Environmental Impact Statement (Rev2)
Proposed Industrial Landfill
SW 06-44-23-W2M
RM of Invergordon (430), Saskatchewan

Invergordon Landfill Inc.

WM566.3 04 April 2025

Prepared by:

WaterMark CONSULTING LTD.

X-TERRA Environmental Services Ltd.

Executive Summary

Project Overview and Justification

Invergordon Landfill Inc. ("the Proponent") is proposing to develop a regional landfill ("the Project") in the northcentral region of Saskatchewan. A Technical Proposal was submitted in December 2023 and it was subsequently determined in April 2024 that the Project would be required to undergo and pass an Environmental Impact Assessment to proceed. WaterMark Consulting Ltd. (WMCL) undertook the preparation of an EIS with support from X-Terra Environmental Services Ltd. (X-Terra) for ecological screening and evaluation.

Invergordon Two previous versions of the EIS were submitted and subject to technical review by relevant regulating agencies. This Rev2 version addresses all of the remarks received during that technical review process. Landfill Inc. is a privately owned corporation based out of Prince Albert, Saskatchewan. The Founder and Director of Invergordon Landfill Ltd is also the director of a waste management organization with over 25 years active hauling operations in northcentral Saskatchewan. He has years of industry knowledge and experience, including experience developing and operating landfill facilities in southern Saskatchewan. The Rural Municipality (RM) of Invergordon (430), which has been seeking a more robust waste management strategy since closing their landfill in 2021, will receive a portion of the gross profits from the development without requiring the upfront finances for screening, permitting and construction. This partnership offers an affordable opportunity to develop a regional landfill that aligns with best practice design, construction, and operations with financial assurance for future decommissioning.

Federal and Provincial governments widely acknowledge the need to modernize landfill infrastructure in Saskatchewan, while also acknowledging the challenges that exist for municipalities and rural communities to fund this transition. The Province's *Solid Waste Management Strategy* urges regional collaboration to achieve sustainable and affordable waste management solutions over the long-term. The Project will address this need to modernize and regionalize the solid waste management, thereby reducing the overall environmental liability of waste disposal in the region. In doing so, it will also provide a more robust and affordable waste management plan for the RM of Invergordon and the surrounding communities.

Project Description

The proposed Project site is located on a portion of SW 06-44-23-W2M, roughly 6 km west of Yellow Creek, Saskatchewan within the RM of Invergordon (430) as shown in Figure A. The Proponent owns the land on which the Project is proposed. Application is being made for an Industrial Landfill since it will be operated as a private enterprise, however most of the waste

accepted at the landfill will be non-hazardous waste from municipal and commercial entities. The landfill will accept waste sourced primarily from within the Greenland Waste Service Area (GWSA), which spans about 70,000 km^2 in north central Saskatchewan. The anticipated waste deposition rate is around 46 tonnes per day, or 12,000 tonnes per year.

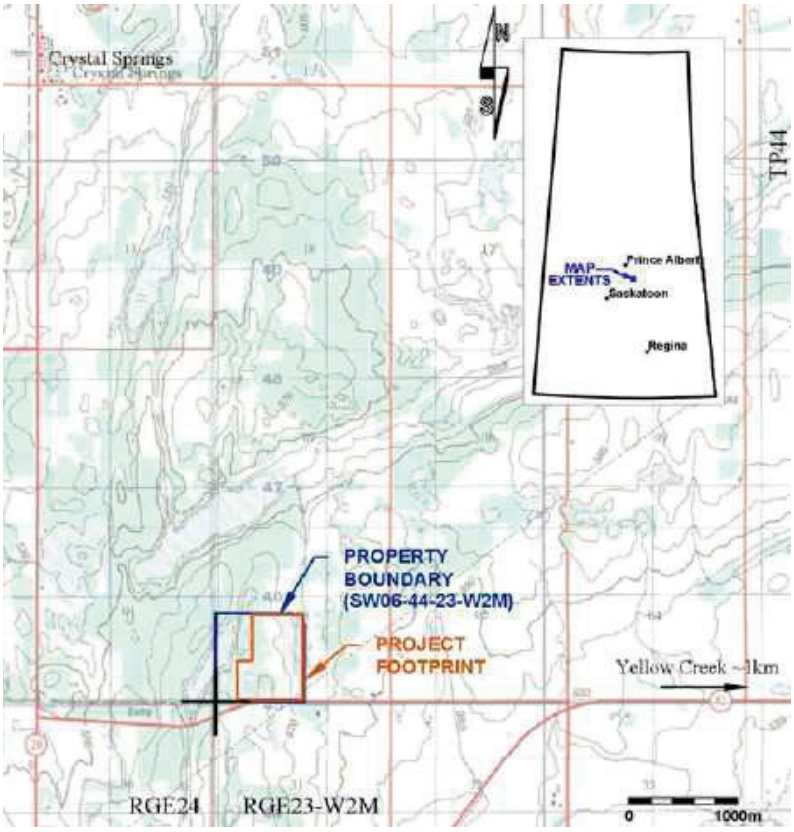

Figure ES-1 Project Location

A phased approach is proposed for the construction of the Project; Phase I includes two (2) landfill cells on the southern half of SW 06-44-23-W2M and would have an operating lifespan in the order of 40 years and Phase II would involve expanding the landfill into the northern half of the quarter section including three (3) or four (4) additional landfill cells providing roughly three times the capacity as Phase I. Phase I will involve the construction of: a fenced and forested perimeter embankment, an operational area, two (2) landfill cells with a total capacity of about 750,000 m^3, two (2) runoff holding ponds and a leachate pond. Phase II will involve the construction of an extended, fenced and forested perimeter berm, three (3) to four (4) landfill cells with an additional capacity of about 2,400,000 m^3 and one (1) additional runoff holding pond or expansion of a Phase I runoff holding pond. Detailed designs have been completed for Phase I, whereas Phase II is conceptual at this stage. The full-scale (Phase I and II) development is considered in the EA. The Project components are illustrated in Figure ES-2.

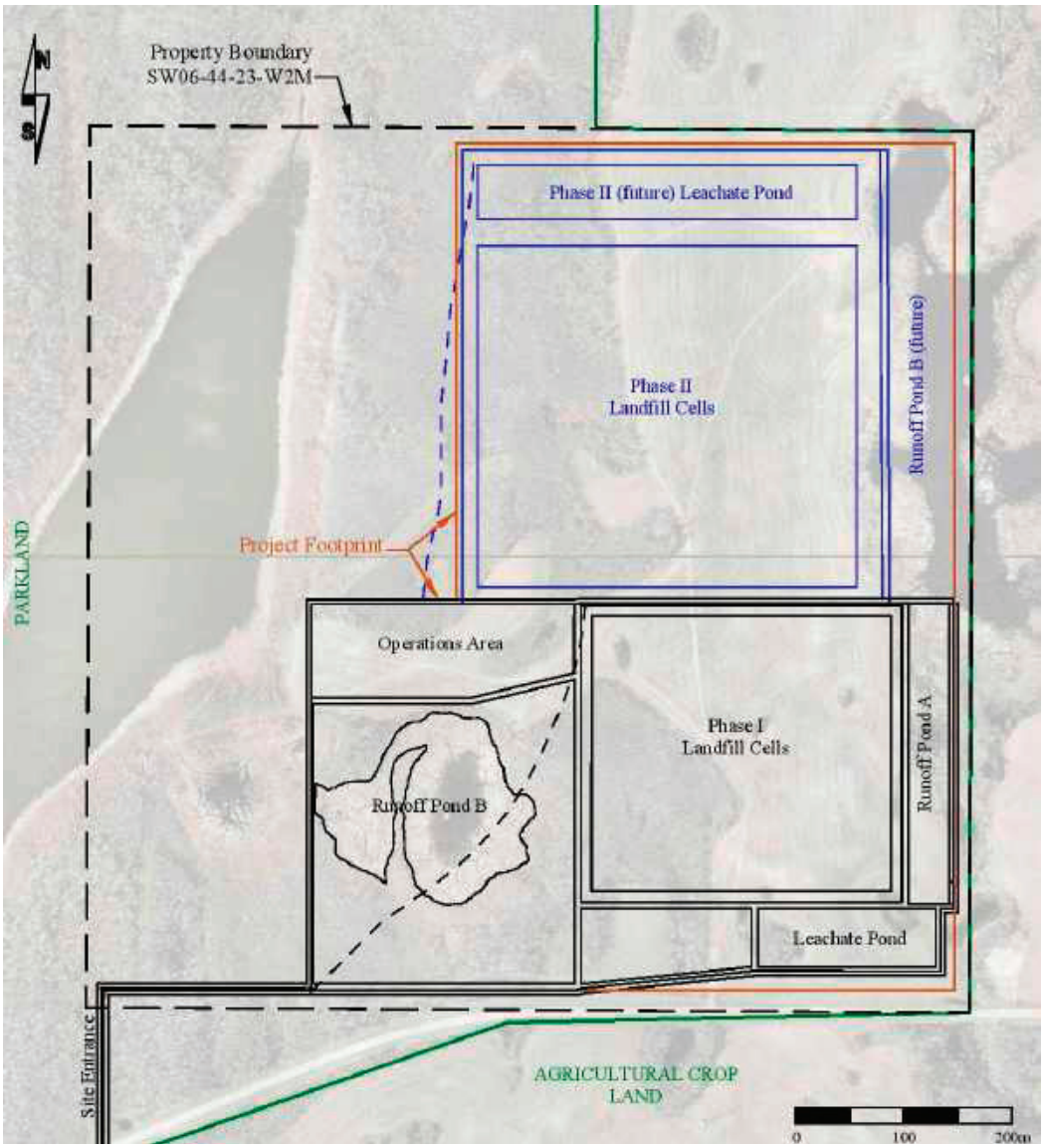

Figure ES-2 Project Components

There are four (4) distinct stages of the Project: construction, operations, decommissioning, and post-closure. At the anticipated acceptance rate of 12,000 tonnes/year the total operations lifespan of the Project would be about 150 years.

Public Consultation

Public engagement was conducted during four (4) RM of Invergordon ratepayer meetings held in between December 2020 and October 2023 and a fifth event in September 2024 that was advertised to the surrounding RMs. Community members were given the opportunity at these meetings to ask questions and voice their concerns. The questions, concerns and discussion were similar at all five (5) events and can be generally categorized as 1) uncertainty about partnering with a private developer to build a landfill rather than alternative options of waste management; 2) worries about

the impacts to RM infrastructure and sightlines; 3) concerns about the impacts to the physical environment; and 4) public health implications. In addition, a neighbouring regional landfill expressed concern, through direct contact with MOE, about the impacts to existing regional landfills. Concerns expressed by the public are addressed in the EA to provide assurance and clarity to the public.

Impacts Assessment Approach

Project effects were assessed for the following valued components (VC) of the environment: groundwater quality, surface water quality and accessibility, climate & air quality, wetlands & aquatic habitat, wildlife & wildlife habitat, vegetation, human health, safety & wellbeing and socioeconomics.

