



# A REUSE PLANNING REPORT

## KENT HIGHLANDS & MIDWAY LANDFILLS

*prepared for*  
City of Seattle, Seattle Public Utilities  
EPA Region 10  
Superfund Redevelopment Initiative

*prepared by*  
E<sup>2</sup> Inc.

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Front Cover Photographs: *Top right:* Midway Landfill

*Bottom right:* Kent Highlands Landfill

## Table of Contents

Introduction	Page 2
Kent Highlands Landfill	Pages 3-12
Site History	Page 3
Characterization Introduction	Page 3
Characterization Description	Page 4
Framework Description	Page 6
Detailed Development Area Description	Page 8
Conceptual Master Plan	Page 10
Midway Landfill	Pages 13-20
Site History	Page 13
Characterization Introduction	Page 13
Characterization Description	Page 14
Framework Description	Page 16
Detailed Development Area Description	Page 18
Potential Next Steps	Page 20
Appendices	
Appendix A: Kent Highlands Slope Analysis	
Appendix B: Landfill Reuse Case Studies	

## Introduction

The City of Seattle owns and maintains two closed landfill sites located in the City of Kent, Washington. The Kent Highlands Landfill and the Midway Landfill were closed in the 1980s, listed on the National Priorities List (NPL) of contaminated sites (Superfund) in the late 1980s and early 1990s, and were remediated under Consent Agreements with the United States Environmental Protection Agency (EPA) and Washington Department of Ecology (Ecology) during the 1990s.

While long-term groundwater monitoring, landfill gas control, and leachate collection at these sites is ongoing, the City of Seattle and Seattle Public Utilities (SPU), which maintains the two sites, are interested in moving these sites toward some form of beneficial use. The City of Seattle recognizes that the reuse of these sites might provide significant benefits to the rapidly growing City of Kent; SPU also has a fiduciary responsibility to optimize the value of its assets for its customers. In an effort to better understand how to approach the consideration of future uses at these sites, the City of Seattle sought the assistance of EPA's Superfund Redevelopment Initiative in April 2006.

The Superfund Redevelopment Initiative (SRI) was created by EPA in 1999 to help communities and stakeholders in their efforts to return Superfund sites to beneficial use. Providing for long-term stewardship and ensuring the implementation of appropriate and effective Institutional Controls (ICs) are important parts of EPA's statutory obligation at sites where waste is left in place. Reuse consideration and planning can often play a critical role in helping to meet these obligations by engaging local stakeholders in a collaborative decision-making process about a site's future use. SRI provides a range of tools and information resources for both EPA staff and stakeholders interested in Superfund site reuse.

To support the City of Seattle's efforts at the Midway Landfill and Kent Highlands Landfill sites, SRI provided the City with the services of E<sup>2</sup> Inc., an environmental consulting and planning firm specializing in the reuse of contaminated sites. In order to extend the scope of services provided by the consulting team, the City of Seattle matched the funding provided by SRI.

Beginning in May 2006, the consulting team coordinated an eight-month reuse evaluation and planning study that was led by staff from the City of Seattle and the City of Kent and supported by staff from SPU, Ecology, and EPA Region 10. This report summarizes the study's findings. This reuse evaluation and planning study creates a framework for thinking about a range of uses for these two valuable but challenged site properties, rather than presenting a definitive plan for the reuse of the sites. The report takes into account Superfund program characteristics and site remedy components, the subsidence challenges associated with landfills, and significant site topography challenges. The report addresses these areas as part of a site characterization analysis and presents an approach for moving forward, identifying both short and long term opportunities at both sites. The report does not include any of the detailed engineering and market studies that will be necessary in subsequent feasibility studies to determine optimal redevelopment strategies at these sites.

# KENT HIGHLANDS LANDFILL

## Site History

The Kent Highlands Landfill site, which was operated by the City of Seattle, includes approximately 110 acres and is located at the intersection of State Route 516 and Military Road in Kent, Washington. The landfill was sited in a deep ravine that sloped downward from west to east toward the Green River, and landfill operations began in 1968. While the majority of material accepted at the landfill was municipal waste, industrial waste and construction and maintenance waste were delivered to the site following closure of the nearby Midway Landfill in 1983. At the time of its closure in 1986, the Kent Highlands Landfill contained approximately eight million cubic yards of waste.

The site was listed on EPA's National Priorities List in 1990 and the construction of the site's remedy was completed in September 1995. Landfill gas control and groundwater monitoring at the site is ongoing and is monitored by the Washington Department of Ecology, which acts as the lead regulatory agency at the site.

## Characterization Introduction

Understanding how to think about reuse at the Kent Highlands Landfill site begins with an attempt to understand and characterize the conditions at the site that will impact or drive the site's current and future use potential. A range of criteria were initially considered as part of the site characterization for the Kent Highlands Landfill, including: site ownership, regulatory issues, contamination issues, human health considerations, public perceptions, site surface topography, type and depth of refuse present, landfill age, settlement rates, and location and characteristics of remedy components. Based on a determination of the factors with the greatest likely impact on the site's future use potential, the criteria that informed the site characterization process were the location of remedy components both above and below the site's surface, presence of refuse, depth of refuse, and site topography. Due to the steep ravine topography that defined the site prior to its use as a landfill, the depth of refuse increases quickly from west to east, and is characterized by either lesser depths (up to 30 feet) or greater depths (more than 30 feet and upwards of 200 feet in some areas). The site's slopes are characterized as minimal (0-5%), moderate (5-10%), moderate to critical (10-20%), and critical (20% or greater).

The results of the site characterization analysis and a future use framework for the Kent Highlands Landfill site are presented in the following pages of the report. A detailed development area description and conceptual master plan, informed by the site's characterization analysis and framework are presented at the end of this section.

### Kent Highlands Landfill



# KENT HIGHLANDS LANDFILL

## Characterization Description

The map located to the right presents the results of the Kent Highlands Landfill Site Characterization. The eight character zones defined by the map are further described below:

### Zone A

Four-acre Zone A is characterized by the absence of refuse, minimal slopes, and limited access. A manifold and gas wells are located along the southern edge of Zone A. Based on these characteristics, this zone could be considered for relatively unrestricted uses in the near term.

### Zone B

Fifteen-acre Zone B is characterized by the absence of refuse and minimal to moderate slopes. This zone also has approximately 500 feet of road frontage along Military Road, houses SPU site offices, and includes a family residence leased to an individual by the City of Seattle. Zone B is also bordered on the north by the South 228 Street extension. Based on these characteristics, this zone could be considered for relatively unrestricted uses in the near term.

### Zone C

Five-acre Zone C is characterized by a lesser depth of refuse (greatest depth approximately 30 feet), slopes of less than 5%, and minimal surface remedy components. While the depth of refuse suggests that building structures on this zone may be technically feasible with the use of pilings or other engineered approaches, the added costs associated with this type of construction, combined with the zone's remedy components, make the building of structures in Zone C impractical at this time. Because this zone is likely to experience more limited subsidence than areas with deeper refuse, it may be most appropriate for surface uses such as parking or active recreation in the near term. Consideration will need to be given to the relocation or protection of surface remedy components and the potential for minor subsidence.

