8.929E+04	5.999E+00	2.979E+01	4.465E+04	3.000E+00
2074	1.061E+02	8.494E+04	5.707E+00	2.833E+01	4.247E+04	2.853E+00
2075	1.009E+02	8.079E+04	5.428E+00	2.695E+01	4.040E+04	2.714E+00
2076	9.598E+01	7.685E+04	5.164E+00	2.564E+01	3.843E+04	2.582E+00
2077	9.130E+01	7.310E+04	4.912E+00	2.439E+01	3.655E+04	2.456E+00
2078	8.684E+01	6.954E+04	4.672E+00	2.320E+01	3.477E+04	2.336E+00
2079	8.261E+01	6.615E+04	4.444E+00	2.207E+01	3.307E+04	2.222E+00
2080	7.858E+01	6.292E+04	4.228E+00	2.099E+01	3.146E+04	2.114E+00
2081	7.475E+01	5.985E+04	4.022E+00	1.997E+01	2.993E+04	2.011E+00
2082	7.110E+01	5.693E+04	3.825E+00	1.899E+01	2.847E+04	1.913E+00
2083	6.763E+01	5.416E+04	3.639E+00	1.807E+01	2.708E+04	1.819E+00
2084	6.433E+01	5.152E+04	3.461E+00	1.718E+01	2.576E+04	1.731E+00
2085	6.120E+01	4.900E+04	3.293E+00	1.635E+01	2.450E+04	1.646E+00
2086	5.821E+01	4.661E+04	3.132E+00	1.555E+01	2.331E+04	1.566E+00
2087	5.537E+01	4.434E+04	2.979E+00	1.479E+01	2.217E+04	1.490E+00
2088	5.267E+01	4.218E+04	2.834E+00	1.407E+01	2.109E+04	1.417E+00
2089	5.010E+01	4.012E+04	2.696E+00	1.338E+01	2.006E+04	1.348E+00
2090	4.766E+01	3.816E+04	2.564E+00	1.273E+01	1.908E+04	1.282E+00
2091	4.534E+01	3.630E+04	2.439E+00	1.211E+01	1.815E+04	1.220E+00
2092	4.312E+01	3.453E+04	2.320E+00	1.152E+01	1.727E+04	1.160E+00
2093	4.102E+01	3.285E+04	2.207E+00	1.096E+01	1.642E+04	1.104E+00
2094	3.902E+01	3.125E+04	2.099E+00	1.042E+01	1.562E+04	1.050E+00
2095	3.712E+01	2.972E+04	1.997E+00	9.915E+00	1.486E+04	9.985E-01
2096	3.531E+01	2.827E+04	1.900E+00	9.431E+00	1.414E+04	9.498E-01
2097	3.359E+01	2.689E+04	1.807E+00	8.971E+00	1.345E+04	9.035E-01
2098	3.195E+01	2.558E+04	1.719E+00	8.534E+00	1.279E+04	8.594E-01

Results (Continued)

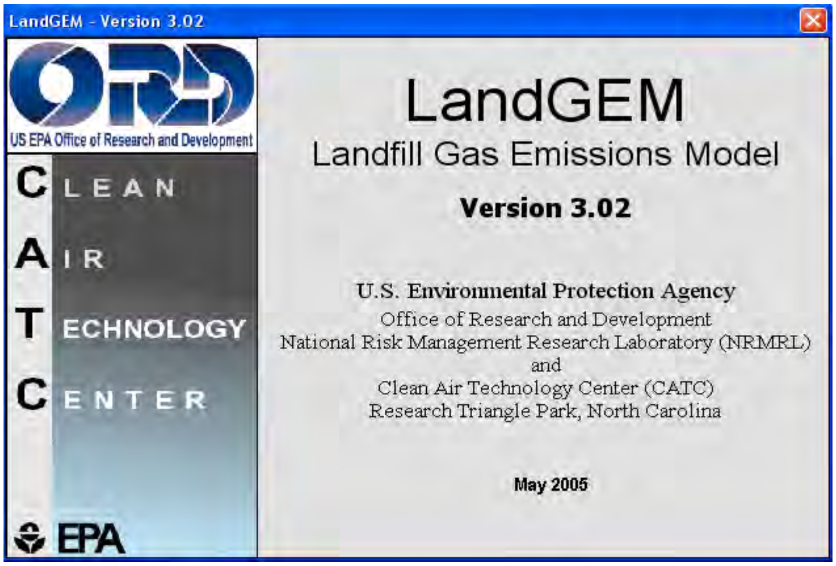
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1958	0	0	0	0	0	0
1959	2.634E+02	1.439E+05	9.668E+00	4.126E+00	1.151E+03	7.734E-02
1960	5.139E+02	2.808E+05	1.886E+01	8.051E+00	2.246E+03	1.509E-01
1961	7.522E+02	4.109E+05	2.761E+01	1.178E+01	3.288E+03	2.209E-01
1962	9.789E+02	5.348E+05	3.593E+01	1.534E+01	4.278E+03	2.875E-01
1963	1.195E+03	6.526E+05	4.385E+01	1.871E+01	5.221E+03	3.508E-01
1964	1.400E+03	7.646E+05	5.138E+01	2.193E+01	6.117E+03	4.110E-01
1965	1.595E+03	8.712E+05	5.854E+01	2.498E+01	6.970E+03	4.683E-01
1966	1.780E+03	9.726E+05	6.535E+01	2.789E+01	7.781E+03	5.228E-01
1967	1.957E+03	1.069E+06	7.183E+01	3.066E+01	8.553E+03	5.746E-01
1968	2.125E+03	1.161E+06	7.800E+01	3.329E+01	9.287E+03	6.240E-01
1969	2.285E+03	1.248E+06	8.386E+01	3.579E+01	9.985E+03	6.709E-01
1970	2.437E+03	1.331E+06	8.944E+01	3.817E+01	1.065E+04	7.155E-01
1971	2.581E+03	1.410E+06	9.474E+01	4.043E+01	1.128E+04	7.579E-01
1972	2.719E+03	1.485E+06	9.979E+01	4.259E+01	1.188E+04	7.983E-01
1973	2.849E+03	1.557E+06	1.046E+02	4.464E+01	1.245E+04	8.367E-01
1974	2.974E+03	1.625E+06	1.092E+02	4.659E+01	1.300E+04	8.733E-01
1975	3.092E+03	1.689E+06	1.135E+02	4.844E+01	1.351E+04	9.080E-01
1976	3.205E+03	1.751E+06	1.176E+02	5.020E+01	1.401E+04	9.411E-01
1977	3.312E+03	1.809E+06	1.216E+02	5.188E+01	1.447E+04	9.725E-01
1978	3.414E+03	1.865E+06	1.253E+02	5.348E+01	1.492E+04	1.002E+00
1979	3.511E+03	1.918E+06	1.289E+02	5.500E+01	1.534E+04	1.031E+00
1980	3.603E+03	1.968E+06	1.322E+02	5.644E+01	1.575E+04	1.058E+00
1981	3.690E+03	2.016E+06	1.355E+02	5.781E+01	1.613E+04	1.084E+00
1982	3.774E+03	2.062E+06	1.385E+02	5.912E+01	1.649E+04	1.108E+00
1983	3.853E+03	2.105E+06	1.414E+02	6.036E+01	1.684E+04	1.131E+00
1984	3.929E+03	2.146E+06	1.442E+02	6.154E+01	1.717E+04	1.154E+00
1985	4.000E+03	2.185E+06	1.468E+02	6.267E+01	1.748E+04	1.175E+00
1986	4.069E+03	2.223E+06	1.493E+02	6.374E+01	1.778E+04	1.195E+00
1987	4.134E+03	2.258E+06	1.517E+02	6.476E+01	1.807E+04	1.214E+00
1988	4.195E+03	2.292E+06	1.540E+02	6.572E+01	1.834E+04	1.232E+00
1989	4.254E+03	2.324E+06	1.562E+02	6.664E+01	1.859E+04	1.249E+00
1990	4.310E+03	2.355E+06	1.582E+02	6.752E+01	1.884E+04	1.266E+00
1991	4.363E+03	2.384E+06	1.602E+02	6.835E+01	1.907E+04	1.281E+00
1992	4.414E+03	2.411E+06	1.620E+02	6.914E+01	1.929E+04	1.296E+00
1993	4.462E+03	2.438E+06	1.638E+02	6.990E+01	1.950E+04	1.310E+00
1994	4.244E+03	2.319E+06	1.558E+02	6.649E+01	1.855E+04	1.246E+00
1995	4.037E+03	2.206E+06	1.482E+02	6.325E+01	1.764E+04	1.186E+00
1996	3.840E+03	2.098E+06	1.410E+02	6.016E+01	1.678E+04	1.128E+00
1997	3.653E+03	1.996E+06	1.341E+02	5.723E+01	1.597E+04	1.073E+00
1998	3.475E+03	1.898E+06	1.276E+02	5.444E+01	1.519E+04	1.020E+00
1999	3.305E+03	1.806E+06	1.213E+02	5.178E+01	1.445E+04	9.706E-01
2000	3.144E+03	1.718E+06	1.154E+02	4.926E+01	1.374E+04	9.233E-01
2001	2.991E+03	1.634E+06	1.098E+02	4.685E+01	1.307E+04	8.783E-01
2002	2.845E+03	1.554E+06	1.044E+02	4.457E+01	1.243E+04	8.354E-01
2003	2.706E+03	1.478E+06	9.934E+01	4.240E+01	1.183E+04	7.947E-01
2004	2.574E+03	1.406E+06	9.449E+01	4.033E+01	1.125E+04	7.559E-01
2005	2.449E+03	1.338E+06	8.988E+01	3.836E+01	1.070E+04	7.191E-01
2006	2.329E+03	1.273E+06	8.550E+01	3.649E+01	1.018E+04	6.840E-01
2007	2.216E+03	1.210E+06	8.133E+01	3.471E+01	9.684E+03	6.506E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2008	2.108E+03	1.151E+06	7.736E+01	3.302E+01	9.211E+03	6.189E-01
2009	2.005E+03	1.095E+06	7.359E+01	3.141E+01	8.762E+03	5.887E-01
2010	1.907E+03	1.042E+06	7.000E+01	2.988E+01	8.335E+03	5.600E-01
2011	1.814E+03	9.910E+05	6.659E+01	2.842E+01	7.928E+03	5.327E-01
2012	1.726E+03	9.427E+05	6.334E+01	2.703E+01	7.542E+03	5.067E-01
2013	1.641E+03	8.967E+05	6.025E+01	2.571E+01	7.174E+03	4.820E-01
2014	1.561E+03	8.530E+05	5.731E+01	2.446E+01	6.824E+03	4.585E-01
2015	1.485E+03	8.114E+05	5.452E+01	2.327E+01	6.491E+03	4.361E-01
2016	1.413E+03	7.718E+05	5.186E+01	2.213E+01	6.175E+03	4.149E-01
2017	1.344E+03	7.342E+05	4.933E+01	2.105E+01	5.873E+03	3.946E-01
2018	1.278E+03	6.984E+05	4.692E+01	2.003E+01	5.587E+03	3.754E-01
2019	1.216E+03	6.643E+05	4.463E+01	1.905E+01	5.314E+03	3.571E-01
2020	1.157E+03	6.319E+05	4.246E+01	1.812E+01	5.055E+03	3.397E-01
2021	1.100E+03	6.011E+05	4.039E+01	1.724E+01	4.809E+03	3.231E-01
2022	1.047E+03	5.718E+05	3.842E+01	1.640E+01	4.574E+03	3.073E-01
2023	9.956E+02	5.439E+05	3.654E+01	1.560E+01	4.351E+03	2.924E-01
2024	9.470E+02	5.174E+05	3.476E+01	1.484E+01	4.139E+03	2.781E-01
2025	9.008E+02	4.921E+05	3.307E+01	1.411E+01	3.937E+03	2.645E-01
2026	8.569E+02	4.681E+05	3.145E+01	1.342E+01	3.745E+03	2.516E-01
2027	8.151E+02	4.453E+05	2.992E+01	1.277E+01	3.562E+03	2.394E-01
2028	7.754E+02	4.236E+05	2.846E+01	1.215E+01	3.389E+03	2.277E-01
2029	7.376E+02	4.029E+05	2.707E+01	1.155E+01	3.223E+03	2.166E-01
2030	7.016E+02	3.833E+05	2.575E+01	1.099E+01	3.066E+03	2.060E-01
2031	6.674E+02	3.646E+05	2.450E+01	1.045E+01	2.917E+03	1.960E-01
2032	6.348E+02	3.468E+05	2.330E+01	9.945E+00	2.774E+03	1.864E-01
2033	6.039E+02	3.299E+05	2.217E+01	9.460E+00	2.639E+03	1.773E-01
2034	5.744E+02	3.138E+05	2.108E+01	8.998E+00	2.510E+03	1.687E-01
2035	5.464E+02	2.985E+05	2.006E+01	8.560E+00	2.388E+03	1.604E-01
2036	5.197E+02	2.839E+05	1.908E+01	8.142E+00	2.271E+03	1.526E-01
2037	4.944E+02	2.701E+05	1.815E+01	7.745E+00	2.161E+03	1.452E-01
2038	4.703E+02	2.569E+05	1.726E+01	7.367E+00	2.055E+03	1.381E-01
2039	4.473E+02	2.444E+05	1.642E+01	7.008E+00	1.955E+03	1.314E-01
2040	4.255E+02	2.325E+05	1.562E+01	6.666E+00	1.860E+03	1.250E-01
2041	4.048E+02	2.211E+05	1.486E+01	6.341E+00	1.769E+03	1.189E-01
2042	3.850E+02	2.103E+05	1.413E+01	6.032E+00	1.683E+03	1.131E-01
2043	3.663E+02	2.001E+05	1.344E+01	5.738E+00	1.601E+03	1.076E-01
2044	3.484E+02	1.903E+05	1.279E+01	5.458E+00	1.523E+03	1.023E-01
2045	3.314E+02	1.810E+05	1.216E+01	5.192E+00	1.448E+03	9.732E-02
2046	3.152E+02	1.722E+05	1.157E+01	4.938E+00	1.378E+03	9.257E-02
2047	2.999E+02	1.638E+05	1.101E+01	4.698E+00	1.311E+03	8.805E-02
2048	2.852E+02	1.558E+05	1.047E+01	4.468E+00	1.247E+03	8.376E-02
2049	2.713E+02	1.482E+05	9.959E+00	4.251E+00	1.186E+03	7.968E-02
2050	2.581E+02	1.410E+05	9.474E+00	4.043E+00	1.128E+03	7.579E-02
2051	2.455E+02	1.341E+05	9.012E+00	3.846E+00	1.073E+03	7.209E-02
2052	2.335E+02	1.276E+05	8.572E+00	3.658E+00	1.021E+03	6.858E-02
2053	2.221E+02	1.214E+05	8.154E+00	3.480E+00	9.709E+02	6.523E-02
2054	2.113E+02	1.154E+05	7.756E+00	3.310E+00	9.235E+02	6.205E-02
2055	2.010E+02	1.098E+05	7.378E+00	3.149E+00	8.785E+02	5.902E-02
2056	1.912E+02	1.045E+05	7.018E+00	2.995E+00	8.356E+02	5.615E-02
2057	1.819E+02	9.936E+04	6.676E+00	2.849E+00	7.949E+02	5.341E-02
2058	1.730E+02	9.451E+04	6.350E+00	2.710E+00	7.561E+02	5.080E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2059	1.646E+02	8.990E+04	6.041E+00	2.578E+00	7.192E+02	4.833E-02
2060	1.565E+02	8.552E+04	5.746E+00	2.452E+00	6.842E+02	4.597E-02
2061	1.489E+02	8.135E+04	5.466E+00	2.333E+00	6.508E+02	4.373E-02
2062	1.416E+02	7.738E+04	5.199E+00	2.219E+00	6.191E+02	4.159E-02
2063	1.347E+02	7.361E+04	4.946E+00	2.111E+00	5.889E+02	3.957E-02
2064	1.282E+02	7.002E+04	4.704E+00	2.008E+00	5.601E+02	3.764E-02
2065	1.219E+02	6.660E+04	4.475E+00	1.910E+00	5.328E+02	3.580E-02
2066	1.160E+02	6.335E+04	4.257E+00	1.817E+00	5.068E+02	3.405E-02
2067	1.103E+02	6.026E+04	4.049E+00	1.728E+00	4.821E+02	3.239E-02
2068	1.049E+02	5.733E+04	3.852E+00	1.644E+00	4.586E+02	3.081E-02
2069	9.982E+01	5.453E+04	3.664E+00	1.564E+00	4.362E+02	2.931E-02
2070	9.495E+01	5.187E+04	3.485E+00	1.487E+00	4.150E+02	2.788E-02
2071	9.032E+01	4.934E+04	3.315E+00	1.415E+00	3.947E+02	2.652E-02
2072	8.591E+01	4.693E+04	3.154E+00	1.346E+00	3.755E+02	2.523E-02
2073	8.172E+01	4.465E+04	3.000E+00	1.280E+00	3.572E+02	2.400E-02
2074	7.774E+01	4.247E+04	2.853E+00	1.218E+00	3.397E+02	2.283E-02
2075	7.395E+01	4.040E+04	2.714E+00	1.158E+00	3.232E+02	2.171E-02
2076	7.034E+01	3.843E+04	2.582E+00	1.102E+00	3.074E+02	2.065E-02
2077	6.691E+01	3.655E+04	2.456E+00	1.048E+00	2.924E+02	1.965E-02
2078	6.365E+01	3.477E+04	2.336E+00	9.970E-01	2.782E+02	1.869E-02
2079	6.054E+01	3.307E+04	2.222E+00	9.484E-01	2.646E+02	1.778E-02
2080	5.759E+01	3.146E+04	2.114E+00	9.022E-01	2.517E+02	1.691E-02
2081	5.478E+01	2.993E+04	2.011E+00	8.582E-01	2.394E+02	1.609E-02
2082	5.211E+01	2.847E+04	1.913E+00	8.163E-01	2.277E+02	1.530E-02
2083	4.957E+01	2.708E+04	1.819E+00	7.765E-01	2.166E+02	1.456E-02
2084	4.715E+01	2.576E+04	1.731E+00	7.386E-01	2.061E+02	1.385E-02
2085	4.485E+01	2.450E+04	1.646E+00	7.026E-01	1.960E+02	1.317E-02
2086	4.266E+01	2.331E+04	1.566E+00	6.683E-01	1.865E+02	1.253E-02
2087	4.058E+01	2.217E+04	1.490E+00	6.357E-01	1.774E+02	1.192E-02
2088	3.860E+01	2.109E+04	1.417E+00	6.047E-01	1.687E+02	1.134E-02
2089	3.672E+01	2.006E+04	1.348E+00	5.752E-01	1.605E+02	1.078E-02
2090	3.493E+01	1.908E+04	1.282E+00	5.472E-01	1.527E+02	1.026E-02
2091	3.323E+01	1.815E+04	1.220E+00	5.205E-01	1.452E+02	9.757E-03
2092	3.161E+01	1.727E+04	1.160E+00	4.951E-01	1.381E+02	9.281E-03
2093	3.006E+01	1.642E+04	1.104E+00	4.710E-01	1.314E+02	8.828E-03
2094	2.860E+01	1.562E+04	1.050E+00	4.480E-01	1.250E+02	8.398E-03
2095	2.720E+01	1.486E+04	9.985E-01	4.262E-01	1.189E+02	7.988E-03
2096	2.588E+01	1.414E+04	9.498E-01	4.054E-01	1.131E+02	7.599E-03
2097	2.461E+01	1.345E+04	9.035E-01	3.856E-01	1.076E+02	7.228E-03
2098	2.341E+01	1.279E+04	8.594E-01	3.668E-01	1.023E+02	6.875E-03