The existing environment was characterized for each VC to establish baseline conditions and to identify potential ways in which the Project may interact with the VC. For each potential interaction, mitigation measures were identified to reduce or eliminate the risk of adverse effect. With mitigation measures considered, residual effects were identified, quantified where possible, and evaluated in terms of likelihood, severity, permanence, spatial extent and temporal extent. The effects assessment culminates in the determination of cumulative effects, which considers how the residual project effects may compound or offset in combination with other Project effects or environmental effects of other physical activities that have been or will be carried out. If the residual effect is not offset or compounded by other factors, then the cumulative effect is equivalent to the residual effect.

Expected Effects of the Project

Impacts to water resources, both groundwater and surface water, are key environmental concerns for any landfill development as there is inherent risk of buried waste leaching into the environment. The EA identified two (2) key water resource receptors in proximity to the Project including a large slough in a natural habitat about 60 m west of the Project and a regional aquifer about 38 m below the site. The EA determined that mitigation measures including siting, engineered containment, and operational controls the Project is not expected to have a measurable effect on water quality or accessibility for any water resource. The Project is expected to impact groundwater in the clay-rich soils on the eastern part of the site, however this system neither constitutes a receptor or pathway of concern and impacts are not expected to extend off-site or into surface water.

GHG emissions are an unavoidable effect of the Project, however mitigation measures such as optimizing haul routes, implementing landfill gas collection and destruction systems, and minimizing disturbance to vegetation and wetlands that act as carbon sinks will help to minimize

the magnitude of GHG emissions. It is important to note that the Project will not increase the cumulative amount of GHG generated regionally, since the Project will not alter the amount of landfilling that occurs in the region. When these offsetting effects are considered, there will be a net zero impact to GHG emissions from landfill gas and vehicle use.

The Project will have minor impacts to the ecological environment mostly related to unavoidable land use changes and disturbance within the Project footprint and the immediate surroundings. These impacts will occur during construction and will largely be reversed when the Project is decommissioned. The Project is not expected to impact the populations of any rare or endangered plants or animals.

Human health, safety and wellbeing impacts are also expected to be minor. The Project will introduce minor traffic-related risk and sensory disturbance associated with the addition of about 6 waste hauling trucks per day. Safety risks associated with dangerous wildlife, hunting on adjacent lands, and standard landfill workplace hazards are expected to be very low. There is very limited opportunity for sensory disturbance associated with the landfill itself and permanent alteration of the landscape to affect individuals given its remote location and the surrounding land use.

The Project's socioeconomic impacts are overwhelmingly positive. The Project is expected to generate in the order of $50,000 in royalties per year for the RM of Invergordon and create 8 full time construction jobs and 2 to 3 full time operational jobs. Impacts to the profitability of neighbouring waste management facilities may occur as an inherent effect of commercial development in a free market, although these are expected to be manageable in scale, largely confined to 8-10% waste diversion from two (2) nearby sites. There are several factors that offset adverse impacts to neighbouring landfills including the extension of existing landfill infrastructure lifespan, more competitive waste disposal pricing for the community, and the strong likelihood that market share will increase over time for regional landfills as smaller landfills close as a deliberate consequence of the Province's Solid Waste Management Strategy.

Conclusions

With the mitigations proposed in this document and summarized in the attached Commitments Register, the Project is expected to have minor impacts on the physical and ecological environments, mostly associated with unavoidable land changes and disturbances within the Project footprint and a small buffer immediately outside the project area that will be subject to sensory outputs, minor wetland alteration, and risk of temporary windblown debris. No widespread impacts to the physical or ecological environments are expected to occur.

Safety impacts are expected to be minimal and are associated with increased traffic in the order of 6 waste trucks per day and standard workplace risks associated with landfills. There will be minor disruption to the waste management market from a modest diversion of waste from existing facilities, however this will be balanced by economic benefit to the region associated with competitive waste management pricing and the RM of Invergordon will benefit from annual profit sharing.

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1.0 INTRODUCTION

1.1 Proponent

The proponent is Invergordon Landfill Ltd., a Saskatchewan-owned corporation headquartered in Prince Albert, Saskatchewan. Invergordon Landfill Inc. will have a Board of Directors, Officials (and a dedicated Manager that oversee staff and daily operations. Curtis West is the Founder and Director of Invergordon Landfill Inc. Mr. West is also the director of Greenland Waste Disposal (2003) Ltd., a waste management organization with over 25 years active hauling operations in northcentral Saskatchewan. He has over 20 years of industry knowledge and experience, including experience developing and operating landfill facilities in Southern Saskatchewan. Kristian Brooks, Manager of Whitewood Landfill for 4 years will also be managing the construction and operation of Invergordon Landfill Inc.

The registered business number for the corporation is 102138921. The Corporate Profile from Information Servies Corporation (ISC) is provided in Appendix A.

1.2 Development Justification

The Project's main benefit will be to provide an environmentally secure, modern landfill that provides an affordable waste management option for northcentral Saskatchewan communities and commercial entities. The Federal and Provincial governments widely acknowledge the need to modernize landfill infrastructure in Saskatchewan, while also acknowledging the challenges that exist for municipalities and rural communities to fund this transition. The Government of Saskatchewan published a Solid Waste Management Strategy in 2020, which was based on recommendations from a Solid Waste Advisory Committee, published in 2019. One of the committee's key recommendations was to create options for advancing regional collaboration, which they relate to sustainability and affordability over the long-term. The strategy acknowledges that some municipalities do not have the financial means or the technical personnel to properly manage a landfill in order to protect human health and the environment, let alone construct such a facility. The strategy therefore encourages regional collaboration to enhance the cost effectiveness of waste management infrastructure by "encouraging municipalities to take advantage of regional opportunities to manage solid waste and reduce these risks" and notes that "forming regional waste management authorities… has resulted in the closure of many unsustainable, stand-alone landfills that pose significant financial, environmental and human health risks and liabilities."

In alignment with the Province's *Solid Waste Management Strategy*, the Project will address the need for a more robust and affordable waste management plan for the RM of Invergordon and the surrounding communities, while reducing the overall environmental liability of waste disposal in the region. The Proponent is associated with an established waste transporter within the proposed landfill's collection area, with industry knowledge and experience developing and operating landfill facilities. In partnering with the RM of Invergordon, which is seeking a more robust waste management strategy, the community will benefit from more affordable waste management and will receive a portion of the gross profits from the development without requiring the upfront costs of screening, permitting and construction.

Eight (8) regional landfills and ten (10) municipal landfills were identified in the Project's waste collection area. Section 5.3.3.2 of this EIS demonstrates that there is capacity within the area for an additional regional landfill facility. Despite regionalization of landfills in recent years, there exist several RMs, municipalities and commercial facilities in the service area that do not receive member-rates at an existing landfill facility. Market competition will benefit residents and commercial entities by offering competitive pricing for waste disposal and may indirectly benefit the environment by reducing illegal burial of solid waste. Increasing the capacity for waste management in the region with an environmentally compliant and professionally managed facility will have the overall impact of modernizing waste management practices and reducing environmental liability.

The landfill will be operated in a for-profit model. A portion of the gross revue will be shared with the RM of Invergordon as outlined in a private contract providing an estimated cash flow of $50,000 per year to the RM.

1.3 Land Controls

The proponent owns the land on which the development is proposed. Ownership includes surface rights only, not mineral rights. The RM of Invergordon has approved the use of the land with respect to bylaws and zoning.

1.4 Regulatory Requirements and Design Standards

Regulatory Requirements

The Saskatchewan Ministry of Environment (MOE) regulates the solid waste management (landfilling) industry within the Province of Saskatchewan. Specifically, landfills are regulated by The Municipal Refuse Management Regulations (1986) under the *Environmental Management and*

Protection Act, 2010. Since the proposed Project is a private development, the landfill will be considered an Industrial Waste Works (IWW). The Project will be developed in phases; each phase will be subject to the permitting and licensing conditions described below.

All landfills in Saskatchewan undergo a permitting process whereby MOE first issues a Permit to Construct which is conditional on the acceptance of the following documents: a Site Suitability report, a Detailed Design report including construction specifications and a construction monitoring plan, a Decommissioning and Reclamation Plan, and conceptual plans for site operation and monitoring. Private landfill developments also require that the Proponent demonstrate assurance of access to funds to carry out the Decommissioning and Reclamation Plan.

Subsequently, MOE issues a Permit to Operation which is conditional on their approval and acceptance of an As-Built report, detailed Operating Plan, and Emergency Response Plan. The Permit to Operate is conditional on ongoing adherence to the Site Operating Plan, including but not limited to adherence to site monitoring and leachate monitoring plans and annual reporting of waste intake, site inspection documents, and site monitoring results. The development is also subject to periodic site inspections by MOE to ensure compliance with operating permit conditions and best-practices.

At some point in the future the site will be at capacity and the site will need to be decommissioned. Site closure is also regulated by MOE through the acceptance of an Environmental Site Assessment that documents the condition of the site pre-corrective actions, a Corrective Actions Plan that outlines detailed methods of decommissioning the site and post-closure monitoring commitments, an As-Built report documenting corrective actions taken, and application for site closure. Post-closure monitoring is a standard requirement for landfill sites which involves regular monitoring, analysis and reporting to document chemistry of groundwater and surface water until it is determined that there are no substances of potential concern lingering in the environment.

Landfills are not necessarily subject to Environmental Assessments, however MOE sited that the Project would be subject to an EA (or Technical Screening) based on it being a greenfield development. MOE uses a results-based process to understand and evaluate the potential environmental impacts of a project before any irreversible decisions are taken that may lead to negative effects on the environment, natural resources, or public health and safety.

The Proponent submitted a Technical Proposal (WaterMark Consulting Ltd., 2023) to MOE in December 2023 under the name 102138921 Sask. Ltd. It was subsequently determined that the Project would require an EA, citing a need for a traffic assessment, consultation with the broader public, and detailed design review to assess impacts to water resources. Upon further consultation

with the Ministry of Highways (MOH), it was determined that a formal Traffic Impact Assessment would not be required for this project.

A Terms of Reference document related to this EA was submitted in September 2024 (WaterMark Consulting Ltd., 2024) and subsequently approved by the MOE. Two previous versions of the EIS were submitted and subject to technical review by relevant regulating agencies. This Rev2 version addresses all of the remarks received during that technical review process.

Table 1.1 tabulates the relevant regulations, acts and legislations that will apply to Project.

Landfill Design Standards

In the absence of landfill siting and design standards published by the Government of Saskatchewan, the Ministry of Environment accepts landfill standards from Alberta and Manitoba. Alternatives to the accepted standards for either siting or design may be justified with adequate scientific rationale.

Alberta's Landfill Standards were selected for the Project. The Project will conform to these standards with one exception related to the thickness of clay soils underlying the landfill cell. This alternative siting is justified by the modelling presented in Section 7.2.4 which demonstrate that with the mitigations proposed the siting poses negligible risk to the environment.