### Zone D

Ten-acre Zone D is characterized by a greater depth of refuse, minimal 0-5% slopes, and some surface remedy components. The scope of potential future uses in this zone may be limited by its depth of refuse. Due to the steep ravine topography that defined the site prior to its use as a landfill, the depth of refuse in Zone D increases from approximately 40 feet to 100 feet moving east (downhill). While above ground methane pipes are located

on part of this zone, large portions of this zone are unobstructed by the site's methane pipe system. This zone may be most appropriate for surface uses such as passive recreational uses or ecological uses that will not be significantly impacted by moderate subsidence in the future. Consideration will also need to be given to the relocation or protection of surface remedy components and the potential for moderate levels of subsidence.

### Zone E

Nine-acre Zone E is characterized by refuse depths of up to 200 feet and minimal to moderate 5-10% slopes. While this zone also includes some areas of unobstructed open space, existing slopes are too steep to support recreational fields and site grading is not feasible due to the potential impact on the site's cap. Future uses on this portion of the site are not feasible in the near term.

### Zone F

Twenty-six-acre Zone F is characterized by by refuse depths of up to 200 feet, moderate to critical slopes of 10-20%, and minimal surface remedy components. While this zone includes significant areas of unobstructed open space, the slopes and depth of refuse mean that this portion of the site is likely poorly suited for development in the near term.

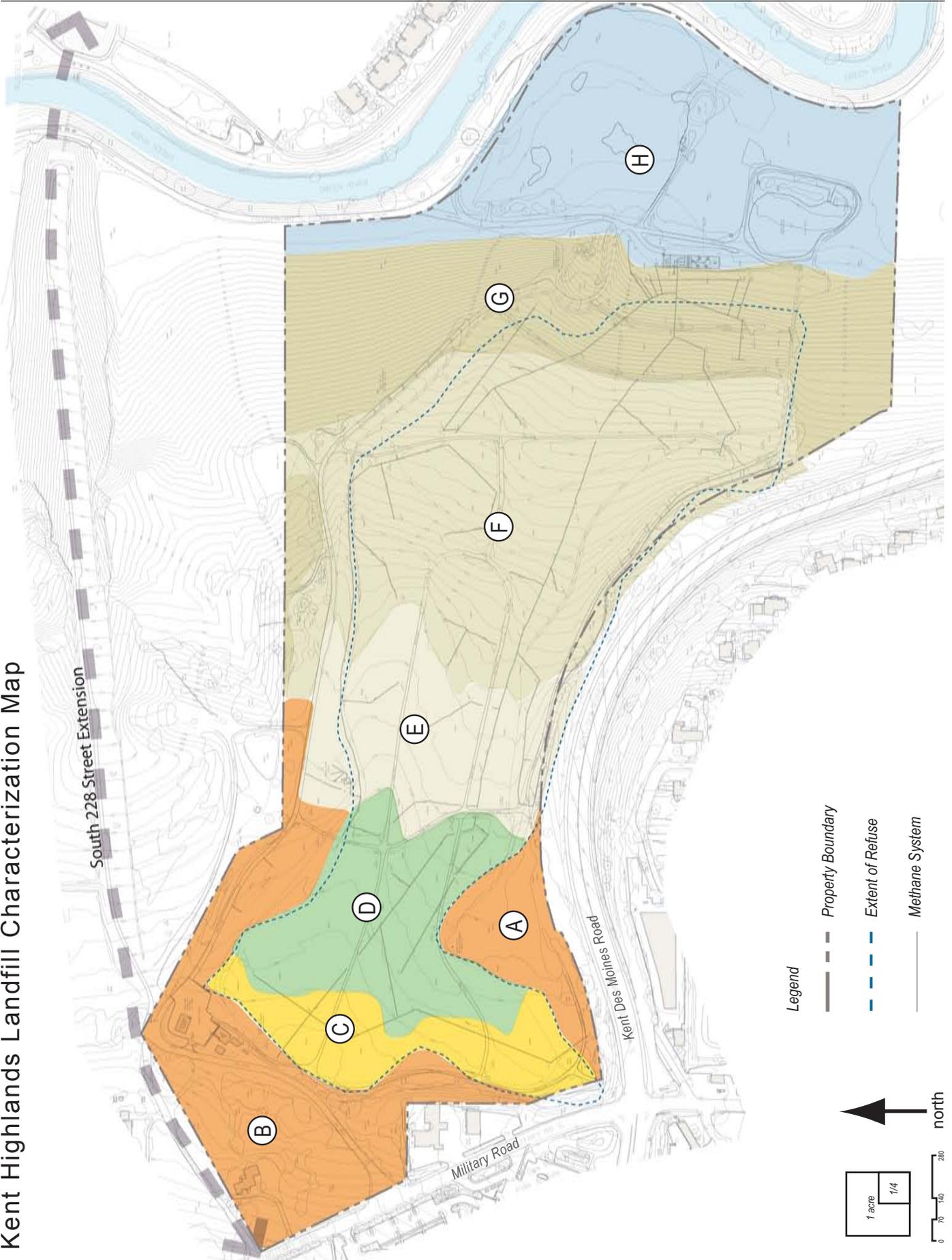
### Zone G

While portions of 21-acre Zone G do not contain refuse, slopes in this zone are considered critical, at 20% and greater, and significant remedy components are located in this zone. There is a concentration of above ground methane pipes within this zone due to the zone's proximity to the site's flare station. Future uses on this portion of the site are not feasible in the near term.

### Zone H

While there is no refuse present in 21-acre Zone H and the topography is relatively flat, this zone houses the site's flare station and leachate ponds, remedy components associated with the long-term operation and maintenance of the remedy at the Kent Highlands Landfill site. This zone is also characterized as both a floodplain of the Green River and a wetland. Future uses on this portion of the site are not feasible in the near term.

# Kent Highlands Landfill Characterization Map



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# KENT HIGHLANDS LANDFILL

## Framework Description

The Framework Map provides an overview of the future use potential of the Kent Highlands Landfill site. The framework also identifies portions of the site where future uses are feasible in the near-term and other portions of the site where future use will likely be a long-term consideration.

### Area 1

Area 1 includes Zones A, B, C, and D as described in the Kent Highlands Site Characterization section of the report. Land in this area is characterized by a limited number of remedy components, minimal slopes, and access via Military Road. Area 1 includes a combination of refuse-free buildable land, areas with limited refuse that could support uses such as parking or hard court recreational surfaces, and an area with greater depths of refuse that could provide open space resources for the development area. Area 1 is developable in the near term, with development potential likely tied to mixed land uses.