Summary Report

Landfill Name or Identifier: Pasco Sanitary Landfill - Balefill Area

Date: Wednesday, August 27, 2014

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation *(m^3/year)*

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate *($year^{-1}$)*

L_o = potential methane generation capacity *(m^3/Mg)*

M_i = mass of waste accepted in the i^{th} year *(Mg)*

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1977**	
Landfill Closure Year (with 80-year limit)	**1989**	
Actual Closure Year (without limit)	***1989***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity	**70,354**	*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.050**	*$year^{-1}$*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1977	3,528	3,881	0	0
1978	3,528	3,881	3,528	3,881
1979	3,528	3,881	7,056	7,761
1980	1,323	1,455	10,584	11,642
1981	1,323	1,455	11,907	13,097
1982	9,261	10,187	13,230	14,553
1983	9,261	10,187	22,491	24,740
1984	9,261	10,187	31,751	34,927
1985	9,261	10,187	41,012	45,114
1986	4,725	5,197	50,273	55,300
1987	4,725	5,197	54,998	60,498
1988	5,316	5,847	59,723	65,695
1989	5,316	5,847	65,039	71,542
1990	0	0	70,354	77,389
1991	0	0	70,354	77,389
1992	0	0	70,354	77,389
1993	0	0	70,354	77,389
1994	0	0	70,354	77,389
1995	0	0	70,354	77,389
1996	0	0	70,354	77,389
1997	0	0	70,354	77,389
1998	0	0	70,354	77,389
1999	0	0	70,354	77,389
2000	0	0	70,354	77,389
2001	0	0	70,354	77,389
2002	0	0	70,354	77,389
2003	0	0	70,354	77,389
2004	0	0	70,354	77,389
2005	0	0	70,354	77,389
2006	0	0	70,354	77,389
2007	0	0	70,354	77,389
2008	0	0	70,354	77,389
2009	0	0	70,354	77,389
2010	0	0	70,354	77,389
2011	0	0	70,354	77,389
2012	0	0	70,354	77,389
2013	0	0	70,354	77,389
2014	0	0	70,354	77,389
2015	0	0	70,354	77,389
2016	0	0	70,354	77,389

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2017	0	0	70,354	77,389
2018	0	0	70,354	77,389
2019	0	0	70,354	77,389
2020	0	0	70,354	77,389
2021	0	0	70,354	77,389
2022	0	0	70,354	77,389
2023	0	0	70,354	77,389
2024	0	0	70,354	77,389
2025	0	0	70,354	77,389
2026	0	0	70,354	77,389
2027	0	0	70,354	77,389
2028	0	0	70,354	77,389
2029	0	0	70,354	77,389
2030	0	0	70,354	77,389
2031	0	0	70,354	77,389
2032	0	0	70,354	77,389
2033	0	0	70,354	77,389
2034	0	0	70,354	77,389
2035	0	0	70,354	77,389
2036	0	0	70,354	77,389
2037	0	0	70,354	77,389
2038	0	0	70,354	77,389
2039	0	0	70,354	77,389
2040	0	0	70,354	77,389
2041	0	0	70,354	77,389
2042	0	0	70,354	77,389
2043	0	0	70,354	77,389
2044	0	0	70,354	77,389
2045	0	0	70,354	77,389
2046	0	0	70,354	77,389
2047	0	0	70,354	77,389
2048	0	0	70,354	77,389
2049	0	0	70,354	77,389
2050	0	0	70,354	77,389
2051	0	0	70,354	77,389
2052	0	0	70,354	77,389
2053	0	0	70,354	77,389
2054	0	0	70,354	77,389
2055	0	0	70,354	77,389
2056	0	0	70,354	77,389

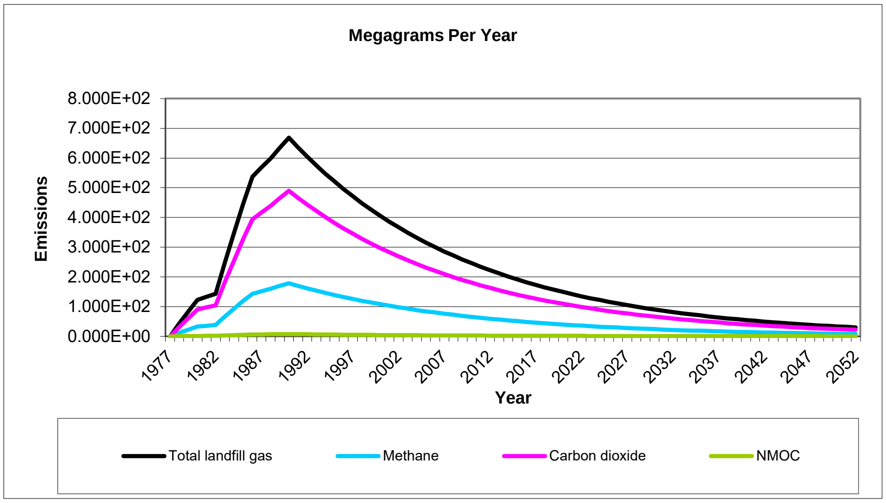
Pollutant Parameters

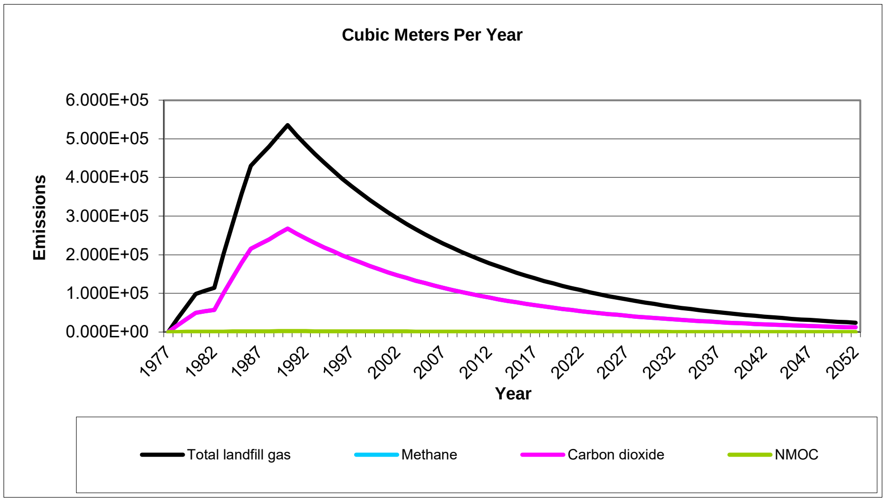
		Gas / Pollutant Default Parameters:		User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