Table 1.1 Regulatory Permits and Approvals for the Project

Agency	Environmental Statute	Objective	Project Requirements
Saskatchewan Ministry of Environment – Environmental Assessments Branch	Environmental Assessment Act, 1980	To screen projects that are considered a 'development' under the Act	**EIS** containing a project description, baseline environment information, residual and cumulative impact evaluation
Saskatchewan Ministry of Environment	The Environmental Management and Protection (Saskatchewan Environmental Code Adoption) Regulation	To outline reporting responsibilities for releases or potential releases (Chapter B1.1 - Discharge and Discovery Reporting)	**Report** must be issued if there is a discharge of a substance that may cause or is causing an adverse effect or for reporting a discovery of such a substance
		To outline requirements for collection, management, and reporting of site assessment data (Chapter B1.2 - Site Assessment)	Routine **monitoring of groundwater and surface water quality** in accordance with the protocols outlined in this Code Chapter.
		To outline the requirements for preparing, monitoring, and documenting corrective actions for an impacted site (Chapter B1.3 - Corrective Action Plan)	For progressive or final decommissioning, an approved **Corrective Action Plan** will be required. Corrective actions will be summarized conceptually in a **Decommissioning and Reclamation Plan**, which will be required as a condition of Permit to Construct.
Saskatchewan Ministry of Environment	Environmental Management and Protection Act (EMPA)	To outline permitting requirements for waste management facilities (Part VI: Division 3 - Solid and Liquid Waste Management)	Landfilling may only occur in a works for which a **Permit** has been issued. The proposed private landfill will require an **Industrial Waste Works (IWW) permit** which requires **Financial Assurance**. A standard landfill permitting process is outlined in the item below.
Saskatchewan Ministry of Environment – Environmental Protection Branch	Environmental Management and Protection Act, 2010	Regulating private landfills through issuing of an Industrial Waste Works (IWW) permit (Section 9)	**Permission to Construct** must be obtained prior to construction. **Permission to Operate** must be obtained prior to operation. Permission to Operate is conditional on ongoing requirements such as annual monitoring, reporting, routine site inspections, and upkeep of an Operating Plan, Environmental Monitoring Plan, Emergency Response Plan and Decommissioning & Reclamation Plan.
Saskatchewan Ministry of Environment	The Wildlife Act, 1998	To protect wildlife and Species at Risk, as defined in this Act, from disturbance, harvesting, collecting, capturing, hunting/killing, or selling/exporting without permit	**Species Detection Permits** obtained from MOE Fish, Wildlife and Lands Branch for field surveys completed for the Project. Mitigation may be required for listed species that may be identified in the Project area
Saskatchewan Ministry of Environment	Management and Reduction of GHG Act, 2010	Regulates the release and reduction of GHG in Saskatchewan	Obligation to **report GHG emissions** if they exceed more than 10,000 tonnes per year
Saskatchewan Ministry of Parks, Culture and Sport – Heritage Conservation Branch	Heritage Property Act, 1980	Conserve heritage resources	Screen the Project area for heritage resources. The **online screening** indicated that the site is cleared for development an no further screening is required.
Water Security Agency (WSA)	Environmental Management and Protection Act, 2010 & Environmental Management and Protection (General) Regulations	*Aquatic Habitat Protection Plan (AHPP)* : To maintain aquatic habitat at the productive level which existed prior to the Project *Drainage Approval* : to provide security, reduce risk and protect downstream neighbors from negative impacts.	**Aquatic Habitat Protection Plan** (AHPP) and **Drainage Approval** were applied for, however it was determined that neither permit is required for the construction of Phase I. Correspondence with WSA is provided in Appendix A.
Water Security Agency (WSA)	The Water Security Act	A Permit to Construct and Operate are required for any non-domestic works where water is to be diverted or impounded.	An **Approval to Construct and Operate Works (ATC/ATO)** will be required for the runoff holding ponds since they are considered industrial/non-domestic impondments.
Saskatchewan Ministry of Environment	Weed Control Act	Outlines responsibilities of regulators and owners/occupants to manage weeds (Division II Part III Owners and Occupants)	A **Weed Control Plan** with provisions for appointed weed inspectors to access the site, duty to notify weed inspectors of prohibited or noxious weed observations, and duty to eradicate, contain or control the establishment of prohibited and noxious weeds
Environment and Climate Change Canada	Environmental Protection Act, 1999 - *Proposed* Regulations Respecting the Reduction in the Release of Methane (Waste Sector)	Regulates the release of Methane in the waste sector to meet Canada's GHG targets (reduce methane emissions from municipal solid waste landfills by 50% below 2019 levels by 2030)	Currently no federal or provincial (SK) regulations in place related to the control of methane emissions from landfills, however it is acknowledged that they are likely to be developed in the Project's lifespan

2.0 DEVELOPMENT DESCRIPTION

2.1 Siting

The proposed site is located on SW 06-44-23-W2M, nominally 5 km south of Crystal Springs and 6 km west of Yellow Creek, Saskatchewan. A regional and local site plan are provided in Drawing WM566.3-1 and Drawing WM566.3-2 respectively. The Proponent purchased quarter section SW 06-44-23-W2M (referred to in this document as "the property"), in 2021 following preliminary geological and hydrogeological investigations that demonstrated competent soils at the site with respect to waste containment. The proposed access road will be constructed within an easement off the southwestern corner of the property development.

The Project footprint will occupy about 63% of the property leaving an undisturbed buffer of natural forest and wetland along the western side of the property. Within the 41.3 ha Project footprint about 49% is currently used as agricultural cropland, 34% is forest or bush, 15% is wetland and 2% is modified grassland. Surrounding land use is roughly split between the west and east. To the east, land use is predominantly agricultural, interspersed with natural wetlands. To the west is a stand of natural forest, also interspersed with wetlands. Two quarter sections immediately west and northwest of the property are designated as Wildlife Habitat Protection areas. Local and regional land use is illustrated in Drawing WM566.3-3. The ecological setting and subsequent implications of the Project are discussed are discussed at length in Sections 5.0 and 7.0.

Site suitability as it relates to soils and water were a major consideration for siting the Project. Wetlands and watercourses are prevalent in the region, including a wetland on the Project's eastern boundary, and a large unnamed slough 60 m west of the Project footprint. No surface water proximal to the site is known to be used as a potable water, livestock watering, irrigation, or industrial water source. The site is understood to be underlain by two (2) regional aquifers at depths of 38 m and 133 m, both comprising potable water resources. The shallow soils are predominantly glacial till, however a channelized sand deposit is also interpreted below portions of the site. With respect to site suitability for landfill siting, the channelized sand deposit represents a potential pathway for contaminant migration to the large slough west of the Project. It is acknowledged that siting the landfill cells over the channelized sand deposit does not conform with the Alberta landfill siting standards for underlying soils, however scientific rationale is provided in Section 7.2.4 to justify the siting, thus conforming with an Alternate Solution. It is also acknowledged that the Project's siting does conform with Manitoba's landfill standards which are also accepted in Saskatchewan.

The nearest First Nations reserves are Muskoday First Nation No. 99 (34 km north), Cumberland Indian Reserve No. 100A (39 km northeast), and One Arrow Indian Reserve No. 95-1E (38 km southwest). There are no known culturally significant features of the landscape, ecologically sensitive areas, sensitive air receptors, lands used for traditional purposes, crown lands or railway right of ways in proximity to the site.

2.2 Infrastructure

Phased development will occur over the life span of the proposed landfill. The initial work (Phase I) will include constructing landfill cells and supporting infrastructure over the southern portion of the site. Phase II, focused on the northern half of the site, will be developed in the future. The proposed project layout is shown in Drawing WM566.3-4.

The Phase I development will support landfilling operations for a period of about 40 years. Phase I will involve the construction of the following site elements:

- A perimeter embankment around the Phase I project footprint;
- An operational area;
- Two (2) landfill cells;
- Two (2) runoff holding ponds; and,
- A leachate pond.

At some point in the future, a Phase II expansion will be undertaken for continued landfilling. Phase II will involve the construction of the following elements:

- A perimeter berm enclosing the Phase II project footprint;
- Three (3) to four (4) landfill cells;
- One (1) additional runoff holding pond, or expansion of a Phase I runoff holding pond; and,
- One (1) additional leachate pond.

The developer will undertake the construction of the elements listed above. The scale, objective, and design considerations of these components are discussed in the following sections along with reference to appendices where detailed design drawings are provided.

The site will require servicing by SaskPower to power lighting and facilities in the administrative building. A cistern system will be used for modest water requirements, mostly to facilitate onsite sanitation facilities for landfill staff.

2.2.1 Perimeter Embankments and Site Containment

Perimeter embankments are proposed to envelope the Phase I footprint and, later, the Phase II footprint to provide trafficability and manage surface water. The embankments will ensure that internal surface water is contained on-site and prevent & divert offsite runoff from entering the facility. Portions of the perimeter berm will also double as containment berms for Runoff Pond A and the leachate pond.

The eastern edge of the Phase I perimeter embankment will be adjacent to, but not disrupt the natural drainage of, the existing slough network along that property boundary. The perimeter embankment and any associated ditching will be fully maintained on the quarter section owned by the Proponent. Discussions with Water Security Agency, which are documented in Appendix B, have concluded that no licensing of drainage features will be necessary for Phase I construction as all surface water will be contained on the site. Application for an Aquatic Habitat Protection Plan (AHPP) has been submitted since the Phase I perimeter berm construction will intersect a small portion of a permanent wetland. Application for a drainage permit and AHPP will be re-submitted in the future prior to Phase II construction.

The main landfill approach will be in the southwestern corner of the quarter section off of Road 776 as shown in Drawing WM566.3-4. A lockable gate, tied into the perimeter fence, will be installed for security at the landfill entrance. Construction of the access road along an RM road easement is a part of the proposed work program.

A fence will be installed around the perimeter of the landfill site. Where possible, bush lines will be maintained outside of the perimeter embankment and in the area surrounding Runoff Pond B. This will provide the benefit of blocked sightlines from the public road, dampened wind, windblown litter containment, limited groundwater infiltration, and maintenance of wildlife habitat. Thick, natural bush lines will remain on the western half of the site. Elsewhere, tree windrows will be planted along the external edge of the perimeter embankment to achieve similar benefits. Where wetlands occur at the base of the perimeter embankment, namely along the eastern site boundary, a terrace will be incorporated on the perimeter embankment's external slope to accommodate fencing and a tree windrow.

Finally, minor internal road network will supplement the perimeter roadways to direct traffic around the site.

Design drawings for the perimeter berm and road network are provided in Appendix C.

2.2.2 Operations Area

The operations area will include the main landfill approach, weigh scale, administrative building, parking area, equipment storage, and maintenance buildings and yards, plus stockpile areas for clean soil and potentially for segregated waste piles. Much of the Operations Area will be situated in a portion of the site that is currently cleared for agricultural production. The entire Operations Area will take up approximately 2.0 ha in the northwest corner of the Phase I project area.

2.2.3 Landfill Cells

Phase I of the Project will involve the construction of two (2) landfill cells, Cell 1 and Cell 2, which are similar in size and follow consistent design principles. Future expansion of the site will involve the construction of three (3) to four (4) additional landfill cells on the northern half of the property. The Phase II cells will follow best-practice design and conform to standards applicable at the time of construction. At a minimum, they will conform with the standards of practice of the Phase I development.

