Forest Preserve District of DuPage County

Landfill and Dump Sites Study of Gaps and Opportunities for the Clean Energy, Resiliency, and Sustainability Plan

Prepared for:

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Table of Contents

Section Page

Figures

Appendices

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EXECUTIVE SUMMARY

The Forest Preserve District of DuPage County (the District) owns and operates four landfills and three dump sites. These locations have a variety public access, use, and character. SCS Engineers (SCS) has prepared this report to evaluate these locations for candidate opportunities as part of the Clean Energy, Resiliency, and Sustainability Plan.

The landfills and dump sites encompass significant land area and have specific management items with long-term care requirements. This includes management of decomposition gases from the landfills, and liquids generated from rainwater or groundwater passing through the landfilled or dumped materials, and maintenance of cover materials.

To prepare this assessment, SCS worked to understand the following at each location:

- Waste Disposed and Cover System
- Environmental Management and Monitoring Systems
- Storm Water Management
- Site Uses and Public Accessibility

Our focus has been to evaluate clean energy, resiliency, and sustainability as follows:

- Candidate land and surface water areas at the landfills and dumps sites that may be suitable for alternative energy generation.
- Reduction of greenhouse gases generated from waste material decomposition.
- Potential use of energy contained within landfill gases via combustion for heat/electricity.
- Applicability of Renewable Natural Gas (RNG) to landfill gas for use within interstate gas pipelines.
- Reduction of leachate generation and alternative leachate disposal.
- Stability of cover systems.
- Ecological enhancements for biodiversity and habitat.

Our initial screening for candidate opportunities is based on the compatibility with the existing site use, and alignment with the District's Mission. Upon this initial screening, we considered opportunities that can integrate in a manner that maintained the character and function of each location.

This effort has revealed opportunities that SCS recommends to the District for consideration of advancement to the next phase of developing recommendations for programs, policies, capital improvement projects, and implementation partnerships. The evaluation results identifying opportunities that are recommended for advancement, recommended with reservations, and not recommended include the following:

Greene Valley

Recommended for Advancement

- Landfill Gas – Burning landfill gas to heat site buildings to potentially offset some, or all, of the existing on-site natural gas demand.
- Underground Injection Control of Landfill Leachate – Potential to eliminate off-site discharge of landfill leachate.
- Landfill Cover Enhancement
  - Potential to enhance ecological diversity and habitat
  - Potential to reduce leachate generation
  - Improved erosion protection

Recommended for Advancement with Reservations

- Solar Power (Land-based units) – Potential to offset on-site electrical demand.
- Renewable Natural Gas – RNG is a potential option due to volume and quality of gas generated.
- Storm Water Improvements (Engineered) – Potential to reduce leachate generation and cover repair needs.
- Trail Improvements – Potential to connect more people with nature and augment existing pathway networks.

Not Recommended for Advancement

- Solar Power (Floating array)
- Wind Power
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Ecological)

Blackwell

Recommended for Advancement

- Landfill Gas – Burning landfill gas to reduce greenhouse gas and provide supplemental heat for education center or a "warming house" for the tube hill.
- Underground Injection Control of Landfill Leachate – Potential to eliminate off-site discharge of landfill leachate.

Recommended for Advancement with Reservations

- Solar Power (Land-based units) – Potential to offset on-site electrical demand.
- Trail Improvements – Potential to connect more people with nature and augment existing pathway networks.

Not Recommended for Advancement

- Solar Power (Floating array)
- Wind Power
- RNG
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Engineered)
- Storm Water Improvements (Ecological)
- Landfill Cover Enhancement

Mallard Lake

Recommended for Advancement

- Solar Power (Land-based units) – Potential to offset on-site electrical demand.
- Underground Injection Control of Landfill Leachate – Potential to eliminate off-site discharge of landfill leachate.
- Landfill Cover Enhancement –
  - Potential to enhance ecological diversity and habitat
  - Potential to reduce leachate generation
  - Improved erosion protection

Recommended for Advancement with Reservations

- Solar Power (Floating array) – Potential to offset on-site electrical demand with floating arrays in wet-bottom storm water basins.
- Wind Power – Potential to offset on-site electrical demand. An ecological impact evaluation is needed.
- Renewable Natural Gas – RNG is a potential due to quantity and quality of landfill gas, with the current output just above the threshold of a feasible project.
- Phyto-utilization Partnership – Potential for Mallard Lake to dispose of leachate within the Mallard North phyto-utilization system.
- Storm Water Improvements (Engineered) – Potential to enhance existing storm water infrastructure to reduce erosion and sedimentation in letdown chutes.
- Storm Water Improvements (Ecological) – Potential to enhance native species diversity, and enhance storm water quality.
- Trail Installation/Improvements – The landfill is not open to the public and does not have designated trails on the landfill face but has connections to existing trails within the preserve.

Not Recommended for Advancement

- Landfill Gas to Energy – Former plant was demolished and deemed not viable.
- Constructed Leachate Treatment Wetland

Mallard North

Recommended for Advancement

- Underground Injection Control of Landfill Leachate – Potential to eliminate off-site discharge of landfill leachate.

Recommended for Advancement with Reservations

- Solar Power (Land-based units) – Potential to offset on-site electrical demand.

Not Recommended for Advancement

- Solar Power (Floating array)
- Wind Power
- Landfill Gas to Energy
- RNG
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Engineered)
- Storm Water Improvements (Ecological)
- Landfill Cover Enhancement
- Trail Improvements

Wheaton Dump

Recommended for Advancement

- Solar Power (Land-based units) – Potential to offset on-site electrical demand.
- Landfill Cover Enhancement –
  - Potential to enhance ecological diversity and habitat
  - Potential to reduce leachate generation
  - Improved erosion protection

Recommended for Advancement with Reservations

- Solar Power (Floating array) – Potential to offset on-site electrical demand with floating arrays in the proposed flood storage area.
- Trail Installation/Improvements – The dump site does not have dedicated walking paths for public use but could be integrated to connect more people with nature and display potential opportunities (solar, cover enhancements).

Not Recommended for Advancement

- Wind Power
- Landfill Gas to Energy
- RNG
- Underground Injection Control of Landfill Leachate
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Engineered)
- Storm Water Improvements (Ecological)

Ajax Pit

Recommended for Advancement

- Landfill Cover Enhancement –
  - Potential to enhance ecological diversity and habitat
  - Potential to reduce leachate generation
  - Improved erosion protection

Recommended for Advancement with Reservations

- Solar Power (Floating array) – Potential to offset on-site electrical demand with floating arrays in the flood storage area.
- Trail Improvements – The dump site has some walking paths that were created by unauthorized foot traffic. Creating designated walking paths on the dump site and designated scenic overlooks could reduce erosion from unauthorized access.

Not Recommended for Advancement

- Solar Power (Land-based unit)
- Wind Power
- Landfill Gas to Energy
- RNG
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Engineered)
- Storm Water Improvements (Ecological)

Barnes Pit

Recommended for Advancement

- Landfill Cover Enhancement –
  - Potential to enhance ecological diversity and habitat
  - Potential to reduce leachate generation
  - Improved erosion protection

Recommended for Advancement with Reservations

- Solar Power (Floating array) – Potential to offset on-site electrical demand with floating arrays in the flood storage area.

Not Recommended for Advancement

- Solar Power (Land-based unit)
- Wind Power
- Landfill Gas to Energy
- RNG
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Engineered)
- Storm Water Improvements (Ecological)
- Trail Improvements

Each opportunity identified above was evaluated for compatibility with existing site conditions, compatibility with the District's mission, and magnitude of impacting the clean energy, sustainability, and resiliency at each site. As shown, there are a number of opportunities at each landfill and dump site that the District can further evaluate to determine the feasibility of implementation, impact on the community, alignment with the District's goals, and future capital expenditures.

A summary matrix of opportunities is provided on the following page. This matrix identifies opportunities that are:

- Recommended for advancement;
- Recommended for advancement with reservations; or
- Not recommended

Section 5.2 further describes each opportunity in more detail. **Section 5.3** describes recommended actions to advance each opportunity.

Opportunity Matrix

Forest Preserve District of DuPage County

DuPage County, Illinois

Clean Energy, Sustainability, and Resiliency Opportunities	Landfill Sites				Dump Sites		
	Greene Valley Landfill	Blackwell Landfill	Mallard Lake Landfill	Mallard North Landfill	Wheaton Dump	Ajax Pit	Barnes Pit
Solar Energy (Land-based Units)	Recommended for advancement with reservations	Recommended for advancement with reservations	Recommended for advancement	Recommended for advancement with reservations	Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement
Solar Energy (Floating Units)	Not Recommended for advancement	Not Recommended for advancement	Recommended for advancement with reservations	Not Recommended for advancement	Recommended for advancement with reservations	Recommended for advancement with reservations	Recommended for advancement with reservations
Wind Energy	Not Recommended for advancement	Not Recommended for advancement	Recommended for advancement with reservations	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement
Renewable Natural Gas Plant	Recommended for advancement with reservations	Not Recommended for advancement	Recommended for advancement with reservations	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement
Gas to Energy Plant	Recommended for advancement	Recommended for advancement	Recommended for advancement with reservations	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement
Underground Injection of Landfill Leachate	Recommended for advancement	Recommended for advancement	Recommended for advancement	Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement
Constructed Leachate Treatment Wetlands	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement
Phyto-Utilization	Not Recommended for advancement	Not Recommended for advancement	Recommended for advancement with reservations	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement
Storm Water Conveyance Improvements (Engineered)	Recommended for advancement with reservations	Not Recommended for advancement	Recommended for advancement with reservations	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement
Storm Water Conveyance Improvements (Ecological)	Not Recommended for advancement	Not Recommended for advancement	Recommended for advancement with reservations	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement	Not Recommended for advancement
Landfill Cover Improvements and Ecological Restoration	Recommended for advancement	Not Recommended for advancement	Recommended for advancement	Not Recommended for advancement	Recommended for advancement	Recommended for advancement	Recommended for advancement
Community Engagement Trail Improvements	Recommended for advancement with reservations	Recommended for advancement with reservations	Recommended for advancement with reservations	Not Recommended for advancement	Recommended for advancement with reservations	Recommended for advancement with reservations	Not Recommended for advancement

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1.0 CLEAN ENERGY, RESILIENCY, AND SUSTAINABILITY PLAN

The Forest Preserve District of DuPage County (the District) is a nationally recognized conservation agency that owns over 26,000 acres with 60 forest preserves throughout DuPage County. The District properties have nearly 6.2 million visitors per year that are drawn in by the wide variety of native plant species and restoration areas, native mammals, birds, and fish; hundreds of miles of meandering trails, rivers, lakes, ponds, and unique nature and cultural centers. The District's purpose is to acquire, preserve, protect, and restore the natural resources in DuPage County while providing opportunities for people to connect with nature.

To advance their purpose, the District is undertaking the development of a Clean Energy, Resiliency, and Sustainability Plan (described herein as "the Plan"). The purpose of the Plan is to provide guidance to the District for future investments with a chief focus on reducing energy consumption and carbon emissions through efficiency, green energy, and sustainability initiatives. The District has engaged with the Delta Institute to evaluate opportunities to establish energy-reduction technologies and practices throughout the District's infrastructure, vehicles, and other key assets.

The District also owns and maintains several closed landfills and dump sites that provide opportunities for the District to reduce energy consumption and carbon emissions. The District retained SCS Engineers (SCS) to evaluate opportunities to support clean energy, resiliency, and sustainability at the District's landfills and dump sites. The first step in this phase of evaluating the District's landfills and dump sites is to summarize existing conditions, including vegetation, landfill leachate, and landfill gas emissions at each landfill and dump site. The second step is to identify opportunities to reduce emissions, enhance and restore each site, or repurpose the land. The opportunities presented in the Plan are assessed based on the following:

- Alignment with the District's mission
- Compatibility with the current site use
- Magnitude of Clean Energy, Sustainability, and Resiliency impact
- Implementation Considerations

Based on the findings of this phase of the Plan development, the District may elect to progress certain opportunities to the second phase of Plan development, focusing on design and implementation.

1.1 DISTRICT'S MISSION

This District's mission is to acquire and hold lands containing forests, prairies, wetlands, and associated plant communities or lands capable of being restored to such natural conditions for the purpose of protecting and preserving the flora, fauna, and scenic beauty for the education, pleasure, and recreation of its citizens. The District's actions and decisions are guided by six principles:

- Stewardship – Responsible stewards of both natural and financial resources.
- Sustainability – Sustainable financial and operational practices.
- Community Engagement – Partnership, trust, and collaboration with communities.
- Innovation – Integrate new technology and respond to changing needs.
- Empowerment – Supportive environment that respects and relies on teamwork.
- Diversity & Inclusion – Honor and represent diversity and accessibility.

The evaluation of opportunities for reduction, enhancement, and repurposing the landfill and dump sites aligns with this mission and guiding principles. The District's landfills and dump sites are located within key ecological corridors within DuPage County, and any adjustments or changes to these facilities must maintain these features.

The District's ultimate goal is to manage the landfill and dump sites in a manner that results in a net zero or better carbon footprint. This goal may be achieved through the implementation of emerging technologies and landfill management techniques compatible with each landfill and dump site.

2.0 SITE CHARACTERISTICS

2.1 LANDFILLS

Landfills are an integral utility for our community and are designed to safely collect, congregate, and store municipal solid waste (MSW), construction and demolition debris (C&D), and other forms of waste. MSW is generally defined as household wastes that include garbage, trash, and sanitary wastes derived from households. C&D is solid waste resulting from construction, remodeling, repair, and demolition of structures, roads, buildings, and land clearings.

The District's landfills were constructed to provide waste disposal capacity necessary to support the exponential growth of DuPage County in the 1960s and 1970s. Many landfills within or near DuPage County were ceasing operation and the District had land that could be used to meet the community's waste disposal needs. All of the District's landfills are closed currently and do not accept new waste. Although these landfills are closed, management and maintenance of environmental control systems is ongoing. The locations of the landfills within DuPage County are shown on below and on **Figure 1**.

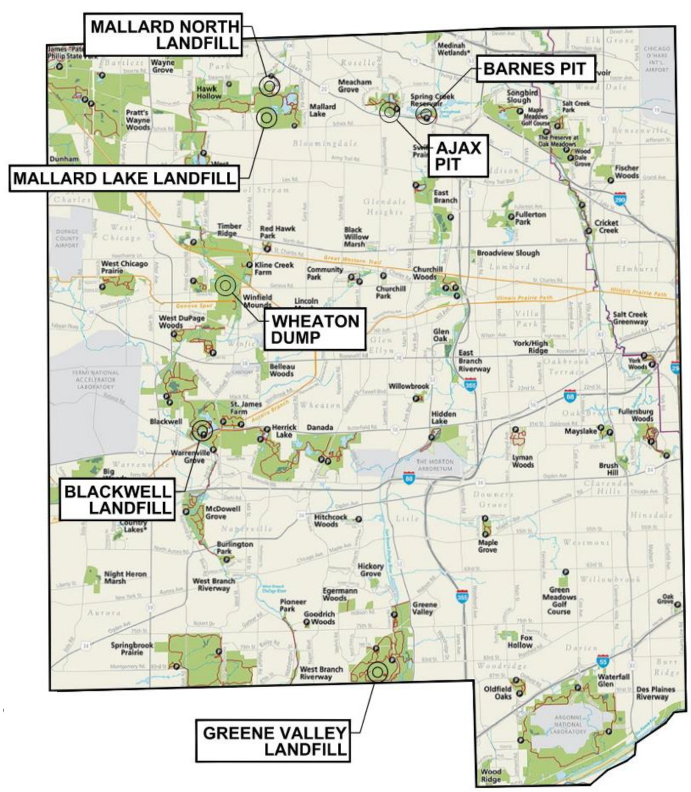


Figure 1 - Location of the District's Landfills and Dump Sites

2.1.1 Greene Valley Landfill (Naperville, IL)

The Greene Valley Landfill is located within the Greene Valley forest preserve in Naperville, Illinois. The landfill began operation in October 1974. Upon authorization of the U.S. Environmental Protection Agency (U.S. EPA) Subtitle D landfill regulations in 1991, the landfill initiated efforts to comply with these new regulations. This required an engineered bottom liner system, leachate extraction system, landfill gas extraction system, and an engineered final cover system. The landfill ceased disposal operation in August 1996 and was certified closed in July 1998. The Greene Valley Landfill is currently operated and maintained by WM (formerly Waste Management). A site layout map identifying key elements at the landfill are shown on **Figure 2.**

2.1.1.1 Waste Disposed and Cover System

During operation, materials disposed of within the landfill included MSW, landscape wastes, C&D, and many special wastes. This landfill has a final cover system with three different configurations at different parts of the landfill based on evolving design practices at their respective time of installation. These cover types and locations are described below and presented on **Figure 2.**

Cover Type 1: 4.0-foot final cover consisting of a minimum 3.5 feet of compacted clay and 0.5 feet of protective cover or topsoil.

Cover Type 2: 6.0-foot final cover consisting of a minimum 3.0 feet of compacted clay and 3.0 feet of protective cover or topsoil.

Cover Type 3: 4.5-foot composite final cover consisting of 1.5 feet of compacted clay, a 40-mil high-density polyethylene (HDPE) geomembrane, geocomposite drainage layer, and 3.0 feet of protective cover. This cover established a specific permeability measurement ($1x10^{-7}$ cm/sec) for the compacted clay layer.

The landfill final cover system also contains a variety of native and invasive species of forbs, grasses, and trees. There are two native species restoration zones / test plots on the final cover that are maintained by the District and are selectively mowed as part of the overall vegetation management plan. The zones are designed to promote ecological diversity, and provide food and habitat resources for insects, plants, and animals. Management of the final cover as grassland recently demonstrated significant benefits by successfully providing habitat for rare and conservative species that now routinely nest there.

Based on information provided by the District, differential settlement of the waste mass and final cover system has occurred in certain areas at the landfill creating “basins” for storm water accumulation. Additional soils were placed in these areas to minimize ponding water and provide positive drainage of storm water off site. There are no measurements or quantities of how much soil has been used to remedy the settlement. Overall, the final cover system does not show signs of degradation or slope stability issues.

2.1.1.2 Landfill Gas Management

Landfill gas is managed by an active landfill gas collection system consisting of approximately 125 vertical extraction wells. In 2021, the landfill gas collection system was operating at 1,178 million standard cubic feet per day (mmscfd). The collected gas is combusted at a permitted gas-to-energy (GTE) plant located within the boundary of the landfill facility. The landfill also maintains a utility flare, which combusts landfill gas if the GTE plant is not consuming all of the available landfill gas. An enclosed flare is also on site and available but is rarely used.

2.1.1.3 Leachate Management

Leachate is managed by a leachate collection and extraction system. Portions of the landfill have a leachate drainage layer between the waste and the engineered bottom liner system. Older portions of the landfill do not have a dedicated leachate drainage layer but maintain a perimeter leachate collection pipe connected to five perimeter sump locations. In addition, there is one dedicated leachate vertical extraction sump located on the west side of the landfill and multiple dual extraction wells (landfill gas and leachate) located throughout the landfill cover.

From 1995 to 2008, leachate disposal volumes were between 1.0 to 2.6 million gallons per year. Starting in 2009, leachate disposal volumes rapidly increased from 2.3 million gallons per year to 10.0 million gallons per year in 2012. Leachate disposal volumes have been between 5.0 and 8.2 million gallons per year through 2019.

Leachate collected in this system is pumped to a leachate storage tank located near the GTE plant. At this time, leachate is hauled by tanker trucks to various wastewater treatment plants (WWTP). A new leachate force main pipe recently completed construction to allow for direct discharge of leachate to the DuPage County Greene Valley/Woodridge WWTP located less than 1 mile northeast of the landfill.

2.1.1.4 Storm Water and Groundwater

Storm water management consists of perimeter ditches, culverts, and two storm water basins. In general, rain that falls on the surface of the landfill travels between 750 and 1,200 feet until it reaches a perimeter ditch.

Groundwater conditions surrounding the landfill undergo compliance monitoring and are sampled on a routine basis. Groundwater impacts discovered within these wells have been attributed by the landfill operator to sources other than the landfill.

2.1.1.5 Other Site Uses

Other uses of this landfill include a public driving pathway and scenic overlook at the top of the landfill. In addition, the site includes a model aircraft launch platform, a bird watching area, and walking paths for visitors to use. These facilities are open on a limited basis due to conflicts with ongoing landfill management activities.

2.1.2 Blackwell Landfill (Warrenville, IL)

The Blackwell Landfill, also known as Mt. Hoy, is located within the Blackwell Forest Preserve in Warrenville, Illinois. Blackwell began operation in 1965 and pre-dates solid waste landfill regulations. As such, this landfill did not operate under a specific solid waste landfill permit from the Illinois Environmental Protection Agency (IEPA). The landfill operated until 1973 and is approximately 50 percent MSW and 50 percent soil fill. A site layout map identifying key elements is shown on **Figure 3.**

2.1.2.1 Remediation Activities through Superfund

Following closure of the landfill, the District detected contaminants leaking into groundwater on the south side of the landfill in the mid-1980s. Coordination with the U.S. EPA was initiated and further site investigation was completed to evaluate the contamination. In 1990, the U.S. EPA identified this landfill on the National Priorities List under the Superfund Program. Routine groundwater monitoring and evaluation was completed for 30 years. In September 2020, the U.S. EPA removed the landfill from the list and determined that the required cleanup was complete and must be maintained to protect human health and the environment.

Cleanup efforts to remedy the contamination included repair of the landfill final cover system, installation of a leachate collection and extraction system, and installation of additional landfill gas extraction wells. The District plans to enhance landfill gas collection and control by converting from a passive system to an active collection system with a new blower and flare to combust the landfill gas.

2.1.2.2 Cover System

Based on available information, the landfill final cover system likely consists of soil installed to meet compaction specifications with no specification for permeability. It is noted that significant settlement of the waste mass and final cover occurred directly after the landfill closed operations. There are no recent instances of settlement within the available information.

The landfill cover vegetation consists of a thriving native species community including forbs, grasses, and trees. There are no signs of degradation or slope stability issues. In addition, the landfill maintains a number of walking paths and a designated tubing hill used in the winter by the local community.

2.1.2.3 Landfill Gas Management

Landfill gas is currently managed by a landfill gas collection system consisting of nine extraction wells installed in 1986. These landfill gas extraction wells allow landfill gas from the waste mass to vent to the atmosphere through a 15-foot-tall passive vent stack located on the top of the landfill. The District plans to enhance landfill gas collection and control by converting from a passive system to an active collection system with a new blower and flare to combust the landfill gas. Additional landfill gas extraction wells and new gas piping will also be installed. This proposed system will significantly reduce the quantity of greenhouse gases emitted from the landfill.

2.1.2.4 Leachate Management

Leachate is managed by a leachate collection and extraction system. A perimeter leachate extraction trench system is used to collect leachate and remove it from the waste mass. Once collected and extracted, leachate is conveyed to a leachate storage tank and loadout system located at a maintenance building on the northwest side of the landfill. Tanker trucks haul the leachate to local WWTPs for treatment. Concurrently with the installation of the active landfill gas collection enhancements, the District plans to construct a new leachate storage tank and loadout pad directly north of the landfill.