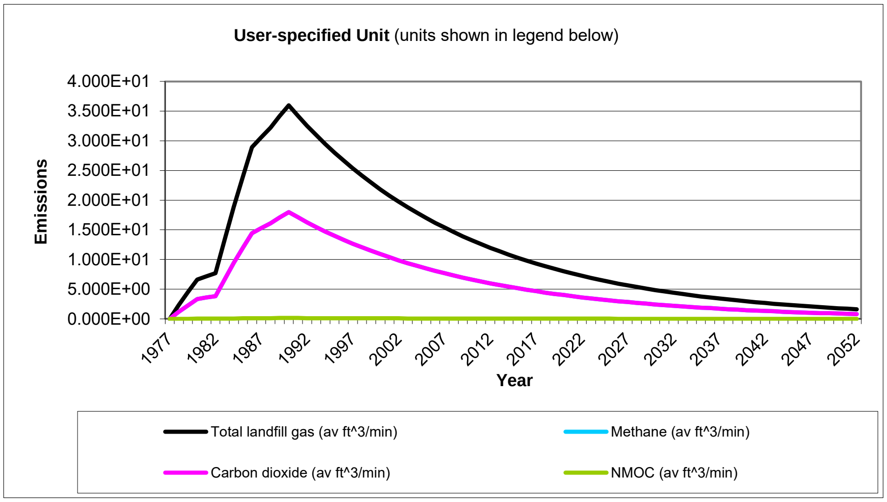
Pollutant Parameters (Continued)

	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
8.000E+02
7.000E+02
6.000E+02
5.000E+02
4.000E+02
3.000E+02
2.000E+02
1.000E+02
0.000E+00
1977
1982
1987
1992
1997
2002
2007
2012
2017
2022
2027
2032
2037
2042
2047
2052
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
6.000E+05
5.000E+05
4.000E+05
3.000E+05
2.000E+05
1.000E+05
0.000E+00
1977
1982
1987
1992
1997
2002
2007
2012
2017
2022
2027
2032
2037
2042
2047
2052
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
4.000E+01
3.500E+01
3.000E+01
2.500E+01
2.000E+01
1.500E+01
1.000E+01
5.000E+00
0.000E+00
1977
1982
1987
1992
1997
2002
2007
2012
2017
2022
2027
2032
2037
2042
2047
2052
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1977	0	0	0	0	0	0
1978	4.308E+01	3.450E+04	2.318E+00	1.151E+01	1.725E+04	1.159E+00
1979	8.406E+01	6.731E+04	4.523E+00	2.245E+01	3.366E+04	2.261E+00
1980	1.230E+02	9.853E+04	6.620E+00	3.287E+01	4.926E+04	3.310E+00
1981	1.332E+02	1.067E+05	7.166E+00	3.558E+01	5.333E+04	3.583E+00
1982	1.429E+02	1.144E+05	7.686E+00	3.816E+01	5.720E+04	3.843E+00
1983	2.490E+02	1.994E+05	1.340E+01	6.651E+01	9.969E+04	6.698E+00
1984	3.499E+02	2.802E+05	1.883E+01	9.347E+01	1.401E+05	9.414E+00
1985	4.460E+02	3.571E+05	2.399E+01	1.191E+02	1.785E+05	1.200E+01
1986	5.373E+02	4.302E+05	2.891E+01	1.435E+02	2.151E+05	1.445E+01
1987	5.688E+02	4.555E+05	3.060E+01	1.519E+02	2.277E+05	1.530E+01
1988	5.987E+02	4.794E+05	3.221E+01	1.599E+02	2.397E+05	1.611E+01
1989	6.345E+02	5.080E+05	3.414E+01	1.695E+02	2.540E+05	1.707E+01
1990	6.684E+02	5.352E+05	3.596E+01	1.785E+02	2.676E+05	1.798E+01
1991	6.358E+02	5.091E+05	3.421E+01	1.698E+02	2.546E+05	1.710E+01
1992	6.048E+02	4.843E+05	3.254E+01	1.616E+02	2.422E+05	1.627E+01
1993	5.753E+02	4.607E+05	3.095E+01	1.537E+02	2.303E+05	1.548E+01
1994	5.473E+02	4.382E+05	2.944E+01	1.462E+02	2.191E+05	1.472E+01
1995	5.206E+02	4.168E+05	2.801E+01	1.391E+02	2.084E+05	1.400E+01
1996	4.952E+02	3.965E+05	2.664E+01	1.323E+02	1.983E+05	1.332E+01
1997	4.710E+02	3.772E+05	2.534E+01	1.258E+02	1.886E+05	1.267E+01
1998	4.481E+02	3.588E+05	2.411E+01	1.197E+02	1.794E+05	1.205E+01
1999	4.262E+02	3.413E+05	2.293E+01	1.138E+02	1.706E+05	1.147E+01
2000	4.054E+02	3.246E+05	2.181E+01	1.083E+02	1.623E+05	1.091E+01
2001	3.856E+02	3.088E+05	2.075E+01	1.030E+02	1.544E+05	1.037E+01
2002	3.668E+02	2.937E+05	1.974E+01	9.799E+01	1.469E+05	9.868E+00
2003	3.489E+02	2.794E+05	1.877E+01	9.321E+01	1.397E+05	9.387E+00
2004	3.319E+02	2.658E+05	1.786E+01	8.866E+01	1.329E+05	8.929E+00
2005	3.157E+02	2.528E+05	1.699E+01	8.434E+01	1.264E+05	8.494E+00
2006	3.003E+02	2.405E+05	1.616E+01	8.022E+01	1.203E+05	8.080E+00
2007	2.857E+02	2.288E+05	1.537E+01	7.631E+01	1.144E+05	7.686E+00
2008	2.718E+02	2.176E+05	1.462E+01	7.259E+01	1.088E+05	7.311E+00
2009	2.585E+02	2.070E+05	1.391E+01	6.905E+01	1.035E+05	6.954E+00
2010	2.459E+02	1.969E+05	1.323E+01	6.568E+01	9.845E+04	6.615E+00
2011	2.339E+02	1.873E+05	1.258E+01	6.248E+01	9.365E+04	6.292E+00
2012	2.225E+02	1.782E+05	1.197E+01	5.943E+01	8.908E+04	5.986E+00
2013	2.116E+02	1.695E+05	1.139E+01	5.653E+01	8.474E+04	5.694E+00
2014	2.013E+02	1.612E+05	1.083E+01	5.378E+01	8.061E+04	5.416E+00
2015	1.915E+02	1.534E+05	1.030E+01	5.115E+01	7.668E+04	5.152E+00
2016	1.822E+02	1.459E+05	9.801E+00	4.866E+01	7.294E+04	4.901E+00
2017	1.733E+02	1.388E+05	9.323E+00	4.629E+01	6.938E+04	4.662E+00
2018	1.648E+02	1.320E+05	8.868E+00	4.403E+01	6.599E+04	4.434E+00
2019	1.568E+02	1.256E+05	8.436E+00	4.188E+01	6.278E+04	4.218E+00
2020	1.491E+02	1.194E+05	8.024E+00	3.984E+01	5.971E+04	4.012E+00
2021	1.419E+02	1.136E+05	7.633E+00	3.790E+01	5.680E+04	3.817E+00
2022	1.350E+02	1.081E+05	7.261E+00	3.605E+01	5.403E+04	3.630E+00
2023	1.284E+02	1.028E+05	6.907E+00	3.429E+01	5.140E+04	3.453E+00
2024	1.221E+02	9.778E+04	6.570E+00	3.262E+01	4.889E+04	3.285E+00
2025	1.162E+02	9.301E+04	6.249E+00	3.103E+01	4.651E+04	3.125E+00
2026	1.105E+02	8.848E+04	5.945E+00	2.951E+01	4.424E+04	2.972E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2027	1.051E+02	8.416E+04	5.655E+00	2.807E+01	4.208E+04	2.827E+00
2028	9.998E+01	8.006E+04	5.379E+00	2.670E+01	4.003E+04	2.689E+00
2029	9.510E+01	7.615E+04	5.117E+00	2.540E+01	3.808E+04	2.558E+00
2030	9.046E+01	7.244E+04	4.867E+00	2.416E+01	3.622E+04	2.434E+00
2031	8.605E+01	6.890E+04	4.630E+00	2.298E+01	3.445E+04	2.315E+00
2032	8.185E+01	6.554E+04	4.404E+00	2.186E+01	3.277E+04	2.202E+00
2033	7.786E+01	6.235E+04	4.189E+00	2.080E+01	3.117E+04	2.095E+00
2034	7.406E+01	5.931E+04	3.985E+00	1.978E+01	2.965E+04	1.992E+00
2035	7.045E+01	5.641E+04	3.790E+00	1.882E+01	2.821E+04	1.895E+00
2036	6.702E+01	5.366E+04	3.606E+00	1.790E+01	2.683E+04	1.803E+00
2037	6.375E+01	5.105E+04	3.430E+00	1.703E+01	2.552E+04	1.715E+00
2038	6.064E+01	4.856E+04	3.262E+00	1.620E+01	2.428E+04	1.631E+00
2039	5.768E+01	4.619E+04	3.103E+00	1.541E+01	2.309E+04	1.552E+00
2040	5.487E+01	4.394E+04	2.952E+00	1.466E+01	2.197E+04	1.476E+00
2041	5.219E+01	4.179E+04	2.808E+00	1.394E+01	2.090E+04	1.404E+00
2042	4.965E+01	3.975E+04	2.671E+00	1.326E+01	1.988E+04	1.336E+00
2043	4.723E+01	3.782E+04	2.541E+00	1.261E+01	1.891E+04	1.270E+00
2044	4.492E+01	3.597E+04	2.417E+00	1.200E+01	1.799E+04	1.208E+00
2045	4.273E+01	3.422E+04	2.299E+00	1.141E+01	1.711E+04	1.150E+00
2046	4.065E+01	3.255E+04	2.187E+00	1.086E+01	1.627E+04	1.093E+00
2047	3.866E+01	3.096E+04	2.080E+00	1.033E+01	1.548E+04	1.040E+00
2048	3.678E+01	2.945E+04	1.979E+00	9.824E+00	1.473E+04	9.894E-01
2049	3.499E+01	2.801E+04	1.882E+00	9.345E+00	1.401E+04	9.411E-01
2050	3.328E+01	2.665E+04	1.790E+00	8.889E+00	1.332E+04	8.952E-01
2051	3.166E+01	2.535E+04	1.703E+00	8.456E+00	1.267E+04	8.516E-01
2052	3.011E+01	2.411E+04	1.620E+00	8.043E+00	1.206E+04	8.101E-01
2053	2.864E+01	2.294E+04	1.541E+00	7.651E+00	1.147E+04	7.705E-01
2054	2.725E+01	2.182E+04	1.466E+00	7.278E+00	1.091E+04	7.330E-01
2055	2.592E+01	2.075E+04	1.394E+00	6.923E+00	1.038E+04	6.972E-01
2056	2.465E+01	1.974E+04	1.326E+00	6.585E+00	9.871E+03	6.632E-01
2057	2.345E+01	1.878E+04	1.262E+00	6.264E+00	9.389E+03	6.309E-01
2058	2.231E+01	1.786E+04	1.200E+00	5.959E+00	8.931E+03	6.001E-01
2059	2.122E+01	1.699E+04	1.142E+00	5.668E+00	8.496E+03	5.708E-01
2060	2.018E+01	1.616E+04	1.086E+00	5.392E+00	8.081E+03	5.430E-01
2061	1.920E+01	1.537E+04	1.033E+00	5.129E+00	7.687E+03	5.165E-01
2062	1.826E+01	1.462E+04	9.826E-01	4.878E+00	7.312E+03	4.913E-01
2063	1.737E+01	1.391E+04	9.347E-01	4.641E+00	6.956E+03	4.674E-01
2064	1.653E+01	1.323E+04	8.891E-01	4.414E+00	6.617E+03	4.446E-01
2065	1.572E+01	1.259E+04	8.458E-01	4.199E+00	6.294E+03	4.229E-01
2066	1.495E+01	1.197E+04	8.045E-01	3.994E+00	5.987E+03	4.023E-01
2067	1.422E+01	1.139E+04	7.653E-01	3.799E+00	5.695E+03	3.826E-01
2068	1.353E+01	1.083E+04	7.280E-01	3.614E+00	5.417E+03	3.640E-01
2069	1.287E+01	1.031E+04	6.925E-01	3.438E+00	5.153E+03	3.462E-01
2070	1.224E+01	9.803E+03	6.587E-01	3.270E+00	4.902E+03	3.293E-01
2071	1.165E+01	9.325E+03	6.266E-01	3.111E+00	4.663E+03	3.133E-01
2072	1.108E+01	8.870E+03	5.960E-01	2.959E+00	4.435E+03	2.980E-01
2073	1.054E+01	8.438E+03	5.669E-01	2.815E+00	4.219E+03	2.835E-01
2074	1.002E+01	8.026E+03	5.393E-01	2.677E+00	4.013E+03	2.696E-01
2075	9.535E+00	7.635E+03	5.130E-01	2.547E+00	3.817E+03	2.565E-01
2076	9.070E+00	7.263E+03	4.880E-01	2.423E+00	3.631E+03	2.440E-01
2077	8.627E+00	6.908E+03	4.642E-01	2.304E+00	3.454E+03	2.321E-01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2078	8.206E+00	6.571E+03	4.415E-01	2.192E+00	3.286E+03	2.208E-01
2079	7.806E+00	6.251E+03	4.200E-01	2.085E+00	3.125E+03	2.100E-01
2080	7.426E+00	5.946E+03	3.995E-01	1.983E+00	2.973E+03	1.998E-01
2081	7.063E+00	5.656E+03	3.800E-01	1.887E+00	2.828E+03	1.900E-01
2082	6.719E+00	5.380E+03	3.615E-01	1.795E+00	2.690E+03	1.807E-01
2083	6.391E+00	5.118E+03	3.439E-01	1.707E+00	2.559E+03	1.719E-01
2084	6.080E+00	4.868E+03	3.271E-01	1.624E+00	2.434E+03	1.635E-01
2085	5.783E+00	4.631E+03	3.111E-01	1.545E+00	2.315E+03	1.556E-01
2086	5.501E+00	4.405E+03	2.960E-01	1.469E+00	2.202E+03	1.480E-01
2087	5.233E+00	4.190E+03	2.815E-01	1.398E+00	2.095E+03	1.408E-01
2088	4.977E+00	3.986E+03	2.678E-01	1.330E+00	1.993E+03	1.339E-01
2089	4.735E+00	3.791E+03	2.547E-01	1.265E+00	1.896E+03	1.274E-01
2090	4.504E+00	3.606E+03	2.423E-01	1.203E+00	1.803E+03	1.212E-01
2091	4.284E+00	3.431E+03	2.305E-01	1.144E+00	1.715E+03	1.152E-01
2092	4.075E+00	3.263E+03	2.193E-01	1.089E+00	1.632E+03	1.096E-01
2093	3.876E+00	3.104E+03	2.086E-01	1.035E+00	1.552E+03	1.043E-01
2094	3.687E+00	2.953E+03	1.984E-01	9.849E-01	1.476E+03	9.920E-02
2095	3.508E+00	2.809E+03	1.887E-01	9.369E-01	1.404E+03	9.436E-02
2096	3.337E+00	2.672E+03	1.795E-01	8.912E-01	1.336E+03	8.976E-02
2097	3.174E+00	2.541E+03	1.708E-01	8.478E-01	1.271E+03	8.538E-02
2098	3.019E+00	2.417E+03	1.624E-01	8.064E-01	1.209E+03	8.121E-02
2099	2.872E+00	2.300E+03	1.545E-01	7.671E-01	1.150E+03	7.725E-02
2100	2.732E+00	2.187E+03	1.470E-01	7.297E-01	1.094E+03	7.349E-02
2101	2.598E+00	2.081E+03	1.398E-01	6.941E-01	1.040E+03	6.990E-02
2102	2.472E+00	1.979E+03	1.330E-01	6.602E-01	9.896E+02	6.649E-02
2103	2.351E+00	1.883E+03	1.265E-01	6.280E-01	9.414E+02	6.325E-02
2104	2.237E+00	1.791E+03	1.203E-01	5.974E-01	8.955E+02	6.017E-02
2105	2.127E+00	1.704E+03	1.145E-01	5.683E-01	8.518E+02	5.723E-02
2106	2.024E+00	1.620E+03	1.089E-01	5.406E-01	8.102E+02	5.444E-02
2107	1.925E+00	1.541E+03	1.036E-01	5.142E-01	7.707E+02	5.178E-02
2108	1.831E+00	1.466E+03	9.852E-02	4.891E-01	7.331E+02	4.926E-02
2109	1.742E+00	1.395E+03	9.371E-02	4.653E-01	6.974E+02	4.686E-02
2110	1.657E+00	1.327E+03	8.914E-02	4.426E-01	6.634E+02	4.457E-02
2111	1.576E+00	1.262E+03	8.480E-02	4.210E-01	6.310E+02	4.240E-02
2112	1.499E+00	1.200E+03	8.066E-02	4.005E-01	6.002E+02	4.033E-02
2113	1.426E+00	1.142E+03	7.673E-02	3.809E-01	5.710E+02	3.836E-02
2114	1.357E+00	1.086E+03	7.298E-02	3.623E-01	5.431E+02	3.649E-02
2115	1.290E+00	1.033E+03	6.943E-02	3.447E-01	5.166E+02	3.471E-02
2116	1.227E+00	9.829E+02	6.604E-02	3.279E-01	4.914E+02	3.302E-02
2117	1.168E+00	9.349E+02	6.282E-02	3.119E-01	4.675E+02	3.141E-02