The proposed Phase I landfill cells each have a surficial expression of 120 m by 258 m. The base of the cells slope toward the east along three (3) subparallel swales that will drain collected fluids to the easternmost edge where the sumps are situated. A network of perforated pipes embedded in free draining aggregate will enhance drainage of collected fluid into the sump. This design will limit the area over which leachate can accumulate. A leachate monitoring pipe and a leachate withdrawal pipe will be installed along the eastern side slope of each cell to allow access to the sump so that leachate can be monitored, sampled, and withdrawn, if necessary.

Design drawings for Phase I landfill cells are provided in Appendix D. Phase II is conceptual at this stage, but the proposed footprint of the Phase II landfill cells are shown in Drawing WM566.3-4.

Combined, Cell 1 and Cell 2 will have a total capacity of about 750,000 m^3, providing for roughly 40 years of operation. Cross sections showing the shape of the final mound surface of the two cells' footprint are shown in Drawing WM566.3-5. As the Phase I site nears capacity the Phase II expansion over the northern portion of the site would be initiated. Technical details of this expansion will be addressed in a subsequent document prepared at that time, although much of the site characterization has been completed with this current investigation. Preliminary estimates of Phase II capacity is in the order of 3,000,000 m^3 which would provide roughly 110 additional years of operation.

The Phase I landfill cell designs feature a 1.0 m thick compacted clay engineered liner underlaying the entire footprint of each landfill cell. The engineered liner thickness is increased to 1.2 m in the vicinity of the leachate collection sump to address the sustained presence of leachate expected in the sumps. A maximum hydraulic conductivity of $1x10^{-9}$ m/s is specified for the compacted clay liners. The liner thickness and hydraulic conductivities are evaluated in the context of the site's conceptual flow model in Section 7.2.4 to demonstrate adequate containment.

The leachate management strategy proposed for the site will include regular monitoring and documentation of leachate levels in all sumps on site and withdrawal of leachate when fluid depth in the sump exceeds 0.3 m.

The waste mounding design will include a runoff management system to separate mound runoff (which will be managed as leachate) from clean runoff generated away from the mound. A nominal berm is designed around the perimeter of the landfill cells to prevent clean runoff from entering the waste footprint. Waste placement procedures, which will be outlined in the Site Operating Plan, will ensure that a nominal ditch is present at the base of the active landfill mound to collect and contain all runoff created on the landfill mound. A conceptual drawing of the ditch is provided in Figure 2.1. The collected fluid will ultimately drain to the base of the cell where it will be directed to the sump. To ensure that fluids to not accumulate in the ditch, a granular bed will be extended up the side slope of the northeastern (downslope) corner of each cell to enhance infiltration. Once a permanent engineered cover is placed over the mound the runoff occurring off the mound can be integrated with the external site and be directed to Runoff Ponds A or B.

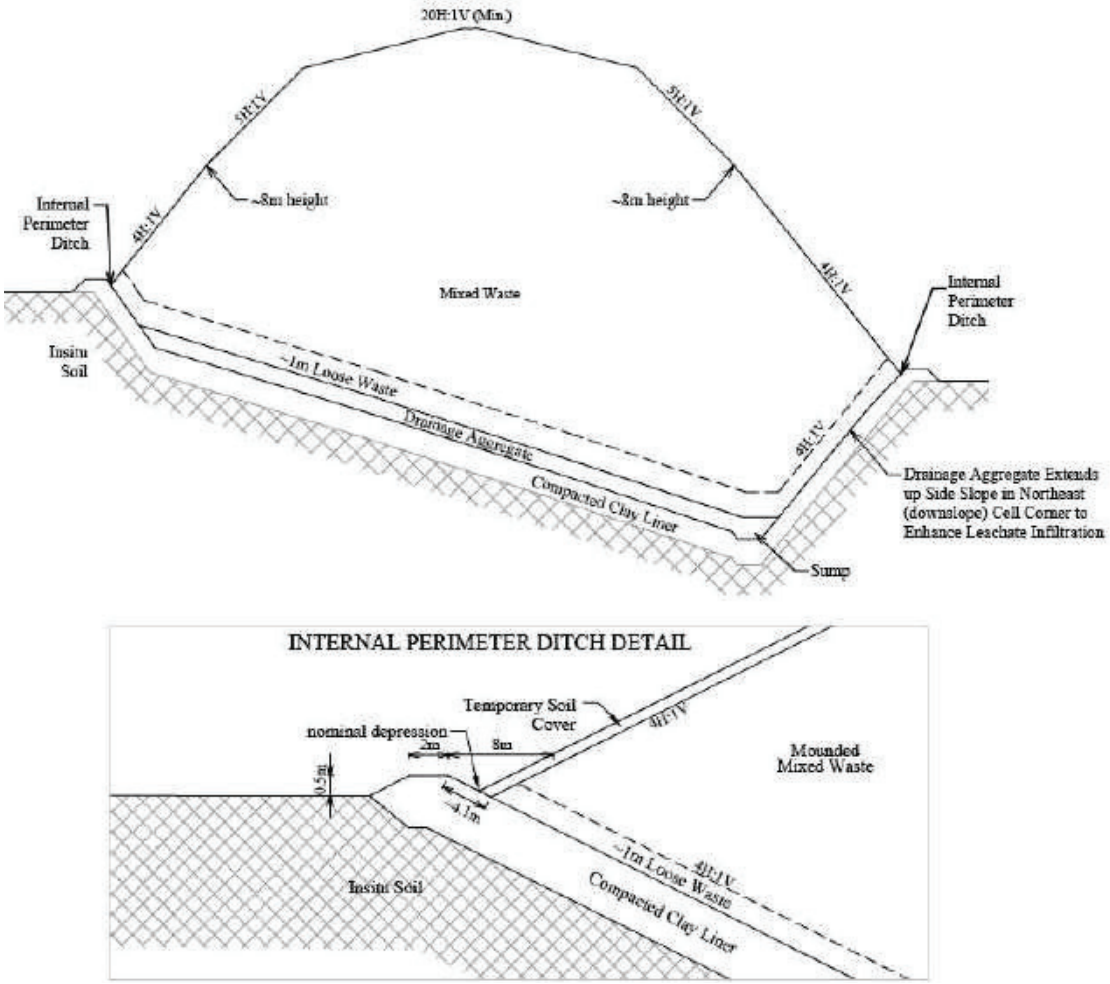


Figure 2.1 Conceptual Waste Placement Above Grade

2.2.4 Runoff Holding Ponds

The landfill site will manage clean onsite runoff separate from contaminated runoff. Contaminated runoff includes any water that comes in contact with landfill waste, and it will be managed as leachate. All other runoff occurring on the landfill property is considered to have low risk of impact and is collected as clean water.

The Phase I grading plan directs internal clean runoff into one (1) of two (2) runoff holding ponds. Drawing WM566.2-7 presents the site drainage plan for the site at full development including two (2) catchment areas. A natural drainage divide occurs roughly in the center of the proposed Phase I footprint, splitting the eastern and western halves. Pond A will be constructed along the eastern edge of the site within a low-lying region adjacent the perimeter embankment and will capture runoff from the eastern half of the site generally. Pond B will occupy a naturally occurring lowland bog on the southwest part of the site and provide runoff containment for the western half of the site with minimal grading required.

Design drawings for site grading and runoff holding ponds are provided in Appendix E.

The ponds are designed to accommodate a 50-year return storm event, which is greater than the minimum design specification of a 25-year return storm. The landfill cell footprint is included in the runoff design calculation to accommodate runoff from progressively decommissioned portions of the landfill.

The Phase II facility will involve the construction of a new holding pond, an expansion of Pond A, or a combination of both. All options would occupy roughly the same footprint along the eastern boundary of the Phase II expansion.

2.2.5 Leachate Pond

The leachate pond will be a key component of leachate management strategy. The anticipated Phase I leachate generation rate is in the order of 7,900 m^3 per year. Preliminary assessments suggest that this volume could be managed by irrigation on the landfill mounds alone. To facilitate and supplement this irrigation method, a leachate staging pond is included in the Phase I layout. The leachate pond will enhance leachate management through evaporation and allow efficient staging of the mound irrigation system.

The primary objective of the leachate pond is to provide temporary storage of fluids collected from the sump(s) of the landfill cell. The leachate pond has sufficient storage for about 5 months of full-scale Phase I leachate production. As fluid is collected in the sump it is withdrawn and stored within the leachate pond. Once in this pond it can be actively pumped back onto the landfill mound to enhance evaporation through irrigation. Fluid application rates can be managed to optimize the evaporative potential of the moist surface without creating additional leachate. A secondary benefit to the leachate pond is the active evaporation that will occur directly from the surface water body. The pond size limits potential evaporation as a primary water management tool, however what does evaporate will contribute to the overall leachate management plan.

A double lined containment system with a leak detection layer has been specified for the leachate pond. A geosynthetic liner is specified for the primary liner. Underlying the primary liner would be a leak detection layer which will intercept, collect and permit withdrawal of fluids once accumulated in a sump. This layer will consist of a combination of free draining aggregate and piping. Finally, a secondary liner consisting of 1.0 m thick compacted clay is specified underlying the leak detection layer to minimize impacts from any accumulated fluids. The secondary liner will include a sump, from which accumulated fluids can be monitored, sampled, and withdrawn. The liner thickness will be thickened to 1.2 m thickness under the sump. A maximum hydraulic

conductivity of $1x10^{-9}$ m/s is specified for the compacted clay liners. The liner thickness and hydraulic conductivities are evaluated in the context of the site's conceptual flow model in Section 7.2.4 to demonstrate adequate containment.

Design drawings for the leachate pond are provided in Appendix F.

2.3 Activities

2.3.1 Timeline

There are four (4) distinct stages of the Project: construction, operation, decommissioning and post-closure. These stages are discussed in the following sections. Figure 2.2 shows the estimated timeline of the Project, broken down by the main project stages.

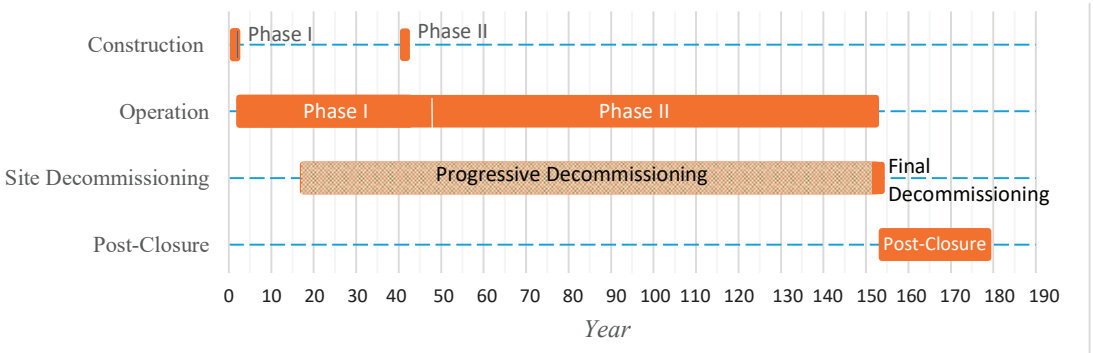


Figure 2.2 Estimated Timeline of the Project

Construction of Phase I infrastructure is anticipated to occur over one (1) to two (2) construction seasons, and a similar time frame will apply to the construction of Phase II infrastructure if and when the Project expands. The construction of Phase I and receipt of a Permit to Operate the landfill is expected to take about 18 months. The total operational lifespan of the Project would be in the order of about 150 years. Phase I has an estimated lifespan of about 40 years. Phase II is estimated to have an additional lifespan of about 110 years. Progressive decommissioning would occur over the landfill's active operational period to manage ongoing risk. Corrective actions required at the end of the Project would be expected to occur over a single construction season. Post-closure monitoring will occur until the groundwater impacted by the Project is shown to have concentrations below all applicable endpoint, which would likely be a minimum period of 25 years.