2.1.2.5 Storm Water

Storm water management systems consist of storm sewers, pipes, and sheet flow to adjacent water bodies within the forest preserve. Based on the abundant plant growth on the final cover, it is assumed that a majority of the storm water is collected and removed via evapotranspiration.

2.1.2.6 Other Site Uses

As described previously, a number of designated walking paths are located on the landfill within the native prairie. The landfill also maintains a designated tubing hill used in the winter by the community. The long-term use of the landfill is restricted by the conditions of the Uniform Environmental Covenant Act agreement and long-term ownership plan approval by the U.S. EPA and IEPA.

2.1.3 Mallard Lake Landfill (Hanover Park, IL)

The Mallard Lake Landfill is located within the Mallard Lake Forest Preserve in Hanover Park, Illinois. The landfill began operation in March 1975. The landfill was originally configured as a North Hill and a South Hill that were later joined via an expansion area. The landfill ceased disposal operation in March 1999 and was certified closed in December 2001. The Mallard Lake Landfill is currently operated and maintained by BFI/Republic Services, Inc. A site layout map identifying key elements is shown on **Figure 4.**

2.1.3.1 Waste Disposed and Cover System

During operation, materials disposed of within the landfill included MSW, landscape wastes, C&D, and many special wastes including notable volumes of sludges. The landfill was closed in compliance with the regulations that existed during the time period of operation. The southern portions of the South Hill and the northern portions of the North Hill were closed with a final cover system consisting of recompacted clay, vegetative zones, and topsoil. The vast majority of the remaining portions of the final cover (approximately 160 acres) were closed using a 1-foot recompacted clay liner overlain by a BentoMat™ geocomposite clay liner (GCL) and a 40-mil linear low-density polyethylene (LLDPE) geomembrane. The final cover types and locations are shown on **Figure 4.**

The landfill final cover vegetation consists primarily of grasses with a small portion of the landfill plateau dedicated as a native species restoration zone. This zone is designed to promote ecological diversity, and provide food and habitat resources for native insects, plants, and animals.

Based on information provided by the District, significant settlement of the waste mass and final cover system has occurred in certain areas at the landfill. Areas of significant settlement were not observed during a recent site visit; however, settlement has not been measured historically.

2.1.3.2 Landfill Gas Management

Landfill gas is managed by an active landfill gas collection system consisting of approximately 240 vertical extraction wells. In 2021, the landfill gas collection system was operating at 1,577 mmscfd. These wells are routinely maintained by BFI/Republic Services, Inc., the landfill operator. Maintenance consists of evaluating the vacuum and pressure each well is operating at, the efficiency of each well, and replacement of pumps. Landfill gas is combusted at two enclosed flares. A GTE plant was constructed on site but was later decommissioned and demolished in 2018.

2.1.3.3 Leachate Management

Leachate is managed by a leachate collection and extraction system under a majority of the landfill. The South Hill, located in the southeast portion of the landfill, is not equipped with a leachate drainage layer. The remaining portions of the landfill are equipped with a leachate drainage layer between the waste and the engineered bottom liner system. Perforated drainage pipes are installed within the leachate drainage layer to collect and convey leachate to 17 perimeter leachate extraction sumps. In addition to these sumps, there are 16 vertical extraction wells dispersed throughout the landfill unit.

Based on leachate disposal rates provided by the District, leachate disposal volumes were between 4.4 to 6.1 million gallons per year from 2001 to 2018. Leachate disposal volumes have fluctuated from 3.5 million gallons per year in 2019 and 1.7 million gallons per year in 2020, to 2.7 million gallons per year in 2021.

Leachate collected in this system is pumped to leachate storage tanks located on the south end of the landfill facility. A forcemain is connected to the leachate storage tanks and directly discharges to the Hanover Park WWTP located approximately 1.5 miles north of the landfill. The leachate storage tanks are equipped with a loadout system to allow hauling via tanker truck to local WWTPs. This method is permitted but not used at this time.

2.1.3.4 Storm Water and Groundwater

Storm water management systems consist of terrace berms, letdown chutes, perimeter ditches, culverts, and multiple storm water basins. Rain falling on the landfill final cover is captured in terrace berms and conveyed to perimeter ditches via designated letdown chutes. These systems remove storm water from the landfill final cover in a manner that minimizes rainfall infiltration and erosion when properly designed and installed. Some letdown chutes were noted to have erosion occurring at the toe of the slope. Once collected from the final cover, storm water is conveyed to storm water basins that eventually discharge to the West Branch of the DuPage River.

Groundwater conditions surrounding the landfill are monitored on a routine basis. Groundwater impacts discovered within these wells have been attributed by the landfill operator to alternative sources that are not caused by the landfill.

2.1.3.5 Other Site Uses

At this time, there are no other uses for this landfill and it is closed to the public.

2.1.4 Mallard North Landfill – Former Heil Landfill (Hanover Park, IL)

The Mallard North Landfill is located within the Mallard Lake Forest Preserve, directly north of the Mallard Lake Landfill, in Hanover Park, Illinois. The landfill began operation as the Heil Landfill in 1970 and ceased accepting waste in 1975. The IEPA certified the Completion of Closure in July 1975, and the 3-year Post-Closure Care Period was completed in July 1978. A site layout map identifying key elements is shown on **Figure 5.**

2.1.4.1 Waste Disposed and Cover System

During operation, materials disposed of within the landfill included MSW and C&D. The landfill was closed in compliance with the regulations that existed during the time period of operation. Based on information provided by the District, the landfill was closed with a minimum 2 feet of random soil, with the top 0.5 feet being topsoil. Additional cover soils were added to the final cover over the years to address settlement and fractures. The thickness of final cover soils is between 5 and 15 feet measured from gas well bore logs from 2018. There quantities of how much soil has been used to remedy settlement is presently unknown.

2.1.4.2 Landfill Gas Management

Landfill gas is managed by an active landfill gas collection system constructed in 2017, consisting of approximately 29 dual vertical extraction wells (landfill gas and leachate). In addition, a 2,400-foot perimeter dual extraction collection trench is located on the south side of the landfill and serves to remove both landfill gas and leachate. In 2021, the landfill gas collection system was operating at 77.5 standard cubic feet per minute (scfm). Landfill gas is combusted at a utility flare that operates on a limited basis.

2.1.4.3 Leachate Management

Leachate is managed by a leachate collection and extraction system. Leachate is extracted through 28 vertical dual extraction wells (landfill gas and leachate) with an additional 13 wells that are not currently equipped with pumps. Leachate is also extracted from the dual extraction trench located on the south side of the landfill.

Once collected, there are two primary disposal methods for leachate at this landfill. The primary disposal method is a phyto-utilization cover system consisting of hybrid poplar and willow trees. The phyto-utilization system irrigates the tree grove with leachate collected from the landfill. The trees soak up the leachate through evapotranspiration and remove the leachate from the landfill. This innovative process has enabled the District to remove approximately 50 percent of the leachate through evapotranspiration, minimizing the cost to treat the leachate at a local WWTP.

From 2012 to 2019, leachate disposal volumes sent to the WWTP have steadily increased from 1.6 million gallons to 7.7 million gallons in 2019. Since then, leachate disposal volumes sent to the WWTP have decreased to 5.9 million gallons per year in 2020 and 2.7 million gallons per year in 2021.

The landfill also maintains a leachate collection tank that has a direct discharge connection to the Hanover Park WWTP located approximately 0.2 miles northeast of the landfill. In addition, the landfill has the capability to use tanker trucks to haul leachate to the Fox River Water Reclamation District WWTP, but this option has never been used.

2.1.4.4 Storm Water and Groundwater

Storm water at the Mallard North Landfill is managed through a series of vegetated channels, riprap channels, culverts, and a storm sewer system to discharge storm water to the West Branch of the DuPage River. The northeast and central portions of the landfill are directed to a channel along the northern portion of the landfill and discharge in the northeast corner through a riprap channel. Southern portions of the landfill collect in vegetated channels and flow to either a culvert or riprap channel that discharges storm water south into the West Branch of the DuPage River. A small portion of the northwest corner of the landfill flows into a catch basin that is connected to a storm sewer coming into the landfill property from the northwest corner and discharging storm water south into the West Branch of the DuPage River. The western portion of the landfill flows overland directly into the West Branch of the DuPage River. Additional detail of the storm water management system is provided in MLN012323.

Groundwater conditions surrounding the landfill are monitored on a routine basis. Some groundwater impacts have been identified in perimeter monitoring wells and, according to the landfill operator, have been adequately addressed.

2.1.4.5 Other Site Uses

The landfill has become valuable habitat to grassland birds among other insects and animals. At this time, there are no other uses for this landfill beyond the phyto-utilization system. The landfill is closed to the public in order to protect the phyto-utilization system and due to the susceptibility of the landfill gas and leachate systems to vandalism.

2.2 DUMP SITES

Dump sites are generally historic locations in which communities used to collect and bury wastes that were not a part of a formal operation and predate solid waste regulations. The historic dump sites owned by the District contain MSW and C&D. These dump sites are located within forest preserves and are now managed by the District. The locations of the dump sites within DuPage County are shown on **Figure 1.**

2.2.1 Wheaton Dump (Winfield, IL)

The Wheaton Dump is located within the Timber Ridge Forest Preserve in Winfield, Illinois. The dump site operated as the Wheaton City Dump from the 1930s to 1956. Additional waste was placed in the dump site under the operation of Kiddie Kar auto junkyard from 1972 to 1979. The dump site does not have any formal solid waste permit. A site layout map identifying key elements is shown on **Figure 6.**

2.2.1.1 Waste Disposed and Cover System

Materials disposed of within the dump site are assumed to be MSW consistent with the time period of operation and some automobile debris. Based on information provided by the District, the dump site is covered with random fill clay and topsoil fill at unknown thicknesses.

2.2.1.2 Environmental Management and Monitoring Systems

There are no gas or leachate collection systems at this dump site. Groundwater is monitored at two groundwater monitoring wells. Based on groundwater monitoring analytical results, the dump site does not appear to have an influence on groundwater quality.

2.2.1.3 Storm Water Management

Storm water generally drains to the north into a pond and to the east toward the West Branch of the DuPage River. To support a bridge improvement adjacent to the dump site, the DuPage Department of Transportation (IDOT) intends to remove a number of trees and construct a flood storage pond between the West Branch of the DuPage River and the dump site. The soils excavated to create the pond will be placed on top of the dump site to provide additional soil cover. In order to accomplish this, the trees and vegetation located on top of the dump site will be removed and provide an opportunity for restoration or repurposing the dump site cover.

2.2.1.4 Other Site Uses

At this time, the dump site is open to be accessed by the public, although it is fairly difficult to access. There is limited access from the adjacent road, and undesirable vegetation is dense and overgrown.

2.2.2 Ajax Pit (Bloomingdale, IL)

The Ajax Pit is located within the Meacham Grove forest preserve in Bloomingdale, Illinois. The dump site operated as a C&D landfill from 1967 to 1974. Significant regrading and typical closure and capping activities occurred from January 1991 to November 1993. The dump site does not have any formal solid waste permit. A site layout map identifying key elements is shown on **Figure 7.**

2.2.2.1 Waste Disposed and Cover System

During operation, materials disposed of within the dump site are assumed to be C&D wastes including soils, paper, cardboard, wood, metal, and other building materials. In general, the District does not have documentation of the waste profile within the dump site. Based on information provided by the District, the dump site is covered with 2.0 feet of compacted clay and a 0.5-foot topsoil layer. Vegetation of the landfill cover consists primarily of native forbs, grasses, and trees.

2.2.2.2 Environmental Management and Monitoring Systems

There are no gas or leachate collection systems at this dump site. Groundwater is monitored at six groundwater monitoring wells. Based on groundwater monitoring analytical results, the dump site does not appear to have an influence on groundwater quality.

2.2.2.3 Storm Water Management

Storm water generally drains from the top slope toward a perimeter ditch along the perimeter of the dump site. The perimeter ditch segment conveys storm water to a pond located directly north of the landfill.

2.2.2.4 Other Site Uses

The forest preserve in which the dump site is located has a series of designated walking paths that surround the dump site, adjacent lake, and adjacent marsh areas. At this time, the dump site is open to the public and appears to have a few eroded areas from unauthorized foot traffic. There is no specific signage that alerts visitors that they cannot access the dump site and there are no specific walking paths to access the top of the dump site.

2.2.3 Barnes Pit (Bloomingdale, IL)

The Barnes Pit is located within the Spring Creek Reservoir forest preserve in Bloomingdale, Illinois. The dump site operated as a sand and gravel quarry from 1968 to 1986. The dump site does not have any formal solid waste permit. The dump site is located on the southern bank of a flood storage reservoir used to reduce flood elevation in the adjacent Spring Brook waterway. A site layout map identifying key elements is shown on **Figure 8.**

2.2.3.1 Waste Disposed and Cover System

During operation of the quarry, undocumented dumping and open burning occurred at the site. Various documents identify substantial quantities of C&D, MSW, and junk vehicles disposed of on site. Twelve barrels of liquid waste associated with asphalt products were disposed of, including one barrel that was determined to be hazardous waste. These barrels and the associated impacted materials were removed under IEPA oversight in August 1988.

The dump site cover system consists of random soil fill at unknown thicknesses, as well as asphalt parking lots and roadways. The soil cover is not routinely inspected but appears to have thriving vegetation growth. The vegetation growth consists of some native species and a large area of aggressive invasive species. The integrity of the parking lots and roadways are routinely inspected and are maintained in good condition.

2.2.3.2 Environmental Management and Monitoring Systems

There are no gas or leachate collection systems at this dump site. Groundwater is monitored at five groundwater monitoring wells. Based on groundwater monitoring analytical results, the dump site does not appear to have an influence on groundwater quality.

2.2.3.3 Storm Water Management

Storm water from the dump site drains directly into the reservoir. There are no additional storm water management features at this dump site.

2.2.3.4 Other Site Uses

The forest preserve in which the dump site is located has a designated walking path that surrounds the reservoir. At this time, the dump site is open to be accessed by the public and appears to have a few eroded areas from unauthorized foot traffic. There is no specific signage that alerts visitors that they cannot access the dump site and there are no specific walking paths to access the dump site sideslopes.

3.0 ASSESSMENT OF ENVIRONMENTAL IMPACTS

Landfilling of solid wastes is the oldest and most common form of waste disposal. Landfilling has the potential to impact the environment through the release of landfill gas (air impact) and leachate (groundwater impact).

Landfill gas is a byproduct of the decomposition of waste. As solid waste materials are consolidated, decomposition of the organic materials will occur. Aerobic decomposition is the first stage by which wastes are broken down in a landfill. This is followed by anaerobic degradation once free oxygen levels are depleted. As a byproduct of decomposition, carbon dioxide (CO_2), methane (CH_4), and other gasses are produced, which are collectively referred to as “landfill gas.” Landfill gas can move through the waste mass and be released through the top of the landfill or migrate underground beyond the waste mass boundary unless it is captured through engineered controls.

In addition to landfill gas, liquids that enter the landfill can percolate through the waste mass and be released through the sides or bottom of the landfill. Liquids can enter the landfill through storm water (rainfall), through the disposal of liquids, or through direct contact with groundwater. Once the liquids have come in contact with waste, the liquid is referred to as “leachate.” Leachate contains a variety of chemical constituents that are present in the waste mass and mobilizes those chemical constituents in liquid form. Containment, collection, and disposal of leachate is important to minimize the mobilization of chemical constituents from the waste as leachate into groundwater and surface waters.

Modern Resource Conservation and Recovery Act (RCRA) Subtitle D landfills are engineered for the purpose of receiving non-hazardous solid waste. These landfills are well-engineered and managed facilities for the disposal of solid waste. They are also designed to protect the environment from contaminants, which may be present in the waste stream. Engineered elements include cover and bottom liner systems, leachate collection systems, and gas collection systems. Extensive groundwater monitoring networks are routinely assessed to detect potential release from the landfill. Landfills that pre-date the RCRA Subtitle D regulations were not Federally-required to have an engineered liner system, leachate collection system, and landfill gas collection system. In most cases, these types of landfills have installed leachate collection systems and landfill gas collection systems to minimize environmental impact.

Landfills and dump sites have the potential to impact the environment through the following primary mechanisms:

- Release of greenhouse gases to the atmosphere.
- Release of methane to adjacent property through the subsurface.
- Release of leachate to the subsurface or groundwater.
- Release of leachate to the ground surface via seeps.
- Erosion of surface cover materials.
- Storm water impacted sediment from erosion or direct contact with exposed waste materials.

Compliance with environmental regulations and proper operation and management of the regulated landfill or dump site reduces or eliminates the potential impacts on the environment. The District's landfills and dump sites have been managed in accordance with Federal and State environmental regulations and have incorporated a variety of appropriate measures to reduce and eliminate the potential for environmental impacts.

The following section presents a summary of the potential environmental impacts of landfills and dump sites. In addition, we explore the potential carbon footprint of the District's facilities if no management systems were in place and how the existing management systems are used to reduce the environmental impact.

3.1 LANDFILL GAS MANAGEMENT

When MSW and C&D wastes are placed and covered with soil and/or geosynthetic liners, the organic materials begin to naturally decompose. This decomposition process produces landfill gas, which includes CH_4, CO_2, and water vapor. By volume, landfill gas typically contains 45 percent to 60 percent CH_4 and 40 percent to 60 percent CO_2. Landfill gas also includes small amounts of nitrogen, oxygen, ammonia, sulfides, hydrogen, carbon monoxide, and non-methane organic compounds (NMOCs). Methane and CO_2 are two potent greenhouse gases that attract and absorb heat from the Sun, and are considered a key contributor to climate change.

The Global Warming Potential (GWP) of various greenhouse gases (GHGs) allow comparisons of the global warming impacts of different gases. According to the U.S. EPA, CO_2 has a GWP of 1, whereas methane has a GWP of 25 and can be thought of as 25 times as potent as CO_2 at trapping heat in the atmosphere. CH_4 is the primary constituent of natural gas. Like natural gas, CH_4 burns in the presence of oxygen to give off CO_2 and water (H_2O). When it undergoes combustion, it produces a great amount of heat, which makes it very useful as a fuel source.

According to the U.S. EPA's inventory of domestic greenhouse gas emissions, waste collection facilities make up about 15 percent of anthropogenic (human-made) GHG emissions in the United States. The contribution to climate change from these facilities can be reduced through modern collection, destruction, and transformation technologies. Many of these technologies are already in use at the District's landfills.

3.1.1 Landfill Gas Collection

Landfill gas collection systems provide a controlled method of landfill gas extraction from the landfill. Without a landfill gas collection system, gas that is generated is emitted to the atmosphere and has the potential to contaminate groundwater or migrate off property in an uncontrolled manner. In some instances, uncontrolled landfill gas migration can generate potentially explosive conditions in nearby buildings, homes, and sewer systems.

Landfill gas collection is typically achieved through wells that are installed by drilling down into the waste mass from atop the landfill cover system. The wells are piped to a vacuum blower that draws the landfill gas out of the landfill. The landfill gas collection flow rate depends on the depth of the landfill, age of the waste, and the types of waste disposed. At some landfills, pumps are installed in the landfill gas wells to recover leachate as well. The landfill gas collection system requires monitoring, maintenance, and repair to properly function and effectively collect landfill gas. Monitoring and maintenance are key factors in removal efficiency because the landfill waste composition is not homogeneous and decomposes at different rates throughout the waste mass.

Options for managing collected gas include direct venting, combustion in a flare, or treatment for energy recovery. Modern landfills are typically required to combust or treat landfill gas. Combustion converts the methane in landfill gas to CO_2, which reduces greenhouse gas emissions. A summary of the GHG emission reductions for the District's landfills is provided in **Section 3.4** and **Appendix A.**

Combustion also reduces odors and destroys non-methane organic compounds. Direct venting is only used for old landfills or dumps with very low landfill gas generation rates. Landfill GTE options include direct use, electrical generation, or methane recovery for renewable natural gas (RNG), as described in more detail below.

For older landfills with limited landfill gas production, a passive landfill gas collection and venting system may be used. A passive system typically includes vertical wells or horizontal collector pipes within the waste, but there is no central blower system. The landfill gas is allowed to vent to the atmosphere.

3.1.2 Landfill Gas to Energy

Energy can be recovered from landfill gas through direct use, electrical generation, or conversion to RNG. Under the direct use option, landfill gas is typically combusted in a boiler system to create heat for buildings or for industrial processes. The gas may be used at the landfill site or piped to an offsite location. Electricity can be generated by using the landfill gas to supply power for internal combustion engines which drive electrical generators to return electrical power back to the electrical grid. RNG can be generated by filtering and processing the landfill gas to reduce the CO_2, nitrogen, and oxygen content. Once processed, the RNG is injected into existing natural gas pipelines as natural gas. The capital costs to construct an RNG plant or an engine plant for electrical generation are significant, so these options are more feasible for larger landfills that are active or recently closed, with relatively high landfill gas generation rates. Direct use for heating or for on-site power use may be feasible at lower landfill gas generation rates at locations possibly including the USRC, concession building, or GRV program support building.

3.2 LEACHATE GENERATION AND TREATMENT

Contamination can occur if landfill leachate discharges into groundwater or surface waters. In order to prevent groundwater and surface water contamination, modern landfills are lined and leachate is collected above the liner. Older landfill and dumps may not be lined, but may still have some form of leachate collection. Leachate that is removed from landfills is typically treated at a local WWTP or publicly owned treatment works (POTW). Discharge to these treatment facilities is achieved through underground piping directly into the facility or by tanker trucks collecting leachate from the landfill or dump site and driving it to the treatment facility. As landfills and dump sites are covered with soil and/or geosynthetic final cover systems, the generation of leachate decreases over time. Depending on the hydrogeologic setting in which the landfill and dump site are located, leachate generation may be eliminated.

Both transport and treatment of leachate have the potential to contribute to greenhouse gas emissions through vehicle usage, construction activities, and operation of treatment facilities. In addition to these traditional transport and treatment methods, the District employs other innovative treatment methods using phyto-technology as described in subsequent sections of this Plan.

Local WWTP and POTWs have a heightened awareness of accepting landfill leachate for treatment. A September 2021 U.S. EPA study presented 95 percent of the 200 landfills assessed contained per- and polyfluoroalkyl substances (PFAS) in leachate. At the time of this report, the State of Illinois has not established regulations for PFAS in wastewater and surface waters. Regulations are anticipated to establish minimum discharge requirements for WWTPs and POTWs which in turn will allow these facilities to establish minimum acceptance requirements for liquids that may contain PFAS.

The changing effluent limitations may result in WWTPs and POTWs refusal to accept landfill leachate for treatment due to the potential presence of PFAS. Moreover, WWTPs and POTWs may reject landfill leachate prior to regulation by the State in preparation of impending discharge requirements, depending on the contract terms between the liquid discharger and the WWTP / POTW.

3.3 GHG EMISSIONS

SCS calculated the greenhouse gases (GHG) emitted at each site. We accounted for the CH_4 and CO_2 generated by the decomposition of the waste in units of metric tons of CO_2 equivalent (MTCO2e). A summary of the GHG calculations is provided in **Appendix A**.