Results (Continued)

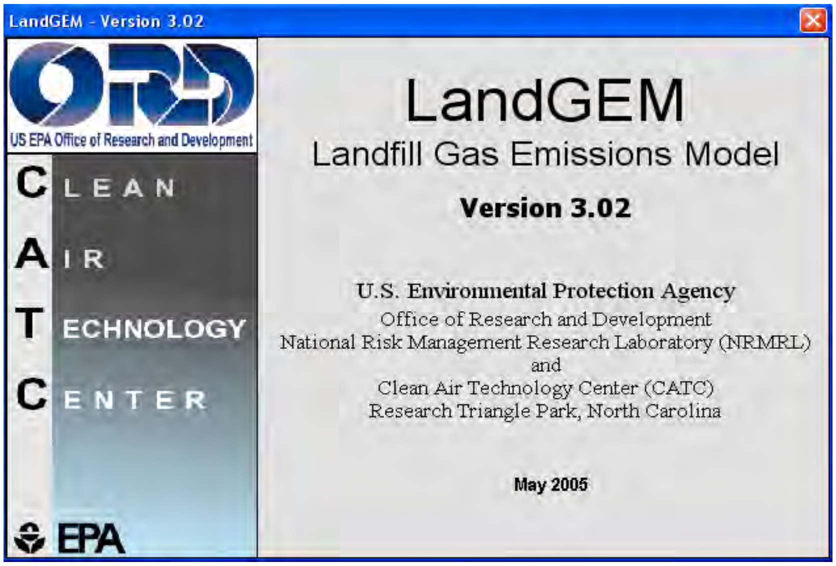
Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1977	0	0	0	0	0	0
1978	3.157E+01	1.725E+04	1.159E+00	4.946E-01	1.380E+02	9.272E-03
1979	6.161E+01	3.366E+04	2.261E+00	9.651E-01	2.693E+02	1.809E-02
1980	9.018E+01	4.926E+04	3.310E+00	1.413E+00	3.941E+02	2.648E-02
1981	9.762E+01	5.333E+04	3.583E+00	1.529E+00	4.266E+02	2.867E-02
1982	1.047E+02	5.720E+04	3.843E+00	1.640E+00	4.576E+02	3.074E-02
1983	1.825E+02	9.969E+04	6.698E+00	2.859E+00	7.975E+02	5.358E-02
1984	2.565E+02	1.401E+05	9.414E+00	4.018E+00	1.121E+03	7.531E-02
1985	3.268E+02	1.785E+05	1.200E+01	5.120E+00	1.428E+03	9.597E-02
1986	3.938E+02	2.151E+05	1.445E+01	6.169E+00	1.721E+03	1.156E-01
1987	4.169E+02	2.277E+05	1.530E+01	6.530E+00	1.822E+03	1.224E-01
1988	4.388E+02	2.397E+05	1.611E+01	6.874E+00	1.918E+03	1.289E-01
1989	4.650E+02	2.540E+05	1.707E+01	7.284E+00	2.032E+03	1.365E-01
1990	4.899E+02	2.676E+05	1.798E+01	7.674E+00	2.141E+03	1.439E-01
1991	4.660E+02	2.546E+05	1.710E+01	7.300E+00	2.037E+03	1.368E-01
1992	4.433E+02	2.422E+05	1.627E+01	6.944E+00	1.937E+03	1.302E-01
1993	4.216E+02	2.303E+05	1.548E+01	6.605E+00	1.843E+03	1.238E-01
1994	4.011E+02	2.191E+05	1.472E+01	6.283E+00	1.753E+03	1.178E-01
1995	3.815E+02	2.084E+05	1.400E+01	5.977E+00	1.667E+03	1.120E-01
1996	3.629E+02	1.983E+05	1.332E+01	5.685E+00	1.586E+03	1.066E-01
1997	3.452E+02	1.886E+05	1.267E+01	5.408E+00	1.509E+03	1.014E-01
1998	3.284E+02	1.794E+05	1.205E+01	5.144E+00	1.435E+03	9.643E-02
1999	3.124E+02	1.706E+05	1.147E+01	4.893E+00	1.365E+03	9.172E-02
2000	2.971E+02	1.623E+05	1.091E+01	4.655E+00	1.299E+03	8.725E-02
2001	2.826E+02	1.544E+05	1.037E+01	4.428E+00	1.235E+03	8.300E-02
2002	2.689E+02	1.469E+05	9.868E+00	4.212E+00	1.175E+03	7.895E-02
2003	2.557E+02	1.397E+05	9.387E+00	4.006E+00	1.118E+03	7.510E-02
2004	2.433E+02	1.329E+05	8.929E+00	3.811E+00	1.063E+03	7.143E-02
2005	2.314E+02	1.264E+05	8.494E+00	3.625E+00	1.011E+03	6.795E-02
2006	2.201E+02	1.203E+05	8.080E+00	3.448E+00	9.620E+02	6.464E-02
2007	2.094E+02	1.144E+05	7.686E+00	3.280E+00	9.151E+02	6.148E-02
2008	1.992E+02	1.088E+05	7.311E+00	3.120E+00	8.705E+02	5.849E-02
2009	1.895E+02	1.035E+05	6.954E+00	2.968E+00	8.280E+02	5.563E-02
2010	1.802E+02	9.845E+04	6.615E+00	2.823E+00	7.876E+02	5.292E-02
2011	1.714E+02	9.365E+04	6.292E+00	2.686E+00	7.492E+02	5.034E-02
2012	1.631E+02	8.908E+04	5.986E+00	2.555E+00	7.127E+02	4.788E-02
2013	1.551E+02	8.474E+04	5.694E+00	2.430E+00	6.779E+02	4.555E-02
2014	1.475E+02	8.061E+04	5.416E+00	2.311E+00	6.449E+02	4.333E-02
2015	1.404E+02	7.668E+04	5.152E+00	2.199E+00	6.134E+02	4.121E-02
2016	1.335E+02	7.294E+04	4.901E+00	2.091E+00	5.835E+02	3.920E-02
2017	1.270E+02	6.938E+04	4.662E+00	1.989E+00	5.550E+02	3.729E-02
2018	1.208E+02	6.599E+04	4.434E+00	1.892E+00	5.280E+02	3.547E-02
2019	1.149E+02	6.278E+04	4.218E+00	1.800E+00	5.022E+02	3.374E-02
2020	1.093E+02	5.971E+04	4.012E+00	1.712E+00	4.777E+02	3.210E-02
2021	1.040E+02	5.680E+04	3.817E+00	1.629E+00	4.544E+02	3.053E-02
2022	9.891E+01	5.403E+04	3.630E+00	1.549E+00	4.323E+02	2.904E-02
2023	9.408E+01	5.140E+04	3.453E+00	1.474E+00	4.112E+02	2.763E-02
2024	8.949E+01	4.889E+04	3.285E+00	1.402E+00	3.911E+02	2.628E-02
2025	8.513E+01	4.651E+04	3.125E+00	1.334E+00	3.720E+02	2.500E-02
2026	8.098E+01	4.424E+04	2.972E+00	1.269E+00	3.539E+02	2.378E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2027	7.703E+01	4.208E+04	2.827E+00	1.207E+00	3.366E+02	2.262E-02
2028	7.327E+01	4.003E+04	2.689E+00	1.148E+00	3.202E+02	2.152E-02
2029	6.970E+01	3.808E+04	2.558E+00	1.092E+00	3.046E+02	2.047E-02
2030	6.630E+01	3.622E+04	2.434E+00	1.039E+00	2.898E+02	1.947E-02
2031	6.306E+01	3.445E+04	2.315E+00	9.879E-01	2.756E+02	1.852E-02
2032	5.999E+01	3.277E+04	2.202E+00	9.398E-01	2.622E+02	1.762E-02
2033	5.706E+01	3.117E+04	2.095E+00	8.939E-01	2.494E+02	1.676E-02
2034	5.428E+01	2.965E+04	1.992E+00	8.503E-01	2.372E+02	1.594E-02
2035	5.163E+01	2.821E+04	1.895E+00	8.089E-01	2.257E+02	1.516E-02
2036	4.912E+01	2.683E+04	1.803E+00	7.694E-01	2.147E+02	1.442E-02
2037	4.672E+01	2.552E+04	1.715E+00	7.319E-01	2.042E+02	1.372E-02
2038	4.444E+01	2.428E+04	1.631E+00	6.962E-01	1.942E+02	1.305E-02
2039	4.227E+01	2.309E+04	1.552E+00	6.622E-01	1.848E+02	1.241E-02
2040	4.021E+01	2.197E+04	1.476E+00	6.299E-01	1.757E+02	1.181E-02
2041	3.825E+01	2.090E+04	1.404E+00	5.992E-01	1.672E+02	1.123E-02
2042	3.639E+01	1.988E+04	1.336E+00	5.700E-01	1.590E+02	1.068E-02
2043	3.461E+01	1.891E+04	1.270E+00	5.422E-01	1.513E+02	1.016E-02
2044	3.292E+01	1.799E+04	1.208E+00	5.158E-01	1.439E+02	9.668E-03
2045	3.132E+01	1.711E+04	1.150E+00	4.906E-01	1.369E+02	9.196E-03
2046	2.979E+01	1.627E+04	1.093E+00	4.667E-01	1.302E+02	8.748E-03
2047	2.834E+01	1.548E+04	1.040E+00	4.439E-01	1.238E+02	8.321E-03
2048	2.695E+01	1.473E+04	9.894E-01	4.223E-01	1.178E+02	7.915E-03
2049	2.564E+01	1.401E+04	9.411E-01	4.017E-01	1.121E+02	7.529E-03
2050	2.439E+01	1.332E+04	8.952E-01	3.821E-01	1.066E+02	7.162E-03
2051	2.320E+01	1.267E+04	8.516E-01	3.634E-01	1.014E+02	6.813E-03
2052	2.207E+01	1.206E+04	8.101E-01	3.457E-01	9.645E+01	6.480E-03
2053	2.099E+01	1.147E+04	7.705E-01	3.289E-01	9.175E+01	6.164E-03
2054	1.997E+01	1.091E+04	7.330E-01	3.128E-01	8.727E+01	5.864E-03
2055	1.899E+01	1.038E+04	6.972E-01	2.976E-01	8.301E+01	5.578E-03
2056	1.807E+01	9.871E+03	6.632E-01	2.831E-01	7.897E+01	5.306E-03
2057	1.719E+01	9.389E+03	6.309E-01	2.692E-01	7.511E+01	5.047E-03
2058	1.635E+01	8.931E+03	6.001E-01	2.561E-01	7.145E+01	4.801E-03
2059	1.555E+01	8.496E+03	5.708E-01	2.436E-01	6.797E+01	4.567E-03
2060	1.479E+01	8.081E+03	5.430E-01	2.317E-01	6.465E+01	4.344E-03
2061	1.407E+01	7.687E+03	5.165E-01	2.204E-01	6.150E+01	4.132E-03
2062	1.339E+01	7.312E+03	4.913E-01	2.097E-01	5.850E+01	3.931E-03
2063	1.273E+01	6.956E+03	4.674E-01	1.995E-01	5.565E+01	3.739E-03
2064	1.211E+01	6.617E+03	4.446E-01	1.897E-01	5.293E+01	3.557E-03
2065	1.152E+01	6.294E+03	4.229E-01	1.805E-01	5.035E+01	3.383E-03
2066	1.096E+01	5.987E+03	4.023E-01	1.717E-01	4.790E+01	3.218E-03
2067	1.042E+01	5.695E+03	3.826E-01	1.633E-01	4.556E+01	3.061E-03
2068	9.916E+00	5.417E+03	3.640E-01	1.553E-01	4.334E+01	2.912E-03
2069	9.433E+00	5.153E+03	3.462E-01	1.478E-01	4.122E+01	2.770E-03
2070	8.973E+00	4.902E+03	3.293E-01	1.406E-01	3.921E+01	2.635E-03
2071	8.535E+00	4.663E+03	3.133E-01	1.337E-01	3.730E+01	2.506E-03
2072	8.119E+00	4.435E+03	2.980E-01	1.272E-01	3.548E+01	2.384E-03
2073	7.723E+00	4.219E+03	2.835E-01	1.210E-01	3.375E+01	2.268E-03
2074	7.346E+00	4.013E+03	2.696E-01	1.151E-01	3.211E+01	2.157E-03
2075	6.988E+00	3.817E+03	2.565E-01	1.095E-01	3.054E+01	2.052E-03
2076	6.647E+00	3.631E+03	2.440E-01	1.041E-01	2.905E+01	1.952E-03
2077	6.323E+00	3.454E+03	2.321E-01	9.905E-02	2.763E+01	1.857E-03

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2078	6.014E+00	3.286E+03	2.208E-01	9.422E-02	2.629E+01	1.766E-03
2079	5.721E+00	3.125E+03	2.100E-01	8.962E-02	2.500E+01	1.680E-03
2080	5.442E+00	2.973E+03	1.998E-01	8.525E-02	2.378E+01	1.598E-03
2081	5.177E+00	2.828E+03	1.900E-01	8.110E-02	2.262E+01	1.520E-03
2082	4.924E+00	2.690E+03	1.807E-01	7.714E-02	2.152E+01	1.446E-03
2083	4.684E+00	2.559E+03	1.719E-01	7.338E-02	2.047E+01	1.375E-03
2084	4.456E+00	2.434E+03	1.635E-01	6.980E-02	1.947E+01	1.308E-03
2085	4.238E+00	2.315E+03	1.556E-01	6.640E-02	1.852E+01	1.245E-03
2086	4.032E+00	2.202E+03	1.480E-01	6.316E-02	1.762E+01	1.184E-03
2087	3.835E+00	2.095E+03	1.408E-01	6.008E-02	1.676E+01	1.126E-03
2088	3.648E+00	1.993E+03	1.339E-01	5.715E-02	1.594E+01	1.071E-03
2089	3.470E+00	1.896E+03	1.274E-01	5.436E-02	1.517E+01	1.019E-03
2090	3.301E+00	1.803E+03	1.212E-01	5.171E-02	1.443E+01	9.693E-04
2091	3.140E+00	1.715E+03	1.152E-01	4.919E-02	1.372E+01	9.220E-04
2092	2.987E+00	1.632E+03	1.096E-01	4.679E-02	1.305E+01	8.770E-04
2093	2.841E+00	1.552E+03	1.043E-01	4.451E-02	1.242E+01	8.343E-04
2094	2.702E+00	1.476E+03	9.920E-02	4.234E-02	1.181E+01	7.936E-04
2095	2.571E+00	1.404E+03	9.436E-02	4.027E-02	1.123E+01	7.549E-04
2096	2.445E+00	1.336E+03	8.976E-02	3.831E-02	1.069E+01	7.181E-04
2097	2.326E+00	1.271E+03	8.538E-02	3.644E-02	1.017E+01	6.830E-04
2098	2.213E+00	1.209E+03	8.121E-02	3.466E-02	9.670E+00	6.497E-04
2099	2.105E+00	1.150E+03	7.725E-02	3.297E-02	9.198E+00	6.180E-04
2100	2.002E+00	1.094E+03	7.349E-02	3.136E-02	8.750E+00	5.879E-04
2101	1.904E+00	1.040E+03	6.990E-02	2.983E-02	8.323E+00	5.592E-04
2102	1.812E+00	9.896E+02	6.649E-02	2.838E-02	7.917E+00	5.319E-04
2103	1.723E+00	9.414E+02	6.325E-02	2.699E-02	7.531E+00	5.060E-04
2104	1.639E+00	8.955E+02	6.017E-02	2.568E-02	7.164E+00	4.813E-04
2105	1.559E+00	8.518E+02	5.723E-02	2.443E-02	6.814E+00	4.578E-04
2106	1.483E+00	8.102E+02	5.444E-02	2.323E-02	6.482E+00	4.355E-04
2107	1.411E+00	7.707E+02	5.178E-02	2.210E-02	6.166E+00	4.143E-04
2108	1.342E+00	7.331E+02	4.926E-02	2.102E-02	5.865E+00	3.941E-04
2109	1.277E+00	6.974E+02	4.686E-02	2.000E-02	5.579E+00	3.749E-04
2110	1.214E+00	6.634E+02	4.457E-02	1.902E-02	5.307E+00	3.566E-04
2111	1.155E+00	6.310E+02	4.240E-02	1.809E-02	5.048E+00	3.392E-04
2112	1.099E+00	6.002E+02	4.033E-02	1.721E-02	4.802E+00	3.226E-04
2113	1.045E+00	5.710E+02	3.836E-02	1.637E-02	4.568E+00	3.069E-04
2114	9.942E-01	5.431E+02	3.649E-02	1.557E-02	4.345E+00	2.919E-04
2115	9.457E-01	5.166E+02	3.471E-02	1.481E-02	4.133E+00	2.777E-04
2116	8.996E-01	4.914E+02	3.302E-02	1.409E-02	3.931E+00	2.642E-04
2117	8.557E-01	4.675E+02	3.141E-02	1.341E-02	3.740E+00	2.513E-04



Summary Report

Landfill Name or Identifier: Pasco Sanitary Landfill - Burn Trenches

Date: Wednesday, August 27, 2014

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation *(m^3/year)*

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate *($year^{-1}$)*

L_o = potential methane generation capacity *(m^3/Mg)*

M_i = mass of waste accepted in the i^{th} year *(Mg)*

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year *(decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1958**	
Landfill Closure Year (with 80-year limit)	**1965**	
Actual Closure Year (without limit)	***1965***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity	**24,570**	*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.050**	*$year^{-1}$*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1958	3,071	3,378	0	0
1959	3,071	3,378	3,071	3,378
1960	3,071	3,378	6,143	6,757
1961	3,071	3,378	9,214	10,135
1962	3,071	3,378	12,285	13,514
1963	3,071	3,378	15,356	16,892
1964	3,071	3,378	18,428	20,270
1965	3,071	3,378	21,499	23,649
1966	0	0	24,570	27,027
1967	0	0	24,570	27,027
1968	0	0	24,570	27,027
1969	0	0	24,570	27,027
1970	0	0	24,570	27,027
1971	0	0	24,570	27,027
1972	0	0	24,570	27,027
1973	0	0	24,570	27,027
1974	0	0	24,570	27,027
1975	0	0	24,570	27,027
1976	0	0	24,570	27,027
1977	0	0	24,570	27,027
1978	0	0	24,570	27,027
1979	0	0	24,570	27,027
1980	0	0	24,570	27,027
1981	0	0	24,570	27,027
1982	0	0	24,570	27,027
1983	0	0	24,570	27,027
1984	0	0	24,570	27,027
1985	0	0	24,570	27,027
1986	0	0	24,570	27,027
1987	0	0	24,570	27,027
1988	0	0	24,570	27,027
1989	0	0	24,570	27,027
1990	0	0	24,570	27,027
1991	0	0	24,570	27,027
1992	0	0	24,570	27,027
1993	0	0	24,570	27,027
1994	0	0	24,570	27,027
1995	0	0	24,570	27,027
1996	0	0	24,570	27,027
1997	0	0	24,570	27,027