2.3.2 Construction

During construction, key activities will include:

- Site preparation including bush clearing and stockpiling within the Project footprint;

- Earthwork construction including general site grading and surfacing, including:
    - Berm and roadway construction;
    - Excavations for landfill cells, runoff ponds and leachate pond; and,
    - Construction of compacted clay liners in the landfill cells and leachate pond
- Installation of leachate containment, collection and monitoring systems, including piping and drainage aggregate throughout landfill cells and leachate pond, and installation of an HDPE liner across the leachate pond;
- Construction of building structures and weigh scale in the operations area;
- Installation of fencing, gates, windrows and signage;
- Decommissioning of redundant piezometers and installation of new optimized monitoring piezometers;
- Supervision, documentation and quality control by qualified professionals; and,
- Preparation and submission of an as-built report documenting dimensions, construction methods, quality control methods and results, and any deviations from the approved design. A statement confirming the construction achieved the design standards will be provided.

The as-built report will be supported by the Site Operating Plan and Emergency Response Plan to achieve the Permit to Operate the constructed elements.

2.3.3 Operation

Landfill Operations are regulated by MOE. The Project will adhere to standard landfill operation procedures, monitoring, maintenance, and reporting.

Key activities during the operational period of the landfill include:

- Maintaining and adhering to a Site Operating Plan, subject to approval by MOE, including, but not limited to:
    - A detailed Emergency Response Plan with various contact information, procedures for landfill personnel and patrons during potential emergencies and duties of specific personnel during and after an emergency event;
    - A Leachate Management Plan including procedures for regular monitoring, annual monitoring, leachate withdrawal, and disposal or recirculation;

  - An Environmental Monitoring Plan including specifications for semi-annual or annual monitoring of groundwater, surface water and leachate, and reporting requirements;

- Waste hauling and unloading is expected to occur between 8am – 5pm Monday through Friday;
  - Provisions may be made for RM ratepayers to drop waste at the site during a specified period on Saturdays as a value-added benefit
  - Operation hours are estimated and may fluctuate from those listed above including slightly earlier or later hours (i.e. 7 am – 6 pm) or the introduction of Saturday operations, although this is not in the current business plan
  - Accepted material is discussed in Section 2.4
- Site supervision by at least one (1) employee during all operation hours who is familiar with and able to enforce the site's operating plan;
- Maintaining records of incoming waste and regular site inspections and reporting annually to MOE;
- Compaction of placed wastes and placement of daily soil cover;
- Regular site inspection and maintenance coupled with sitewide litter collection to ensure a tidy and secure site;
- Leachate management tasks including monitoring fluid levels in various sumps, extracting leachate from pumps periodically to maintain fluid depths below 0.3 m, and irrigating active landfill surface(s) with leachate to manage excess fluid;
- Monitoring groundwater and surface water at regular intervals and reporting results and interpretations annually to MOE;
- Routine maintenance of site infrastructure including but not limited to roads, culverts, buildings, fencing and signage; and,
- Progressive decommissioning of the landfill cells when they have reached their final capacity.

2.3.4 Decommissioning and Reclamation

Decommissioning efforts will be tailored to the site's intended post-closure end use, which is anticipated to be either recreational or forage. A Decommissioning and Reclamation Plan (D&R) will be prepared and approved by MOE prior to construction as a standard condition of licensing a private landfill in accordance with the Environmental Management and Protection Act so that an accepted approach is in place for site closure. Environmental Management and Protection regulations also stipulate that, as a privately operated landfill which qualifies as an Industrial Waste Works, the Proponent must provide financial assurance for the estimated costs associated with decommissioning and reclamation.

The D&R Plan will contain the following information:

- An inventory of the landfill elements proposed for construction which will ultimately require decommissioning;
- A strategy for decommissioning each of the elements identified above, along with specifications and controls, and design drawings for decommissioning the landfill cells;
- A cost estimate for decommissioning and reclaiming each site element based on typical unit rates for the proposed work program; and,
- A long-termed closure monitoring strategy, which will be dependent on local groundwater trends and geochemical behavior experienced during site operation.

In brief, the D&R will specify that the completed landfill cells be decommissioned and reclaimed with the construction of an engineered cover system that adheres to accepted standards. The current standards for an engineered cover consist of minimum thicknesses of 600 mm compacted clay, 350 mm loose soil and 200 mm seeded topsoil. A conceptual cross section of the decommissioned Phase I landfill mound is shown in Drawing WM566.3-5. Roads and berms will likely be maintained as surface water management features, however they will be rounded, covered with topsoil and seeded. The runoff holding ponds will also require little modification. The leachate pond will be emptied, the HDPE liner will be cut up and disposed of and the underlying soils will be tested to determine whether the pond can simply be left as a wetland feature, or whether it will require removal and replacement of impacted soils with clean fill.

Key activities during the decommissioning period include:

- Decommissioning of landfill cells, including construction of an engineered cover, which will likely be completed progressively through the life cycle of the Project to minimize the active areas of landfilling and thus liability;

- Decommissioning of leachate pond including removal and regulated disposal of liner and impacted soils;
- Repurposing or demolition of buildings and other structures;
- Regrading and resurfacing of the site with topsoil and vegetation;
- An as built report will be prepared and submitted to MOE documenting all corrective actions taken, the state of the site upon closure, and any substances of potential concern (SOPC) that have been identified in soils or groundwater which will require post-closure monitoring.

The land will be subject to administrative controls that will prevent activity on the property that could disturb the decommissioned cells since disturbance could result in changes to groundwater and surface water quality conditions. These controls will continue to apply in the event of transfer of land ownership.

2.3.5 Post-Closure

After the site is fully decommissioned, the proposed facility will enter a post-closure period during which time the decommissioned and reclaimed site will be monitored for lingering impacts to groundwater and surface water. The term of monitoring is undefined and dependent upon the geochemical trends; however, a minimum period of 25 years is considered reasonable for most sites.

Key activities during the decommissioning period include:

- Routine sampling and analysis of surface and groundwater;
- Annual reporting of water chemistry results and interpretations to MOE;
- Transfer of land ownership likely to occur at the end of the post-closure monitoring, after it has been demonstrated that any impacts to surface or groundwater are below SEQG standards or are consistent with naturally occurring background levels.

2.4 Project Inputs and Outputs

The Project's expected inputs and outputs are summarized in Table 2.1 below.

Table 2.1 Anticipated Project Inputs and Outputs

Input	Source	Estimated Quantity
Landfilling Material		
Household Waste	Greenland Waste Service Area	12,000 tonnes/yr
Resource use		
Gasoline (construction)	construction equipment	9,440 L
Diesel (construction)		70,400 L
Gasoline (operation)	hauling trucks & on site equipment, heating and power	5,880 L/yr
Diesel (operation)		50,400 L/yr
Gasoline (decommissioning)	construction equipment	14,160 L
Diesel (decommissioning)		105,600 L
Utilities		
Electricity	SaskPower	7200 kwh/yr
Water	Privately-sourced water truck	500 m3/year
Output	**Source**	**Quantity**
Landfill Leachate		
Phase I	Landfill cells 1 & 2 cumulative	7,900 m^3/yr
Phase II	Future landfill cells	12,700 m^3/yr
Onsite Runoff		
Phase I	Based on average annual precipitation	55,500 m^3/yr
Phase II		84,400 m^3/yr
Greenhouse Gas Emissions		
GHG Emissions (CO2 eq. at peak after >100 years of operation)	See Table 7.6	29,600 tonnes/yr
Carbon Sink Alterations		
Phase I Net Wetland Lost	Land use modifications	-0.4 ha
Phase I Net Forest Lost		3.9 ha
Phase I Net Cropland Lost		10.2 ha
Phase I Net Modified Grassland Lost		0.7 ha
Phase II Net Wetland Lost	Land use modifications	0.5 ha
Phase II Net Forest Lost		4.7 ha
Phase II Net Cropland Lost		10.4 ha
Phase II Net Modified Grassland Lost		0 ha
Socioeconomic		
Construction Jobs - local		8 jobs
Operation Jobs - local		2-3 jobs
Indirect Jobs		road maintenance, monitoring
Royalties to RM of Invergordon		4% of annual gross revenue (~$50,000/year)

Landfilling Material

Application is being made for an Industrial Landfill since this is the only option for a private landfill enterprise, however most of the waste accepted at the landfill will be municipal. The landfill will accept municipal waste sourced primarily from within the Greenland Waste Service Area (GWSA), which is depicted in Drawing WM566.3-6. For the Phase I development, and likely the Phase II development, it is expected that the landfill will accept waste solely from Greenland Waste, as a contract waste hauler. As previously noted, Greenland Waste. owns and operates a municipal solid waste collection and hauling company that operates in the general region of the Project. In other words, the Project will not use or require the ancillary service of a new waste hauling entity which could disrupt the local waste pick-up and hauling environment. Exception may be made for RM of Invergordon ratepayers who may be offered access to the site for solid waste drop off over a limited period on weekends. The amount of waste generated by this stream is expected to be very minor as the RM already receives residential waste pickup. This service is intended as a value-added service to the RM to assist with the infrequent need for additional waste disposal.

The types of waste accepted at the landfill will be detailed in the Site Operating Plan, which will be prepared under separate cover. Segregation of waste is not within the scope of the Project. A staging area included in the Phase I layout could be used to stockpile diverted waste in the future including shingles, concrete, clean fill, and clean wood, however this activity is not within the Project scope at this time.

The anticipated waste deposition rate is around 46 tonnes per day, or 12,000 tonnes per year. Assuming a density of 0.6 tonnes/m^3 this translates to a waste volume rate of approximately 20,000 m^3 per year. Considering the regular use of daily soil cover, the total cell consumption rate is expected to be roughly 21,000 m^3 per year to remain conservative. This is an estimated average rate of waste deposition; actual raw waste acceptance may fluctuate depending on market factors but is not expected to exceed 15,000 tonnes per year.

Resource Use

Fuel for vehicles and equipment will be the main natural resource input. Fuel consumption estimates presented in Table 2.1 are based on the Proponent's experience in constructing and operating similar facilities. A gasoline consumption rate of 1,180 L/month and diesel consumption rate of 8,800 L/month were estimated for an 8-month construction period and a 12-month decommissioning period. A gasoline consumption rate of 490 L/month and diesel consumption rate of 4,200 L/month are estimated for the landfill operational phase.