The GHG emission calculations include emissions associated with landfill gas and leachate management, with the landfill gas contributing the majority of the GHG emissions. GHG emissions associated with landfill gas are calculated based on data and/or assumptions regarding the quantity and type of wastes disposed, when the wastes were disposed, and what type of cover system overlies the waste (e.g., clay, geomembrane, general soil). For the landfills with landfill gas collection systems, the calculations also incorporate current landfill gas collection rates, gas composition, and gas combustion or use.

For the dump sites, the GHG calculations are based on limited data and assumptions regarding waste volume, in-place density, waste types, and disposal timing. The calculated GHG emissions for the dump sites represent an approximate and conservative estimate of emissions. Based on the lack of odor issues or groundwater impacts that could indicate landfill gas emissions, GHG emissions for these sites appear to be very low.

CO_2 emissions from MSW landfills are not considered to contribute to an increase of GHG emissions because the carbon was contained in recently living biomass (is biogenic). That biogenic CO_2 would be emitted as a result of the natural decomposition of the organic waste materials if not in the landfilled. This approach is consistent with international GHG protocols.

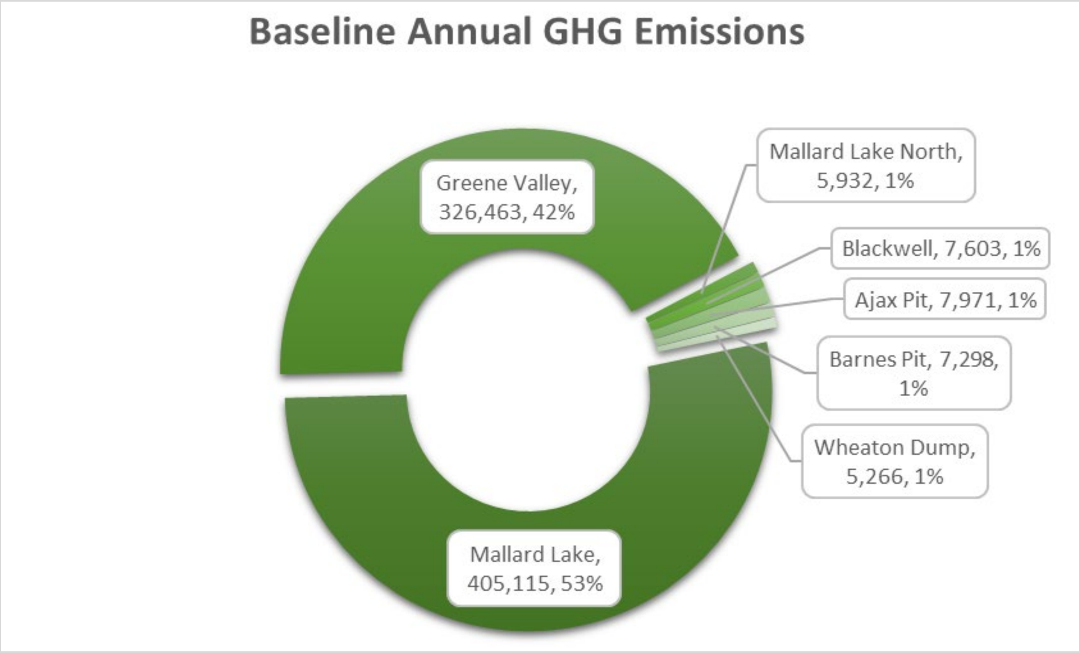
However, being all-inclusive, the GHG emissions accounted for here does include the biogenic GHG emissions attributed to the recovery and flaring of all landfill gas (CO2 and CH4) for each site.

The GHG emission calculations indicate that the largest source of GHG emissions is Mallard Lake at an annual rate of 405,115 MTCO2e. Greene Valley is the second largest at 326,463 MTCO2e. Annual GHG emission estimates for the smaller landfills and dumps range from 2,632 to 7,603 MTCO2e. Total annual GHG emissions for all the sites are calculated to be 765,648 MTCO2e. Calculated annual GHG emissions for each landfill and dump site are summarized in **Table 1** and on **Graph 1**.

Table 1. GHG Emissions 2022 Baseline

Site	**Mallard Lake**	**Greene Valley**	**Mallard Lake North**	**Blackwell**	**Ajax Pit**	**Barnes Pit**	**Wheaton Dump**	
Description	Landfill	Landfill	Landfill	Landfill	Dump	Dump	Dump	**Total**
Baseline [MTCO2e]	405,115	326,463	5,932	7,603	7,971	7,298	5,266	765,648

Graph 1. GHG Emissions 2022 Baseline



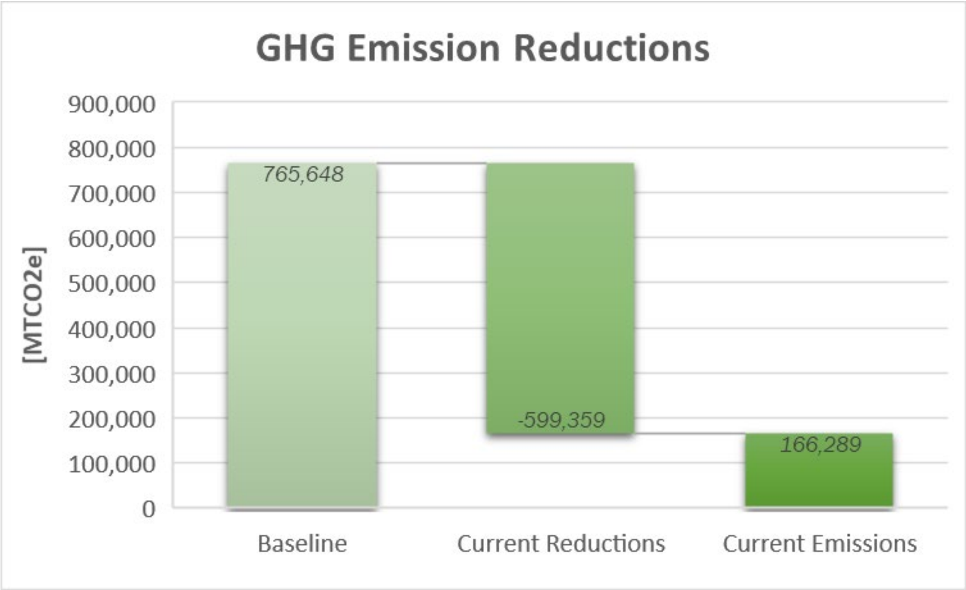
3.4 EXISTING COLLECTION AND MANAGEMENT SYSTEMS

As described in **Section 2.0**, the District's landfills and dump sites employ environmental controls to reduce the GHG emissions of each respective facility. The largest reduction of GHG emissions can be attributed to the collection of methane. GHG emissions are also reduced due to oxidation of methane in landfill cover soils. For the District's larger landfills, existing landfill gas collection and management cause a significant reduction in GHG emissions relative to the potential baseline emissions without these systems in place. Reductions in GHG emissions due to existing systems are shown in **Graph 2**.

Table 2. GHG Emissions Reductions

Site	**Mallard Lake**	**Greene Valley**	**Mallard Lake North**	**Blackwell**	**Ajax Pit**	**Barnes Pit**	**Wheaton Dump**	
Description	Landfill	Landfill	Landfill	Landfill	Dump	Dump	Dump	**Total**
Baseline [MTCO2e]	405,115	326,463	5,932	7,603	7,971	7,298	5,266	765,648
Current [MTCO2e]	84,154	62,223	2,162	6,466	4,390	4,527	2,368	166,289

Graph 2. GHG Emission Reductions



The existing management practices employed by the District serve to reduce GHG emissions by approximately 78 percent. While significant, the remaining emission from landfills represent approximately 95 percent of the Districts overall GHG emissions. The Delta Institute identified approximately 8,323 $MTCO_2e$ from non-landfill sources while the landfills represent 166,289 $MTCO_2e$. Additional GHG reduction measures at the landfills offer the District with the most significant opportunity to affect emissions.

4.0 CLEAN ENERGY, RESILIENCY, AND SUSTAINABILITY OPPORTUNITIES

The purpose of this Plan is to evaluate opportunities for reduction, enhancement, and repurposing the landfill and dump sites in alignment with the District's mission. Each opportunity is summarized below.

4.1 EMISSIONS ACCOUNTING – GREENE VALLEY OFFSET

When landfill gas is used for either electricity generation or direct-use projects, reductions of GHG emissions can be accounted for as GHG offsets. GHG emission offsets for electricity generated by the generators at Greene Valley are shown in **Table 3**.

4.2 OPPORTUNITIES FOR REDUCTION

4.2.1 Reducing Air Emissions – Planned Blackwell GCCS

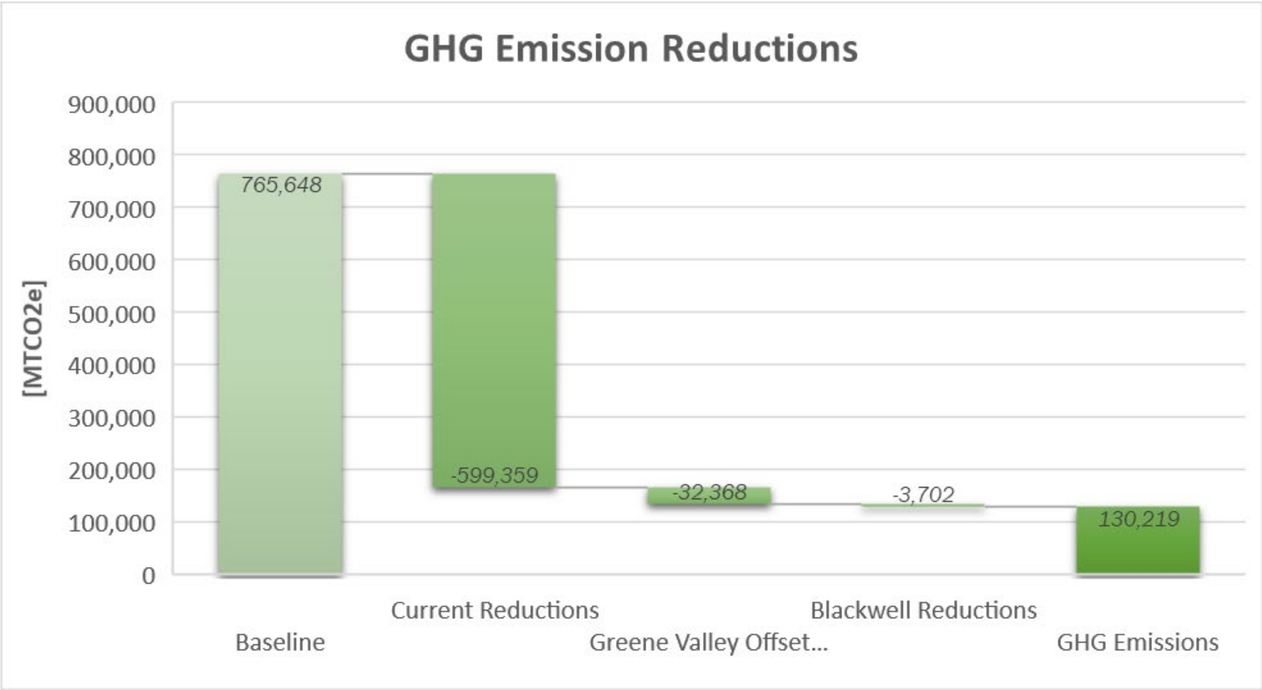
As an example, the proposed addition of a landfill gas collection and control system at the Blackwell Landfill could reduce GHG emissions by collecting and combusting methane that is currently vented to the atmosphere. The potential GHG emissions reduction associated with this project is also shown in **Table 3.**

Table 3. GHG Emission Reductions and Opportunities

Site	**Mallard Lake**	**Greene Valley**	**Mallard Lake North**	**Blackwell**	**Ajax Pit**	**Barnes Pit**	**Wheaton Dump**	
Description	Landfill	Landfill	Landfill	Landfill	Pit	Pit	Pit	**Total**
Baseline [MTCO2e]	405,115	326,463	5,932	7,603	7,971	7,298	5,266	765,648
Current [MTCO2e]	84,154	62,223	2,162	6,466	4,390	4,527	2,368	166,289
Greene Valley Offset [MTCO2e]	84,154	29,855	2,162	6,466	4,390	4,527	2,368	133,921
Planned Blackwell GCCS [MTCO2e]	84,154	29,855	2,162	2,763	4,390	4,527	2,368	130,219

The total GHG emissions reduced represent an 83 percent reduction of GHG emissions from 765,648 MTCO2e to 130,219 MTCO2e.

Graph 3. GHG Emission Reductions and Opportunities



4.3 OPPORTUNITIES TO REPURPOSE

4.3.1 Solar Power Generation

Landfills and dump sites are generally configured to be higher in elevation compared to surrounding areas. Due to the elevated landmass, landfill side slopes can be optimal locations for installing solar panel arrays. Solar panels harness energy from the sun and convert this energy into electricity. This energy can be a part of a community solar installation, or offset use at specific facilities, and additional financial benefits can be achieved to reduce the operation costs of the landfill and dump sites.

Technical siting considerations for installing a solar system on a landfill would include acreage of the site, landfill characteristics, closure status and post-closure use, waste composition, slope and stability, settlement, landfill systems, and long-term maintenance requirements. When reviewing options for foundation supports, the choices are typically ballasted concrete systems or shallow poured concrete footings. Steeper slopes are generally avoided. If used, they require special design considerations to avoid increased static and dynamic loadings that could affect side slope stability.

4.3.2 Wind Power Generation

With the elevated landmass, smaller wind turbine units can be used to harness wind energy and convert it to electricity. These smaller units reduce the potential for obstructing avian species and can effectively reduce electrical demand for the landfill and dump sites. SCS envisions vertical axis wind turbines (VAWT) for their reduced noise output and reduced danger to birds compared to horizontal axis wind turbines (HAWT). The United States Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (Nov. 2021) provides a framework for assessing potential wildlife impacts of utility-scale wind-energy projects. In the event wind energy improvements are considered, the USFWS guidance consisting of performing preliminary site evaluation, site characterization, field studies, and post-construction monitoring will be an important component of a wind project.

Payback periods for alternative energy projects often range from 7 to 15 years without additional incentives. The United States Department of Energy Office (DOE) of Energy Efficiency and Renewal Energy provides guidance in their Federal Financing for Clean Energy (2016) publication provide guidance to U.S. government programs to support the development of clean energy projects.

At the time of this report, the State of Illinois and the Inflation Reduction Act of 2022 provide financial incentives for alternative energy projects. Financial assessment can be supporting through DOE funding and financing tools at: https://www.energy.gov/funding-financing; and, the Database of State Incentives for Renewables & Efficiency: https://www.dsireusa.org/.

4.3.3 Renewable Natural Gas Revenue Opportunities

Landfill RNG projects provide an avenue for a revenue for the District through the value of the physical natural gas, and through the value of U.S. EPA Renewable Identification Numbers (RINs) Credits under the Renewable Fuel Standard Program. Current landfill gas generation and the projected rate over time is a critical component of a RNG project. Some aspects that affect landfill gas generation are the age of the waste, the tightness of the wellfield, and the level of saturation of the waste. Typical minimum landfill gas generation rates, for a viable RNG project, can be as low as 1,500 SCFM. This minimum increases to approximately 2,500 SCFM if Nitrogen (N_2) removal is required. In the event landfill gas generation is near these threshold values, additional modeling is warranted to further assess a possible RNG project. Many RNG projects have payback periods of under 5 years, in the absence of the use of RINs credits, and as low as 18 months when leveraging the RINs credits.

Modeling landfill recovery can be particularly challenging for RNG projects, and projecting the impact of wellfield tightening, and assessing the need for supplemental gas wells for optimizing gas quality and quantity is a critical step. N_2 removal can sometimes be accomplished by wellfield tightening, however this tightening can result in reduced landfill gas generation rates.

4.3.4 Landfill Gas to Energy Opportunities

Landfill gas can serve as an energy source for electrical generation, heating, or vehicle fuel, and these options could be explored for the District's landfills. For example, landfill gas could be used to provide heat to greenhouses and nurseries or maintenance buildings.

For the larger landfills, RNG generation is another opportunity to repurpose the landfill gas. RNG facilities use the landfill gas collected from the waste mass and remove impurities from the landfill gas. A series of filtration processes are used to reduce CO_2, nitrogen, and oxygen in the gas and generate pipeline-quality natural gas. Once cleaned, the RNG can be sold. These systems allow a potential landfill and greenhouse gas liability to be repurposed into a necessary utility used by the County's citizens.

4.3.5 Reducing Leachate Generation

Leachate generation can be reduced by maintaining positive drainage of the landfill cover system and providing storm water management systems designed to remove storm water from the landfill cover during storm events. Storm water that is not effectively removed from the landfill cover system has more potential to infiltrate into the landfill waste mass to generate leachate. Storm water management systems include terrace berms, letdown chutes, letdown pipes, and perimeter ditches outside of the landfill waste mass. In the event of a solar installation, storm water dynamics will change. A solar installation can serve to support leachate reduction as part of an integrated storm water design.

In addition, leachate generation can be reduced by establishing native forbs, grasses, and trees on the final cover system that have deep roots. Solar installations may require different native forbs and grasses that will serve in the same capacity with selection based on expected mature height. These systems are further described in the next section.

4.4 OPPORTUNITIES TO ENHANCE AND RESTORE

4.4.1 Underground Injection Control of Leachate

Leachate disposal via Underground Injection Control has become increasingly utilized for leachate disposal as more stringent surface water discharge standards take effect or as receiving facilities find their needs changing over time. Recently, polyfluoroalkyl substances (PFAS) have garnered attention as "forever chemicals." In 2021, U.S. EPA began studying PFAS in landfill leachate from more than 200 landfills across the country and found PFAS in leachate in over 95 percent of the landfills. Based on that data, U.S. EPA has deemed it necessary to develop landfill Effluent Limitation Guidelines (ELGs). As announced in the U.S. EPA Effluent Guidelines Program Plan 15 (January 2023), EPA has completed a detailed study of the Landfills category. Based on the information and data collected through that study, the development of effluent guidelines and pretreatment standards for landfills that discharge their leachate was determined as warranted. The U.S. EPA intends to revise the existing Landfills Point Source Category ELGs to address PFAS discharge from these landfills, though it currently has no timetable for that rulemaking.

In the future, former leachate pre-treatment and disposal solutions may no longer be options for the District, or may be too costly due to potential future regulations. Deep well injection is a viable leachate management option in many parts of the United States, including Illinois, yet it is sometimes overlooked as a viable alternative due to a lack of understanding of the technology or misconceptions about its acceptance or applicability.

The Mount Simon Sandstone is a saline unit separated from regional drinking water aquifers and exhibits suitable characteristics for underground injection of leachate and the depth to the top of that unit is approximately 1,500 to 2,000 feet below ground surface. To fully understand the suitability and function include:

- Proper design of the well casings and injection tubing for strength and chemical compatibility. These components are recertified a minimum of every 5 years with a robust mechanical integrity testing program to demonstrate that the well and its various components are not leaking.

- Demonstration that there is a confining zone of low permeability rocks to prevent upward migration of injected fluids into the underground sources of drinking water (USDW). This demonstration includes documenting that any other nearby wells or borings drilled into the confining zone have been properly completed or plugged to prevent a short circuit contamination pathway.

- Testing the injection interval to prove it can accept the fluids at the proposed rates and pressures.
- Continuous monitoring of the well pressures and flows that include the well annulus monitoring
- Frequent sampling and reporting of the injected fluid.
- Financial assurance via various means to plug and abandon the well if required.

The U.S. EPA Underground Injection Control (UIC) program is designed with one goal: protect the nation's aquifers and the USDW. There are several protective measures in an injection well design that are intended to meet this objective.

4.4.2 Constructed Treatment Wetlands for Leachate Treatment

Constructed Treatment Wetlands (CTW) are on-site treatment systems managed in a specific manner for the treatment of waste streams including landfill leachate. On-site treatment using CTW have been widely practiced for many years at many landfills with varying degrees of success. Because CTWs are biological systems, design for climatic extremes such as high levels of precipitation, or drought periods is required for a successful installation. For on-site treatment to be successful for the District, a low complexity, easy to maintain, and low cost to operate system is preferred.

The quantity and characteristics of leachate generated at a given landfill site is site specific, and varies depending on waste composition, waste age, landfilling practices, and climate. During waste decomposition of waste materials, high concentrations of ammonia nitrogen (>300 milligrams per liter [mg/L]) and total dissolved solids (>1,000 mg/L) are produced and can be difficult to treat with CTWs. Additional design including pre-treatment elements, or mechanical systems to augment treatment become necessary, with the CTW serving as a "polishing" component. These elements serve to generate side-streams of solids that require disposal. As a "polishing" component, CTWs can be low maintenance and add an operational element when installed.

CTWs do not serve to treat PFAS and oversizing a system is important to mitigate the risk of a release of leachate to the environment from increasing intensity precipitation events such as recurring 100-year precipitation events.

4.4.3 Storm Water Enhancements

4.4.3.1 Engineering Improvements

Engineered storm water management systems can reduce leachate generation by removing storm water from the final cover prior to infiltration. Storm water that is not effectively removed from the landfill cover system has more potential to infiltrate into the landfill waste mass to generate leachate. Storm water management systems include terrace berms, letdown chutes, letdown pipes, and perimeter ditches outside of the landfill waste mass.

4.4.3.2 Ecological Improvements

Storm water management systems can also be improved by retrofitting existing wet-bottom basins to dry-bottom basins and incorporating native vegetation. In addition, existing dry-bottom basins can be modified to remove invasive vegetation and integrate native vegetation.

This improvement will enhance water quality in storm water runoff but also create habitat for insects and birds. In addition, overall maintenance and repairs may decrease in frequency once native vegetation is established.

4.4.4 Phyto-technology Solutions

Phytotechnology is a process that uses vegetation to degrade, remove, contain, or stabilize contaminated surface water, groundwater, and soils. Phytotechnology has been effectively implemented at landfills to:

- Consumptively use leachate
- Evapotranspiration (ET) covers to minimize infiltration of precipitation
- Gradient control of impaired groundwater
- Phytoremediation of impaired groundwater

While phyto-technologies offer a variety of solutions, specific design is essential to ensure functionality and compatibility with the environment. Using vegetation to remove man-made contamination is a sustainable practice that requires more land area than other traditional engineered systems. The tradeoff for land can significantly reduce the time, materials, and cost to operate treatment works that would otherwise be necessary.

These systems require particular maintenance to inflow systems, as well as proper vegetation management. A clear vegetation management plan is necessary for sustainable, long-lasting solutions for leachate and storm water treatment.

4.4.5 Landfill Cover Improvements & Ecological Restoration

The District's landfills and dump sites are covered with a variety of vegetation including both native and invasive forbs, grasses, and trees. The landfill and dump facilities are located within key ecological corridors within DuPage County, providing opportunity for additional habitat, food sources, and diversity on top of the landfills and dump sites.

Management of invasive species and integration of native species further enhances the landfills and dump sites and aligns with the District's mission and guiding principles. The District established and utilizes an Impacted Sites Vegetation Maintenance Plan for each landfill and dump site to assess invasive species, establish techniques to manage and remove invasive species, and identify ways to integrate native species back into the cover systems. In addition, the District maintains "test plots" of native species at Greene Valley and Mallard Lake.