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1998	0	0	24,570	27,027
1999	0	0	24,570	27,027
2000	0	0	24,570	27,027
2001	0	0	24,570	27,027
2002	0	0	24,570	27,027
2003	0	0	24,570	27,027
2004	0	0	24,570	27,027
2005	0	0	24,570	27,027
2006	0	0	24,570	27,027
2007	0	0	24,570	27,027
2008	0	0	24,570	27,027
2009	0	0	24,570	27,027
2010	0	0	24,570	27,027
2011	0	0	24,570	27,027
2012	0	0	24,570	27,027
2013	0	0	24,570	27,027
2014	0	0	24,570	27,027
2015	0	0	24,570	27,027
2016	0	0	24,570	27,027
2017	0	0	24,570	27,027
2018	0	0	24,570	27,027
2019	0	0	24,570	27,027
2020	0	0	24,570	27,027
2021	0	0	24,570	27,027
2022	0	0	24,570	27,027
2023	0	0	24,570	27,027
2024	0	0	24,570	27,027
2025	0	0	24,570	27,027
2026	0	0	24,570	27,027
2027	0	0	24,570	27,027
2028	0	0	24,570	27,027
2029	0	0	24,570	27,027
2030	0	0	24,570	27,027
2031	0	0	24,570	27,027
2032	0	0	24,570	27,027
2033	0	0	24,570	27,027
2034	0	0	24,570	27,027
2035	0	0	24,570	27,027
2036	0	0	24,570	27,027
2037	0	0	24,570	27,027

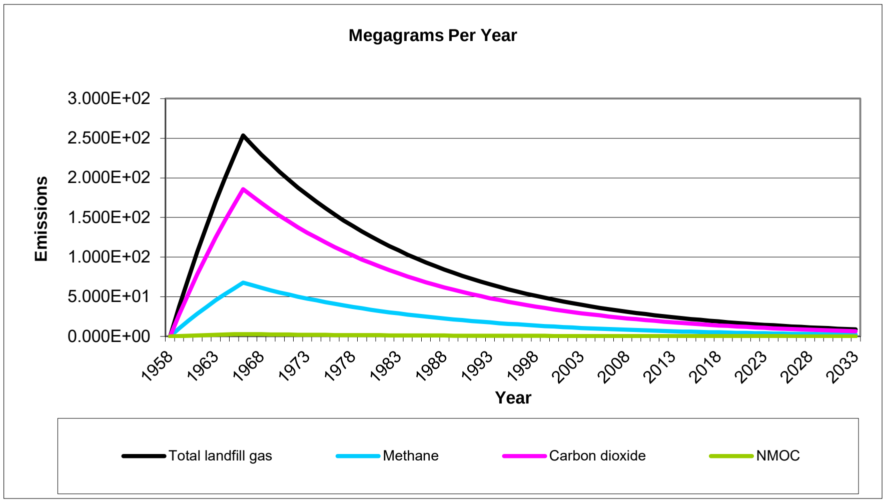
Pollutant Parameters

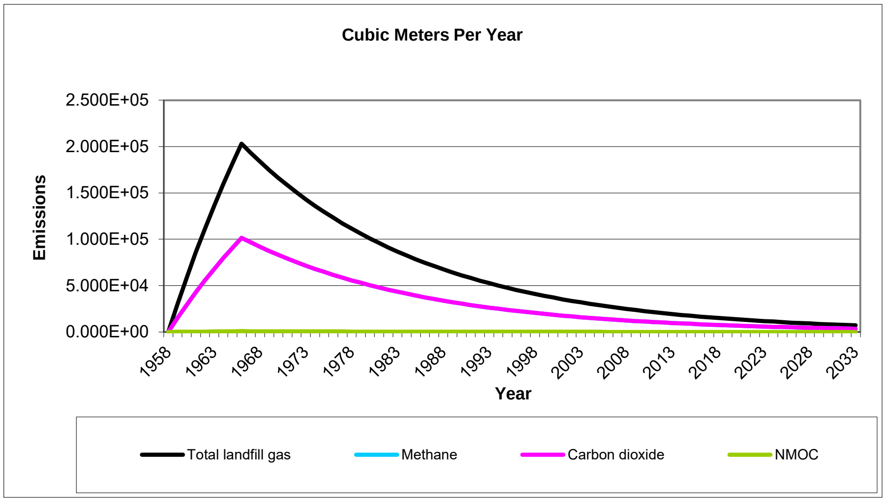
	Compound	Gas / Pollutant Default Parameters: Concentration (*ppmv*)	Molecular Weight	User-specified Pollutant Parameters: Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

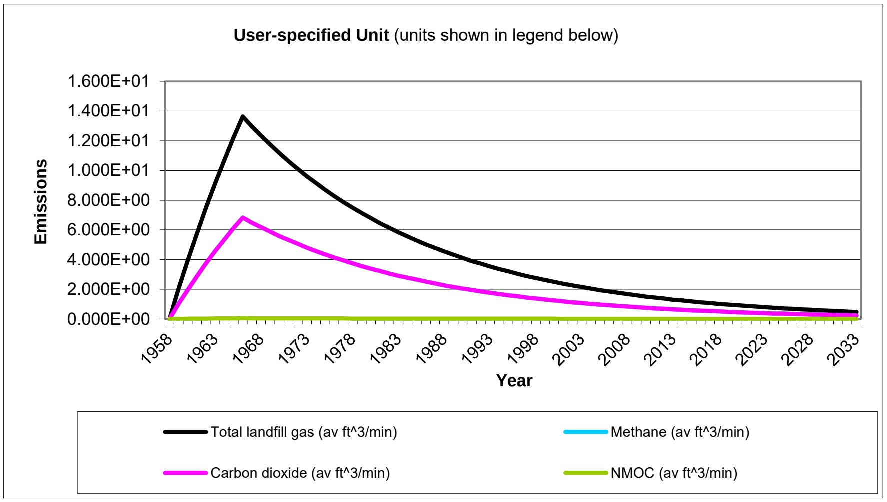
Pollutant Parameters (Continued)