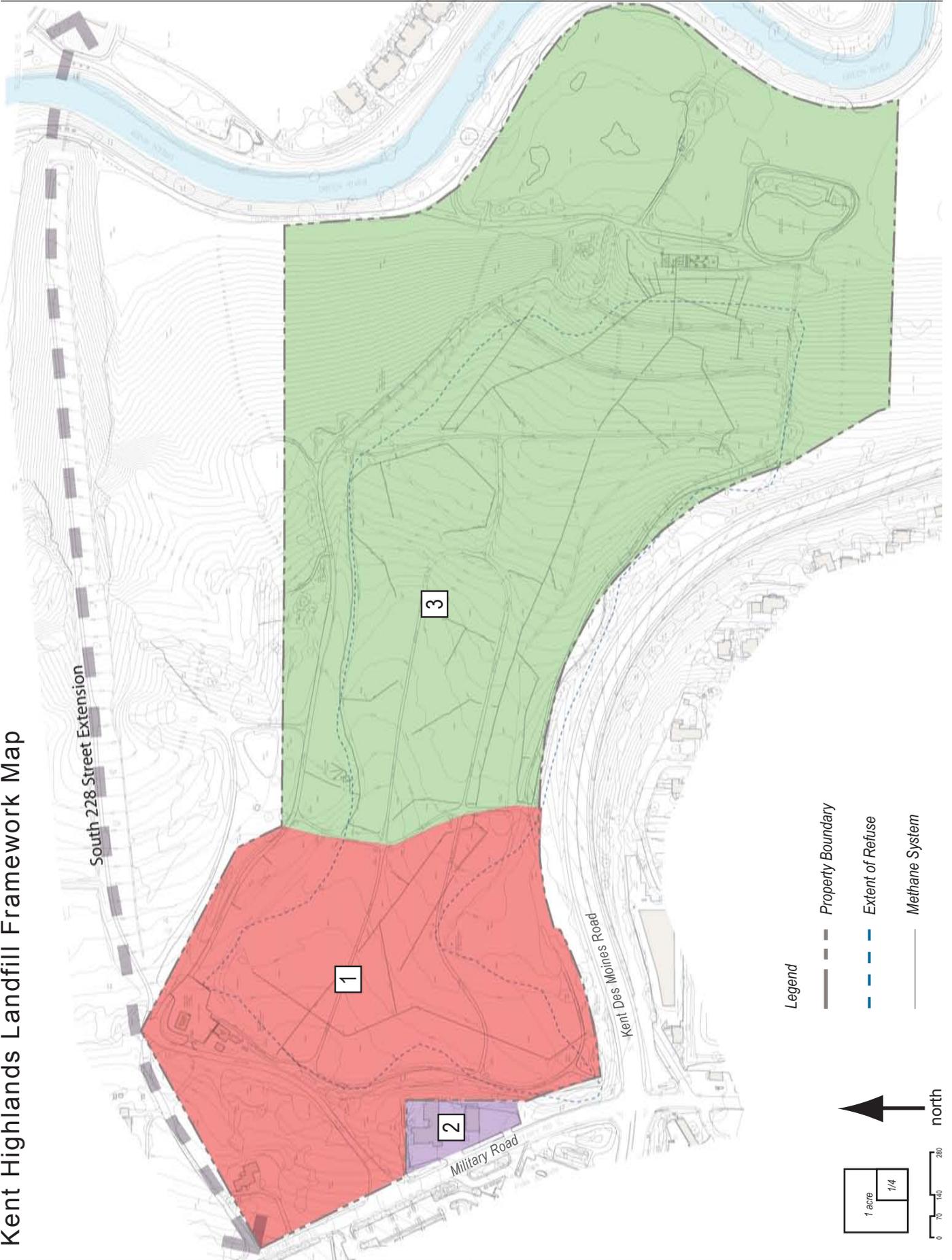
### Area 2

While the land in Area 2 is not included in the Kent Highlands Landfill site, acquisition of this land would expand Area 1's redevelopment potential by increasing its frontage along Military Road and increasing the total amount of refuse-free buildable land area available for development.

### Area 3

Area 3 includes the portions of the Kent Highlands Landfill site characterized by the greatest depths of refuse as well as by moderate and steep slopes. This area also includes the greatest number of remedy components, including above ground methane pipes, the site's flare station, and leachate ponds, all of which will need to remain in place to support long-term operations and maintenance activities at the site. Area 3 could be considered for recreational uses in the future based on characteristics such as its proximity to and potential access to the Green River. Creative approaches such as enclosing the site's methane piping system in earth berms could enable recreational opportunities while restricting public access to the site's remedy components. A berming system or similar approach could be designed to ensure access to the site's methane piping system.

# Kent Highlands Landfill Framework Map



# KENT HIGHLANDS LANDFILL

## Detailed Development Area Description

The Kent Highlands Detailed Development Area Map on the following page further characterizes sub-areas located within Area 1 for closer consideration of potential development opportunities at the Kent Highlands Landfill site.

It is also important to keep in mind that the feasibility of future development at the Kent Highlands Landfill site will not be guided solely by the site's physical characteristics. Future use plans will also need to include appropriate and effective institutional controls that maintain the protectiveness of the site's remedy and ensure the site's long-term stewardship.

### **Sub-area A**

Key attributes of sub-area A include its visibility and accessibility via Military Road, the absence of refuse, and its relatively flat topography. A mixed use development that combines commercial office and retail uses at the street level with residential uses on upper floors could capitalize on these key attributes and maximize the sub-area's development potential.

### **Sub-area B**

Sub-area B is well-suited to future development opportunities, given the absence of refuse and its relatively flat topography. While this sub-area is not directly accessible via Military Road, the sub-area could be connected through sub-area A, as described above. Additional attributes include the sub-area's access to open space in sub-area D, which could enhance sub-area B's development appeal, particularly for residential land uses.

### **Sub-area C**

Sub-area C is well-suited to provide supporting land uses like parking, given the low levels of refuse and its proximity to sub-areas A, B, and D. Other potential uses could include hard court recreation elements such as a playground or tennis courts.