Utilities

The following utilities will be required primarily to service the administration building and mechanical shop:

- Electricity will be required to provide power for the buildings and weigh scale in the order of 7200 kwh per year.
- Water will be required to service bathroom and personal washing facilities in the administration building in accordance with Saskatchewan's Occupational Health and Safety (OH&S) Regulations (2020). Provisions may also be made at the Proponent's discretion for an emergency shower, although this provision exceeds the OH&S regulations which state the need for shower only "*if a worker's skin is likely to be contaminated by harmful or offensive substances as part of the regular work processes*". While there is a potential risk of exposure to asbestos and other harmful chemicals, landfill workers are not likely to have direct contact with these substances (occupational health and safety including PPE and safe work practices will be addressed in the site's operating plan). Emergency showers and other decontamination facilities are not specified in the accepted standards nor are they routinely required at landfills in the province. In any case, a cistern system serviced by water and sewage trucks is proposed for water use on site for all sanitation needs.

Landfill Leachate

Landfill leachate typically contains elevated concentrations of dissolved organic matter, inorganic macro-components, heavy metals, and xenophobic organic compounds that can have adverse effects on the environment. Any fluid that that comes in contact with landfilling waste will be considered landfill leachate. Leachate production volumes be equivalent to the volume of precipitation that infiltrates or runs off (and is subsequently collected and directed into) the landfill mounds. Annual leachate production is estimated using the historic precipitation for the Melfort Region published by Environment Canada and discounting rainfall would be stored in the soil and evaporated or snowfall that would be sublimated. Using this approach the estimated rate of leachate production for the Phase I site is in the range of 7,900 m^3/year.

This fluid will require monitoring, containment and management, as discussed in Sections 7.2.2 and 11.3.

Onsite Runoff

Runoff will be generated on portions of the site that are not occupied by landfill cells or a leachate pond. While it is not expected that this excess water will be impacted, it is standard practice to collect, contain, and monitor clean runoff on site. Periodic releases of clean runoff may occur through a regulated process involving water chemistry analysis to demonstrate that the collected runoff is unimpacted by landfilling activities and requiring approval by MOE. Historic climate data published by Environment Canada data indicates that mean annual precipitation for the region is 396 mm. Based on mean annual precipitation rates, the anticipated annual runoff volume that will require collection, containment, and monitoring in Phase I is estimated to be 55,500 m^3/yr.

Due to seasonal distribution of precipitation and evaporation potential, runoff is expected to accumulate on site, at least for some periods of the year. The accepted design standards for runoff management includes provisions for a 1 in 25-year 24-hour rainfall event, which is 83 mm for the region. The Project design includes provisions for a 1 in 50-year 24-hour rainfall event, 93 mm for the region, to account for the potential increase in rainfall intensity and wet antecedent conditions, equivalent to roughly 18,830 m^3 for the Phase I site.

Total runoff storage on site for Phase I is 21,740 m^3.

Greenhouse Gas Emissions

Landfills are known to generate GHG due to the anaerobic decomposition of waste. Landfill gas is comprised primarily of carbon dioxide and methane.

The Project also has the potential to emit vehicular GHG emissions through the construction and operations phases of the site and to change the capacity of the site to store carbon in vegetation through land cover changes.

Greenhouse gas emission estimates are discussed in detail in Section 7.4.4.

Sensory Outputs

Vehicular traffic and operation will generate nominal off site noise and dust associated with increased traffic at an expected rate of 6 waste hauling trucks per day. Noise, dust, odor and light will occur on site during construction, operation and decommissioning although only properties immediately adjacent the Project have potential of being impacted by these sensory outputs.

The magnitude of these impacts will be low, consistent with typical agricultural operations which are prevalent in the region. The duration will be more consistent, however the lack of residences or facilities in the area suggest the impact will be low if at all detectable.

2.5 Project Alternatives

The Project aims to provide a solid waste management option for north central Saskatchewan that optimizes: 1) environmentally sustainability, 2) cost-effectiveness for waste producers, and 3) palatability to the general public. These objectives align with many of the objectives outlined in the province's waste management strategy. To achieve these objectives, the following alternatives to the proposed project were considered:

- Maintain the status quo; that is, continue to haul waste to existing landfill sites (namely Melfort Regional Landfill and Prince Albert Landfill) which would result in expansion of the existing facilities and little to no change in waste disposal fees for waste producers. This option is not cost effective for the RM of Invergordon and for other communities in the region who do not belong to a regional landfill authority due to costs associated with hauling distance and tipping fees at those existing facilities. The RM of Invergordon acknowledges that a transfer station approach is undesirable as it is unfeasible for operations to, at a minimum, become revenue-neutral due to high costs (attendant wages, site maintenance and undiscounted service rates for transfer bins) and relatively low patronage.
- Early in the planning process, the developer explored the possibilities of acquiring and expanding the footprint of an existing landfill. This approach would minimize new impacts to the community in terms of traffic and nuisances and would benefit the developer by providing upfront knowledge of site conditions from previous investigations and analysis. The developer considered the historic RM of Invergordon Landfill and the Melfort Landfill since they are located centrally in the GWSA. Upon consultation with an engineering consultant, it was determined expanding either of these two landfills would not satisfy the first two objectives listed above given the environmental sensitivity of these sites and the high engineering and construction costs that would be associated with engineering containment and monitoring.
- A parcel of land in the RM of Birch Hills was also investigated as a potential site but it was determined that the site did not satisfy the objectives listed above.

It was subsequently decided that acquiring a new, geologically secure site would best satisfy the three objectives listed above. Quarter section SW 06-44-23-W2M was initially selected based on the following:

- Proximity to the historic RM landfill to align future operations with historic trends of traffic and other disturbance.
    - The historic RM landfill and RM transfer station (because Greenland now offers discounted waste service to each farm site, the transfer station no longer exists) site is located 600 m west of the Project.
- Its relative isolation from occupied yard sites, towns and villages.
    - The nearest yard site to the PSA is 1,160 m to the southeast, although this yard is unoccupied. The closest occupied yard occurs about 1,900 m to the northwest with thick bush separation, which will be effective disruption to noise and sightline.
    - The nearest community is Crystal Springs roughly 5,150 m to the north-northwest and Yellow Creek is roughly 6,000 m to the east.
- Proximity to highways.
    - The Project is located less than 200 m east of Highway 20 and about 3.4 km west of Highway 41. No occupied residences exist along these portions of the RM grid road.
- Prevalence of cleared land on the site.

Further field investigation confirmed the prevalence of competent till soil with excellent waste containment properties underlying the site and a lack of extensive aquifers in the shallow subsurface.

3.0 INTEREST-BASED ENGAGEMENT

3.1 RM of Invergordon Ratepayer Engagement

Over the past four (4) years, stakeholder engagement has been conducted to allow interested parties to express their concerns and to become informed of the proposed landfill facility. Ratepayers in the RM of Invergordon were consulted through a series of public notices, four (4) meetings specifically targeting RM of Invergordon ratepayers, and one (1) meeting targeting the broader public following MOE's announcement of EIA studies for the proposed Project. The proponent has sought feedback from interested parties through invitations to speak at designated meetings, and requests for written feedback that was subsequently discussed at other meetings. Detailed documentation of the public engagement effort is provided in Appendix H in a series of 'Attachments' which are referenced below.

- RM of Invergordon (430) ratepayers were first made aware that the RM was considering an expansion to their landfill by way of a public notice distributed August 17, 2020. Notice is included as Attachment 1. Notice was distributed via direct mail and posted to the RM website as a 'Local Notice'.
- In the following months, an expansion to the current RM landfill site was ruled out resulting from the inability to purchase land that was adjacent to the current landfill site. That land is owned by the Government of Saskatchewan. After investigating various potential other sites, the developer selected the western half of 06-44-23-W2M as the proposed site for a new landfill (later, the southwestern quarter section was selected).
- On December 21, 2020, a meeting took place in the Yellow Creek Hall to provide information and facilitate discussion with stakeholders in the immediate vicinity of the proposed landfill site. This meeting opportunity was mailed to landowners adjacent the proposed site along with any residents within a 2-mile radius of the proposed site. The notice was distributed via direct mail and posted on the RM website as a 'Local Notice' December 11, 2020. The publication included the proposed agenda and is included as Attachment 2. The list of ratepayers that received the mail out is included as Attachment 3 while the list of attendees is included as Attachment 4. The meeting was attended by the developer, RM Council and Administration, and approximately 8 ratepayers. Included as Attachment 5 are photographs that were presented at this meeting to offer a glimpse of what a regional landfill would look like.
- Two ratepayer letters of concern were received by RM 430, both dated December 17, 2020, and are included as Attachment 6.
    - [redacted] attended RM 430 Council Meeting February 10, 2021, to share his concerns. [redacted] concerns dissipated once he understood the proposed site was not adjacent to property he owned.
    - [redacted] expressed his concerns about containment of wind-blown debris, groundwater contamination, and size of region that the landfill would service in an RM 430 Council Meeting and ratepayer meeting, as discussed below.
- On April 12, 2021, a ratepayer meeting was held at the RM Shop in Crystal Springs in which the developer presented the proposed project. The notice, including proposed agenda, was mailed to ratepayers on March 26, 2021, posted on the RM's website and is included as Attachment 7. This meeting was attended by the developer, RM Council and Administration, and approximately 30 ratepayers. The list of attendees is included as

Attachment 8. The PowerPoint presentation from this meeting is included as Attachment 9.

- A third ratepayer letter of concern was received by RM 430 dated April 18, 2021, included as Attachment 10. The letter is from [redacted]). [redacted] expressed their concerns at the August 16 ratepayer meeting, which is discussed below.
- On 29 April 2021, an RM 430 Council Meeting was held in which [redacted] expressed their concerns about the Project.
- Another ratepayer meeting was held August 16, 2021, also at the RM Shop in Crystal Springs. The notice was mailed to ratepayers along with their tax notices on July 30, 2021, as part of the RM's newsletter, posted on the RM's website and is included as Attachment 11. Due to an error in the newsletter, a public notice noting the correction was distributed August 31, 2021, presented as Attachment 12. This meeting was attended by the Developer, RM Council and Administration, Tara Pidborochynski with MOE, and approximately 34 ratepayers, four (4) of which attended via Zoom. A list of attendees is included as Attachment 13. Discussion points/questions/comments from the meeting, transcribed by RM 430 CAO Courtney Beaulieu, are included as part of Attachment 14.
- A fourth meeting was held on October 18, 2023, at the RM Shop in Crystal Springs to describe the progress to date. Notice of the meeting was individually mailed to each ratepayer in the RM. The total number of mail-outs was 1,061. A copy of the notice is attached as Attachment 15. Not including RM Council, RM Administration, RM staff or their respective spouses, a total of 4 ratepayers attended the meeting. Attendance listing attached as Attachment 16. In addition to the 4 attendees, 1 email submission and 2 phone calls (received by the RM Administrator) resulted in response to the mail-out. These submissions are included in Attachment 17. A copy of the PowerPoint and the associated speaking notes of the Developer are attached as Attachments 18 and 19. A hard copy of the PowerPoint presentation was provided to each attendee along with a handout that was provided by the RM referencing an RM Resolution from April of 2021. That correspondence is attached as Attachment 20. A transcription of the open dialogue that occurred after the Developer's presentation is attached as Attachment 21.