	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
3.000E+02
2.500E+02
2.000E+02
1.500E+02
1.000E+02
5.000E+01
0.000E+00
Emissions
1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023 2028 2033
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
2.500E+05
2.000E+05
1.500E+05
1.000E+05
5.000E+04
0.000E+00
Emissions
1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023 2028 2033
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
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1.400E+01
1.200E+01
1.000E+01
8.000E+00
6.000E+00
4.000E+00
2.000E+00
0.000E+00
Emissions
1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023 2028 2033
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1958	0	0	0	0	0	0
1959	3.751E+01	3.003E+04	2.018E+00	1.002E+01	1.502E+04	1.009E+00
1960	7.318E+01	5.860E+04	3.937E+00	1.955E+01	2.930E+04	1.969E+00
1961	1.071E+02	8.577E+04	5.763E+00	2.861E+01	4.289E+04	2.882E+00
1962	1.394E+02	1.116E+05	7.500E+00	3.723E+01	5.581E+04	3.750E+00
1963	1.701E+02	1.362E+05	9.152E+00	4.544E+01	6.811E+04	4.576E+00
1964	1.993E+02	1.596E+05	1.072E+01	5.324E+01	7.980E+04	5.362E+00
1965	2.271E+02	1.818E+05	1.222E+01	6.066E+01	9.092E+04	6.109E+00
1966	2.535E+02	2.030E+05	1.364E+01	6.772E+01	1.015E+05	6.820E+00
1967	2.412E+02	1.931E+05	1.298E+01	6.442E+01	9.656E+04	6.488E+00
1968	2.294E+02	1.837E+05	1.234E+01	6.128E+01	9.185E+04	6.171E+00
1969	2.182E+02	1.747E+05	1.174E+01	5.829E+01	8.737E+04	5.870E+00
1970	2.076E+02	1.662E+05	1.117E+01	5.544E+01	8.311E+04	5.584E+00
1971	1.974E+02	1.581E+05	1.062E+01	5.274E+01	7.905E+04	5.312E+00
1972	1.878E+02	1.504E+05	1.011E+01	5.017E+01	7.520E+04	5.053E+00
1973	1.787E+02	1.431E+05	9.612E+00	4.772E+01	7.153E+04	4.806E+00
1974	1.699E+02	1.361E+05	9.143E+00	4.539E+01	6.804E+04	4.572E+00
1975	1.617E+02	1.294E+05	8.697E+00	4.318E+01	6.472E+04	4.349E+00
1976	1.538E+02	1.231E+05	8.273E+00	4.107E+01	6.157E+04	4.137E+00
1977	1.463E+02	1.171E+05	7.870E+00	3.907E+01	5.856E+04	3.935E+00
1978	1.391E+02	1.114E+05	7.486E+00	3.717E+01	5.571E+04	3.743E+00
1979	1.324E+02	1.060E+05	7.121E+00	3.535E+01	5.299E+04	3.560E+00
1980	1.259E+02	1.008E+05	6.774E+00	3.363E+01	5.041E+04	3.387E+00
1981	1.198E+02	9.590E+04	6.443E+00	3.199E+01	4.795E+04	3.222E+00
1982	1.139E+02	9.122E+04	6.129E+00	3.043E+01	4.561E+04	3.065E+00
1983	1.084E+02	8.677E+04	5.830E+00	2.894E+01	4.339E+04	2.915E+00
1984	1.031E+02	8.254E+04	5.546E+00	2.753E+01	4.127E+04	2.773E+00
1985	9.805E+01	7.851E+04	5.275E+00	2.619E+01	3.926E+04	2.638E+00
1986	9.327E+01	7.468E+04	5.018E+00	2.491E+01	3.734E+04	2.509E+00
1987	8.872E+01	7.104E+04	4.773E+00	2.370E+01	3.552E+04	2.387E+00
1988	8.439E+01	6.758E+04	4.540E+00	2.254E+01	3.379E+04	2.270E+00
1989	8.028E+01	6.428E+04	4.319E+00	2.144E+01	3.214E+04	2.160E+00
1990	7.636E+01	6.115E+04	4.108E+00	2.040E+01	3.057E+04	2.054E+00
1991	7.264E+01	5.816E+04	3.908E+00	1.940E+01	2.908E+04	1.954E+00
1992	6.909E+01	5.533E+04	3.717E+00	1.846E+01	2.766E+04	1.859E+00
1993	6.572E+01	5.263E+04	3.536E+00	1.756E+01	2.631E+04	1.768E+00
1994	6.252E+01	5.006E+04	3.364E+00	1.670E+01	2.503E+04	1.682E+00
1995	5.947E+01	4.762E+04	3.200E+00	1.589E+01	2.381E+04	1.600E+00
1996	5.657E+01	4.530E+04	3.044E+00	1.511E+01	2.265E+04	1.522E+00
1997	5.381E+01	4.309E+04	2.895E+00	1.437E+01	2.154E+04	1.448E+00
1998	5.119E+01	4.099E+04	2.754E+00	1.367E+01	2.049E+04	1.377E+00
1999	4.869E+01	3.899E+04	2.620E+00	1.301E+01	1.949E+04	1.310E+00
2000	4.632E+01	3.709E+04	2.492E+00	1.237E+01	1.854E+04	1.246E+00
2001	4.406E+01	3.528E+04	2.370E+00	1.177E+01	1.764E+04	1.185E+00
2002	4.191E+01	3.356E+04	2.255E+00	1.119E+01	1.678E+04	1.127E+00
2003	3.986E+01	3.192E+04	2.145E+00	1.065E+01	1.596E+04	1.072E+00
2004	3.792E+01	3.036E+04	2.040E+00	1.013E+01	1.518E+04	1.020E+00
2005	3.607E+01	2.888E+04	1.941E+00	9.635E+00	1.444E+04	9.703E-01
2006	3.431E+01	2.747E+04	1.846E+00	9.165E+00	1.374E+04	9.230E-01
2007	3.264E+01	2.613E+04	1.756E+00	8.718E+00	1.307E+04	8.780E-01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2008	3.105E+01	2.486E+04	1.670E+00	8.293E+00	1.243E+04	8.352E-01
2009	2.953E+01	2.365E+04	1.589E+00	7.888E+00	1.182E+04	7.944E-01
2010	2.809E+01	2.249E+04	1.511E+00	7.504E+00	1.125E+04	7.557E-01
2011	2.672E+01	2.140E+04	1.438E+00	7.138E+00	1.070E+04	7.188E-01
2012	2.542E+01	2.035E+04	1.368E+00	6.790E+00	1.018E+04	6.838E-01
2013	2.418E+01	1.936E+04	1.301E+00	6.458E+00	9.681E+03	6.504E-01
2014	2.300E+01	1.842E+04	1.237E+00	6.143E+00	9.208E+03	6.187E-01
2015	2.188E+01	1.752E+04	1.177E+00	5.844E+00	8.759E+03	5.885E-01
2016	2.081E+01	1.666E+04	1.120E+00	5.559E+00	8.332E+03	5.598E-01
2017	1.980E+01	1.585E+04	1.065E+00	5.288E+00	7.926E+03	5.325E-01
2018	1.883E+01	1.508E+04	1.013E+00	5.030E+00	7.539E+03	5.066E-01
2019	1.791E+01	1.434E+04	9.637E-01	4.784E+00	7.172E+03	4.819E-01
2020	1.704E+01	1.364E+04	9.167E-01	4.551E+00	6.822E+03	4.584E-01
2021	1.621E+01	1.298E+04	8.720E-01	4.329E+00	6.489E+03	4.360E-01
2022	1.542E+01	1.235E+04	8.295E-01	4.118E+00	6.173E+03	4.147E-01
2023	1.467E+01	1.174E+04	7.890E-01	3.917E+00	5.872E+03	3.945E-01
2024	1.395E+01	1.117E+04	7.505E-01	3.726E+00	5.585E+03	3.753E-01
2025	1.327E+01	1.063E+04	7.139E-01	3.544E+00	5.313E+03	3.570E-01
2026	1.262E+01	1.011E+04	6.791E-01	3.372E+00	5.054E+03	3.396E-01
2027	1.201E+01	9.614E+03	6.460E-01	3.207E+00	4.807E+03	3.230E-01
2028	1.142E+01	9.146E+03	6.145E-01	3.051E+00	4.573E+03	3.072E-01
2029	1.086E+01	8.700E+03	5.845E-01	2.902E+00	4.350E+03	2.923E-01
2030	1.033E+01	8.275E+03	5.560E-01	2.760E+00	4.138E+03	2.780E-01
2031	9.830E+00	7.872E+03	5.289E-01	2.626E+00	3.936E+03	2.644E-01
2032	9.351E+00	7.488E+03	5.031E-01	2.498E+00	3.744E+03	2.516E-01
2033	8.895E+00	7.123E+03	4.786E-01	2.376E+00	3.561E+03	2.393E-01
2034	8.461E+00	6.775E+03	4.552E-01	2.260E+00	3.388E+03	2.276E-01
2035	8.048E+00	6.445E+03	4.330E-01	2.150E+00	3.222E+03	2.165E-01
2036	7.656E+00	6.130E+03	4.119E-01	2.045E+00	3.065E+03	2.060E-01
2037	7.282E+00	5.831E+03	3.918E-01	1.945E+00	2.916E+03	1.959E-01
2038	6.927E+00	5.547E+03	3.727E-01	1.850E+00	2.774E+03	1.864E-01
2039	6.589E+00	5.277E+03	3.545E-01	1.760E+00	2.638E+03	1.773E-01
2040	6.268E+00	5.019E+03	3.372E-01	1.674E+00	2.510E+03	1.686E-01
2041	5.962E+00	4.774E+03	3.208E-01	1.593E+00	2.387E+03	1.604E-01
2042	5.672E+00	4.542E+03	3.051E-01	1.515E+00	2.271E+03	1.526E-01
2043	5.395E+00	4.320E+03	2.903E-01	1.441E+00	2.160E+03	1.451E-01
2044	5.132E+00	4.109E+03	2.761E-01	1.371E+00	2.055E+03	1.381E-01
2045	4.882E+00	3.909E+03	2.626E-01	1.304E+00	1.954E+03	1.313E-01
2046	4.644E+00	3.718E+03	2.498E-01	1.240E+00	1.859E+03	1.249E-01
2047	4.417E+00	3.537E+03	2.376E-01	1.180E+00	1.768E+03	1.188E-01