Expansion of these test plots and integrating native species on other landfills and dumps sites can serve to expand ecological restoration benefits in areas that are presently turf-grass. Enhancing and expanding native species on the landfills and dump sites provides another opportunity for the community to connect with nature through these properties.

In addition, floating solar installations can also provide an ecological enhancement to the landfills and dump sites. Floating solar installations can be coupled with floating waterfowl habitat to help protect the solar infrastructure from human interaction while increasing habitat. These features may also provide an opportunity for public education and community engagement. This could be achieved through education on how floating solar installations function, explanation why floating arrays reduce impact to valuable land, and provide some opportunity to describe the waterfowl that make their home in the habitat.

4.4.6 Community Engagement and Other Opportunities

In addition to technologies specific to landfill management, these properties can provide additional value as they reside within forest preserves. In alignment with the District's mission to connect the community to nature in DuPage County, the landfill and dump sites provide opportunity to integrate walking pathways, bird-watching areas, scenic overlooks, and picnic areas. Implementing these types of features will provide public access to these properties which would otherwise be inaccessible if they were not located within a forest preserve.

Through this repurposing method, citizens have an opportunity to engage with nature in a new manner at the District's properties. These types of enhancement require special consideration based on the underlying quality of the buried materials. Appropriate footings and compaction efforts are important components for future structural improvements. Walking or biking paths require careful design and installation to prevent erosion. Implementing these features is a viable option that aligns with the District's mission.

5.0 FEASIBILITY ASSESSMENT

5.1 SCREENING CRITERIA

The purpose of this Plan is to identify opportunities at the District's landfills and dump sites to reduce emissions, enhance and restore each site, and repurpose the landmass. The District has identified emphasis on landfill gas and leachate reductions. Landfill gas accounts for the most significant amount of GHG emissions, and leachate disposal results in significant long-term, and on-going operating costs.

In order to determine which opportunities are compatible with each landfill or dump site, SCS evaluated each site based on the current site use, and screened for alignment with the District's mission and guiding principles and viability on a site-by-site basis. For instance, a solar array at Blackwell would interfere with existing site uses such as the tube hill, archery range, and native prairie areas. In such instances, we have identified certain clean energy, sustainability, or resiliency option as Non-Viable (NV).

After completion of the preliminary screening, we prepared a series of screening criteria to evaluate each opportunity further based on likelihood of success. These have been weighed as "viable," "potentially viable," and "non-viable" based on the following:

<u>Screening Criteria (in order of priority):</u>
1. Compatibility with the current site use
2. Magnitude of Clean Energy, Sustainability, Resiliency impact
3. Implementation Considerations

The following presents a site-by-site assessment.

5.2 OPPORTUNITIES AT EACH SITE

5.2.1 Greene Valley Landfill (Naperville, IL)

5.2.1.1 Solar Power Opportunities

Compatibility with Site Use	**MODERATE**
	Advantages: • The majority of the site is restricted to public use. • Educational opportunities. • Potential to incorporate storm water drainage from the installed panels to collection headers and letdown chutes. • When incorporated with native grasses or wildflowers, can provide habitat for pollinators such as bees and butterflies. **Disadvantages:** • Potential interference with operations and maintenance activities for leachate and gas collection. • Increased maintenance for the District. • Impacts to plants and animals.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT**
	The calculated maximum solar potential could offset approximately 4,800 homes. The solar potential is summarized in **Table 4**. The maximum estimated solar potential may be reduced based on areas that may be identified as unsuitable by the District or the landfill operator.
Implementation Considerations	• Further assessment is needed to identify suitable areas for solar and the potential for ecological impacts if advanced by the District. • Alignment with District's current and future use of these areas. • Requires coordination with landfill operator (WM).
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

Based on the size and configuration of Greene Valley, there are many different locations and opportunities for harnessing solar power through PV panels. There are multiple transformers on site, and the site is directly adjacent to a Commonwealth Edison right-of-way with transmission lines. There are no evident obstructions from surrounding areas that would interrupt solar technology.

The table below shows the solar potential for the site while taking an aggressive approach. A more conservative and a less densely populated system could be pursued.

Table 4. Preliminary Solar Potential for Greene Valley

Location	Slope (°)	Footprint Area (ac)	Capacity (MW_dc)	Solar Panels (Qty.)	Elec. Production (kWh/yr)	Budget Installation Cost ($)	Emissions Offset (MTCO2e)	Elec. Offset (Homes /yr)
Greene Valley Landfill								
North-1	14.0	12.9	1.6	3,600	2,252,000	$2,850,000	1,097	306
North-2	11.3	60.4	7.6	16,800	10,577,000	$13,370,000	5,154	1,435
North-3	11.3	27.0	3.4	7,500	4,727,000	$5,980,000	2,304	641
South-1	11.3	33.6	6.7	14,900	9,416,000	$11,910,000	4,589	1,278

Location	Slope (°)	Footprint Area (ac)	Capacity (MW_dc)	Solar Panels (Qty.)	Elec. Production (kWh/yr)	Budget Installation Cost ($)	Emissions Offset (MTCO2e)	Elec. Offset (Homes /yr)
Greene Valley Landfill								
South-2	14.0	13.7	2.7	6,100	3,839,000	$4,850,000	1,871	521
Southeast-1	14.0	33.1	6.6	14,700	7,932,000	$11,700,000	3,865	1,256
	Subtotal	180.7	28.6	63,600	38,743,000	$50,660,000	18,880	5,437

5.2.1.2 Wind Power Opportunities

Compatibility with Site Use	**LOW TO MODERATE** **Advantages:** • Ability to offset on-site energy use. • Opportunity for additional community engagement. • Demonstration of the District's commitment to sustainability. • Areas at the top of the landfill, near the observation area, provide access to windy conditions on a regular basis. **Disadvantages:** • Limited area for use based on potential obstruction with the model aircraft use. • Impacts to avian species.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT** Potential to off-set some, or all, of the on-site energy requirements to operate leachate pumps and gas wells.
Implementation Considerations	• Further assessment is needed to identify suitable areas for wind and the potential for ecological impacts if advanced by the District. • Vertical Axis Wind Turbines are envisioned for their reduced noise output and reduced danger to birds compared to Horizontal Axis Wind Turbines.
Recommendation (See Section 5.3)	• Not recommended for advancement.

5.2.1.3 Landfill Gas Opportunities

Compatibility with Site Use	**SIGNIFICANT** Existing buildings are utilized at Greene Valley, and gas collection infrastructure has been developed as part of the Gas to Energy Plant. Burning the collected landfill gas to generate heat for the site buildings. **Advantages:** • Enhances existing site use. **Disadvantages:** • Improvement presents an additional item for District maintenance.

Magnitude of CERAS Impact	**MODERATE** The volume of the gas at Green Valley is moderate. Presently, the landfill gas is used in the Gas-to-Energy plant. Additional benefit can be derived by the use of the landfill gas for heat to offset existing natural gas and/or electrical heating demands.
Implementation Considerations	Further analysis of heat demand from the site buildings will help determine cost effectiveness. Potential integration with an RNG (described in Section 5.2.1.4) to facility to offset current natural gas use.
Recommendation (See Section 5.3)	• Recommended for advancement.

5.2.1.4 Renewable Natural Gas Opportunity

Compatibility with Site Use	**MODERATE** **Advantages:** • Gas quality and quantity are potentially suitable to RNG. • Demonstration of the District's commitment to sustainability. • Significant greenhouse gas reduction. **Disadvantages:** • RNG facilities generate noise that may require mitigation.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT** Opportunity for Renewable Identification Numbers (RINs) credits to offset capital investment and generate revenue.
Implementation Considerations	• Because the landfill is closed, the quality and quantity of gas are expected to decrease over time. • Significant capital expense. The gas quality and quantity are near the threshold volumes and quality for generally accepted payback periods. • Gas modeling to assess results of wellfield tightening and wellfield improvements with additional wells will be required to determine viability.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.1.5 Underground Injection of Landfill Leachate

Compatibility with Site Use	**SIGNIFICANT** Existing infrastructure is in-place to collect and convey leachate. **Advantages:** • Could serve to eliminate discharge to the WWTP. • Mitigates risks from emerging and tightening regulations (e.g., PFAS). **Disadvantages:** • Improvement presents an additional item for District maintenance. • Additional groundwater monitoring required.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT** Underground injection of landfill leachate offers a resilient and sustainable discharge point from a District owned location. The District is not dependent on discharge limits from the receiving entity, or subject to risk of cut-off from the receiving WWTP.

Implementation Considerations	• Further analysis of receiving geology and site suitability is required to determine applicability. • Operations and maintenance will increase to manage the injection well system, and pretreatment system. • Injection wells can provide substantial receiving capacity, allowing the landfill to maintain compliance with leachate head requirements. • Potential incorporation of other leachate waste streams from other District landfills for injection. • Presently not cost competitive with current disposal at the WWTP, this option is presented for consideration in the event discharge to the current WWTP is prohibited or cost for disposal at the WWTP increase.
Recommendation (See Section 5.3)	• Recommended for advancement.

5.2.1.6 Constructed Treatment Wetlands for Leachate Treatment

Compatibility with Site Use	**LOW TO MODERATE** Some infrastructure is in-place to collect and convey leachate. Rerouting to a possible use area at the southwest area of the facility would be required. A preliminary assessment of land area requirements suggests inadequate land available. **Advantages:** • Could serve to eliminate discharge to the WWTP. • Mitigates risks from emerging and tightening regulations (e.g., PFAS) • Potential for leachate volume reduction through evapotranspiration losses. **Disadvantages:** • Potential to concentrate total dissolved concentration through evapotranspiration losses. • Enhancement needed to address ammonia concentrations. • Discharge to WWTP likely required after treatment in a wetland. • Potential for release to the environment during force majeure precipitation events. • Improvement presents an additional item for District maintenance. • Additional groundwater monitoring required.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT** CTW offer a potential low-intensity manner to treat landfill leachate. Sometimes, CTWs offer an ability to minimize mechanical complexity by employing a large land area. The CERAS impact is low because of the likely addition of mechanical systems because of the limited land availability.
Implementation Considerations	• Further analysis of leachate constituents and likely additional treatment elements would be required to assess applicability. • Aeration, high cation-exchange-capacity media, sludge management and removal are likely elements for a successful CTW.
Recommendation (See Section 5.3)	• Not recommended for advancement.

5.2.1.7 Storm Water Improvements - Engineered

Compatibility with Site Use	**MODERATE** Implement storm water conveyance features such as terrace berms, letdown chutes, or letdown pipes to remove storm water from the final cover surface in a more efficient way. **Advantages:** • Reduce leachate generation through controlled conveyance of storm water from final cover. • Reduced repair needs of final cover. **Disadvantages:** • Coordination with landfill operation to overhaul landfill final cover. • Maneuvering around existing infrastructure (gas wells, leachate extraction wells). • Potential modifications to existing storm water basins (increased run-off rate and velocity). • Potential destruction of existing habitat.
Magnitude of CERAS Impact	**MODERATE** Reduction of leachate generation will reduce the resources required to treat the extracted leachate. An existing forcemain is used to efficiently convey leachate to a local WWTP and provides an effective treatment/discharge method for the landfill.
Implementation Considerations	• Coordination and agreement with the landfill operator. • Evaluation for compatibility with existing landfill permit. • Borrow soil source for terrace berms, swales, etc.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.1.8 Storm Water Improvements - Ecological

Compatibility with Site Use	**MODERATE** Manage invasive species and integrate native species into both storm water basins to further enhance water quality. **Advantages:** • Enhance water quality through implementation of native species in existing storm water basins. • Reduce ongoing maintenance once native species become established. **Disadvantages:** • Increased maintenance to remove invasive species. • Storm water quality is not an issue at this landfill. • Public engagement / accessibility to these areas is limited.

Magnitude of CERAS Impact	LOW TO MODERATE	
	Overall impact is relatively low due to the existing vegetation in the storm water basins which results in water quality that is not currently an issue at this landfill.	
Implementation Considerations	• Overall cost of implementation and maintenance compared to existing system. • Opportunities for public engagement / accessibility to these areas for education purposes.	
Recommendation (See Section 5.3)	• Not recommended for advancement.	

5.2.1.9 Landfill Cover Enhancement

Compatibility with Site Use	SIGNIFICANT
	Advantages: • Consistent with existing site use. • Simple installation and readily available materials. • Cover enhancements could reduce leachate by increasing evapotranspiration and initial abstraction of incident precipitation (buffalo grass or other prairie grasses). • Reduced maintenance requirements. • Enhancement of avian habitat for existing bird watching. **Disadvantages:** • Landfill operators less familiar with maintenance requirements. • Introduction of potential nuisance species.
Magnitude of CERAS Impact	MODERATE TO SIGNIFICANT
	The resiliency and sustainability impact can be significant. Cover improvement with buffalo grass or other prairie grass takes advantage of natural processes that are sustainable in and of themselves by the following means: • Improved erosion protection with denser rooting. • Higher evapotranspiration providing less infiltration. • Enhanced ecological diversity. Growth height is limited, requiring less mowing.
Implementation Considerations	• Coordination and agreement with the landfill operator for use. • Evaluation for compatibility with existing landfill permit.
Recommendation (See Section 5.3)	• Recommended for advancement.

5.2.1.10 Community Engagement

Compatibility with Site Use	**MODERATE**
	Increasing the quantity of walking paths in addition to the existing bird watching area, picnic area, and parking areas. **Advantages:** • Connect more citizens to the restored areas at the landfill. • Increase education opportunities for landfill management and ecological restoration of the final cover. **Disadvantages:** • Increased potential for vandalism of landfill infrastructure. • Destruction of potential habitat to implement more walking paths. • Increased maintenance for erosion control to align with existing storm water management system.
Magnitude of CERAS Impact	**MODERATE**
	More opportunities to connect the community with nature is aligned with the District's goals. Additional maintenance is feasible and may provide an opportunity to enhance the overall storm water management system of the landfill.
Implementation Considerations	• Evaluation of ecological impact of proposed walking paths. • Coordination and agreement with the landfill operator. • Evaluation for compatibility with existing landfill permit. • Effective means to deter vandalism of landfill infrastructure.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.2 Blackwell Landfill (Warrenville, IL)

5.2.2.1 Solar Power Opportunities

Compatibility with Site Use	**MODERATE**
	The southernmost pond is not accessible for public use and is a candidate area for a floating solar array. **Advantages:** • A floating solar array can provide habitat and enhance wildlife corridors for waterfowl. • Educational opportunities. **Disadvantages:** • Increased maintenance for the District. • Potential interference with the fresh water mussel program. • Impacts to plants and animals.
Magnitude of CERAS Impact	**MODERATE**
	• The calculated maximum solar potential could offset approximately 329 homes. The solar potential is summarized in **Table 5.** The maximum estimated solar potential may be reduced based on areas that may be identified as unsuitable by the District. • The potential ecological impacts are presently unknown and require assessment for suitability.
Implementation Considerations	Further assessment is needed to identify suitable areas for solar and the potential for ecological impacts if advanced by the District.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

The table below shows the solar potential for the site while taking an aggressive approach. A more conservative and a less densely populated system could be pursued.

Table 5. Preliminary Solar Potential for the Blackwell Landfill

Location	Slope (°)	Footprint Area (ac)	Capacity (MW_dc)	Solar Panels (Qty.)	Elec. Production (kWh/yr)	Budget Installation Cost ($)	Emissions Offset (MTCO2e)	Elec. Offset (Homes /yr)
Blackwell Landfill								
North-1	11.3	9.7	1.2	2,700	1,701,000	$2,150,000	829	231
Float-1	0	3.1	0.5	1,100	723,000	$910,000	352	98
	Subtotal	12.8	1.7	3,800	2,424,000	$3,060,000	1,181	329

5.2.2.2 Landfill Gas Opportunities

Compatibility with Site Use	**SIGNIFICANT** Existing buildings are utilized at Blackwell, and the site is used for winter recreation. Burning the collected landfill gas to generate heat has two potential opportunities. 1) Heat for the educational center. 2) Potential addition of a "warming house" for the tube hill, heated with waste heat. **Advantages:** • Enhances existing site use. • Existing collection systems plans are in development. • Educational Opportunities. **Disadvantages:** • Improvement presents an additional item for District maintenance.
Magnitude of CERAS Impact	**MODERATE** The volume of the gas at Blackwell is low, and offers limited options. Presently, the landfill gas is passively vented to the atmosphere without converting the methane to CO_2. Flaring the collected gas will have an improvement to the greenhouse gases generated from the preserve. Taking advantage of the heat generated from flaring serves a higher functional purpose. Greenhouse gas reduction by burning the methane will be an improvement. Using the generated heat for enhancing the community experience with a "warming house" offers tangential community benefit. The highest CERAS impact will be to offset existing energy use at the Urban Stream Research Center.
Implementation Considerations	Further analysis of heat demand from the educational center will help determine cost effectiveness. This consists of simple and cost-effective use of landfill gas.
Recommendation (See Section 5.3)	• Recommended for advancement.

5.2.2.3 Underground Injection of Landfill Leachate

Compatibility with Site Use	**SIGNIFICANT** Existing infrastructure is in-place to collect and convey leachate. **Advantages:** • Could serve to eliminate discharge to the WWTP. • Mitigates risks from emerging and tightening regulations (e.g., PFAS). **Disadvantages:** • Improvement presents an additional item for District maintenance. • Additional groundwater monitoring required.

Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT** Underground injection of landfill leachate offers a resilient and sustainable discharge point from a District owned location. The District is not dependent on discharge limits from the receiving entity, or subject to risk of cut-off from the receiving WWTP.
Implementation Considerations	• Further analysis of receiving geology and site suitability is required to determine applicability. • Operations and maintenance will increase to manage the injection well system, and pretreatment system. • Injection wells can provide substantial receiving capacity, allowing the landfill to maintain compliance with leachate head requirements. • Potential incorporation of other leachate waste streams from other District landfills for injection. • Presently not cost competitive with current disposal at the WWTP, this option is presented for consideration in the event discharge to the current WWTP is prohibited or cost for disposal at the WWTP increase.
Recommendation (See Section 5.3)	• Recommended for advancement.

5.2.2.4 Constructed Treatment Wetlands for Leachate Treatment

Compatibility with Site Use	**LOW** Some infrastructure is in-place to collect and convey leachate. Rerouting to a possible use area at the southwest area of the facility would be required. A preliminary assessment of land area requirements suggests inadequate land available. **Advantages:** • Potential for leachate volume reduction through evapotranspiration losses. **Disadvantages:** • Potential to concentrate total dissolved concentration through evapotranspiration losses. • Enhancement needed to address ammonia concentrations. • Discharge to WWTP likely required after treatment in a wetland. • Potential for release to the environment during force majeure precipitation events. • Improvement presents an additional item for District maintenance. • Not compatible with the U.S. EPA approved Long-Term Stewardship Plan (2020).

Magnitude of CERAS Impact	LOW CTW offer a potential low-intensity manner to treat landfill leachate. Sometimes, CTWs offer an ability to minimize mechanical complexity by employing a large land area. The CERAS impact is low because of the likely addition of mechanical systems because of the limited land availability.
Implementation Considerations	• Further analysis of leachate constituents and likely additional treatment elements would be required to assess applicability. • Aeration, high cation-exchange-capacity media, sludge management and removal are likely elements for a successful CTW. • Modification of the U.S. EPA approved Long-Term Stewardship Plan (2020) required.
Recommendation (See Section 5.3)	• Not recommended for advancement.

5.2.2.5 Storm Water Improvements - Engineered

Compatibility with Site Use	SIGNIFICANT Implement soil stabilization measures to reduce erosion and sedimentation of heavily-utilized areas (recreational area, current off-trail pathways). **Advantages:** • Reduce erosion and increase water quality in storm water run-off. • Reduce maintenance and repair frequency. • Provide stable accessways for use during and immediately following precipitation events. **Disadvantages:** • Construction in heavily-used areas. • Potential destruction of existing habitat. • Potential modification of Long-Term Stewardship Plan.
Magnitude of CERAS Impact	SIGNFICANT Enhancing existing accessways to provide more, stable access to citizens will directly increase the opportunity to connect with nature.
Implementation Considerations	• Modification of the U.S. EPA approved Long-Term Stewardship Plan (2020) required. • Evaluation of ecological impact of proposed reinforcements.
Recommendation (See Section 5.3)	• Not recommended for advancement.

5.2.2.6 Community Engagement

Compatibility with Site Use	**MODERATE** Increasing the quantity of walking paths in addition to the existing pathways and scenic overlook. **Advantages:** • Connect more citizens to the established native habitats at the landfill. • Increase education opportunities for landfill management and ecological restoration of the final cover. • Establish more pathway networks to enhance the existing, highly-used pathway. **Disadvantages:** • Destruction of potential habitat to implement more walking paths. • Potential modification of Long-Term Stewardship Plan. Increased potential for vandalism of landfill infrastructure. • Increased maintenance for erosion control to align with existing storm water management system.
Magnitude of CERAS Impact	**LOW TO MODERATE** Increasing the number of pathways will reduce the quantity of native habitat already established at the landfill. Overall, this does not align with the District's goals.
Implementation Considerations	• Modification of the U.S. EPA approved Long-Term Stewardship Plan (2020) required. • Evaluation of ecological impact of proposed walking paths. Coordination and agreement with the landfill operator. • Effective means to deter vandalism of landfill infrastructure.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.3 Mallard Lake Landfill (Hanover Park, IL)

5.2.3.1 Solar Power Opportunities

<table>
<tr><td rowspan="2">Compatibility with Site Use</td><td>MODERATE TO SIGNIFICANT</td></tr>
<tr><td>Advantages:
• The site is restricted to public use.
• Potential to use harnessed energy to supply power to extraction wells.
• Educational opportunities.
• When incorporated with native grasses or wildflowers, can provide habitat for pollinators such as bees and butterflies.
• Floating arrays may be suitable:
  ◦ A floating solar array can provide habitat and enhance wildlife corridors for waterfowl.
  ◦ Educational opportunities.
Disadvantages:
• Potential interference with operations and maintenance activities for leachate and gas collection.
• The potential ecological impacts are presently unknown and require assessment for suitability.
• Increased maintenance for the District.
• Impacts to plants and animals.</td></tr>
<tr><td rowspan="2">Magnitude of CERAS Impact</td><td>SIGNIFICANT</td></tr>
<tr><td>The calculated maximum solar potential could offset approximately 5,244 homes. The solar potential is summarized in Table 6. The maximum estimated solar potential may be reduced based on areas that may be identified as unsuitable by the District or the landfill operator.</td></tr>
<tr><td>Implementation Considerations</td><td>Further assessment is needed to identify suitable areas for solar and the potential for ecological impacts if advanced by the District.</td></tr>
<tr><td>Recommendation (See Section 5.3)</td><td>• Land-based Units = Recommended for advancement.
• Floating Arrays = Recommended for advancement with reservations.</td></tr>
</table>

Based on the size and configuration of Mallard Lake Landfill, there are many different locations and opportunities for harnessing solar power through PV panels. There are multiple transformers on site to connect to the grid. There are no evident obstructions from surrounding areas that would interrupt solar technology.

The table below shows the solar potential for the site while taking an aggressive approach. A more conservative and a less densely populated system could be pursued.