3.2 Broader Public Engagement

As a condition for the EA, a final public engagement meeting was held on September 4, 2024 to offer broader public engagement. This meeting was widely advertised to communities and entities outside of the RM of Invergordon. The advertisements directed people to invergordonlandfill.ca, a website containing the speaking notes and PowerPoint presentation for the Public Meeting, the Project's Technical Proposal submission, and MOE's Reasons for Determination related to the requirement of an EIA. The targeted advertisements included an email address with which comments and questions could be sent.

Advertisements for this meeting (Attachment 22) were widely distributed included the following:

- Emailed to surrounding rural municipalities including RM of Lake Lenore No. 399, RM of Three Lakes No. 400, RM of Hoodoo No. 401, RM of Flett's Springs No. 429, RM of Invergordon No. 430, RM of St. Louis No. 431, RM of Kinistino No. 459, and RM of Birch Hills No. 460 (Attachment 23);
- Emailed to surrounding municipal landfill operations including the City of Prince Albert, the City of Melfort, and the Town of Tisdale (Attachment 23);
- Emailed to the REACT Waste Authority that has a landfill operation and was identified as a concerned stakeholder by MOE (Attachment 24);
- Emailed to surrounding municipalities including St. Brieux, Cudworth, Wakaw and Birch Hills (Attachment 25);
- Posted dozens of hard copies of the Public Meeting Announcement in surrounding rural municipalities and towns including post offices, libraries, gas stations and grocery stores;
- Advertised online with Prince Albert Herald August 23rd to September 5th and in the printed version of the Prince Albert Herald August 29th, 2024 (Attachment 26).
- Advertised online with Northeast Now August 23 through September 4, 2024.
- Advertised in the printed version of Junction Review August 28th and September 4th, 2024.
- Advertised in the printed version of the Wakaw Recorder August 29th (Attachment 27).

The Proponent received zero emails in response to this extensive advertising campaign. The meeting was attended by eight (8) individuals, not counting presenters, RM Councillors, RM staff and their spouses, and an invited MLA (Attachment 28). Four billboards were displayed at the Public Meeting for the public to view. The billboards were diagrams of the Proposed Site

Location, Site Design, Cell Design and Leachate Sump Design (Attachment 29). Questions were posed by three (3) individuals. A summary of the Question-and-Answer period of this public meeting is included as Attachment 30.

MOE also initiated the following advertisements regarding the upcoming EA:

- The proposed development was advertised in the Regina Leader Post and the Saskatoon Star Phoenix September 7th, 2024 (Attachments 31 and 32)
- The proposed development was advertised in the Melfort Nipawin Journal September 13th, 2024 (Attachment 33)
- The proposed development was advertised on the MOE website (Attachment 34)

The Proponent is not aware of any public response to these MOE initiated advertisements.

3.3 Public Response

The public engagement efforts described above provided an opportunity for interested or concerned parties to ask questions and voice their concerns. The questions, concerns and discussion were similar at all meetings. The recurring themes include 1) liability and project justification; 2) traffic concerns and impacts to RM roads; and 3) ecological and public health impacts of landfills. Specific questions, concerns and responses are provided in Appendix H as Attachment 35. The main concerns, responses, and mitigation measures are as follows:

- **Concern:** Partnering with a private developer to build a landfill rather than alternative options of public controlled waste management.

  Response: Since closing its historic landfill, the RM of Invergordon has struggled to find an affordable strategy for managing solid waste. It is financially unfeasible for the RM to develop and operate a landfill on its own and the current waste transfer station model is costly. Under the proposed development, the Proponent will pay for licensing, design, construction, operation, monitoring and decommissioning, while sharing a portion of the gross revenue with the RM, in the order of $50,000 per year.

  The Proponent has an excellent track record of landfill development and management in Saskatchewan. To manage risk, the Proponent will be required by MOE to demonstrate financial assurance to cover decommissioning costs for all constructed features, likely up to $1,000,000. In addition, the Proponent has $5,000,000 in Environmental Insurance and $10,000,000 in Commercial Liability Insurance.

- **Concern:** Impacts to RM roads and increased traffic.

Response: Traffic will increase in the order of 6 trucks per day (earlier in the public engagement process it was estimated at 8 to 10 trucks daily). To manage adverse impacts the Proponent will incorporate dust control measures, implement a revenue sharing program far in excess of increased road maintenance fees, limit landfill operating hours, and site the Project on a portion of municipal roadway where there are no residences.

Note that after the last public engagement meeting, it was decided through consultation with the MOH that site access will be from Highway 20 instead of Highway 41. This route will utilize a nominally shorter length of municipal road and mitigate interchange traffic safety concerns.

- **Concern:** Ecological and public health implications of a landfill.

  Response: Landfills are heavily regulated in the province to avoid adverse ecological and human health impacts. During the public engagement events, the attendees were educated on the regulations in place for landfill development including standards for demonstrating site suitability, best practice landfill design, monitoring requirements and decommissioning plan requirements all of which mitigate risk. Other relevant mitigation measures include landfill liners, leachate collection and withdrawal systems, landfill siting, plant and wildlife surveys and impact assessment, and avoidance of unnecessary vegetation and habitat disturbance.

In addition to these concerns, MOE received a letter in June 2022 from REACT Waste Management District implying concern about the impacts to existing regional landfills. The partially redacted letter, which was obtained through a Freedom of Information request, is provided as Attachment 36 in Appendix H. A response to this concern was provided in the Technical Proposal and is reiterated with additional detail in this document in the evaluation of socioeconomic impacts of the Project. It is important to note that REACT Waste Management District was directly contacted regarding involvement in the broader public engagement consultation process, documented in Section 3.2, and no response was received.

3.4 Ongoing Engagement Commitments

Maintaining communication and engagement with interested parties, including the public, is important for the entire project lifespan. Invergordon Landfill Inc. is committed to identifying opportunities to share information and engage with the public on the project. The following activities will foster meaningful engagement throughout the project lifespan:

- Maintenance of corporate website including, but not limited to, the following:

- Postings of new information that has emerged since public engagement events;
- A link to the government website where the EIS and determinations can be accessed; and,
- The Proponent's email address to provide a channel of communication that all interested parties can use to provide written feedback, questions, and complaints.

- Complaints received from interested parties, if any, will be resolved using the following process:
  - Complaints will be addressed if received in written form addressed to the Proponent. Third party complaints will not necessarily be considered;
  - Investigation of complaint by the Proponent to verify the complainant's claims, assess the root cause of the problem, define the impact to persons or environment, and identify a mitigative action plan to remove or minimize adverse effects, if practical;
    - Where appropriate, Ministry of Environment will be included in the investigation to assess the magnitude of complaint and identify reasonable mitigative solutions;
  - Provide a written response to the complainant summarizing the investigation's findings;
  - Follow up with the complainant as required to address actions that have been taken; and,
  - Document all complaints received, investigations, and communications with parties involved in complaint resolution.

4.0 EIA BOUNDARIES

4.1 Spatial Boundaries

Three (3) distinct study areas are considered in the EIA: a Project Study Area (PSA), Local Study Area (LSA), and Regional Study Area (RSA). Spatial boundaries of the local and regional study areas will vary depending on the Valued Component (VC) that is being assessed to reflect a reasonable geographical extent of study depending on the potential receptors and types of impact that may occur.

Project Study Area

The PSA is defined as the area contained within the Project's footprint, which is shown in Drawing WM566.3-4. This spatial boundary is fixed for all VCs.

Local Study Area

Unique LSAs were established for each VC. Generally, the LSA will be defined as the geographical area immediately surrounding the PSA where direct impacts from onsite activities could conceivably occur. For ecological surveys, the LSAs were determined based on species activity restriction setbacks (MOE FWB 2017) for potentially occurring species in the area. The LSAs for various VCs are shown in Drawing WM566.3-7.

Regional Study Area

Generally, the RSA will be defined as a larger buffer around the LSA where indirect, cumulative or cascading impacts could conceivably occur. The RSAs for various VCs are shown in Drawing WM566.3-8.

The spatial study areas that are expected to be used for various VC assessments are tabulated below in Table 4.1.

Table 4.1 Spatial Boundaries for Various VC Assessments

	Local Study Area (LSA)		**Regional Study Area (RSA)**	
Valued Component (VC)	Setback from PSA	Area (ha)	Setback from PSA	Area (ha)
Physical Environment				
Groundwater Quality	Neighbouring quarter sections	603	3.2 km	4,107
Surface Water Quality	Neighbouring quarter sections	603	1.6 km	1,271
Climate & Air Quality	RM of Invergordon	88,082	GWSA [1]	7,005,071
Ecological Environment				
Wetlands & Aquatic Life	500 m [2]	254	5 km	9,218
Terrestrial Habitat & Wildlife	1 km [3]	622	5 km	9,218
Vegetation	30 m [4]	50	5 km	9,218
Human Environment				
Human Health & Wellbeing	RM of Invergordon	88,082	GWSA	7,005,071
Socioeconomics	RM of Invergordon	88,082	GWSA	7,005,071

[1] Greenland Waste Service Area, see Drawing WM566.3-6

[2] Wetland Survey 45m setback from PSA and any no direct slope from PSA, aquatic survey LSA was 30 m setback from PSA based on the largest setback listed by MOE FWB 2017 for potential species of concern present in the area and wetland survey was 45 m setback

[3] Surveys for raptor nests was 10000m, sharp-tailed grouse leks was 400 m, common nighthawk 200 m and Canada warbler 300 m

[4] selected the greatest setback for plant species tracked by SCDC since no plant species listed under SARA as endangered, threatened, special concern, or extirpated, or plant species listed in the Wildlife Act, 1998, was likely to be present in the Project area

Considerations of the spatial boundaries for each VC is described below.

Groundwater Quality

Spatial boundaries are guided by the measured rates of groundwater movement below the Project. Analysis suggests that lateral groundwater movement is generally slow, in the order of 10 m/year or less. The LSA is defined as adjacent quarter sections of land to a distance of 800 m from the Project and RSA considers groundwater resources with 3.2 km of the Project, which is a standard distance for groundwater investigations.

Surface Water Quality

Surface water bodies occur on and near the PSA and have indirect connectivity to regional water bodies and streams. The LSA is defined as adjacent quarter sections of land to a distance of 800 m from the Project and RSA considered water resources within 1.6 km of the Project.

Climate & Air Quality

Greenhouse gas (GHG) emissions are the main concern with respect to the Project's effects on climate and air quality. Boundaries for this assessment are guided by the range over which the Project will conceivably impact the production of GHG emissions, either directly or indirectly. The impacts of greenhouse gas emissions are global in nature, so the spatial assessment focuses on the area over which GHGs are produced, not the area over which their effects are felt. The LSA is defined as the RM of Invergordon and RSA is defined as the entire GWSA.