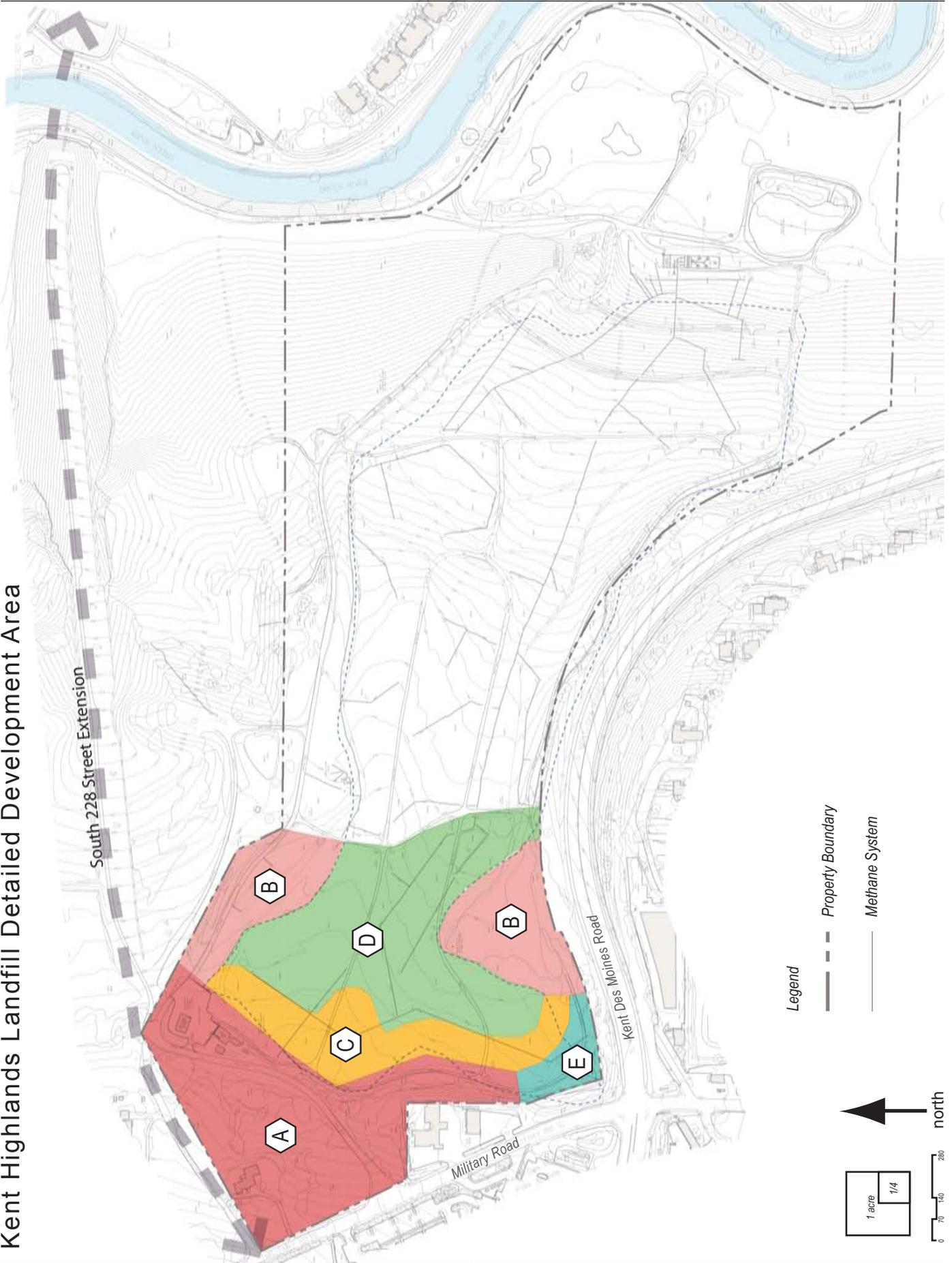
### **Sub-area D**

Sub-area D could provide open space amenities for adjacent sub-areas and provide connectivity between development in these areas. Open space uses could include walking trails, athletic fields, and garden features that contain shallow rooted plants. Some modification of methane pipe system elements in this area may be necessary. Modifications could include pipe relocation or placement in earth berms designed to maintain ease of access for ongoing operations and maintenance activities at the site.

### **Sub-area E**

As outlined in the City of Kent's Comprehensive Plan, sub-area E could be part of a potential entrance corridor for the City of Kent. Installation of appropriate signage and landscape features that do not disturb the landfill cover system could convert this sub-area into part of an attractive entrance corridor. The sub-area is located adjacent to the intersection of Kent Des Moines Road with Military Road.

Kent Highlands Landfill Detailed Development Area



# KENT HIGHLANDS LANDFILL

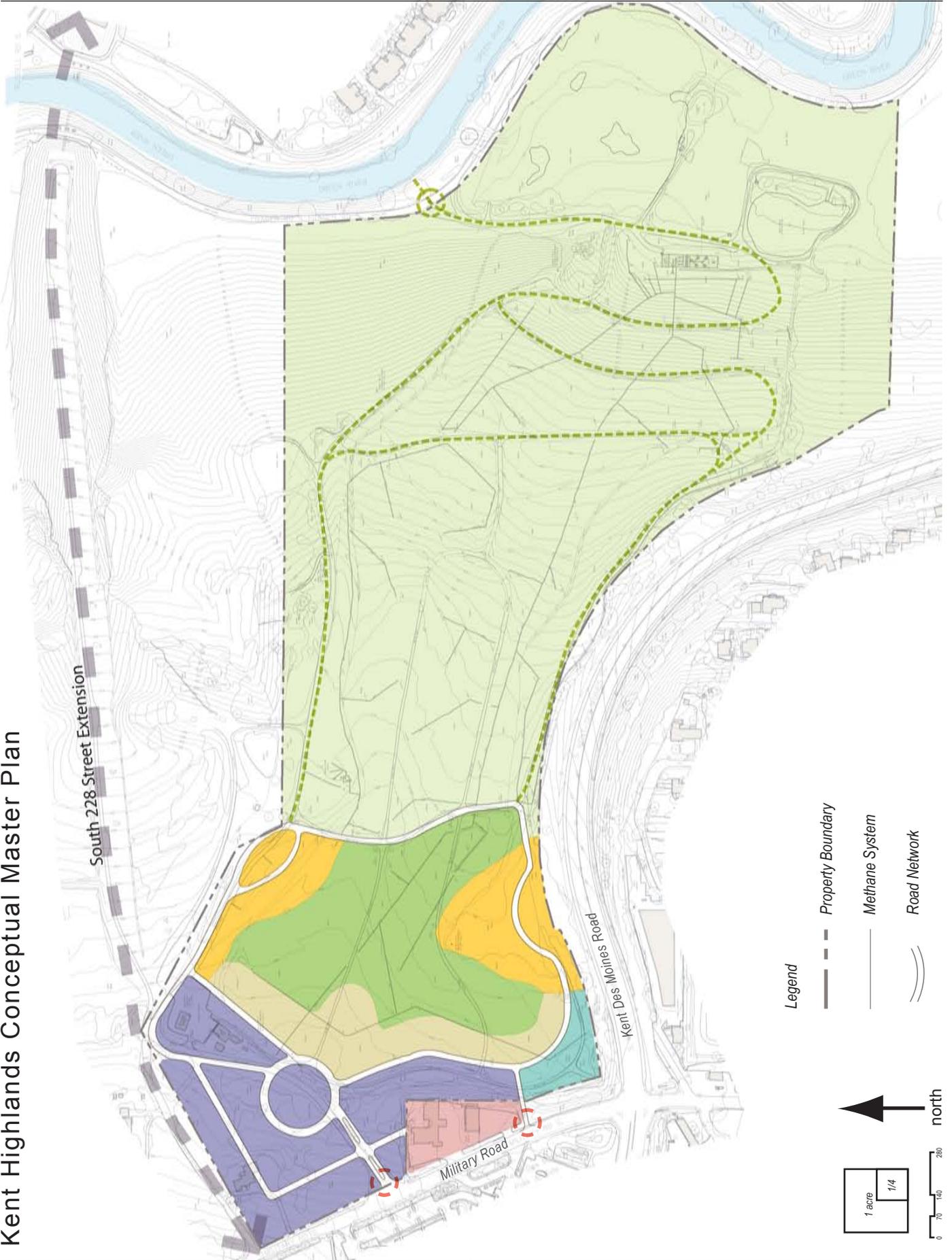
## Conceptual Master Plan

The Kent Highlands Conceptual Master Plan presents a circulation pattern that could support future uses on the portion of the Kent Highlands Landfill site that is developable in the near term. The conceptual master plan also incorporates long-term use considerations. The plan defines a trail network that could connect development areas on the western portion of the site with passive recreation opportunities located on the eastern portion of the site, as well the Green River.