Table 6. Preliminary Solar Potential for Mallard Lake Landfill

Location	Slope (°)	Footprint Area (ac)	Capacity (MW_dc)	Solar Panels (Qty.)	Elec. Production (kWh/yr)	Budget Installation Cost ($)	Emissions Offset (MTCO2e)	Elec. Offset (Homes /yr)
Mallard Lake Landfill								
North-1	12.5	72.7	9.1	20,200	12,724,000	$16,090,000	6,201	1,727
North-2	11.3	21.2	2.6	5,900	3,705,000	$4,680,000	1,806	503
West-1	12.5	22.1	4.4	9,800	5,306,000	$7,830,000	2,586	840
West-2	12.5	12.3	2.5	5,500	2,945,000	$4,340,000	1,435	466
South-1	14.0	28.7	5.7	12,800	8,036,000	$10,160,000	3,916	1,091
East-1	11.3	11.7	2.3	5,200	2,818,000	$4,160,000	1,373	446
Float-1	0.0	1.3	0.2	500	303,000	$380,000	148	41
Float-2	0.0	1.4	0.2	500	327,000	$410,000	159	44
Float-3	0.0	2.0	0.3	700	467,000	$590,000	228	63
Float-4	0.0	0.7	0.1	300	163,000	$210,000	79	22
	Subtotal	174.1	27.6	61,400	36,794,000	$48,850,000	17,931	5,244

5.2.3.2 Wind Power Opportunities

Compatibility with Site Use	MODERATE TO SIGNIFICANT **Advantages:** • Ability to offset on-site energy use. • Opportunity for additional community engagement. • Demonstration of the District's commitment to sustainability. • Areas at the top of the landfill have little to no obstruction from buildings or other structures surrounding the landfill and provide windy conditions on a regular basis. **Disadvantages:** • Establishing maintenance procedures for a new technology. • Impacts to avian species.
Magnitude of CERAS Impact	MODERATE TO SIGNIFICANT Potential to off-set some, or all, of the on-site energy requirements to operate extraction wells.
Implementation Considerations	• Further assessment is needed to identify suitable areas for wind and the potential for ecological impacts if advanced by the District. • Vertical Axis Wind Turbines are envisioned for their reduced noise output and reduced danger to birds compared to Horizontal Axis Wind Turbines.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.3.3 Renewable Natural Gas Opportunity

Compatibility with Site Use	**MODERATE** **Advantages:** • Gas quality and quantity are potentially suitable to RNG. • Demonstration of the District's commitment to sustainability. • Significant greenhouse gas reduction. **Disadvantages:** • RNG facilities generate noise that may require mitigation.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT** Opportunity for Renewable Identification Numbers (RINs) credits to offset capital investment and generate revenue.
Implementation Considerations	• The quality and quantity of gas are expected to decrease over time due to the landfill being capped and closed. • Significant capital expense. The gas quality and quantity are near the threshold volumes and quality for generally accepted payback periods. • Gas modeling to assess results of wellfield tightening and wellfield improvements with additional wells will be required to determine viability.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.3.4 Underground Injection of Landfill Leachate

Compatibility with Site Use	**SIGNIFICANT** Existing infrastructure is in-place to collect and convey leachate. **Advantages:** • Could serve to eliminate discharge to the WWTP. • Mitigates risks from emerging and tightening regulations (e.g., PFAS). **Disadvantages:** • Improvement presents an additional item for District maintenance. • Additional groundwater monitoring required.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT** Underground injection of landfill leachate offers a resilient and sustainable discharge point from a District owned location. The District is not dependent on discharge limits from the receiving entity, or subject to risk of cut-off from the receiving WWTP.
Implementation Considerations	• Further analysis of receiving geology and site suitability is required to determine applicability. • Operations and maintenance will increase to manage the injection well system, and pretreatment system. • Injection wells can provide substantial receiving capacity, allowing the landfill to maintain compliance with leachate head requirements. • Potential incorporation of other leachate waste streams from other District landfills for injection. • Presently not cost competitive with current disposal at the WWTP, this option is presented for consideration in the event discharge to the current WWTP is prohibited or cost for disposal at the WWTP increase.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.3.5 Constructed Treatment Wetlands for Leachate Treatment

Compatibility with Site Use	LOW Some infrastructure is in-place to collect and convey leachate. Rerouting to a possible use area at the southwest area of the facility would be required. A preliminary assessment of land area requirements suggests inadequate land available. **Advantages:** • Potential for leachate volume reduction through evapotranspiration losses. **Disadvantages:** • Potential to concentrate total dissolved concentration through evapotranspiration losses. • Enhancement needed to address ammonia concentrations. • Discharge to WWTP likely required after treatment in a wetland. • Potential for release to the environment during high intensity precipitation events. • Improvement presents an additional item for District maintenance.
Magnitude of CERAS Impact	LOW CTW offer a potential low-intensity manner to treat landfill leachate. Sometimes, CTWs offer an ability to minimize mechanical complexity by employing a large land area. The CERAS impact is low because of the likely addition of mechanical systems because of the limited land availability.
Implementation Considerations	• Further analysis of leachate constituents and likely additional treatment elements would be required to assess applicability. • Aeration, high cation-exchange-capacity media, sludge management and removal are likely elements for a successful CTW.
Recommendation (See Section 5.3)	• Not recommended for advancement.

5.2.3.6 Phyto-Utilization Partnership Opportunity

The Mallard North Landfill is located directly adjacent to the Mallard Lake Landfill and manages an effective phyto-utilization system on the landfill cover. This opportunity explores the option of sending leachate collected from the Mallard Lake Landfill to be used to irrigate the phyto-utilization system at the Mallard North Landfill.

Compatibility with Site Use	MODERATE **Advantages:** • Reduce volume of leachate treated at the local WWTP. • Provide integral feedstock for phyto-utilization system. **Disadvantages:** • Leachate may be different and not well suited for existing system. • Permitting may be required. • Existing system may not be able to effectively operate with additional leachate volumes.
Magnitude of CERAS Impact	MODERATE TO SIGNIFICANT This opportunity would allow for an existing, effective treatment system to assist with reduction of the carbon footprint of two District landfills. As long as the phyto-utilization system can continue to be effective, this would provide an important message to the community about maximizing the existing investment.
Implementation Considerations	• Evaluate leachate compatibility. • Determine permitting requirements, if applicable. • Explore contracting mechanisms to determine feasibility.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.3.7 Storm Water Improvements - Engineered

Compatibility with Site Use	MODERATE Implement soil stabilization measures to reduce erosion and sedimentation of letdown chutes. **Advantages:** • Reduce erosion and increase water quality in storm water run-off. • Reduce maintenance and repair frequency. **Disadvantages:** • Potential destruction of existing habitat.
Magnitude of CERAS Impact	MODERATE TO SIGNIFICANT Enhancing existing storm water system to provide stable system and reduce erosion impact in other storm water conveyance features.
Implementation Considerations	• Overall cost of implementation and maintenance compared to existing system. • Evaluation of ecological impact of proposed reinforcements.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.3.8 Storm Water Improvements - Ecological

Compatibility with Site Use	**MODERATE** Retrofit existing wet-bottom basins to dry-bottom basins and integrate native species into storm water basins to further enhance water quality. **Advantages:** • Enhance water quality through implementation of native species in existing storm water basins. • Reduce ongoing maintenance once native species become established. • Increase habitat for certain birds and mammals. **Disadvantages:** • Increased maintenance to remove invasive species. • Storm water quality is not an issue at this landfill. • Public engagement / accessibility to these areas is limited. • Reduce habitat for certain birds (waterfowl) and aquatic species.
Magnitude of CERAS Impact	**MODERATE** Overall impact is moderate due to existing water quality of the storm water discharged from the basins. Habitat will be created for some species and destroyed for other species.
Implementation Considerations	• Overall cost of implementation and maintenance compared to existing system. • Opportunities for public engagement / accessibility to these areas for education purposes.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.3.9 Landfill Cover Enhancement Opportunity

Compatibility with Site Use	**SIGNIFICANT** **Advantages:** • Consistent with existing site use. • Simple installation and readily available materials. • Cover enhancements could reduce leachate by increasing evapotranspiration and initial abstraction of incident precipitation (buffalo grass or other prairie grasses). • Reduced maintenance requirements. • Enhancement of avian habitat for existing bird watching. **Disadvantages:** • Landfill operators less familiar with maintenance requirements. • Introduction of potential nuisance species.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT** The resiliency and sustainability impact can be significant. Cover improvement with buffalo grass or other prairie grass takes advantage of natural processes that are sustainable in and of themselves by the following means: • Improved erosion protection with denser rooting. • Higher evapotranspiration providing less infiltration. • Enhanced ecological diversity. • Growth height is limited, requiring less mowing.

Implementation Considerations	• Coordination and agreement with the landfill operator for use. • Evaluation for compatibility with existing landfill permit.
Recommendation (See Section 5.3)	• Recommended for advancement.

5.2.3.10 Community Engagement

Compatibility with Site Use	**MODERATE** Add walking paths, bird watching areas, picnic areas, and parking in establish accessibility similar to Greene Valley Landfill. **Advantages:** • Connect more citizens to the restored areas at the landfill. • Increase education opportunities for landfill management and ecological restoration of the final cover. **Disadvantages:** • Increased potential for vandalism of landfill infrastructure. • Destruction of potential habitat to implement more walking paths. • Increased maintenance for erosion control to align with existing storm water management system.
Magnitude of CERAS Impact	**MODERATE** More opportunities to connect the community with nature is aligned with the District's goals. Views from the top of the landfill may prompt more citizens to visit the forest preserve. Additional maintenance is feasible.
Implementation Considerations	• Evaluation of ecological impact of proposed walking paths. • Coordination and agreement with the landfill operator. • Evaluation for compatibility with existing landfill permit. • Effective means to deter vandalism of landfill infrastructure.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.4 Mallard North Landfill (Bloomingdale, IL)

5.2.4.1 Solar Power Opportunities

Compatibility with Site Use	**MODERATE** **Advantages:** • The site is restricted to public use. • Potential to supply power to leachate extraction and phyto-utilization pump systems. • Educational opportunities. **Disadvantages:** • Potential interference with operations and maintenance activities for future enhancements of leachate collection system. • Impacts to plants and animals.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT** The calculated maximum solar potential could offset approximately 203 homes but can likely supply power to operate the leachate collection and phyto-utilization systems. The solar potential is summarized in **Table 7**. The maximum estimated solar potential may be reduced based on areas that may be identified as unsuitable by the District or the landfill operator.
Implementation Considerations	• Further assessment is needed to identify suitable areas for solar, if advanced by the District. • Alignment with District's current and future use of these areas.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

The table below shows the solar potential for the site while taking an aggressive approach. A more conservative and a less densely populated system could be pursued.

Table 7. Preliminary Solar Potential for Mallard North Landfill

Location	Slope (°)	Footprint Area (ac)	Capacity (MW_dc)	Solar Panels (Qty.)	Elec. Production (kWh/yr)	Budget Installation Cost ($)	Emissions Offset (MTCO2e)	Elec. Offset (Homes /yr)
Mallard North Landfill								
South-1	5.7	2.9	0.6	1,300	823,000	$1,040,000	401	112
South-2	5.7	2.4	0.5	1,100	672,000	$850,000	327	91
	Subtotal	5.3	1.1	2,400	1,495,000	$1,890,000	729	203

5.2.4.2 Underground Injection of Landfill Leachate

Compatibility with Site Use	**MODERATESIGNIFICANT** Existing infrastructure is in-place to collect and convey leachate. **Advantages:** • Could serve to eliminate discharge to the WWTP. • Mitigates risks from emerging and tightening regulations (e.g., PFAS). **Disadvantages:** • Potential to concentrate total dissolved concentration through evapotranspiration losses. • Enhancement needed to address ammonia concentrations. • Discharge to WWTP likely required after treatment in a wetland. • Potential for release to the environment during high intensity precipitation events. • Improvement presents an additional item for District maintenance.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT** Underground injection of landfill leachate offers a resilient and sustainable discharge point from a District owned location. The District is not dependent on discharge limits from the receiving entity, or subject to risk of cut-off from the receiving WWTP.
Implementation Considerations	• Further analysis of receiving geology and site suitability is required to determine applicability. • Operations and maintenance will increase to manage the injection well system, and pretreatment system. • Injection wells can provide substantial receiving capacity, allowing the landfill to maintain compliance with leachate head requirements. • Potential incorporation of other leachate waste streams from other District landfills for injection. • Presently not cost competitive with current disposal at the WWTP, this option is presented for consideration in the event discharge to the current WWTP is prohibited or cost for disposal at the WWTP increase.
Recommendation (See Section 5.3)	• Recommended for advancement.

5.2.4.3 Constructed Treatment Wetlands for Leachate Treatment

Compatibility with Site Use	LOW Some infrastructure is in-place to collect and convey leachate. Rerouting to a possible use area at the southwest area of the facility would be required. A preliminary assessment of land area requirements suggest inadequate land available. **Advantages:** • Potential for leachate volume reduction through evapotranspiration losses. **Disadvantages:** • Potential to concentrate total dissolved concentration through evapotranspiration losses. • Enhancement needed to address ammonia concentrations. • Discharge to WWTP likely required after treatment in a wetland. • Potential for release to the environment during high intensity precipitation events. • Improvement presents an additional item for District maintenance.
Magnitude of CERAS Impact	LOW CTW offer a potential low-intensity manner to treat landfill leachate. Sometimes, CTWs offer an ability to minimize mechanical complexity by employing a large land area. The CERAS impact is low because of the likely addition of mechanical systems because of the limited land availability.
Implementation Considerations	• Further analysis of leachate constituents and likely additional treatment elements would be required to assess applicability. • Aeration, high cation-exchange-capacity media, sludge management and removal are likely elements for a successful CTW.
Recommendation (See Section 5.3)	• Not recommended for advancement.

5.2.4.4 Community Engagement

Compatibility with Site Use	LOW The phyto-utilization system was envisioned to be both a cost-effective leachate treatment system as well as a demonstration and education site for wastewater treatment professionals and the general public. The landfill gas and leachate systems are susceptibility to vandalism; therefore, site access should be restricted to scheduled tours escorted by the District staff. **Advantages:** • Connect more citizens to effective treatment system. **Disadvantages:** • Vandalism of infrastructure. • Destruction of potential habitat to implement more walking paths. • Increased maintenance for erosion control to align with existing storm water management system.

Magnitude of CERAS Impact	LOW More opportunities to connect the community with nature is aligned with the District's goals.
Implementation Considerations	• Evaluation of tour scheduling and staff to conduct this. • Evaluation of ecological impact of proposed walking paths.
Recommendation (See Section 5.3)	• Not recommended for advancement.

5.2.5 Wheaton Dump (Winfield, IL)

5.2.5.1 Solar Power Opportunity

Compatibility with Site Use	**MODERATE TO SIGNIFICANT**
	Advantages: 1. Clearing activities already scheduled in this area will open up the overstory to allow for more exposure to the dump site. 2. Access restrictions to this area exist and can be enhanced. 3. Easy access to electrical grid along the north side of Geneva Rd. 4. Educational Opportunities. **Disadvantages:** 1. Access for maintenance vehicles and crews may require additional construction. 2. Impacts to plants and animals.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT**
	The calculated maximum solar potential could offset approximately 148 homes. The solar potential is summarized in **Table 8.** The maximum estimated solar potential may be reduced based on areas that may be identified as unsuitable by the District.
Implementation Considerations	• Further assessment is needed to identify suitable areas for solar and the potential for ecological impacts if advanced by the District.
Recommendation (See Section 5.3)	• Recommended for advancement.

Based on the size and configuration of the Wheaton Dump, there are very few locations for solar power to be harnessed, and it will be dictated by the size and area of clearing associated with the adjacent flood storage project. The table below shows the solar potential for the site while taking an aggressive approach. A more conservative and a less densely populated system could be pursued.

Table 8. Preliminary Solar Potential for the Wheaton Dump

Location	Slope (°)	Footprint Area (ac)	Capacity (MW_dc)	Solar Panels (Qty.)	Elec. Production (kWh/yr)	Budget Installation Cost ($)	Emissions Offset (MTCO2e)	Elec. Offset (Homes /yr)
Wheaton Dump								
North-1	0	4.7	0.8	1,700	1,092,000	1,380,000	532	148
	Subtotal	4.7	0.8	1,700	1,092,000	1,380,000	532	148

5.2.5.2 Dump Site Cover Enhancement

Compatibility with Site Use	**SIGNIFICANT**
	Advantages: • Consistent with existing site use and surrounding area. • Aligns with scheduled clearing activities and additional soil to be placed on the cover system. • Simple installation and readily available materials. • Cover enhancements will increase evapotranspiration and initial abstraction of incident precipitation (buffalo grass or other prairie grasses). • Reduced maintenance requirements once native species are established. • Enhancement of avian habitat and ecological restoration of the preserve. **Disadvantages:** • Will require ongoing maintenance to combat invasive species. • Introduction of potential nuisance species.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT**
	The resiliency and sustainability impact can be significant. Cover improvement with buffalo grass or other prairie grass takes advantage of natural processes that are sustainable in and of themselves by the following means: • Improved erosion protection with denser rooting. • Higher evapotranspiration providing less infiltration. • Enhanced ecological diversity. • Growth height is limited, requiring less mowing and maintenance.
Implementation Considerations	• Determine extent of clearing and soil replacement. • Determine compatible species of plants and trees. • Evaluate compatibility with other opportunities.
Recommendation (See Section 5.3)	• Recommended for advancement.

5.2.5.3 Community Engagement

Compatibility with Site Use	**MODERATE**
	Add walking paths, picnic areas, and parking in establish accessibility to the dump site a new flood storage pond. **Advantages:** • Connect more citizens to restored areas. • Increase education opportunities for flood storage management and ecological restoration of the dump site. **Disadvantages:** • Destruction of potential habitat to implement more walking paths. • Increased maintenance for erosion control to align with existing storm water management system.

Magnitude of CERAS Impact	**MODERATE**	
	More opportunities to connect the community with nature is aligned with the District's goals. Views from this area, overlooking the new flood storage area and river may prompt more citizens to visit the forest preserve. Additional maintenance is feasible.	
Implementation Considerations	• Evaluation of ecological impact of proposed walking paths. • Evaluation for compatibility with existing landfill permit.	
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.	

5.2.6 Ajax Pit (Bloomingdale, IL)

5.2.6.1 Floating Solar Power Opportunity

Compatibility with Site Use	MODERATE **Advantages:** • Floating solar units can optimize energy harnessing without obstructing preserve accessed by the public. • Arrays can be protected with floating avian habitat to surround the unit and protect from human interaction. • Access restrictions to this area exist and can be enhanced. • Easy access to electrical grid within neighborhood directly south and west of the preserve. • Educational Opportunities. **Disadvantages:** • Floating arrays require special maintenance access via boat or other system. • Establishing avian habitat within forest preserve ponds may not align with current and future use of the ponds.
Magnitude of CERAS Impact	MODERATE The calculated maximum solar potential could offset approximately 516 homes. The solar potential is summarized in **Table 9**. The maximum estimated solar potential may be reduced based on areas that may be identified as unsuitable by the District.
Implementation Considerations	• Alignment with District's current and future use of the pond. • Maintenance plans including access to a boat. • Further assessment is needed to identify potential for ecological impacts if advanced by the District.
Recommendation (See Section 5.3)	• Not recommended for advancement.

The table below shows the solar potential for the site while taking an aggressive approach. A more conservative and a less densely populated system could be pursued.

Table 9. Preliminary Solar Potential for the Ajax Pit

Location	Slope (°)	Footprint Area (ac)	Capacity (MW_dc)	Solar Panels (Qty.)	Elec. Production (kWh/yr)	Budget Installation Cost ($)	Emissions Offset (MTCO2e)	Elec. Offset (Homes /yr)
Ajax Pit								
Float-1	0.0	16.3	2.7	6,000	3,806,000	$4,810,000	1,855	516
	Subtotal	16.3	2.7	6,000	3,806,000	$4,810,000	1,855	516

5.2.6.2 Wind Power Opportunities

Compatibility with Site Use	**LOW TO MODERATE** **Advantages:** • Opportunity for additional community engagement. • Demonstration of the District's commitment to sustainability. • Areas at the top of the landfill provide access to windy conditions on a regular basis. **Disadvantages:** • Impacts to avian species.
Magnitude of CERAS Impact	**LOW TO MODERATE** • Potential to provide energy to the grid. There are no on-site energy uses.
Implementation Considerations	• Further assessment is needed to identify suitable areas for wind and the potential for ecological impacts if advanced by the District. • Vertical Axis Wind Turbines are envisioned for their reduced noise output and reduced danger to birds compared to Horizontal Axis Wind Turbines.
Recommendation (See Section 5.3)	• Not recommended for advancement.

5.2.6.3 Dump Site Cover Enhancement

Compatibility with Site Use	**SIGNIFICANT** **Advantages:** • Consistent with existing site use and surrounding area. • Simple installation and readily available materials. • Cover enhancements will increase evapotranspiration and initial abstraction of incident precipitation (buffalo grass or other prairie grasses). • Reduced maintenance requirements once native species are established. • Enhancement of avian habitat and ecological restoration of the preserve. **Disadvantages:** • Will require ongoing maintenance to combat invasive species. • Introduction of potential nuisance species.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT** The resiliency and sustainability impact can be significant. Cover improvement with buffalo grass or other prairie grass takes advantage of natural processes that are sustainable in and of themselves by the following means: • Improved erosion protection with denser rooting. • Higher evapotranspiration providing less infiltration. • Enhanced ecological diversity. • Growth height is limited, requiring less mowing and maintenance.
Implementation Considerations	• Determine extent of desired restoration. • Determine compatible species of plants. • Evaluate compatibility with other opportunities.
Recommendation (See Section 5.3)	• Recommended for advancement.

5.2.6.4 Community Engagement

Compatibility with Site Use	**MODERATE** Implement soil stabilization measures to reduce erosion and sedimentation of heavily-utilized areas (current off-trail pathways). **Advantages:** • Reduce erosion and increase water quality in storm water run-off. • Reduce maintenance and repair frequency. • Provide stable accessways for use during and immediately following precipitation events. • Connect more citizens to restored areas. • Increase education opportunities for flood storage management and ecological restoration of the dump site. **Disadvantages:** • Destruction of potential habitat to implement more walking paths. • Increased maintenance for erosion control to align with existing storm water management system.
Magnitude of CERAS Impact	**MODERATE** More opportunities to connect the community with nature is aligned with the District's goals. Views from this area, overlooking the flood storage area and river may prompt more citizens to visit the forest preserve. Additional maintenance is feasible.
Implementation Considerations	• Evaluation of ecological impact of proposed walking paths. • Evaluation for compatibility with existing landfill permit.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

5.2.7 Barnes Pit (Bloomingdale, IL)

5.2.7.1 Floating Solar Power Opportunity

Compatibility with Site Use	MODERATE **Advantages:** 1. Floating solar units can optimize energy harnessing without obstructing preserve accessed by the public. 2. Arrays can be protected with floating avian habitat to surround the unit and protect from human interaction. 3. Easy access to electrical grid through existing on-site infrastructure that has power. 4. Educational opportunities. **Disadvantages:** • Modification to flood storage reservoir would require approval from DuPage County. • Floating array design will require safeguards to protect the unit during use of the reservoir for flood storage. • Floating arrays require special maintenance access via boat or other system. • Establishing avian habitat within forest preserve ponds may not align with current and future use of the ponds.
Magnitude of CERAS Impact	MODERATE The calculated maximum solar potential could offset approximately 460 homes. The solar potential is summarized in **Table 10**. The maximum estimated solar potential may be reduced based areas that may be identified as unsuitable by the District.
Implementation Considerations	• Alignment with District's current and future use of the pond. • Maintenance plans including access to a boat. • Further assessment is needed to identify potential for ecological impacts if advanced by the District.
Recommendation (See Section 5.3)	• Recommended for advancement with reservations.