2048	4.202E+00	3.364E+03	2.261E-01	1.122E+00	1.682E+03	1.130E-01
2049	3.997E+00	3.200E+03	2.150E-01	1.068E+00	1.600E+03	1.075E-01
2050	3.802E+00	3.044E+03	2.045E-01	1.015E+00	1.522E+03	1.023E-01
2051	3.616E+00	2.896E+03	1.946E-01	9.660E-01	1.448E+03	9.728E-02
2052	3.440E+00	2.755E+03	1.851E-01	9.189E-01	1.377E+03	9.254E-02
2053	3.272E+00	2.620E+03	1.761E-01	8.740E-01	1.310E+03	8.803E-02
2054	3.113E+00	2.492E+03	1.675E-01	8.314E-01	1.246E+03	8.373E-02
2055	2.961E+00	2.371E+03	1.593E-01	7.909E-01	1.185E+03	7.965E-02
2056	2.816E+00	2.255E+03	1.515E-01	7.523E-01	1.128E+03	7.577E-02
2057	2.679E+00	2.145E+03	1.441E-01	7.156E-01	1.073E+03	7.207E-02
2058	2.548E+00	2.041E+03	1.371E-01	6.807E-01	1.020E+03	6.856E-02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2059	2.424E+00	1.941E+03	1.304E-01	6.475E-01	9.706E+02	6.521E-02
2060	2.306E+00	1.846E+03	1.241E-01	6.159E-01	9.232E+02	6.203E-02
2061	2.193E+00	1.756E+03	1.180E-01	5.859E-01	8.782E+02	5.901E-02
2062	2.086E+00	1.671E+03	1.123E-01	5.573E-01	8.354E+02	5.613E-02
2063	1.985E+00	1.589E+03	1.068E-01	5.301E-01	7.946E+02	5.339E-02
2064	1.888E+00	1.512E+03	1.016E-01	5.043E-01	7.559E+02	5.079E-02
2065	1.796E+00	1.438E+03	9.662E-02	4.797E-01	7.190E+02	4.831E-02
2066	1.708E+00	1.368E+03	9.191E-02	4.563E-01	6.839E+02	4.595E-02
2067	1.625E+00	1.301E+03	8.743E-02	4.340E-01	6.506E+02	4.371E-02
2068	1.546E+00	1.238E+03	8.316E-02	4.129E-01	6.189E+02	4.158E-02
2069	1.470E+00	1.177E+03	7.911E-02	3.927E-01	5.887E+02	3.955E-02
2070	1.399E+00	1.120E+03	7.525E-02	3.736E-01	5.600E+02	3.762E-02
2071	1.330E+00	1.065E+03	7.158E-02	3.554E-01	5.327E+02	3.579E-02
2072	1.266E+00	1.013E+03	6.809E-02	3.380E-01	5.067E+02	3.404E-02
2073	1.204E+00	9.639E+02	6.477E-02	3.215E-01	4.820E+02	3.238E-02
2074	1.145E+00	9.169E+02	6.161E-02	3.059E-01	4.585E+02	3.080E-02
2075	1.089E+00	8.722E+02	5.860E-02	2.909E-01	4.361E+02	2.930E-02
2076	1.036E+00	8.297E+02	5.575E-02	2.768E-01	4.148E+02	2.787E-02
2077	9.856E-01	7.892E+02	5.303E-02	2.633E-01	3.946E+02	2.651E-02
2078	9.375E-01	7.507E+02	5.044E-02	2.504E-01	3.754E+02	2.522E-02
2079	8.918E-01	7.141E+02	4.798E-02	2.382E-01	3.571E+02	2.399E-02
2080	8.483E-01	6.793E+02	4.564E-02	2.266E-01	3.396E+02	2.282E-02
2081	8.069E-01	6.461E+02	4.341E-02	2.155E-01	3.231E+02	2.171E-02
2082	7.676E-01	6.146E+02	4.130E-02	2.050E-01	3.073E+02	2.065E-02
2083	7.301E-01	5.847E+02	3.928E-02	1.950E-01	2.923E+02	1.964E-02
2084	6.945E-01	5.561E+02	3.737E-02	1.855E-01	2.781E+02	1.868E-02
2085	6.607E-01	5.290E+02	3.554E-02	1.765E-01	2.645E+02	1.777E-02
2086	6.284E-01	5.032E+02	3.381E-02	1.679E-01	2.516E+02	1.691E-02
2087	5.978E-01	4.787E+02	3.216E-02	1.597E-01	2.393E+02	1.608E-02
2088	5.686E-01	4.553E+02	3.059E-02	1.519E-01	2.277E+02	1.530E-02
2089	5.409E-01	4.331E+02	2.910E-02	1.445E-01	2.166E+02	1.455E-02
2090	5.145E-01	4.120E+02	2.768E-02	1.374E-01	2.060E+02	1.384E-02
2091	4.894E-01	3.919E+02	2.633E-02	1.307E-01	1.960E+02	1.317E-02
2092	4.656E-01	3.728E+02	2.505E-02	1.244E-01	1.864E+02	1.252E-02
2093	4.428E-01	3.546E+02	2.383E-02	1.183E-01	1.773E+02	1.191E-02
2094	4.212E-01	3.373E+02	2.266E-02	1.125E-01	1.687E+02	1.133E-02
2095	4.007E-01	3.209E+02	2.156E-02	1.070E-01	1.604E+02	1.078E-02
2096	3.812E-01	3.052E+02	2.051E-02	1.018E-01	1.526E+02	1.025E-02
2097	3.626E-01	2.903E+02	1.951E-02	9.685E-02	1.452E+02	9.754E-03
2098	3.449E-01	2.762E+02	1.856E-02	9.212E-02	1.381E+02	9.278E-03

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1958	0	0	0	0	0	0
1959	2.749E+01	1.502E+04	1.009E+00	4.306E-01	1.201E+02	8.071E-03
1960	5.363E+01	2.930E+04	1.969E+00	8.402E-01	2.344E+02	1.575E-02
1961	7.850E+01	4.289E+04	2.882E+00	1.230E+00	3.431E+02	2.305E-02
1962	1.022E+02	5.581E+04	3.750E+00	1.600E+00	4.465E+02	3.000E-02
1963	1.247E+02	6.811E+04	4.576E+00	1.953E+00	5.448E+02	3.661E-02
1964	1.461E+02	7.980E+04	5.362E+00	2.288E+00	6.384E+02	4.289E-02
1965	1.664E+02	9.092E+04	6.109E+00	2.607E+00	7.274E+02	4.887E-02
1966	1.858E+02	1.015E+05	6.820E+00	2.911E+00	8.121E+02	5.456E-02
1967	1.767E+02	9.656E+04	6.488E+00	2.769E+00	7.724E+02	5.190E-02
1968	1.681E+02	9.185E+04	6.171E+00	2.634E+00	7.348E+02	4.937E-02
1969	1.599E+02	8.737E+04	5.870E+00	2.505E+00	6.989E+02	4.696E-02
1970	1.521E+02	8.311E+04	5.584E+00	2.383E+00	6.649E+02	4.467E-02
1971	1.447E+02	7.905E+04	5.312E+00	2.267E+00	6.324E+02	4.249E-02
1972	1.376E+02	7.520E+04	5.053E+00	2.156E+00	6.016E+02	4.042E-02
1973	1.309E+02	7.153E+04	4.806E+00	2.051E+00	5.722E+02	3.845E-02
1974	1.246E+02	6.804E+04	4.572E+00	1.951E+00	5.443E+02	3.657E-02
1975	1.185E+02	6.472E+04	4.349E+00	1.856E+00	5.178E+02	3.479E-02
1976	1.127E+02	6.157E+04	4.137E+00	1.765E+00	4.925E+02	3.309E-02
1977	1.072E+02	5.856E+04	3.935E+00	1.679E+00	4.685E+02	3.148E-02
1978	1.020E+02	5.571E+04	3.743E+00	1.597E+00	4.457E+02	2.994E-02
1979	9.700E+01	5.299E+04	3.560E+00	1.520E+00	4.239E+02	2.848E-02
1980	9.227E+01	5.041E+04	3.387E+00	1.445E+00	4.033E+02	2.709E-02
1981	8.777E+01	4.795E+04	3.222E+00	1.375E+00	3.836E+02	2.577E-02
1982	8.349E+01	4.561E+04	3.065E+00	1.308E+00	3.649E+02	2.452E-02
1983	7.942E+01	4.339E+04	2.915E+00	1.244E+00	3.471E+02	2.332E-02
1984	7.554E+01	4.127E+04	2.773E+00	1.183E+00	3.302E+02	2.218E-02
1985	7.186E+01	3.926E+04	2.638E+00	1.126E+00	3.141E+02	2.110E-02
1986	6.835E+01	3.734E+04	2.509E+00	1.071E+00	2.987E+02	2.007E-02
1987	6.502E+01	3.552E+04	2.387E+00	1.019E+00	2.842E+02	1.909E-02
1988	6.185E+01	3.379E+04	2.270E+00	9.689E-01	2.703E+02	1.816E-02
1989	5.883E+01	3.214E+04	2.160E+00	9.217E-01	2.571E+02	1.728E-02
1990	5.596E+01	3.057E+04	2.054E+00	8.767E-01	2.446E+02	1.643E-02
1991	5.323E+01	2.908E+04	1.954E+00	8.339E-01	2.327E+02	1.563E-02
1992	5.064E+01	2.766E+04	1.859E+00	7.933E-01	2.213E+02	1.487E-02
1993	4.817E+01	2.631E+04	1.768E+00	7.546E-01	2.105E+02	1.414E-02
1994	4.582E+01	2.503E+04	1.682E+00	7.178E-01	2.002E+02	1.345E-02
1995	4.358E+01	2.381E+04	1.600E+00	6.828E-01	1.905E+02	1.280E-02
1996	4.146E+01	2.265E+04	1.522E+00	6.495E-01	1.812E+02	1.217E-02
1997	3.944E+01	2.154E+04	1.448E+00	6.178E-01	1.724E+02	1.158E-02
1998	3.751E+01	2.049E+04	1.377E+00	5.877E-01	1.640E+02	1.102E-02
1999	3.568E+01	1.949E+04	1.310E+00	5.590E-01	1.560E+02	1.048E-02
2000	3.394E+01	1.854E+04	1.246E+00	5.317E-01	1.483E+02	9.967E-03
2001	3.229E+01	1.764E+04	1.185E+00	5.058E-01	1.411E+02	9.481E-03
2002	3.071E+01	1.678E+04	1.127E+00	4.811E-01	1.342E+02	9.019E-03
2003	2.922E+01	1.596E+04	1.072E+00	4.577E-01	1.277E+02	8.579E-03
2004	2.779E+01	1.518E+04	1.020E+00	4.354E-01	1.215E+02	8.161E-03
2005	2.644E+01	1.444E+04	9.703E-01	4.141E-01	1.155E+02	7.763E-03
2006	2.515E+01	1.374E+04	9.230E-01	3.939E-01	1.099E+02	7.384E-03
2007	2.392E+01	1.307E+04	8.780E-01	3.747E-01	1.045E+02	7.024E-03