### Map Key

- 
**Mixed Uses**  
 Residential above  
 Commercial retail/office below
  
- 
**Residential Use**  
 Multi-story units
  
- 
**Supporting Uses**  
 Parking  
 Open Space
  
- 
**Open Space**  
 Civic, Active Recreation
  
- 
**Entrance Corridor**  
 Signage, Landscape Features
  
- 
**Open Space**  
 Trails, Passive Recreation
  
- 
**Commercial Use**  
 Retail or Office
  
- 
**Site & River Access**  
 Trail Network Opportunity
  
- 
**Site Access Points**

# Kent Highlands Conceptual Master Plan



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## MIDWAY LANDFILL

### Site History

The 70-acre Midway Landfill site is located between Pacific Highway South and Interstate 5 in the City of Kent, Washington. The landfill was operated by the City of Seattle and sited in a location that served as a gravel pit between 1945 and 1966; landfill operations began in 1966. Material disposed of at the landfill included primarily demolition materials, wood waste, and materials that degrade slowly. At the time of its closure in 1983, the Midway Landfill contained approximately three million cubic yards of waste.

The site was listed on EPA's National Priorities List in 1986 and the construction of the site's remedy was completed in September 2000. Landfill gas control and groundwater monitoring at the site is ongoing and is monitored by the Washington Department of Ecology, which acts as the lead regulatory agency at the site.

### Site Characterization Introduction

Understanding how to think about reuse at the Midway Landfill site begins with an attempt to understand and characterize the conditions at the site that will impact or drive the site's current and future use potential. A range of criteria were initially considered as part of the site characterization for the Midway Landfill, including: site ownership, regulatory issues, contamination issues, human health considerations, public perceptions, site surface topography, type and depth of refuse present, landfill age, settlement rates, and location and characteristics of remedy components. Based on a determination of the factors with the greatest likely impact on the site's future use potential, the criteria that informed the site characterization process were the location of remedy components both above and below the site's surface, presence of refuse, depth of refuse, site topography, and the anticipated impacts of an I-5 roadway widening project located along the site's eastern boundary. Depths of refuse at the Midway site include lesser depths (averaging 50 feet with some areas at 60 feet), moderate depths (up to 90 feet), and greater depths (greater than 90 feet). The site is relatively flat, and slopes across the site are characterized as minimal (0-5%).

The results of the site characterization analysis and a future use framework for the Midway Landfill site are presented in the following pages of the report. A detailed development area description that is informed by the site's characterization analysis and framework, is presented at the end of this section.

#### Midway Landfill



# MIDWAY LANDFILL

## Site Characterization Description

The map located to the right presents the results of the Midway Landfill Site Characterization. The six character zones defined by the map are further described below:

### **Zone A**

Fourteen-acre Zone A houses the site's flare station and detention pond, remedy components associated with the long-term operation and maintenance of the Midway Landfill site's remedy. No refuse is located in Zone A. The retention pond provides stormwater management services for the surrounding community as well as the site. Zone A is not immediately available for future uses.

### **Zone B**

Four-acre Zone B is characterized by the absence of refuse and minimal remedy components. This zone also includes frontage along Pacific Highway South. Based on these characteristics, this zone could be considered for relatively unrestricted uses in the near term.

### **Zone C**

Seven-acre Zone C is characterized by a lesser depth of refuse (average depth approximately 50 feet, with some areas at 60 feet) and minimal surface remedy components – two methane pipes. Zone C's boundary is defined by the landfill extent to the west and an above ground methane pipe system to the east. While the depth of refuse suggests that building structures on this zone may be technically feasible with the use of pilings or other engineered approaches, the added costs associated with this type of construction combined with the zone's remedy components, make the building of structures in Zone C impractical at this time. Because this zone is likely to experience more limited subsidence than areas with deeper refuse, it may be most appropriate for surface uses such as parking or active recreation in the near term. Consideration will need to be given to relocation or protection of surface remedy components and the potential for minor subsidence.

### **Zone D**

Twenty-three-acre Zone D is characterized by a moderate depth of refuse (up to 90 feet) and extensive surface remedy components. Future uses in this zone could be feasible in the long term.

### **Zone E**

Fourteen-acre Zone E is characterized by the greatest depth of refuse at the site (greater than 90 feet) and a moderate number of surface remedy components. The feasibility of future uses in this zone is even longer term than future use opportunities in Zone D, given the remedy components and subsidence likely in this area.

### **Zone F**

Nine-acre Zone F is a WashDOT Right of Way and will be used in the future for an I-5 roadway widening project. Because of this project, there are no future use opportunities associated with this zone and the zone is not further considered in the site analysis.

# Midway Landfill Characterization Map



**Legend**

- Property Boundary
- Edge of Membrane (extent of refuse)
- Methane System
- Underground Leachate System

# MIDWAY LANDFILL

## Framework Description

The Framework Map provides an overview of likely development potential for the Midway Landfill site. The framework also identifies portions of the site where future use is feasible in the near-term and others where future use will likely be a long-term consideration.

### Area 1

Area 1 includes Zone B and a segment of Zone C as described in the Midway Landfill Site Characterization. The Zone B portion of Area 1 has no landfilled areas and includes approximately 400 feet of road frontage along Pacific Highway South. The Zone C portion of Area 1 is adjacent to an area with limited refuse that could accommodate supporting uses such as parking. Area 1 is developable in the near term, with commercial land uses likely given its location and road frontage.

### Area 2

Area 2 includes the portion of Zone C that is not adjacent to a portion of the site likely to experience new development in the near term. Characterized by a lesser depth of refuse (30 to 60 feet) and minimal surface remedy components, Area 2 could accommodate support services for Area 1 uses, such as parking and circulation, or hard court recreational facilities. If adjacent property along Pacific Highway South were to be redeveloped, Area 2 could provide this new development with similar support services.