The table below shows the solar potential for the site while taking an aggressive approach. A more conservative and a less densely populated system could be pursued.

Table 10. Preliminary Solar Potential for the Ajax Pit

Location	Slope (°)	Footprint Area (ac)	Capacity (MW_dc)	Solar Panels (Qty.)	Elec. Production (kWh/yr)	Budget Installation Cost ($)	Emissions Offset (MTCO2e)	Elec. Offset (Homes /yr)
Barnes Pit								
Float-1	0.0	14.5	2.4	5,400	3,393,000	$4,290,000	1,653	460
	Subtotal	14.5	2.4	5,400	3,393,000	$4,290,000	1,653	460

5.2.7.2 Wind Power Opportunities

Compatibility with Site Use	**LOW**
	Advantages: • Opportunity for additional community engagement. • Demonstration of the District's commitment to sustainability. **Disadvantages:** • Dump site is the lowest elevation at the forest preserve. • Steep slopes toward the flood storage area. • Impacts to avian species.
Magnitude of CERAS Impact	**LOW TO MODERATE**
	• Potential to provide energy to the grid.
Implementation Considerations	• Further assessment is needed to identify suitable areas for wind and the potential for ecological impacts if advanced by the District. • Vertical Axis Wind Turbines are envisioned for their reduced noise output and reduced danger to birds compared to Horizontal Axis Wind Turbines.
Recommendation (See Section 5.3)	• Not recommended for advancement.

5.2.7.3 Dump Site Cover Enhancement

Compatibility with Site Use	**SIGNIFICANT**
	Advantages: • Consistent with existing site use and surrounding area. • Simple installation and readily available materials. • Native species exist throughout this area; however, most are being overtaken by an invasive species [Crown Vetch (*Securigera varia*)]. • Reduced maintenance requirements once native species are established. • Enhancement of avian habitat and ecological restoration of the preserve. **Disadvantages:** • Will require ongoing maintenance to combat invasive species. Current invasive species in this area is Crown Vetch (*Securigera varia*). • Introduction of potential nuisance species.
Magnitude of CERAS Impact	**MODERATE TO SIGNIFICANT**
	The resiliency and sustainability impact can be significant. Cover improvement with buffalo grass or other prairie grass takes advantage of natural processes that are sustainable in and of themselves by the following means: • Improved erosion protection with denser rooting. • Higher evapotranspiration providing less infiltration. • Enhanced ecological diversity. • Growth height is limited, requiring less mowing and maintenance.
Implementation Considerations	• Determine extent of desired restoration. • Determine compatible species of plants. • Evaluate compatibility with other opportunities.
Recommendation (See Section 5.3)	• Recommended for advancement.

5.2.7.4 Community Engagement

Compatibility with Site Use	**LOW TO MODERATE** Implement soil stabilization measures to reduce erosion and sedimentation of heavily-utilized areas (current off-trail pathways). **Advantages:** • Reduce erosion and increase water quality in storm water run-off. • Reduce maintenance and repair frequency. • Connect more citizens to restored areas. • Increase education opportunities for flood storage management and ecological restoration of the dump site. **Disadvantages:** • Destruction of potential habitat to implement more walking paths. • Increased maintenance for erosion control to align with existing storm water management system. • Potential safety hazard as the dump site is a steep slope toward a flood storage area.
Magnitude of CERAS Impact	**LOW TO MODERATE** More opportunities to connect the community with nature is aligned with the District's goals. Views from this area, overlooking the flood storage area and river may prompt more citizens to visit the forest preserve. Additional maintenance is feasible.
Implementation Considerations	• Evaluation of ecological impact of proposed walking paths. • Evaluation for compatibility with existing landfill permit.
Recommendation (See Section 5.3)	• Not recommended for advancement.

5.3 RECOMMENDATIONS FOR ADVANCEMENT

5.3.1 Solar Power Opportunities

Within this Plan, SCS identified multiple locations at each landfill and dump site to implement land-based and floating solar PV arrays. Prior to moving forward with solar PV arrays at the landfill and dump sites, further assessment is needed to identify potential ecological impacts in these areas. If designated areas limit the potential ecological impact, further investigation on an individual basis would be completed by evaluating solar patterns, PV array alignments and configuration, storm water management features, payback periods, revenue generating opportunities, incentives, and a refined cost to implement.

5.3.2 Wind Power Opportunities

Wind power opportunities are only identified at Mallard Lake, with reservations. Prior to moving forward with any wind power technology, further assessment is needed to identify potential ecological impacts in these areas. Evaluating the weather conditions at Mallard Lake will dictate whether vertical axis wind turbines are feasible. Publicly available data include wind speed and direction measured on an hourly basis would be used to determine the quantity of power generated, payback period, and feasibility of these systems.

5.3.3 Renewable Natural Gas Opportunities

RNG opportunities are identified at Greene Valley and Mallard Lake, with reservations. Advancement consists of performing gas quantity, gas quality, well-field tightness evaluation, and gas generation modeling to further assess viability. An RNG project, if viable, may allow for revenue opportunities by way of RINs credits, and we recommend rapid implementation if determined to be viable. The evaluation should also consider whether the District would own and operate the RNG Plant or sell landfill gas to a third-party RNG Plant owner/operator.

5.3.4 Landfill Gas Opportunities

Landfill gas can also be used as a fuel source to heat on-site buildings and structures. Repurposing the landfill gas is a viable opportunity at Greene Valley and Blackwell. Greene Valley can utilize landfill gas to heat the GRV building, which will house maintenance equipment and seed storage/sorting areas. Blackwell can utilize landfill gas to heat proposed structures / warming areas to enhance the existing tube hill. Further analysis of heat demand, proposed site structures, on-site uses, and landfill gas collection system configuration will determine cost effectiveness.

5.3.5 Underground Injection Control Opportunities

Opportunities for underground injection are solely for leachate disposal and are recommended for advancement at Greene Valley, Blackwell, Mallard Lake, and Mallard North landfills. Further analysis of receiving geology and site suitability is required to determine applicability. Overall landfill operations and maintenance will increase to manage the injection well system and pretreatment system, if applicable. In addition, assessing the possibility of incorporating a centralized injection well for leachate from multiple District landfills could reduce the overall capital expenditure. In addition, assessing the disposal rates and acceptable constituents are local WWTPs may also be a valuable step in evaluating the applicable of underground injection opportunities.

5.3.6 Phyto-Utilization Partnership Opportunity

This opportunity was identified without a complete understanding of the contractual conditions and agreements at the Mallard Lake and Mallard North Landfills. Advancement would require an evaluation of these conditions and agreements. If this option is deemed viable by the District, further evaluation of leachate compatibility, permitting requirements, and contractual mechanisms to achieve an agreement are recommended.

5.3.7 Storm Water Improvement Opportunities

Storm water improvement opportunities are broken down into two categories; Engineered systems and Ecological systems. Engineered system improvements are identified at both Greene Valley and Mallard Lake, with reservations. At Greene Valley, evaluating compatibility with the existing landfill permit, evaluating soil borrow source areas, and evaluating the overall cost benefit are important evaluations prior to implementing storm water conveyance features onto the final cover system. At Mallard Lake, evaluating the current condition of letdown chutes and storm water flows to those areas as well as ecological impacts of proposed reinforcements are important factors to evaluate prior to implementation.

Ecological system improvements are identified at and Mallard Lake, with reservations. At Mallard Lake, evaluating compatibility with the existing landfill permit, evaluating soil borrow source areas, evaluating maintenance accessibility, and assessing the overall cost benefit are important considerations prior to retrofitting wet-bottom basins into dry-bottom basins and integrating native species. At both sites, assessing the compatibility with the site-specific Impacted Sites Vegetation Maintenance Plan is also an important consideration.

5.3.8 Cover Improvements / Community Engagement Opportunity

Opportunities for community engagement are viable at Greene Valley, Blackwell, Mallard Lake, Wheaton Dump, and Ajax Pit, all with reservations. Further assessment is necessary to evaluate whether larger portions of the Greene Valley, Blackwell, and Mallard Lake properties can become available for public access. Currently, there are restrictions to these properties that deter open, public access in certain areas. Improvements to existing walking paths and additions of new walking paths can help integrate the landfills and dump sites into the District's mission of connect citizens to nature. Further assessment of ecological impacts and compatibility with existing landfill permits are necessary prior to moving these opportunities forward.

5.4 INFORMATION GAPS

Further refinement of each opportunity will require additional information to determine whether an opportunity can be constructed and/or implemented at this time.

Additional information that would assist with further evaluating the aforementioned opportunities include:

- Contractual agreements with WM (Greene Valley Landfill) and BFI/Republic Services (Mallard Lake Landfill).
- Illinois Department of Transportation construction plans for flood storage construction adjacent to the Wheaton Dump.
- Impacted Sites Vegetation Maintenance Plan for each landfill and dump site.

6.0 CONCLUSION

The purpose of this Plan is to prepare an inventory of existing conditions at the District's landfills and dump sites; identify opportunities to implement clean energy, resiliency, and sustainability features; and describe steps to advance these opportunities.

Our initial screening for candidate opportunities is based on the compatibility with the existing site use, and alignment with the District's Mission. Upon this initial screening, we considered opportunities that can integrate in a manner that maintained the character and function of each location.

This effort has revealed opportunities that SCS recommends to the District for consideration of advancement to the next phase of developing recommendations for programs, policies, capital improvement projects, and implementation partnerships. The evaluation results identifying opportunities that are recommended for advancement, recommended with reservations, and not recommended include the following:

<u>Greene Valley</u>

Recommended for Advancement

- Landfill Gas – Burning landfill gas to heat site buildings to potentially offset some, or all, of the existing on-site natural gas demand.
- Underground Injection Control of Landfill Leachate – Potential to eliminate off-site discharge of landfill leachate.
- Landfill Cover Enhancement
  - Potential to enhance ecological diversity and habitat
  - Potential to reduce leachate generation
  - Improved erosion protection

Recommended for Advancement with Reservations

- Solar Power (Land-based units) – Potential to offset on-site electrical demand.
- Renewable Natural Gas – RNG is a potential option due to volume and quality of gas generated.
- Storm Water Improvements (Engineered) – Potential to reduce leachate generation and cover repair needs.
- Trail Improvements – Potential to connect more people with nature and augment existing pathway networks.

Not Recommended for Advancement

- Solar Power (Floating array)
- Wind Power
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Ecological)

Blackwell

Recommended for Advancement

- Landfill Gas – Burning landfill gas to reduce greenhouse gas and provide supplemental heat for education center or a "warming house" for the tube hill.
- Underground Injection Control of Landfill Leachate – Potential to eliminate off-site discharge of landfill leachate.

Recommended for Advancement with Reservations

- Solar Power (Land-based units) – Potential to offset on-site electrical demand.
- Trail Improvements – Potential to connect more people with nature and augment existing pathway networks.

Not Recommended for Advancement

- Solar Power (Floating array)
- Wind Power
- Renewable Natural Gas
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Engineered)
- Storm Water Improvements (Ecological)
- Landfill Cover Enhancement

Mallard Lake

Recommended for Advancement

- Solar Power (Land-based units) – Potential to offset on-site electrical demand.
- Underground Injection Control of Landfill Leachate – Potential to eliminate off-site discharge of landfill leachate.
- Landfill Cover Enhancement –
  - Potential to enhance ecological diversity and habitat
  - Potential to reduce leachate generation
  - Improved erosion protection

Recommended for Advancement with Reservations

- Solar Power (Floating array) – Potential to offset on-site electrical demand with floating arrays in wet-bottom storm water basins.
- Wind Power – Potential to offset on-site electrical demand. An ecological impact evaluation is needed.
- Renewable Natural Gas – RNG is a potential due to quantity and quality of landfill gas, with the current output just above the threshold of a feasible project.
- Phyto-utilization Partnership – Potential for Mallard Lake to dispose of leachate within the Mallard North phyto-utilization system.
- Storm Water Improvements (Engineered) – Potential to enhance existing storm water infrastructure to reduce erosion and sedimentation in letdown chutes.
- Storm Water Improvements (Ecological) – Potential to enhance native species diversity, and enhance storm water quality.
- Trail Installation/Improvements – The landfill is not open to the public and does not have designated trails on the landfill face but has connections to existing trails within the preserve.

Not Recommended for Advancement

- Landfill Gas to Energy – Former plant was demolished and deemed not viable.
- Constructed Leachate Treatment Wetland

Mallard North

Recommended for Advancement

- Underground Injection Control of Landfill Leachate – Potential to eliminate off-site discharge of landfill leachate.

Recommended for Advancement with Reservations

- Solar Power (Land-based units) – Potential to offset on-site electrical demand.

Not Recommended for Advancement

- Solar Power (Floating array)
- Wind Power
- Landfill Gas to Energy
- Renewable Natural Gas
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Engineered)
- Storm Water Improvements (Ecological)
- Landfill Cover Enhancement
- Trail Improvements

Wheaton Dump

Recommended for Advancement

- Solar Power (Land-based units) – Potential to offset on-site electrical demand.
- Landfill Cover Enhancement –
    - Potential to enhance ecological diversity and habitat
    - Potential to reduce leachate generation
    - Improved erosion protection

Recommended for Advancement with Reservations

- Solar Power (Floating array) – Potential to offset on-site electrical demand with floating arrays in the proposed flood storage area.
- Trail Installation/Improvements – The dump site does not have dedicated walking paths for public use but could be integrated to connect more people with nature and display potential opportunities (solar, cover enhancements).

Not Recommended for Advancement

- Wind Power
- Landfill Gas to Energy
- Renewable Natural Gas
- Underground Injection Control of Landfill Leachate
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Engineered)
- Storm Water Improvements (Ecological)

Ajax Pit

Recommended for Advancement

- Landfill Cover Enhancement –
  - Potential to enhance ecological diversity and habitat
  - Potential to reduce leachate generation
  - Improved erosion protection

Recommended for Advancement with Reservations

- Solar Power (Floating array) – Potential to offset on-site electrical demand with floating arrays in the flood storage area.
- Trail Improvements – The dump site has some walking paths that were created by unauthorized foot traffic. Creating designated walking paths on the dump site and designated scenic overlooks could reduce erosion from unauthorized access.

Not Recommended for Advancement

- Solar Power (Land-based unit)
- Wind Power
- Landfill Gas to Energy
- Renewable Natural Gas
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Engineered)
- Storm Water Improvements (Ecological)

Barnes Pit

Recommended for Advancement

- Landfill Cover Enhancement –
  - Potential to enhance ecological diversity and habitat
  - Potential to reduce leachate generation
  - Improved erosion protection

Recommended for Advancement with Reservations

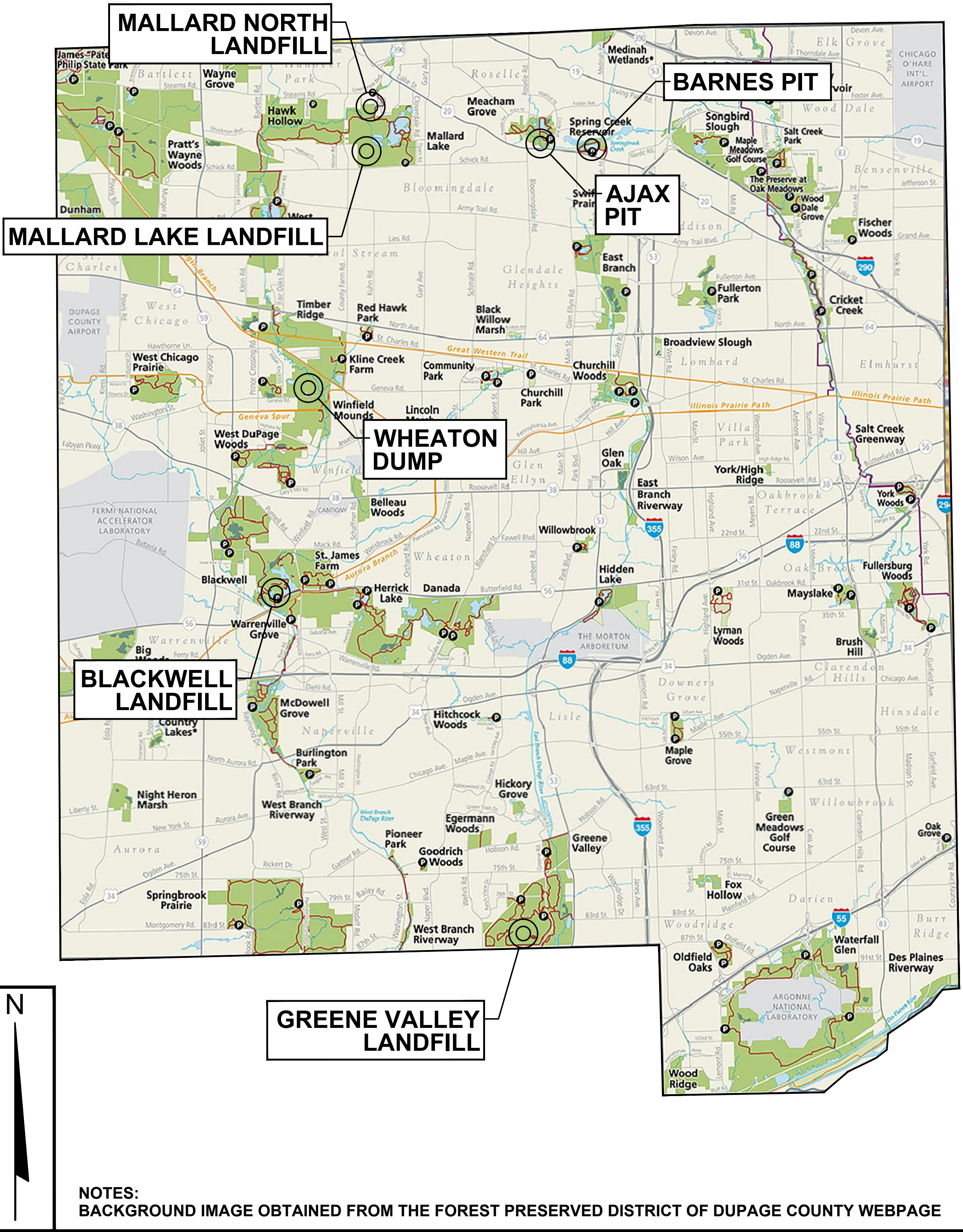
- Solar Power (Floating array) – Potential to offset on-site electrical demand with floating arrays in the flood storage area.

Not Recommended for Advancement

- Solar Power (Land-based unit)
- Wind Power
- Landfill Gas to Energy
- Renewable Natural Gas
- Constructed Leachate Treatment Wetland
- Phyto-utilization
- Storm Water Improvements (Engineered)
- Storm Water Improvements (Ecological)
- Trail Improvements

Each opportunity identified above was evaluated for compatibility with existing site conditions, compatibility with the District's mission, and magnitude of impacting the clean energy, sustainability, and resiliency at each site. As shown, there are a number of opportunities at each landfill and dump site that the District can further evaluate to determine the feasibility of implementation, impact on the community, alignment with the District's goals, and future capital expenditures.

Figures

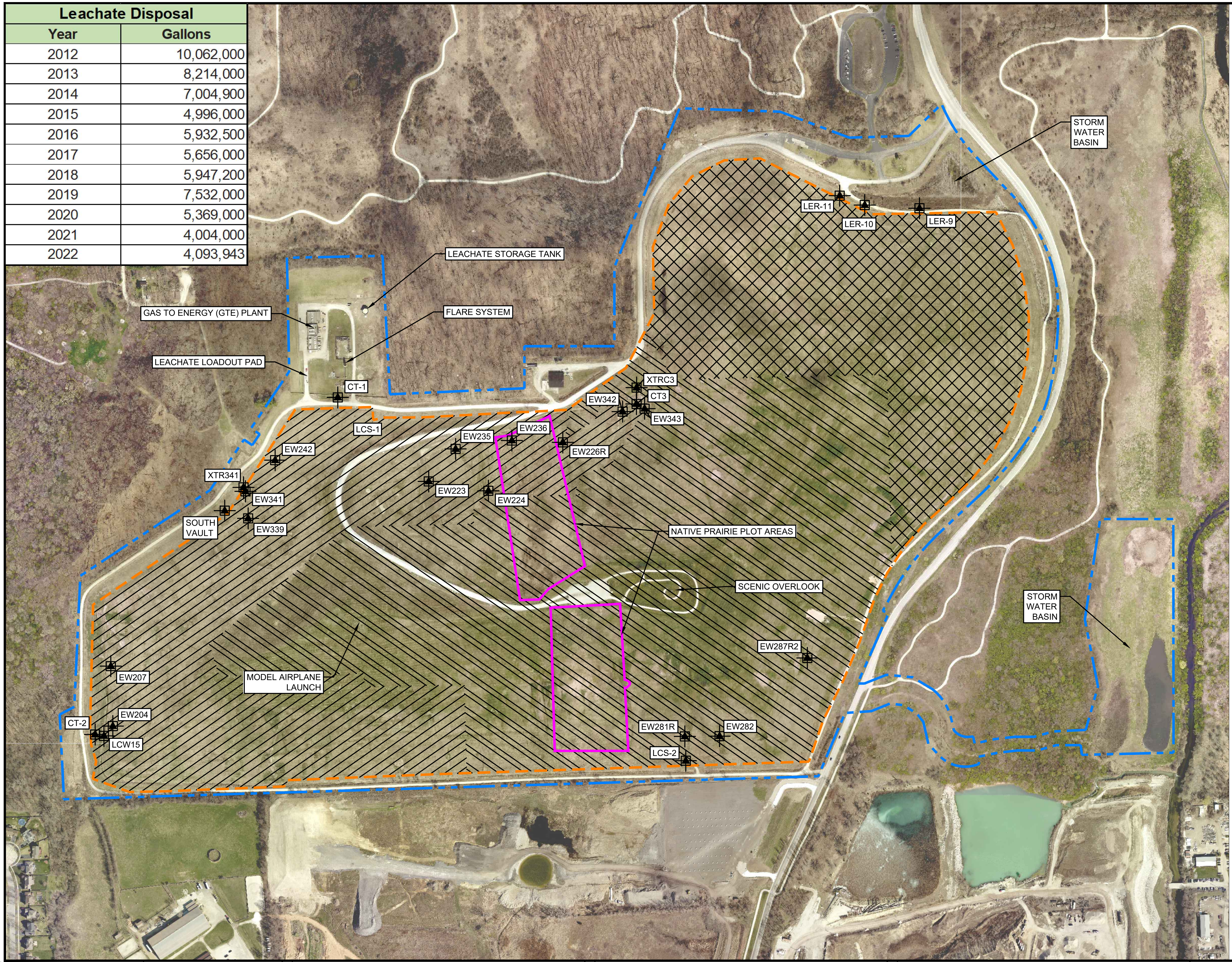


NOTES:
BACKGROUND IMAGE OBTAINED FROM THE FOREST PRESERVED DISTRICT OF DUPAGE COUNTY WEBPAGE

I:\25222244.00\Drawings\Figures\230222_FPDDC_OverallMap.dwg, 2/20/2023 1:59:18 PM

CLIENT: Forest Preserve District of DuPage County	SITE: DUPAGE COUNTY		FIGURE 1 MAP OF LANDFILLS AND DUMP SITES
PROJECT NO.: 25222244.00	DRAWN BY: SJL/BWM	ENGINEER: SCS ENGINEERS, 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563, PHONE: (331) 806-4295	DATE: FEB. 2023
CHECKED BY: SKK	APPROVED BY: SCC		FIGURE 1 OF 8

Leachate Disposal	
Year	Gallons
2012	10,062,000
2013	8,214,000
2014	7,004,900
2015	4,996,000
2016	5,932,500
2017	5,656,000
2018	5,947,200
2019	7,532,000
2020	5,369,000
2021	4,004,000
2022	4,093,943



LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE WASTE BOUNDARY
- APPROXIMATE LOCATION OF LEACHATE EXTRACTION WELLS
- APPROXIMATE NATIVE PRAIRIE TEST PLOT BOUNDARY
- APPROXIMATE LOCATION OF 3.5-FT COMPACTED CLAY AND 0.5-FT PROTECTIVE COVER
- APPROXIMATE LOCATION OF 3.0-FT COMPACTED CLAY AND 3.0-FT PROTECTIVE COVER
- APPROXIMATE LOCATION OF 1.5-FT COMPACTED CLAY, 40-MIL HDPE GEOMEMBRANE, GEOCOMPOSITE, AND 3-FT OF PROTECTIVE COVER

NOTES

1. AERIAL IMAGERY OBTAINED FROM DUPAGE COUNTY, 2021 IMAGERY. THIS IMAGE WAS LAST UPDATED ON NOVEMBER 29, 2021.
2. APPROXIMATE WASTE BOUNDARY OBTAINED FROM THE FOREST PRESERVE DISTRICT OF DUPAGE COUNTY.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
4. APPROXIMATE LOCATION OF LEACHATE EXTRACTION WELLS OBTAINED FROM FILE GV011223A.
5. APPROXIMATE LOCATION OF EACH FINAL COVER CONFIGURATION OBTAINED FROM RUST ENVIRONMENT & INFRASTRUCTURE MAP (DATED JULY 1993) AND SUPPORTING LANDFILL REPORT (DATED JULY 1994).