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2008	2.275E+01	1.243E+04	8.352E-01	3.564E-01	9.944E+01	6.681E-03
2009	2.164E+01	1.182E+04	7.944E-01	3.391E-01	9.459E+01	6.356E-03
2010	2.059E+01	1.125E+04	7.557E-01	3.225E-01	8.998E+01	6.046E-03
2011	1.958E+01	1.070E+04	7.188E-01	3.068E-01	8.559E+01	5.751E-03
2012	1.863E+01	1.018E+04	6.838E-01	2.918E-01	8.142E+01	5.470E-03
2013	1.772E+01	9.681E+03	6.504E-01	2.776E-01	7.744E+01	5.203E-03
2014	1.686E+01	9.208E+03	6.187E-01	2.641E-01	7.367E+01	4.950E-03
2015	1.603E+01	8.759E+03	5.885E-01	2.512E-01	7.007E+01	4.708E-03
2016	1.525E+01	8.332E+03	5.598E-01	2.389E-01	6.666E+01	4.479E-03
2017	1.451E+01	7.926E+03	5.325E-01	2.273E-01	6.341E+01	4.260E-03
2018	1.380E+01	7.539E+03	5.066E-01	2.162E-01	6.031E+01	4.052E-03
2019	1.313E+01	7.172E+03	4.819E-01	2.056E-01	5.737E+01	3.855E-03
2020	1.249E+01	6.822E+03	4.584E-01	1.956E-01	5.457E+01	3.667E-03
2021	1.188E+01	6.489E+03	4.360E-01	1.861E-01	5.191E+01	3.488E-03
2022	1.130E+01	6.173E+03	4.147E-01	1.770E-01	4.938E+01	3.318E-03
2023	1.075E+01	5.872E+03	3.945E-01	1.684E-01	4.697E+01	3.156E-03
2024	1.022E+01	5.585E+03	3.753E-01	1.602E-01	4.468E+01	3.002E-03
2025	9.725E+00	5.313E+03	3.570E-01	1.523E-01	4.250E+01	2.856E-03
2026	9.251E+00	5.054E+03	3.396E-01	1.449E-01	4.043E+01	2.716E-03
2027	8.800E+00	4.807E+03	3.230E-01	1.379E-01	3.846E+01	2.584E-03
2028	8.370E+00	4.573E+03	3.072E-01	1.311E-01	3.658E+01	2.458E-03
2029	7.962E+00	4.350E+03	2.923E-01	1.247E-01	3.480E+01	2.338E-03
2030	7.574E+00	4.138E+03	2.780E-01	1.186E-01	3.310E+01	2.224E-03
2031	7.205E+00	3.936E+03	2.644E-01	1.129E-01	3.149E+01	2.116E-03
2032	6.853E+00	3.744E+03	2.516E-01	1.074E-01	2.995E+01	2.012E-03
2033	6.519E+00	3.561E+03	2.393E-01	1.021E-01	2.849E+01	1.914E-03
2034	6.201E+00	3.388E+03	2.276E-01	9.714E-02	2.710E+01	1.821E-03
2035	5.899E+00	3.222E+03	2.165E-01	9.240E-02	2.578E+01	1.732E-03
2036	5.611E+00	3.065E+03	2.060E-01	8.790E-02	2.452E+01	1.648E-03
2037	5.337E+00	2.916E+03	1.959E-01	8.361E-02	2.333E+01	1.567E-03
2038	5.077E+00	2.774E+03	1.864E-01	7.953E-02	2.219E+01	1.491E-03
2039	4.829E+00	2.638E+03	1.773E-01	7.565E-02	2.111E+01	1.418E-03
2040	4.594E+00	2.510E+03	1.686E-01	7.196E-02	2.008E+01	1.349E-03
2041	4.370E+00	2.387E+03	1.604E-01	6.845E-02	1.910E+01	1.283E-03
2042	4.157E+00	2.271E+03	1.526E-01	6.512E-02	1.817E+01	1.221E-03
2043	3.954E+00	2.160E+03	1.451E-01	6.194E-02	1.728E+01	1.161E-03
2044	3.761E+00	2.055E+03	1.381E-01	5.892E-02	1.644E+01	1.104E-03
2045	3.578E+00	1.954E+03	1.313E-01	5.605E-02	1.564E+01	1.051E-03
2046	3.403E+00	1.859E+03	1.249E-01	5.331E-02	1.487E+01	9.993E-04
2047	3.237E+00	1.768E+03	1.188E-01	5.071E-02	1.415E+01	9.506E-04
2048	3.079E+00	1.682E+03	1.130E-01	4.824E-02	1.346E+01	9.042E-04
2049	2.929E+00	1.600E+03	1.075E-01	4.589E-02	1.280E+01	8.601E-04
2050	2.786E+00	1.522E+03	1.023E-01	4.365E-02	1.218E+01	8.182E-04
2051	2.650E+00	1.448E+03	9.728E-02	4.152E-02	1.158E+01	7.783E-04
2052	2.521E+00	1.377E+03	9.254E-02	3.949E-02	1.102E+01	7.403E-04
2053	2.398E+00	1.310E+03	8.803E-02	3.757E-02	1.048E+01	7.042E-04
2054	2.281E+00	1.246E+03	8.373E-02	3.574E-02	9.970E+00	6.699E-04
2055	2.170E+00	1.185E+03	7.965E-02	3.399E-02	9.484E+00	6.372E-04
2056	2.064E+00	1.128E+03	7.577E-02	3.234E-02	9.021E+00	6.061E-04
2057	1.963E+00	1.073E+03	7.207E-02	3.076E-02	8.581E+00	5.766E-04
2058	1.868E+00	1.020E+03	6.856E-02	2.926E-02	8.163E+00	5.484E-04

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2059	1.777E+00	9.706E+02	6.521E-02	2.783E-02	7.765E+00	5.217E-04
2060	1.690E+00	9.232E+02	6.203E-02	2.647E-02	7.386E+00	4.963E-04
2061	1.608E+00	8.782E+02	5.901E-02	2.518E-02	7.026E+00	4.721E-04
2062	1.529E+00	8.354E+02	5.613E-02	2.395E-02	6.683E+00	4.490E-04
2063	1.455E+00	7.946E+02	5.339E-02	2.279E-02	6.357E+00	4.271E-04
2064	1.384E+00	7.559E+02	5.079E-02	2.168E-02	6.047E+00	4.063E-04
2065	1.316E+00	7.190E+02	4.831E-02	2.062E-02	5.752E+00	3.865E-04
2066	1.252E+00	6.839E+02	4.595E-02	1.961E-02	5.472E+00	3.676E-04
2067	1.191E+00	6.506E+02	4.371E-02	1.866E-02	5.205E+00	3.497E-04
2068	1.133E+00	6.189E+02	4.158E-02	1.775E-02	4.951E+00	3.326E-04
2069	1.078E+00	5.887E+02	3.955E-02	1.688E-02	4.709E+00	3.164E-04
2070	1.025E+00	5.600E+02	3.762E-02	1.606E-02	4.480E+00	3.010E-04
2071	9.750E-01	5.327E+02	3.579E-02	1.527E-02	4.261E+00	2.863E-04
2072	9.275E-01	5.067E+02	3.404E-02	1.453E-02	4.053E+00	2.723E-04
2073	8.822E-01	4.820E+02	3.238E-02	1.382E-02	3.856E+00	2.591E-04
2074	8.392E-01	4.585E+02	3.080E-02	1.315E-02	3.668E+00	2.464E-04
2075	7.983E-01	4.361E+02	2.930E-02	1.251E-02	3.489E+00	2.344E-04
2076	7.594E-01	4.148E+02	2.787E-02	1.190E-02	3.319E+00	2.230E-04
2077	7.223E-01	3.946E+02	2.651E-02	1.132E-02	3.157E+00	2.121E-04
2078	6.871E-01	3.754E+02	2.522E-02	1.076E-02	3.003E+00	2.018E-04
2079	6.536E-01	3.571E+02	2.399E-02	1.024E-02	2.856E+00	1.919E-04
2080	6.217E-01	3.396E+02	2.282E-02	9.739E-03	2.717E+00	1.826E-04
2081	5.914E-01	3.231E+02	2.171E-02	9.264E-03	2.585E+00	1.737E-04
2082	5.625E-01	3.073E+02	2.065E-02	8.813E-03	2.459E+00	1.652E-04
2083	5.351E-01	2.923E+02	1.964E-02	8.383E-03	2.339E+00	1.571E-04
2084	5.090E-01	2.781E+02	1.868E-02	7.974E-03	2.225E+00	1.495E-04
2085	4.842E-01	2.645E+02	1.777E-02	7.585E-03	2.116E+00	1.422E-04
2086	4.606E-01	2.516E+02	1.691E-02	7.215E-03	2.013E+00	1.352E-04
2087	4.381E-01	2.393E+02	1.608E-02	6.863E-03	1.915E+00	1.286E-04
2088	4.167E-01	2.277E+02	1.530E-02	6.528E-03	1.821E+00	1.224E-04
2089	3.964E-01	2.166E+02	1.455E-02	6.210E-03	1.732E+00	1.164E-04
2090	3.771E-01	2.060E+02	1.384E-02	5.907E-03	1.648E+00	1.107E-04
2091	3.587E-01	1.960E+02	1.317E-02	5.619E-03	1.568E+00	1.053E-04
2092	3.412E-01	1.864E+02	1.252E-02	5.345E-03	1.491E+00	1.002E-04
2093	3.246E-01	1.773E+02	1.191E-02	5.084E-03	1.418E+00	9.531E-05
2094	3.087E-01	1.687E+02	1.133E-02	4.836E-03	1.349E+00	9.066E-05
2095	2.937E-01	1.604E+02	1.078E-02	4.601E-03	1.283E+00	8.624E-05
2096	2.793E-01	1.526E+02	1.025E-02	4.376E-03	1.221E+00	8.203E-05
2097	2.657E-01	1.452E+02	9.754E-03	4.163E-03	1.161E+00	7.803E-05
2098	2.528E-01	1.381E+02	9.278E-03	3.960E-03	1.105E+00	7.422E-05