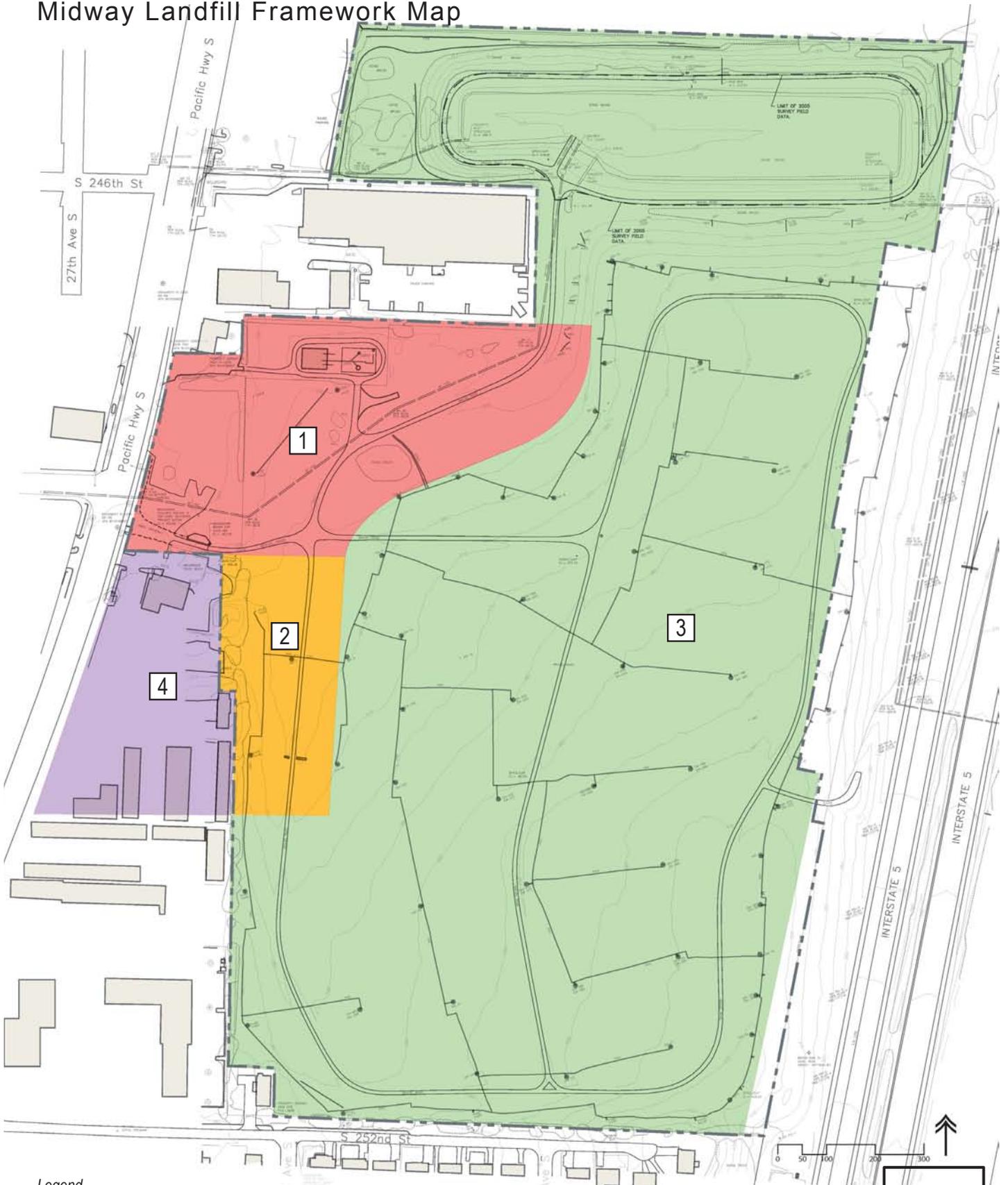
### Area 3

Area 3 includes Zones D, E, and F as described in the Midway Landfill Site Characterization. Some parts of Area 3 are associated with the site's long-term operations and maintenance activities, while other parts of Area 3 are characterized by moderate and the greatest depths of refuse at the site. Due to the presence of remedy components and the potential for differential settlement, future use of this portion of the site should be considered for the long term. This area is likely best suited for recreational purposes such as a park and trails that can capitalize on the views available from the site's southeast corner, its highest point.

### Area 4

While the land in Area 4 is not part of the Midway Landfill site, the future redevelopment capacity of this area could be maximized by locating support services such as parking and circulation on adjacent Area 2 of the Midway Landfill site.

# Midway Landfill Framework Map



**Legend**

- Property Boundary
- Edge of Membrane (extent of refuse)

—●— Methane System

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## MIDWAY LANDFILL

### Detailed Development Area Description

The Midway Detailed Development Area Map on the facing page further characterizes sub-areas located within Area 1 for closer consideration of potential development opportunities at the Midway Landfill site.

It is important to keep in mind that the feasibility of future development at the Midway Landfill site will not be guided solely by the site's physical characteristics. Future use plans will also need to establish appropriate and effective institutional controls that maintain the protectiveness of the site's remedy and ensure the site's long-term stewardship.

#### **Sub-area A**

Sub-area A is well-suited for commercial development, given its frontage on Pacific Highway South, the absence of refuse, and its flat topography. Sub-area A has the greatest development potential at the Midway site, and relocation of the site's flare station from its current location to sub-area B would further maximize the contiguous developable acreage in this sub-area.

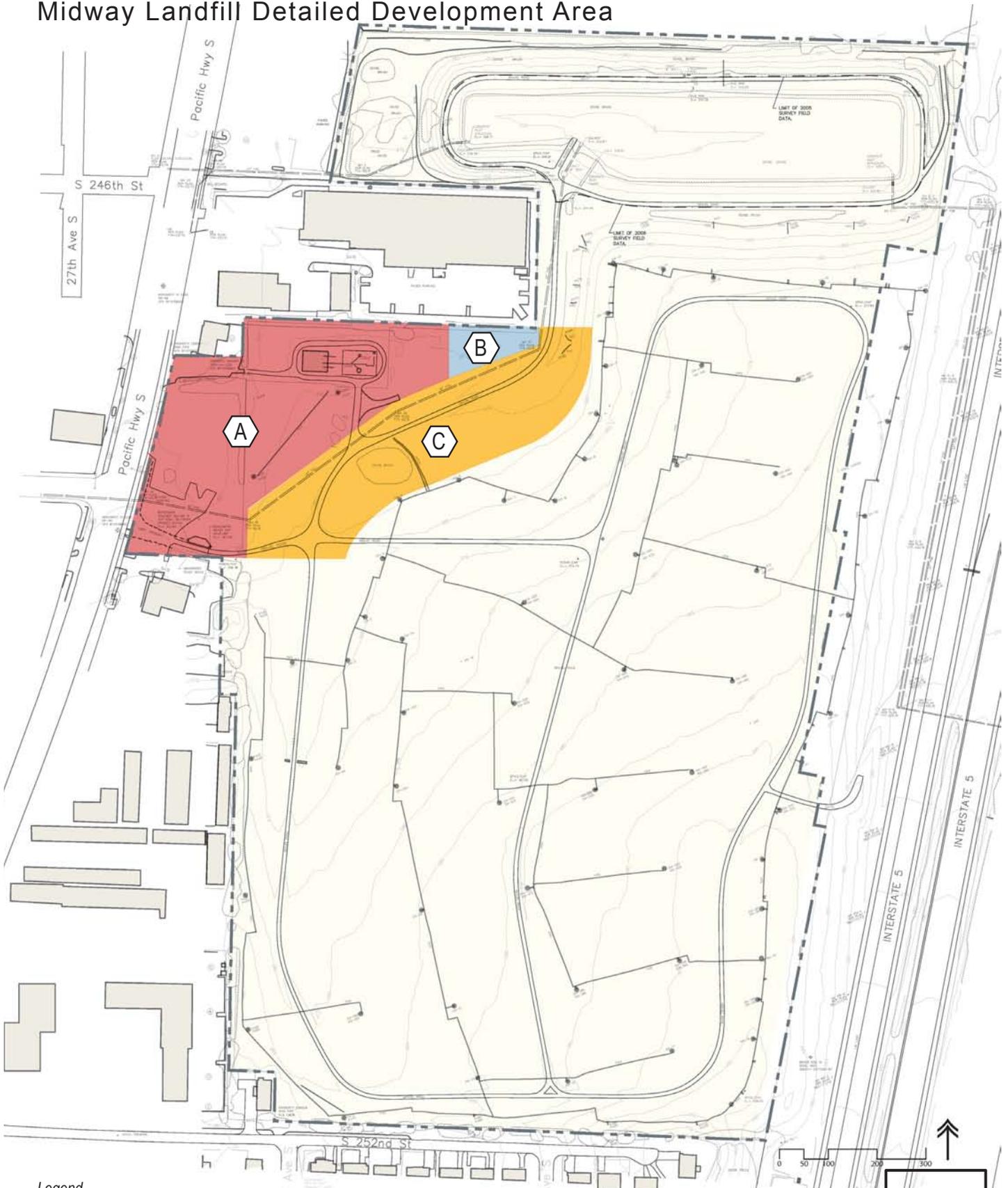
#### **Sub-area B**

The amount of contiguous developable acreage at the site could be increased by relocating the Midway Landfill site's flare station to sub-area B.