PROJECT NO.: 25222244.00	DRAWN BY: SJL	ENGINEER: SCS ENGINEERS, 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563, PHONE: (331) 806-4295	CLIENT: Forest Preserve District of DuPage County	SITE: GREENE VALLEY LANDFILL NAPERVILLE, ILLINOIS	FIGURE 2 GREENE VALLEY LANDFILL SITE LAYOUT	DATE: FEB. 2023
CHECKED BY: SKK	APPROVED BY: SCC					FIGURE 2 OF 8

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Leachate Disposal

Year	Gallons
2012	597,500
2013	769,550
2014	652,000
2015	890,700
2016	995,700
2017	1,078,450
2018	942,880
2019	1,014,550
2020	1,048,900
2021	1,347,950
2022	1,260,000

N

200 0 200

GRAPHIC SCALE: 1" = 200'

LEGEND

APPROXIMATE WASTE BOUNDARY

APPROXIMATE LOCATION OF LEACHATE EXTRACTION WELLS

NOTES

1. AERIAL IMAGERY OBTAINED FROM DUPAGE COUNTY, 2021 IMAGERY. THIS IMAGE WAS LAST UPDATED ON NOVEMBER 29, 2021.
2. APPROXIMATE WASTE BOUNDARY OBTAINED FROM THE FOREST PRESERVE DISTRICT OF DUPAGE COUNTY.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
4. APPROXIMATE LOCATION OF LEACHATE EXTRACTION WELLS OBTAINED FROM FILE BW022020.

PROJECT NO.: 25222244.00	DRAWN BY: SJL	ENGINEER: SCS ENGINEERS, 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563, PHONE: (331) 806-4295	CLIENT: Forest Preserve District of DuPage County	SITE: BLACKWELL LANDFILL, WARRENVILLE, ILLINOIS	FIGURE 3 BLACKWELL LANDFILL SITE LAYOUT	DATE: FEB. 2023
CHECKED BY: SKK	APPROVED BY: SCC					FIGURE 3 OF 8

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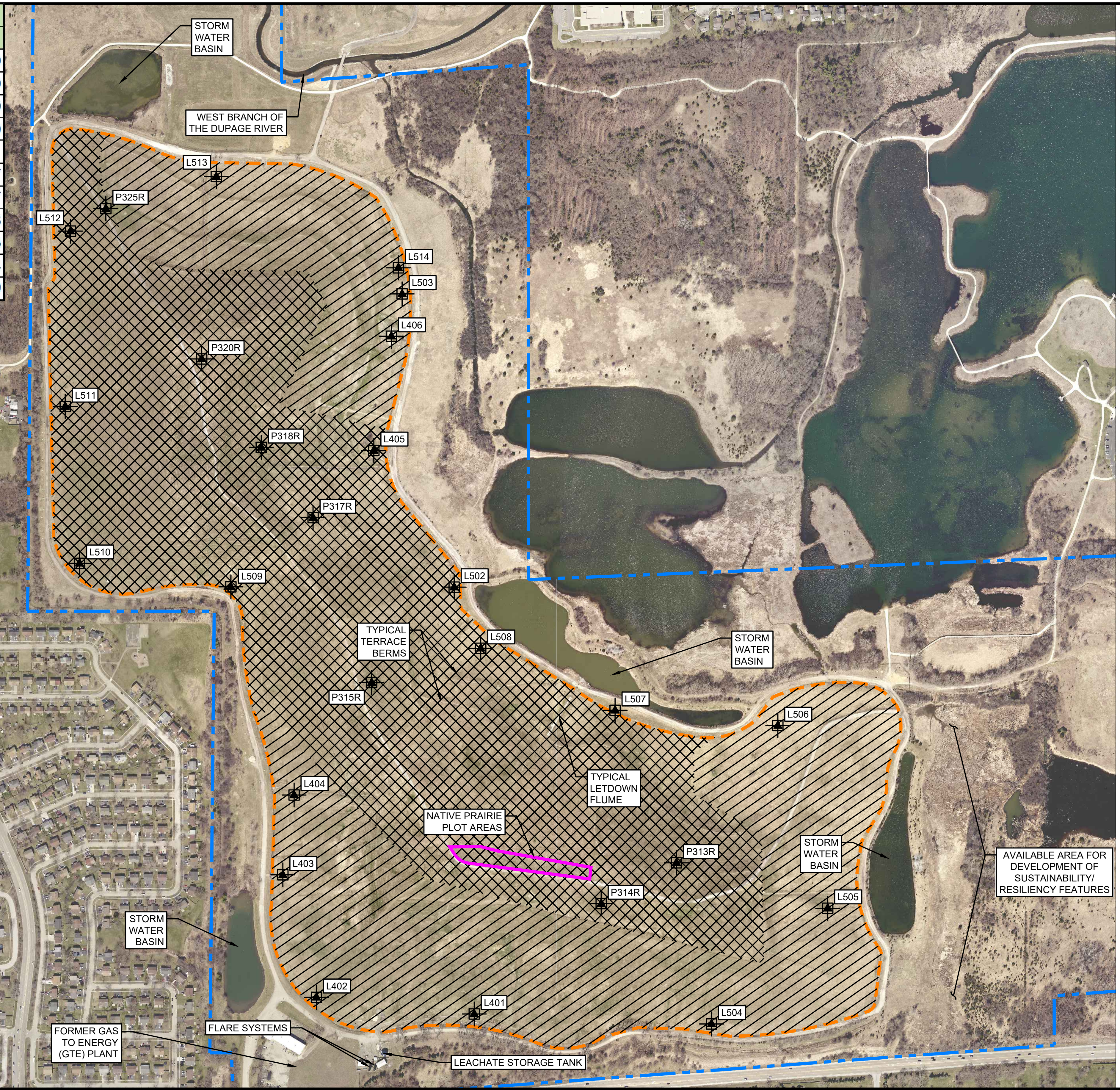
Leachate Disposal	
Year	Gallons
2012	4,447,460
2013	4,627,070
2014	4,920,519
2015	5,645,330
2016	6,149,391
2017	5,514,127
2018	4,582,877
2019	3,524,676
2020	1,649,825
2021	2,662,844
2022	3,974,000



N

600 0 600

GRAPHIC SCALE: 1" = 600'

LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE WASTE BOUNDARY
- APPROXIMATE NATIVE PRAIRIE TEST PLOT BOUNDARY
- APPROXIMATE LOCATION OF LEACHATE EXTRACTION WELLS
- APPROXIMATE LOCATION OF INITIAL CLOSURE VIA RECOMPACTED CLAY, VEGETATIVE ZONES, AND TOPSOIL
- APPROXIMATE LOCATION OF 1.0-FT RECOMPACTED CLAY OVERLAIN BY A GCL AND 40-MIL LLDPE GEOMEMBRANE

NOTES

1. AERIAL IMAGERY OBTAINED FROM DUPAGE COUNTY, 2021 IMAGERY. THIS IMAGE WAS LAST UPDATED ON NOVEMBER 29, 2021.
2. APPROXIMATE WASTE BOUNDARY OBTAINED FROM THE FOREST PRESERVE DISTRICT OF DUPAGE COUNTY.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
4. APPROXIMATE LOCATION OF LEACHATE EXTRACTION WELLS OBTAINED FROM FILE ML070819 & ML082018C.
5. APPROXIMATE LOCATION OF EACH FINAL COVER CONFIGURATION OBTAINED FROM MALLARD LAKE LF 2014 ERA REPORTED PREPARED BY AECOM (DATED JULY 2014).

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PROJECT NO.: 25222244.00	DRAWN BY: SJL		
CHECKED BY: SKK	APPROVED BY: SCC		

ENGINEER: SCS ENGINEERS, 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563, PHONE: (331) 806-4295

CLIENT: Forest Preserve District of DuPage County

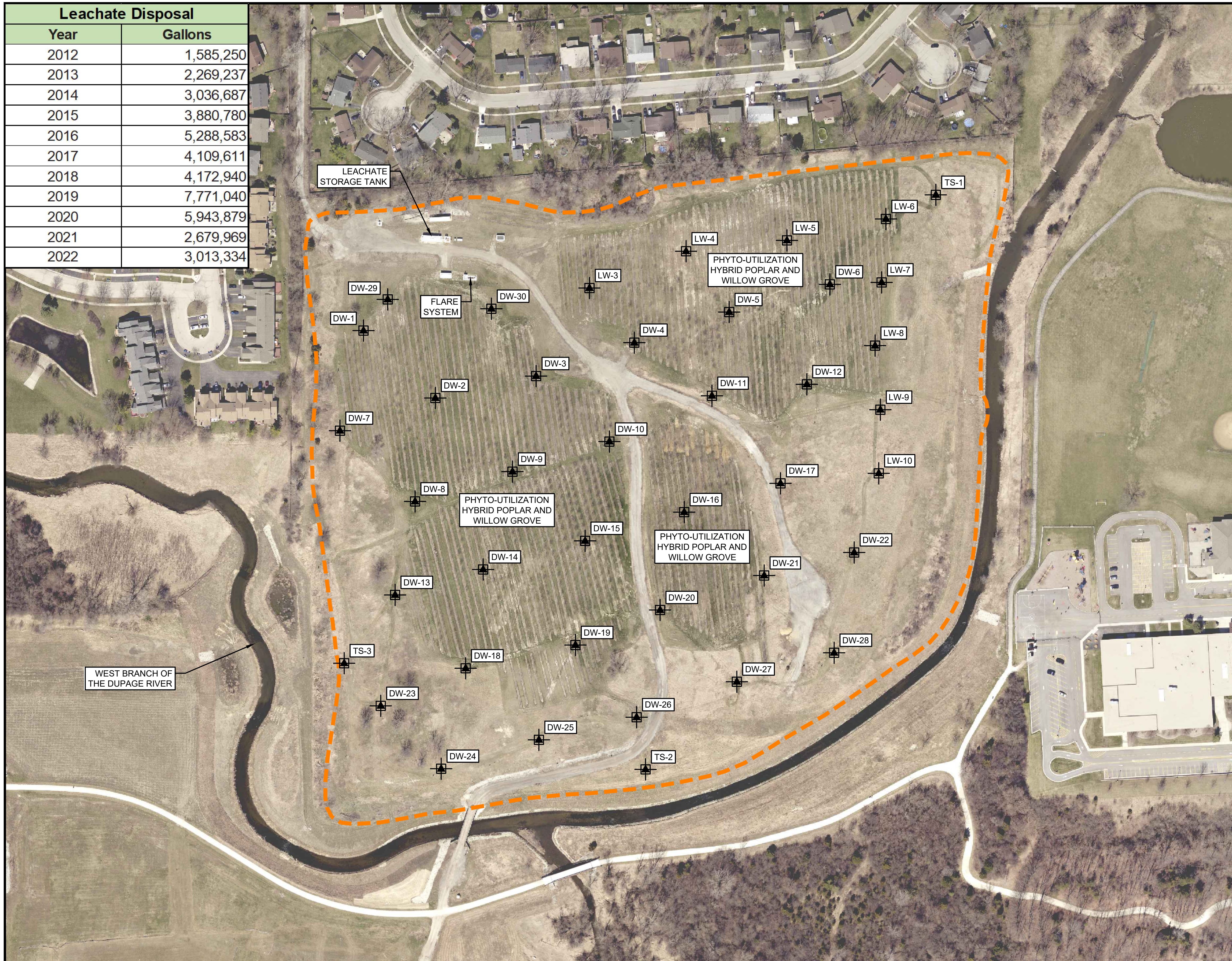
SITE: MALLARD LAKE LANDFILL, HANOVER PARK, ILLINOIS

FIGURE 4
MALLARD LAKE LANDFILL SITE LAYOUT

DATE: FEB. 2023

FIGURE 4 OF 8

Leachate Disposal	
Year	Gallons
2012	1,585,250
2013	2,269,237
2014	3,036,687
2015	3,880,780
2016	5,288,583
2017	4,109,611
2018	4,172,940
2019	7,771,040
2020	5,943,879
2021	2,679,969
2022	3,013,334



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200 0 200

GRAPHIC SCALE: 1" = 200'

LEGEND

APPROXIMATE WASTE BOUNDARY

APPROXIMATE LOCATION OF LEACHATE EXTRACTION WELLS

NOTES

1. AERIAL IMAGERY OBTAINED FROM DUPAGE COUNTY, 2021 IMAGERY. THIS IMAGE WAS LAST UPDATED ON NOVEMBER 29, 2021.
2. APPROXIMATE WASTE BOUNDARY OBTAINED FROM THE FOREST PRESERVE DISTRICT OF DUPAGE COUNTY.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
4. APPROXIMATE LOCATION OF LEACHATE EXTRACTION WELLS OBTAINED FROM FILE MLN000204.

PROJECT NO.: 25222244.00	DRAWN BY: SJL
CHECKED BY: SKK	APPROVED BY: SCC

ENGINEER: SCS ENGINEERS
40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563
PHONE: (331) 806-4295

CLIENT: Forest Preserve District of DuPage County

SITE: MALLARD NORTH LANDFILL
HANOVER PARK, ILLINOIS

FIGURE 5
MALLARD NORTH LANDFILL
SITE LAYOUT

DATE: FEB. 2023

FIGURE
5 OF 8

N

150 0 150

GRAPHIC SCALE: 1" = 150'

LEGEND

- APPROXIMATE WASTE BOUNDARY (orange dashed line)
- APPROXIMATE AREA OF PROPOSED FLOOD STORAGE (blue dashed line)

NOTES

1. AERIAL IMAGERY OBTAINED FROM DUPAGE COUNTY, 2021 IMAGERY. THIS IMAGE WAS LAST UPDATED ON NOVEMBER 29, 2021.
2. APPROXIMATE WASTE BOUNDARY OBTAINED FROM THE FOREST PRESERVE DISTRICT OF DUPAGE COUNTY.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
4. APPROXIMATE AREA OF PROPOSED FLOOD STORAGE DELINEATED BY THE FOREST PRESERVE DISTRICT OF DUPAGE COUNTY.

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PROJECT NO.: 25222244.00	DRAWN BY: SJL	ENGINEER: SCS ENGINEERS, 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563, PHONE: (331) 806-4295	CLIENT: Forest Preserve District of DuPage County	SITE: WHEATON DUMP, WINFIELD, ILLINOIS	FIGURE 6 WHEATON DUMP SITE LAYOUT
CHECKED BY: SKK	APPROVED BY: SCC				DATE: FEB. 2023; FIGURE 6 OF 8

N

150 0 150

GRAPHIC SCALE: 1" = 150'

LEGEND

APPROXIMATE WASTE BOUNDARY

NOTES

1. AERIAL IMAGERY OBTAINED FROM DUPAGE COUNTY, 2021 IMAGERY. THIS IMAGE WAS LAST UPDATED ON NOVEMBER 29, 2021.
2. APPROXIMATE WASTE BOUNDARY OBTAINED FROM THE FOREST PRESERVE DISTRICT OF DUPAGE COUNTY.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.

PROJECT NO.: 25222244.00	DRAWN BY: SJL	ENGINEER: SCS ENGINEERS 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563 PHONE: (331) 806-4295	CLIENT: Forest Preserve District of DuPage County	SITE: AJAX PIT BLOOMINGDALE, ILLINOIS	FIGURE 7 AJAX PIT DUMP SITE LAYOUT	DATE: FEB. 2023
CHECKED BY: SKK	APPROVED BY: SCC					FIGURE 7 OF 8

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200 0 200

GRAPHIC SCALE: 1" = 200'

LEGEND

APPROXIMATE WASTE BOUNDARY

NOTES

1. AERIAL IMAGERY OBTAINED FROM DUPAGE COUNTY, 2021 IMAGERY. THIS IMAGE WAS LAST UPDATED ON NOVEMBER 29, 2021.
2. APPROXIMATE WASTE BOUNDARY OBTAINED FROM THE FOREST PRESERVE DISTRICT OF DUPAGE COUNTY.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.

PROJECT NO.: 25222244.00	DRAWN BY: SJL	ENGINEER	SCS ENGINEERS 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563 PHONE: (331) 806-4295	CLIENT	Forest Preserve District of DuPage County	SITE	BARNES PIT BLOOMINGDALE, ILLINOIS	FIGURE 8 BARNES PIT DUMP SITE LAYOUT	DATE: FEB. 2023 FIGURE 8 OF 8
CHECKED BY: SKK	APPROVED BY: SCC								

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Appendix A

Greenhouse Gas Emissions Calculations

FPDDC GHG Landfill Emissions

Eq.	Item	Unit	Mallard Lake	Greene Valley	Mallard Lake North	Blackwell	Ajax Pit	Barnes Pit	Wheaton Dump	Total	Unit
	METHANE EMISSIONS BASED ON MODELED GENERATION	Sources	2022 Est w/ 2021 GHG Summary	2022 Est w/ 2021 GHG Summary	AEI Report 2021	Estimate	Estimate	Estimate	Estimate		
	Input Summary										
	Year Start		1975	1974	1970	1965	1967	1968	1930		
Equation	Year End		1999	1996	1975	1973	1974	1986	1956		
1	Operating Years	years	25	23	6	9	8	19	27	117	years
	Modeled Area	ft^2	10,018,908	8,624,893	--	--	829,157	757,490	833,712	21,064,160	ft^2
	Depth of Waste	ft	109	198	--	--	60	50	20	437	ft
2a,2b	Volume Above Surrounding Grade	ft^3	1,091,955,774	1,707,717,539	--	--	24,874,710	18,937,250	8,337,120	2,851,822,393	ft^3
	Depth of Waste Below Surrounding Grade	ft	0	0	--	--	5	5	10	20	ft
3	Volume Below Surrounding Grade	ft^3	0	0	--	--	4,145,785	3,787,450	8,337,120	16,270,355	ft^3
4	Total Volume	cy	40,442,806	63,248,798	--	1,500,000	1,074,833	841,656	617,564	107,725,657	cy
	Estimated Waste Density	lb/cy	1,109	515	--	1,200	1,200	1,200	1,200		lb/cy
5	Waste-In-Place	tons	22,419,470	16,282,296	500,000	900,000	644,900	504,993	370,539	41,622,198	tons
6	Waste-In-Place	metric tons	20,335,120	14,768,523	500,000	816,327	584,943	458,044	336,089	37,799,046	metric tons
7	Waste Acceptance Rate	metric ton/year	813,400	642,100	83,300	90,700	73,100	24,100	12,400		
	Methane Generation Rate	k (year^{-1})	0.038	0.038	0.04	0.04	0.04	0.04	0.04		k (year^{-1})
	Potential Methane Generation Capacity	L_0 (M^3/Mg)	100	100	100	100	100	100	100		L_0 (M^3/Mg)
	Output Summary										
	LFG Generation Estimate for 2023	scfm	--	--	37.4	52	39.3	40.6	21.2	191	scfm
	Methane Generation Estimate Eq. HH-1	MTCH4	14,286.00	11,732.00	178.77	258.62	195.10	201.18	105.26	26,957	MTCH4
	Conversion Factor CH4 to CO2e	MTCO2e/MTCH4	25	25	25	25	25	25	25		MTCO2e/MTCH4
	Carbon Dioxide Generation Estimate	MTCO2	47,964.53	33,163.03	1,463.00	1,137.93	3,093.96	2,268.30	2,634.21	91,725	MTCO2
8	Potential GHG Emissions (No Controls)	MTCO2e	405,115	326,463	5,932	7,603	7,971	7,298	5,266	765,648	MTCO2e
	Methane Oxidation Fraction HH-5	Oxidation Rate	0.25	0.25	0.22	0.00	0.10	0.10	0.10		Oxidation Rate
	CH4 Emissions Corrected for Oxidation Eq. HH-5	MTCH4	10,714.50	8,799.00	139.44	258.62	175.59	181.06	94.74	20,363	MTCH4
9	GHG Emissions With Landfill Cover (no GCCS)	MTCO2e	267,863	219,975	3,486	6,466	4,390	4,527	2,368	509,074	MTCO2e
	Reduction due to Cover	MTCO2e	137,252.03	106,488.03	2,446.22	1,137.93	3,581.71	2,771.25	2,897.37	256,575	MTCO2e
	Reduction due to Cover	%	34%	33%	41%	15%	45%	38%	55%		%
	METHANE EMISSIONS BASED ON RECOVERY										
	Input Summary										
	Number of LFG control devices		2	3	1	--	--	--	--		
	Total collected LFG sent to all devices.	scf/year	1,594,765,484	1,179,842,800	40,734,000	0	0	0	0	2.815E+09	scf/year
	Annual Operating Hours	hour	8,730	8,741	8,760	0	0	0	0		hour
10	Average LFG cfm of LFG Sent to all Devices (cfm at 1 atm and 60 F)	cfm	3,044.45	2,249.71	77.50	0	0	0	0	5,372	cfm
	Collection Efficiency Used in Calculations Eq. HH-3	%	95%	95%	90%	0	0	0	0		%
	LFG Generation Rate	cfm	3,204.68	2,368.12	86.11	0.00	0.00	0.00	0.00	5,659	cfm
	Average Methane Concentration	%	47.15%	51.87%	25.80%	40%	15%	20%	10%		%
	Methane Oxidation Fraction HH-5	Oxidation Rate	0.25	0.25	0.22	0	0.1	0.1	0.1		Oxidation Rate
	Methane Oxidation Fraction HH-6	Oxidation Rate	0.35	0.35	0.35	0	0.1	0.1	0.1		Oxidation Rate
	Methane Oxidation Fraction HH-7	Oxidation Rate	0.25	0.25	0.25	0	0.1	0.1	0.1		Oxidation Rate
	Methane Oxidation Fraction HH-8	Oxidation Rate	0.35	0.35	0.35	0	0.1	0.1	0.1		Oxidation Rate
	Output Summary										
11	CH4 Collected and Routed to Control Devices Eq. HH-4	MTCH4	14,441.17	11,752.03	201.81	0.00	0.00	0.00	0.00	26,395	MTCH4
	CO2 equivalent Eq. HH-4	MTCO2e	361,029.29	293,800.83	5,045.33	0.00	0.00	0.00	0.00	659,875	MTCO2e
	Basis of methane generation used for eq HH-6:		Equation HH-1	Equation HH-4	Equation HH-4					0	
12	CH4 Emissions from Modeled/Recovered CH4 Eq. HH-6	MTCH4	43.55	117.52	2.02	0.00	0.00	0.00	0.00	163	MTCH4
13	CH4 Generation from Collection Efficiency Eq. HH-7	MTCH4	11,437.52	9,298.09	168.18	0.00	0.00	0.00	0.00	20,904	MTCH4
14	CH4 Emissions Eq. HH-8	MTCH4	670.17	537.32	16.92	0.00	0.00	0.00	0.00	1,224	MTCH4
		MTCH4	670.17	537.32	16.92	258.62	175.59	181.06	94.74	1,934	MTCH4
	CARBON DIOXIDE EMISSIONS BASED ON RECOVERY										
	Output Summary - CO2										
	CO2 Collected and Routed to Control Devices	MTCO2e	44,970.18	30,298.62	1,612.66	0.00	0.00	0.00	0.00	76,881	MTCO2e
	CO2 Emissions from the Flare (CO2e)	MTCO2e	39,183.51	31,924.42	549.44	0.00	0.00	0.00	0.00	71,657	MTCO2e
	CO2 Emissions from the Flare (CH4 + CO2e)	MTCO2e	84,153.69	62,223.04	2,162.10	0.00	0.00	0.00	0.00	148,539	MTCO2e
	CO2 emissions from the Unrecovered Gas as Landfill Surface	MTCO2e	2,889.39	2,019.90	192.75	0.00	0.00	0.00	0.00	5,102	MTCO2e
	Total GHG Emissions (CO2 flare, CO2 surface, CH4 flare and CH4 surface	MTCO2e	103,868.28	77,842.46	2,777.73	6,465.52	4,389.75	4,526.54	2,368.42	202,239	MTCO2e
	SUBPART C EMISSIONS										
	Number of stationary combustion devices		3	3	1	0	0	0	0	7	
	Tier 1 Fuel CO2 Emissions	MTCO2	70.90	0.00	0.00	0.00	0.00	0.00	0.00	71	MTCO2
	Tier 1 Fuel CH4 Emissions	MTCH4	0.00	1.99	0.00	0.00	0.00	0.00	0.00	2	MTCH4
	Tier 1 Fuel N20 Emissions	MTN20	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0	MTN20
	Tier 1 Fuel biogenic CO2 Emissions	MTCO2	0.00	32,368.00	0.00	0.00	0.00	0.00	0.00	32,368	MTCO2
	Tier 1 Fuel non-biogenic CO2 Emissions	MTCO2	70.90	0.00	0.00	0.00	0.00	0.00	0.00	71	MTCO2
	SUBPART A EMISSIONS									0	
15	Total non-biogenic CO2e from Subparts C and HH	MTCO2e	16,825	13,600	423	6,466	4,390	4,527	2,368	48,598	MTCO2e
16	Total biogenic CO2e from Subparts C and HH	MTCO2e	0.00	32,368.00	0.00	0.00	0.00	0.00	0.00	32,368	MTCO2e
	EMISSIONS FROM LEACHATE TREATMENT										
	Leachate 2022	gallons/year	3,974,000	4,093,943	2,847,056	1,260,000	0	0	0	12,174,999	gallons/year
	Leachate Trucked	Yes/No	No	No	No	Yes	No	No	No		
17	Diesel	fuel gallons/year	0	0	0	360	0	0	0	360	fuel gallons/yr
18	Diesel emissions	MTCO2e	0.0	0.0	0.0	3.7	0.0	0.0	0.0	4	MTCO2e
19	Electricity to Treat Leachate	kWh	9,935	10,235	7,118	3,150	0	0	0	30,437	kWh
20	WWTP Emissions	MTCO2e	5	5	3	2	0	0	0	15	MTCO2e
21	Emissions Leachate Treatment	MTCO2e	4.8	5.0	3.5	5.2	0.0	0.0	0.0	19	MTCO2e
	EMISSIONS FROM SITE ELECTRICITY USE										
	Site Electricity Use	kWh								0	kWh
22	Electricity Emissions	MTCO2e	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	MTCO2e
	GHG EMISSIONS - BASELINE										
	Potential GHG Emissions (No Controls)	MTCO2e	405,115	326,463	5,932	7,603	7,971	7,298	5,266	765,648	MTCO2e
	GHG EMISSIONS - CURRENT										
24	Emission Savings GCCS & Biogenic Offsets	MTCO2e	183,709	157,752	1,324	0	0	0	0	342,785	
	Emission Savings GCCS & Biogenic Offsets	%	68.6%	71.7%	38.0%	0.0%	0.0%	0.0%	0.0%	2	
25	Emission Savings Cover, GCCS, & Biogenic Offsets	MTCO2e	320,961	264,240	3,770	1,138	3,582	2,771	2,897	599,359	
	Emission Savings Cover, GCCS, & Biogenic Offsets	%	79.2%	80.9%	63.6%	15.0%	44.9%	38.0%	55.0%	4	
23	Current GHG Emissions (Actual)	MTCO2e	84,154	62,223	2,162	6,466	4,390	4,527	2,368	166,289	MTCO2e
	GHG EMISSIONS - GREENE VALLEY OFFSET										
	Biogenic Offsets	MTCO2e	0	32,368	0	0	0	0	0	32,368	
	Biogenic Offsets	%	0.0%	52.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.5%	
	GHG Emissions Greene Valley GTE	MTCO2e	84,154	29,855	2,162	6,466	4,390	4,527	2,368	133,921	MTCO2e
	GHG EMISSIONS - PLANNED BLACKWELL										
	Blackwell GCCS										
26	Emission Savings Blackwell GCCS Installation	MTCO2e	0	0	0	3,702	0	0	0	3,702	MTCO2e
27	GHG Emissions GV Offset + Blackwell GCCS	MTCO2e	84,154	29,855	2,162	2,763	4,390	4,527	2,368	130,219	MTCO2e
	GHG EMISSIONS - PLANNED + SOLAR Option										
	Solar Potential										
	Footprint	acres	174	181	5	13	16	15	5	409	acres
28	Solar Electricity Production	kWh	-36,794,000	-38,743,000	-1,495,000	-2,424,000	-3,806,000	-3,393,000	-1,092,000	-87,747,000	kWh
29	Electricity Emissions Offset	MTCO2e	-17,931	-18,880	-729	-1,181	-1,855	-1,653	-532	-42,761	MTCO2e
30	GHG Emissions Blackwell & Solar	MTCO2e	66,223	10,975	1,434	1,582	2,535	2,873	1,836	87,458	MTCO2e

FPDDC GHG Landfill Emissions	Unit	Mallard Lake	Greene Valley	Mallard Lake North	Blackwell	Ajax Pit	Barnes Pit	Wheaton Dump	Total	Unit

Example Equations

1 Operating Years (years) = Ending Year - Starting Year + 1
2a If Source GHG Summary Report: Volume Above Surrounding Grade (ft^3) = Area (ft^2) * Height (ft)
2b If Estimate: Volume Above Surrounding Grade (ft^3) = Area (ft^2) * Height (ft) * 0.5
3 If Estimate: Volume Below Surrounding Grade (ft^3) = Area (ft^2) * Height (ft) * 0.5
4 Total Volume (cy) = (Volume Above Surrounding Grade (ft^3) + Volume Below Surrounding Grade (ft^3)) * 0.037 cy/ft^3
5 Waste in Place (ton) = Total Volume (cy) * Waste Density (lb/cy) * 0.0005 ton/lb
6 Waste in Place (metric ton) = Total Volume (cy) * Waste Density (lb/cy) * 0.00045351 ton/lb
7 Waste Acceptace Rate (metric ton/year) = Waste in Place (metric ton) / Operating Years (year)
8 Potential GHG Emissions (No Controls) (MTCO2e) = Methane Generation Estimate Eq. HH-1 (MTCH4) * 25 MTCO2e/MTCH4 + Carbon Dioxide Generation Estimate (MTCO2)
9 GHG Emissions With Landfill Cover (no GCCS) (MTCO2e) = Methane Generation Estimate Eq. HH-1 (MTCH4) * (1 - Oxidation Rate) * 25 MTCO2e/MTCH4
10 Average LFG cfm of LFG Sent to all Devices (cfm at 1 atm and 60 F) (cfm) = Total collected LFG sent to all devices (scf) / Hours of Operation (hour) / 60 min/hour
11 Eq. HH-4 CH4 Collected and Routed to Control Devices (MTCH4) = Volume Collected Gas (scf) * Methane Concentration (CH4 %) * 0.0423 lb CH4/scf CH4 * 0.0004536 metric ton/lb
12 Eq. HH-6 CH4 Emissions from Modeled/Recovered CH4 (MTCH4) = Modeled CH4 (MTCH4) - Recovered CH4 (MTCH4) * (1 - Oxidation Rate) + Recovered CH4 (MTCH4) * (1 - Destruction Efficiency)
13 Eq. HH-7 CH4 Emissions from Generation (MTCH4) = Recovered CH4 (MTCH4) * (1 - Oxidation Rate) / Collection Efficiency / Fraction of operating hours
14 Eq. HH-8 CH4 Emissions from Collection (MTCH4) = Recovered CH4 (MTCH4) * (1 - Oxidation Rate) / Collection Efficiency / Fraction of operating hours + Recovered CH4 (MTCH4) * (1 - Destruction Efficiency)
15 Total non-biogenic CO2e from Subparts C and HH = Non-Biogenic Subpart C Emissions (MTCO2e) + Subpart HH Methane Emissions (MTCH4) * 25 MTCO2e/MTCH4
16 Total biogenic CO2e from Subparts C and HH = Biogenic Subpart C Emissions (MTCO2e) + Subpart HH Methane Emissions (MTCH4) * 25 MTCO2e/MTCH4
17 Diesel Fuel (gal) = Leachate (gallons) / 5,000 gallons/trip *8.6 miles/round trip / 6 miles/gal
18 Diesel Emissions (MTCO2e) = Diesel Fuel (gal) * 10.21 kg CO2e/gal / 1,000 kg/metric ton
19 Electricity to Treat Leachate (kWh) = Leachate (gallons) * 0.0025 kWh/gallon
20 WWTP Emissions (MTCO2e) = Electricity (kWh) * 0.000487324 MTCO2e/kWh
21 Leachate Treatment Emissions (MTCO2e) = Diesel Emissions (MTCO2e) + WWTP Emissions (MTCO2e)
22 Site Electricity Emissions (MTCO2e) = Electricity (kWh) * 0.000487324 MTCO2e/kWh
23 Current GHG Emissions (Actual) (MTCO2e) = Total non-biogenic CO2e (MTCO2e) + Leachate Treatment Emissions (MTCO2e) + Site Electricity Emissions (MTCO2e) - Total Biogenci CO2e (MTCO2e)
24 Emission Savings GCCS & Biogenic Offsets (MTCO2e) = Potential GHG Emissions (No Controls) (MTCO2e) - Current GHG Emissions (Actual) (MTCO2e)
25 Emission Savings Cover, GCCS, & Biogenic Offsets (MTCO2e) = Potential GHG Emissions (No Controls) (MTCO2e) - Current GHG Emissions (with Cover and GCCS) (MTCO2e)
26 Emission Savings Blackwell GCCS Installation (MTCO2e) = Methane Generation Estimate (MTCH4) * 95% Collection Efficiency * 25 MTCO2e/MTCH4
27 GHG Emissions With GCCS & Blackwell GCCS (MTCO2e) = Current GHG Emissions (with Cover and GCCS) (MTCO2e) - Emission Savings Blackwell GCCS Installation (MTCO2e)
28 Electricity Production (kWh) = See Preliminary Solar Summary Table assumptions 1-3
29 Electricity Emissions Offset (MTCO2e) = Solar Electricity Production (kWh) * 0.000487324 MTCO2e/kWh
30 GHG Emissions With GCCS, Blackwell GCCS, & Solar (MTCO2e) = GHG Emissions With GCCS & Blackwell GCCS (MTCO2e) + Electricity Emissions Offset (MTCO2e)

Appendix B

Photovoltaic (Solar Panel) Evaluation and Calculations

Preliminary Summary Table

Location	Slope (°)	Footprint Area (ac)	Capacity (MW_dc)	Solar Panels (Qty.)	Elec Production (kWh/year)	Budget Installation Cost	Emissions Offset (MTCO2e)	Electricity Offset (Homes/year)
Mallard Lake								
North-1	12.5	72.7	9.1	20,200	12,724,000	$16,090,000	6,201	1,727
North-2	11.3	21.2	2.6	5,900	3,705,000	$4,680,000	1,806	503
West-1	12.5	22.1	4.4	9,800	5,306,000	$7,830,000	2,586	840
West-2	12.5	12.3	2.5	5,500	2,945,000	$4,340,000	1,435	466
South-1	14.0	28.7	5.7	12,800	8,036,000	$10,160,000	3,916	1,091
East-1	11.3	11.7	2.3	5,200	2,818,000	$4,160,000	1,373	446
Float-1	0.0	1.3	0.2	500	303,000	$380,000	148	41
Float-2	0.0	1.4	0.2	500	327,000	$410,000	159	44
Float-3	0.0	2.0	0.3	700	467,000	$590,000	228	63
Float-4	0.0	0.7	0.1	300	163,000	$210,000	79	22
	Subtotal	174.1	27.6	61,400	36,794,000	$48,850,000	17,931	5,244
Greene Valley Landfill								
North-1	14.0	12.9	1.6	3,600	2,252,000	$2,850,000	1,097	306
North-2	11.3	60.4	7.6	16,800	10,577,000	$13,370,000	5,154	1,435
North-3	11.3	27.0	3.4	7,500	4,727,000	$5,980,000	2,304	641
South-1	11.3	33.6	6.7	14,900	9,416,000	$11,910,000	4,589	1,278
South-2	14.0	13.7	2.7	6,100	3,839,000	$4,850,000	1,871	521
Southeast-1	14.0	33.1	6.6	14,700	7,932,000	$11,700,000	3,865	1,256
	Subtotal	180.7	28.6	63,600	38,743,000	$50,660,000	18,880	5,437
Mallard Lake North Landfill								
South-1	5.7	2.9	0.6	1,300	823,000	$1,040,000	401	112
South-2	5.7	2.4	0.5	1,100	672,000	$850,000	327	91
	Subtotal	5.3	1.1	2,400	1,495,000	$1,890,000	729	203
Blackwell Landfill								
North-1	11.3	9.7	1.2	2,700	1,701,000	$2,150,000	829	231
Float-1	0	3.1	0.5	1,100	723,000	$910,000	352	98
	Subtotal	12.8	1.7	3,800	2,424,000	$3,060,000	1,181	329
Ajax Pit								
Marsh-1	0.0	0.0	0.0	0	0	$0	0	0
Marsh-2	0.0	0.0	0.0	0	0	$0	0	0
Float-1	0.0	16.3	2.7	6,000	3,806,000	$4,810,000	1,855	516
	Subtotal	16.3	2.7	6,000	3,806,000	$4,810,000	1,855	516
Barnes Pit								
Perimeter Bank-1	11.3	0.0	0.0	0	0	$0	0	0
Float-1	0.0	14.5	2.4	5,400	3,393,000	$4,290,000	1,653	460
	Subtotal	14.5	2.4	5,400	3,393,000	$4,290,000	1,653	460
Wheaton Dump								
North-1		4.7	0.8	1,700	1,092,000	$1,380,000	532	148
	Subtotal	4.7	0.8	1,700	1,092,000	$1,380,000	532	148
	Total	**408.5**	**64.9**	**144,300**	**87,747,000**	**$114,940,000**	**42,761**	**12,338**

Notes
1. Land utilization assumptions: North face = 8 acres/MW; East, West, and South face = 5 acres/MW; Other = 6 acres/MW
2. Energy yield = 1,400 kWh/kW; East/West face = 1,200 kWh/kW.
3. Solar panels = 450 W/panel.
4. Installation Cost Estimate = $1.77/W
5. Emission factor offset = 0.000487324 MTCO2e/kWh (RFCW utility grid)
6. Typical home electricity offset = 190 home/MW

Abbreviations
ac = acre
MW = MegaWatt
kWh = kiloWatt-hour
MTCO2e = metric ton carbon dioxide equivalent
W = Watt

N

500 0 500

GRAPHIC SCALE: 1" = 500'

LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE WASTE BOUNDARY
- APPROXIMATE BOUNDARY OF SOLAR FEASIBILITY AREAS
- APPROXIMATE AREA OUTSIDE OF SOLAR FEASIBILITY ASSESSMENT

NOTES

1. AERIAL IMAGERY OBTAINED FROM DUPAGE COUNTY, 2021 IMAGERY. THIS IMAGE WAS LAST UPDATED ON NOVEMBER 29, 2021.
2. EXISTING TOPOGRAPHY AND APPROXIMATE WASTE BOUNDARY OBTAINED FROM THE FOREST PRESERVE DISTRICT OF DUPAGE COUNTY.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.

PROJECT NO.: 25222244.00	DRAWN BY: SJL	ENGINEER: SCS ENGINEERS, 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563, PHONE: (331) 806-4295	CLIENT: Forest Preserve District of DuPage County	SITE: GREENE VALLEY LANDFILL NAPERVILLE, ILLINOIS	APPENDIX B GREENE VALLEY LANDFILL SOLAR FEASIBILITY
CHECKED BY: TK	APPROVED BY: SCC				DATE: FEB. 2023 FIGURE 1 OF 7

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LEGEND

- APPROXIMATE WASTE BOUNDARY
- APPROXIMATE BOUNDARY OF SOLAR FEASIBILITY AREAS
- APPROXIMATE AREA OUTSIDE OF SOLAR FEASIBILITY ASSESSMENT

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CHECKED BY: TK	APPROVED BY: SCC					FIGURE 2 OF 7

LEGEND

- APPROXIMATE WASTE BOUNDARY
- APPROXIMATE BOUNDARY OF SOLAR FEASIBILITY AREAS
- APPROXIMATE AREA OUTSIDE OF SOLAR FEASIBILITY ASSESSMENT

NOTES

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CHECKED BY: TK	APPROVED BY: SCC						

APPENDIX B
MALLARD LAKE LANDFILL
SOLAR FEASIBILITY

DATE: FEB. 2023

FIGURE 3 OF 7

LEGEND

- APPROXIMATE WASTE BOUNDARY
- APPROXIMATE BOUNDARY OF SOLAR FEASIBILITY AREAS
- APPROXIMATE AREA OUTSIDE OF SOLAR FEASIBILITY ASSESSMENT

NOTES

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3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.

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PROJECT NO.: 25222244.00	DRAWN BY: SJL	ENGINEER: SCS ENGINEERS, 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563, PHONE: (331) 806-4295	CLIENT: Forest Preserve District of DuPage County	SITE: MALLARD NORTH LANDFILL, HANOVER PARK, ILLINOIS	APPENDIX B MALLARD NORTH LANDFILL SOLAR FEASIBILITY
CHECKED BY: TK	APPROVED BY: SCC				DATE: FEB. 2023 FIGURE 4 OF 7

N

150 0 150

GRAPHIC SCALE: 1" = 150'

LEGEND

- APPROXIMATE WASTE BOUNDARY
- APPROXIMATE BOUNDARY OF SOLAR FEASIBILITY AREAS
- APPROXIMATE AREA OUTSIDE OF SOLAR FEASIBILITY ASSESSMENT

NOTES

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2. EXISTING TOPOGRAPHY AND APPROXIMATE WASTE BOUNDARY OBTAINED FROM THE FOREST PRESERVE DISTRICT OF DUPAGE COUNTY.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.

PROJECT NO.: 25222244.00	DRAWN BY: SJL	ENGINEER	SCS ENGINEERS 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563 PHONE: (331) 806-4295	CLIENT	Forest Preserve District of DuPage County	SITE	WHEATON DUMP WINFIELD, ILLINOIS	APPENDIX B WHEATON DUMP SOLAR FEASIBILITY	DATE: FEB. 2023 FIGURE 5 OF 7
CHECKED BY: TK	APPROVED BY: SCC								

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NOTES

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3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.

PROJECT NO.: 25222244.00	DRAWN BY: SJL	ENGINEER: SCS ENGINEERS, 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563, PHONE: (331) 806-4295	CLIENT: Forest Preserve District of DuPage County	SITE: AJAX PIT BLOOMINGDALE, ILLINOIS	APPENDIX B AJAX PIT DUMP SOLAR FEASIBILITY
CHECKED BY: TK	APPROVED BY: SCC				DATE: FEB. 2023 FIGURE 6 OF 7

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LEGEND

- APPROXIMATE WASTE BOUNDARY
- APPROXIMATE BOUNDARY OF SOLAR FEASIBILITY AREAS
- APPROXIMATE AREA OUTSIDE OF SOLAR FEASIBILITY ASSESSMENT

NOTES

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2. EXISTING TOPOGRAPHY AND APPROXIMATE WASTE BOUNDARY OBTAINED FROM THE FOREST PRESERVE DISTRICT OF DUPAGE COUNTY.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.

PROJECT NO.: 25222244.00	DRAWN BY: SJL	ENGINEER	SCS ENGINEERS 40 SHUMAN, SUITE 216, NAPERVILLE, IL 60563 PHONE: (331) 806-4295	CLIENT	Forest Preserve District of DuPage County	SITE	BARNES PIT BLOOMINGDALE, ILLINOIS
CHECKED BY: TK	APPROVED BY: SCC						

APPENDIX B
BARNES PIT DUMP
SOLAR FEASIBILITY

DATE: FEB. 2023

FIGURE 7 OF 7

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