#### **Sub-area C**

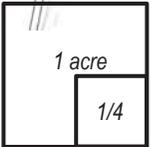
Sub-area C is well-suited to provide supporting land uses, given its location adjacent to sub-area A and the presence of minimal levels of refuse. Potential uses could include surface parking, outdoor storage, and recreational uses like hard court surfaces and trails.

# Midway Landfill Detailed Development Area



**Legend**

- Property Boundary
- Methane System



## Potential Next Steps

This report summarizes the findings of an eight-month planning process for the Kent Highlands and Midway Landfill sites, which included site research and analysis that yielded site characterization and framework maps, stakeholder work sessions in August and December 2006 that informed the process, and the preparation of detailed development maps intended to guide future use considerations for both sites. The following section outlines potential next steps for both sites that the City of Seattle could consider in moving forward.

The City of Seattle will need to work with EPA, Ecology, and local jurisdictions to address regulatory issues related to future use at both sites. The City of Seattle should consider securing the services of a land use attorney who has Superfund experience at the state and federal levels. Issues to consider include:

- Liability and mechanisms for transferring the property or, if appropriate, portions of the property to a developer. Portions of these sites are free of contamination and could be considered for partial NPL deletion in order to streamline a property transfer. In order to successfully develop the sites, it is likely that a developer will need to use and/or control portions of the site that may not be able to be deleted at this time. Coordination with an attorney who specializes in complex land transfers that involve CERCLA liability will be essential.
- The development of effective and appropriate institutional controls for the sites will be a critically important step in order to meet EPA and Ecology requirements and ensure the protection of public health. The development of effective and appropriate institutional controls will also address potential future liability for the City and site developers.

The City of Seattle and/or a developer will need to conduct further studies to clarify the current status of the Midway Landfill and Kent Highlands Landfill sites, to determine how to best address potential site reuse barriers, to determine the land uses that the local economy will support, and to identify key steps necessary to support future site uses. These studies may include:

- Market studies to determine the types, mix, and absorption potential for different types of land uses at each of the sites;
- An engineering study for portions of the Midway Landfill site in particular, to develop a more accurate understanding of the site's potential future settlement, which will inform the selection and timing of future site uses; and
- A remedy component relocation feasibility study to inform the consideration of future use opportunities at both the Midway and Kent Highlands Landfill sites. The study will need to evaluate the technical feasibility and costs associated with the relocation of multiple remedy components, including methane pipes, vents, and possibly the Midway Landfill flare station.

## **Potential Next Steps continued**

The City of Seattle and the City of Kent can also work together to optimize site reuse opportunities. For instance, the City of Seattle can work with the City of Kent to clarify the ownership and anticipated future use of properties surrounding both sites. This information will inform opportunities to expand the acreage of contiguous developable land at the Kent Highlands Landfill site in particular.

In addition to working with legal and technical advisors, the City of Seattle and the City of Kent could also begin engaging local stakeholders in planning for site reuse. A community involvement process could include a series of public meetings that provide local residents and property owners with a forum to learn about the sites' current status and plans for future action, as well as an opportunity to provide feedback at key points during the process. These meetings could provide a forum for the City of Seattle, the City of Kent, and potential developers to understand how the public would respond to various development proposals.

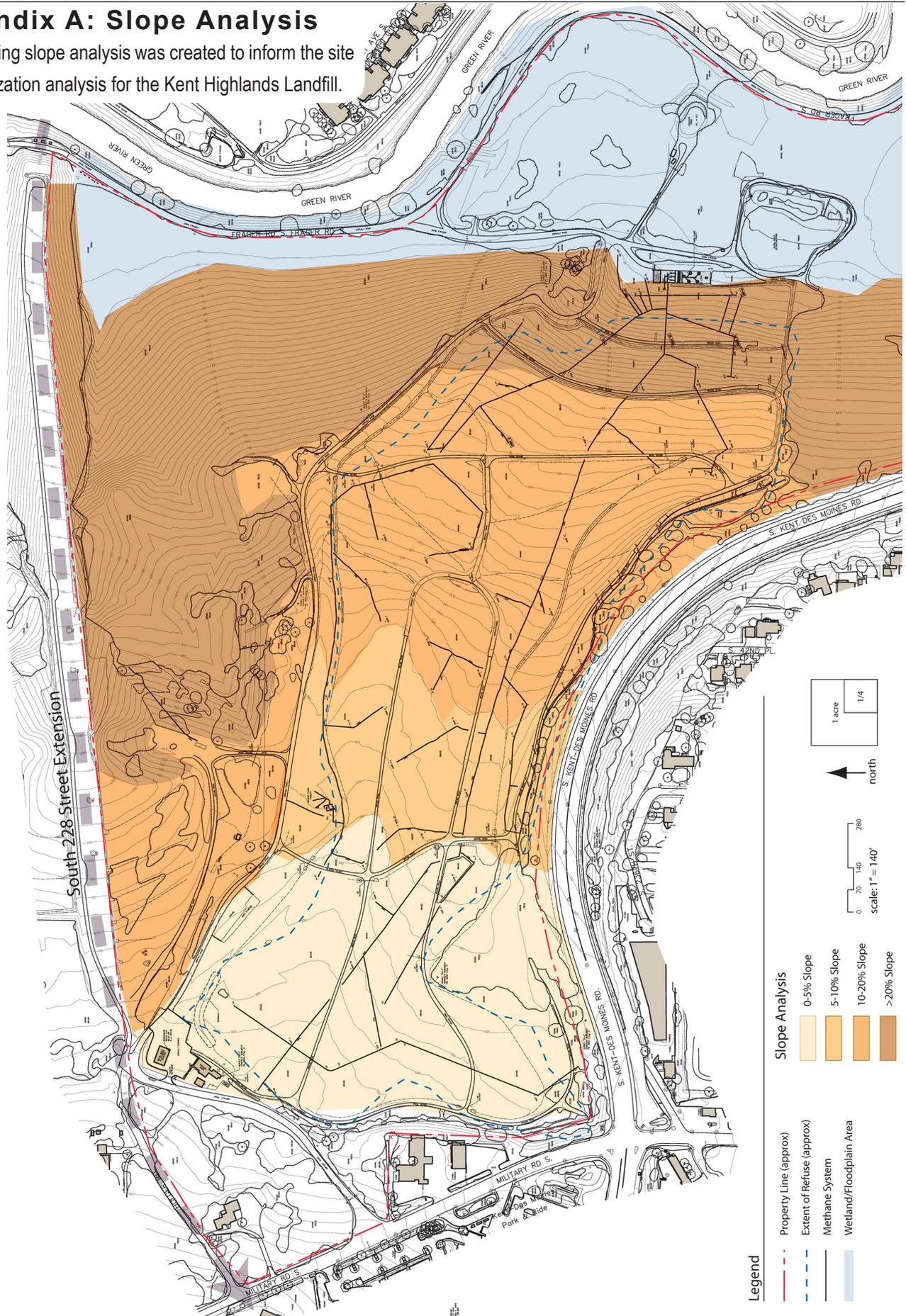
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# Appendices

# Appendix A: Slope Analysis

The following slope analysis was created to inform the site characterization analysis for the Kent Highlands Landfill.

## Kent Highlands Slope Analysis



## Appendix B: Landfill Reuse Case Studies

### *Home Depot Oregon City, Oregon*

In May 2002, the Home Depot opened a retail store on the site of the former Rossmans Landfill located near the intersection of Interstate 205 and Highway 213 in Oregon City, Oregon. The Home Depot negotiated a long-term ground lease with the owner of the unlined, closed landfill for use of a 16.7-acre portion of the 100 acre site.

The project's engineering and design consultants designed the site to address key concerns expressed by the Oregon Department of Environmental Quality (DEQ), which included landfill gas (LFG) fire or explosion hazards, LFG buildup in confined spaces, potential human exposure to LFG emissions, additional groundwater contamination from construction activities, and refuse settlement and potential disturbance to unknown wastes that could be located in the landfill.

Site preparation included covering the site with ten feet of imported fill to establish desired site grades. A five-foot surcharge fill was also placed to compress on-site materials and reduce post-construction settlement.

Pile foundations consisting of closed-end, two-foot diameter steel pipe piles were driven through the refuse into the underlying sand and gravel. Approximately 1,230 piles were installed to support the building,

<b>Landfill Size:</b>	100 acres
<b>Reuse Area:</b>	16.7 acres
<b>Landfill Age:</b>	Operated between 1969-1983
<b>Depth of Refuse:</b>	30-40 feet thick
<b>Consultants:</b>	Landau Associates and Parisi & Parisi

perimeter concrete slab and entrance driveway, and certain other structures. Key elements of the system designed to protect the site's utility lines from potential differential settlement included the use of ductile iron piping where appropriate; installation of flex-joints at manholes and other selected locations; and pile support of the site's water line and stormwater manholes within the structural slab areas.

The site's landfill gas control and monitoring system includes a barrier that minimizes LFG migration into the store and through surrounding paved areas; a gas extraction system that removes LFG from beneath the store and paved areas; and a gas monitoring system that monitors LFG concentrations in the store and beneath the development. Additional seals, plugs, and gas-proof electric conduits and vaults prevent the migration of LFG along buried utilities and into confined spaces.

This project qualified for DEQ certification under the Brownfields Initiative portions of the Taxpayer Relief Act of 2000.

## Appendix B: Landfill Reuse Case Studies

### *Walkers Brook Crossing Reading, Massachusetts*

The Walker's Brook Crossing lifestyle shopping center is located on the 33.5-acre former Reading Landfill near the intersection of Route 128 with I-95, an entrance corridor to the Town of Reading, Massachusetts. The site was purchased by Dickinson Development LLC in 2003 for redevelopment as a mixed use commercial center.

Site redevelopment was implemented in two phases. Phase I opened in the fall of 2004 and included a building supply retailer, a furniture store, a movie theater, and a restaurant. Phase II construction took place between April and September 2005 and included an office supply store, a home goods store, a bank, a coffee shop, and several restaurants.

To maximize retail space at the site, the Phase I retail venues were stacked. Site parking facilities were also stacked to provide sufficient parking and direct access to both levels of retail development. Retaining walls required to support the structured parking system were constructed using a new technology that employed grid-reinforced solid waste from the site to provide both stable and settlement-tolerant retaining walls.

Environmental consulting firm Haley & Aldrich conducted hydrogeologic and geotechnical investigations at the site and worked with the Massachusetts Department of

<b>Landfill Size:</b>	33.5 acres
<b>Landfill Age:</b>	Operated between 1930-1984
<b>Depth of Refuse:</b>	Up to 50 feet thick
<b>Developer:</b>	Dickinson Development
<b>Consultants:</b>	Haley & Aldrich

Environmental Protection to develop a remedial action plan. Based on the firm's findings, the development team built a mechanically stabilized fill retaining wall around the site perimeter and capped the landfill using advanced geosynthetic materials to protect the local environment and meet state guidelines.

The site's anchor retail building was constructed above the site's cap on piles driven through the landfill waste and into glacial deposits above the bedrock. Gas protection systems were installed in all of the site's buildings to prevent landfill gas from accumulating in the indoor spaces. Advanced underground systems for storm water drainage and landfill gas management were also constructed to further promote long-term safety at the site.

This project received the American Council of Engineering Companies of Massachusetts (ACEC/MA) Grand Conceptor Award and a national ACEC Honor Award in 2006.

## Appendix B: Landfill Reuse Case Studies

### *Home Depot, San Mateo County, California*

The San Mateo Home Depot is located on the former Juniper Serra (Colma) Landfill near a State Route 92 interchange in San Mateo County, California.

The site was purchased and redeveloped by Bocci-Schneider Interests ten years after the landfill closed in 1983.

Due to California landfill regulations that limit the installation of deep foundations through closed landfill sites, project engineers designed an innovative foundation for the site that included placing the building atop a deep pile foundation and allowing a hinged slab attached to the building to “float” with the settlement of the landfill, providing a controlled transition between the building and the parking lot, which is supported by waste.

The deep pile foundation consisted of 150-foot long steel “H” piles that extended through the buried trash and 20 feet into the Colma formation below the landfill. A cathodic protection system was used to protect the steel piles from corrosive landfill conditions.

An active landfill gas extraction system was constructed at the site to protect structures from landfill gas by collecting and combusting landfill gas in a fully-enclosed ground flare. The system controls off-site gas migration

<b>Landfill Age:</b>	<i>Closed in 1983</i>
<b>Depth of Refuse:</b>	<i>Up to 130 feet thick</i>
<b>Developer:</b>	<i>Bocci-Schneider Interests</i>
<b>Engineer:</b>	<i>Brian Kangus Faulk (BFK Engineers)</i>

and protects on-site buildings. A dual membrane liner system installed below the Home Depot building structural slab further protects the building from landfill gas infiltration. Penetrations of the membrane for utilities and other purposes are sealed using butyl tape, polyurethane sealant, or special boots.

Environmental services firm SCS Field Services provides operation, monitoring and maintenance services for the landfill gas extraction, treatment, and sensor systems. The firm also provides health and safety support and construction oversight for below-grade repairs to site utilities and the hinged slab that doubles as the store entrance. Repairs such as jacking and shimming the parking slab to restore it to design grade are expected to take place throughout the life of the project.

This project received the Solid Waste Association’s Silver Award in 2002 for landfill gas control, in recognition for successful long-term operations and monitoring of the landfill gas control system that allowed the former landfill to be redeveloped and returned to productive use for the community.

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