Wetlands & Aquatic Life

Spatial boundaries are guided by regulatory requirements and guidelines for wetlands and aquatic life. The LSA is defined as adjacent land up to 500 m from the Project, and the RSA includes the area within 5 km of the Project. The spatial boundary for wetland field assessments (the LSA) includes all wetlands inside, and within 45 m, of the Project footprint, as well as any wetlands along a direct slope from the Project area. The spatial boundary for aquatic wildlife species field assessments was 500m, while the boundary for aquatic plant species field assessments was 30m, as the greatest setbacks for an aquatic wildlife (Northern Leopard frog) and plant species (those tracked by the Saskatchewan Conservation Data Center [SCDC], but not listed under the *Species at Risk Act* [SARA] or *Wildlife Act, 1998*), respectively, likely to be present in the Project area (MOE FWB 2017).

Wildlife & Wildlife Habitat

Spatial boundaries are guided by regulatory requirements and guidelines for wildlife and wildlife habitat. The LSA is defined as adjacent land up to 1000 m from the Project, and the RSA includes

the area within 5 km of the Project. The spatial boundary (LSA) for the surveys completed are based on the setbacks for potential species of conservation concern likely to be present in the Project area (MOE FWB 2017). These include raptor nests (1000m), Sharp-tailed Grouse leks (400m), Common Nighthawk (200m), and for breeding birds Canada Warbler (300m) setbacks were used.

Vegetation

Spatial boundaries are guided by regulatory requirements and guidelines for vegetation and plant species of conservation concern. The LSA is defined as adjacent land up to 30 m from the Project, and the RSA includes the area within 5 km of the Project. The spatial boundary (LSA) for the surveys completed are based on the setbacks for potential species of conservation concern likely to be present in the Project area (MOE FWB 2017). As no plant species listed under SARA as endangered, threatened, special concern, or extirpated, or plant species listed in the *Wildlife Act, 1998*, was likely to be present in the Project area, the greatest setback for plant species tracked by the SCDC, 30m, was used.

Human Health & Wellbeing

A landfill project has the potential to impact various aspects of human life that impact general wellbeing. Concerns over human health impacts and various nuisances were voiced during stakeholder engagement. Spatial boundaries for the human health and wellbeing assessment of the Project are guided by the range over which the Project could conceivably influence day to day life and wellness of individuals. With this rationale the LSA is defined as the RM of Invergordon and the RSA is defined as the GWSA.

Socioeconomics

The Project will have socioeconomic implications for individuals, communities, and other solid waste management facilities. Spatial boundaries for the socioeconomic assessment of the Project are guided by the range over which the Project could conceivably influence individual or community finances, either directly or indirectly. For this assessment the LSA is generally defined as the RM of Invergordon and the RSA is defined as the GWSA. The exception is that for the assessment of impacts to neighbouring solid waste management facilities the LSA defined as the GWSA (with provision to include the RMs of Rosthern and Leask since they both have landfills very close to the GWSA boundary) and the RSA is defined as the Province of Saskatchewan broadly.

4.2 Temporal Boundaries

Project impacts will be assessed for the four (4) stages of the Project presented in Section 2.3, including:

- Construction;
- Operations;
- Decommissioning; and,
- Post-closure.

The Project's impacts on will be discussed in terms of the Project timeline as different periods may have unique considerations and distinct impacts associated with the activities involved in each stage. The assessment will also consider the permanence of impacts, in other words whether they are reversible, partially reversible, or irreversible.

5.0 EXISTING ENVIRONMENT

The existing environment is defined for the physical, ecological, and socioeconomic environments in this section to characterize the environment in which the Project will be sited and to provide a basis for assessing the significance of immediate and long-term impacts of the Project. Information can also be used as a reference point for monitoring changes resulting from the Project over time. Where it was possible or reasonable to do so the existing environment is defined quantitatively to allow for precise predictions and future measurements of change.

5.1 Physical Environment

5.1.1 Study Overview & Data

WaterMark Consulting Ltd. undertook several field investigation programs between spring 2021 and summer 2022 and subsequent analysis to characterize the existing physical environment. In addition to field data, regional groundwater maps (SRC, 1990) were consulted to define the hydrogeological setting and provincial water body, and water course mapping was consulted to define the surface water and drainage network at and around the site.

Field data collection consisted of the following tasks:

- The subsurface conditions of the site were investigated through four drilling programs which are summarized in Table 5.1 below. Borehole locations are shown in Drawing

WM566.3-9. Lithology of each borehole was described by WaterMark Consulting Ltd. personnel and is documented in the attached borehole logs in Appendix I.

- During the auger drilling investigations, soil samples were collected at 1.5 m intervals from auger stems and select soil samples were submitted for geotechnical testing, as summarized in Table 5.2.
- Water samples were collected at select piezometer locations, at the large slough on the western property boundary, and at the small slough on the eastern property boundary to define baseline groundwater and surface water chemistry. The sampling program is summarized in Table 5.3. The groundwater and surface water chemistry results are summarized in Tables B.1 and B.2 in Appendix J, respectively. Certified laboratory reports are also provided in Appendix J.
- Groundwater piezometric levels were monitored during several site visits. The measurements that best represent normal static high-water levels are summarized in Table 5.4. In addition to the discrete water level measurements, pressure transducers were installed in select piezometers and left for six weeks during spring 2022 to characterize natural fluctuations and establish the peak levels associated with the spring melt. Several of the piezometers remained dry for the duration of measurement but three (3) provided continuous water level data, which is presented below in Table 5.4.
- The main soil types that represent potential flow pathways and confining layers were subject to field testing and laboratory testing to establish hydraulic conductivities. The results are summarized in Table 5.5.
- LiDAR and orthoimagery surveys were completed. A topographic contour map of the site is presented in Drawing WM566.3-10.
- The Water Security Agency (WSA) water well driller database was queried to identify all licensed wells within 3200 m of the Project footprint. The results are shown graphically in Drawing WM566.3-11 and are summarized in Table 5.6.

Regional maps indicate that Middle and Lower Floral Formation Aquifers occur below the site and extend to the south. These aquifers are mapped regionally at elevations of about 515 mASL and 485 mASL respectively, corresponding to depths in the range of 50 m and 80 m below the site. In addition, an Empress Group Aquifer occurs nominally 7 km to the southwest at structural elevations of about 350 mASL, roughly 200 m below ground surface.

Table 5.1 Summary of Drilling Program

Test Hole	Land Location	UTM Location* (m) Easting	Northing	Elev	Top of Casing (mASL)	Drilled Depth (m)	Tip Depth (m)	Completion
31-May-2021 Drilling Investigation								
BH101	SW 06-44-23-W2M	13U 477,724	5,845,061	569.3	570.36	15.2	5.8	Ox Till
BH102	SW 06-44-23-W2M	13U 477,144	5,845,387	574.6	575.69	15.2	9.1	Unox Till
BH102A	SW 06-44-23-W2M	13U 477,142	5,845,386	574.5	575.68	6.1	5.5	Ox Till
BH103	SW 06-44-23-W2M	13U 477,668	5,845,839	566.5	567.63	12.2	7.0	Ox Till
BH104	SW 06-44-23-W2M	13U 477,659	5,845,466	566.3		13.7	-	-
BH105	NW 06-44-23-W2M	13U 477,705	5,846,420	~565.3		15.2	-	-
BH106	NW 06-44-23-W2M	13U 477,426	5,846,156	~576.4		15.2	-	-
BH107	SW 06-44-23-W2M	13U 477,443	5,845,600	572.8		12.2	-	-
18-Oct-2021 Drilling Investigation								
BH201	SW 06-44-23-W2M	13U 477,522	5,845,057	578.3		15.2	-	-
BH202	SW 06-44-23-W2M	13U 477,528	5,845,263	574.1		15.2	-	-
BH203	SW 06-44-23-W2M	13U 477,703	5,845,260	566.4		15.2	-	-
BH204	SW 06-44-23-W2M	13U 477,659	5,845,462	566.3	567.23	6.1	6.1	Ox Till
BH204A	SW 06-44-23-W2M	13U 477,659	5,845,465	566.5	567.47	12.2	12.2	Unox Till
BH205	SW 06-44-23-W2M	13U 477,497	5,845,460	574	573.11	9.1	7.6	Ox Till
BH205A	SW 06-44-23-W2M	13U 477,494	5,845,458	573.2		15.2	-	-
BH206	SW 06-44-23-W2M	13U 477,326	5,845,445	578.1	579.13	15.2	7.6	Ox Till
BH207	SW 06-44-23-W2M	13U 477,470	5,845,681	572.4		15.2	-	-
BH208	SW 06-44-23-W2M	13U 477,680	5,845,660	566.3		15.2	-	-
BH209	SW 06-44-23-W2M	13U 477,473	5,845,837	572.4	573.25	15.2	10.7	Ox Till
28-Mar-2022 Drilling Investigation								
BH301	SW 06-44-23-W2M	13U 477,140	5,845,052	~592.1		9.1	-	-
BH302	SW 06-44-23-W2M	13U 477,283	5,845,074	579.8	580.86	16.8	5.2	Ox Till
BH303	SW 06-44-23-W2M	13U 477,364	5,845,278	582.6		9.1	-	-
BH304	SW 06-44-23-W2M	13U 477,145	5,845,382	575.7	574.67	10.4	10.2	Sand
BH305	SW 06-44-23-W2M	13U 477001	5,845,030	584.1	585.29	13.0	5.5	Ox Till
BH306	SW 06-44-23-W2M	13U 477,000	5,845,283	574.9		9.1	-	-
BH307	SW 06-44-23-W2M	13U 477,175	5,845,643	582.6		15.2	-	-
BH308	SW 06-44-23-W2M	13U 477,162	5,845,569	578.2		9.1	-	-
BH309	SW 06-44-23-W2M	13U 477,374	5,845,877	576.2	577.21	12.2	4.6	Ox Till
BH310	SW 06-44-23-W2M	13U 477,178	5,845,272	575.2		12.2	-	-
BH311	SW 06-44-23-W2M	13U 477,492	5,845,309	573.9		4.6	-	-
10-May-2022 Drilling Investigation								
BH401	SW 06-44-23-W2M	13U 477649	5,845,740	566.4		148.7	-	-
BH401A	SW 06-44-23-W2M	13U 477650	5,845,737	566.30	567.48	51.8	48.5	Mid Floral
BH401B	SW 06-44-23-W2M	13U 477651	5,845,732	566.2	567.20	24.4	24.4	Unox Till
BH402	SW 06-44-23-W2M	13U 477,520	5,845,067	578.6		91.4	-	-

Table 5.2 Summary of Geotechnical Laboratory Results

Borehole	Depth (m)	Grain Size Classification (%) gravel	c sand	m sand	f sand	sand	silt	clay	fines	Atterberg Limits (%) LL	PL	PI	natural m/c
Glacial Till 22 sample avg	1.5-9.1	5.1	2.0	7.7	21.0	30.6	34.1	30.2	64.3	29.1	13.1	16.0	14.3
Sand Unit 3 BH102	10.7	1	1	12	50	63	19	17	36	16	12	4	15.0

Table 5.3 Summary of Water Sampling

Analyte	BH102	BH102D	BH102A	BH103	BH204	BH204A	BH304	West Slough	East Slough
Sample Date	*30-Mar-22 unox till*	*30-Mar-22 unox till*	*30-Mar-22 ox till*	*30-Mar-22 ox till*	*30-Mar-22 ox till*	*30-Mar-22 unox till*	*30-Mar-22 Sand U3*	*11-May-22 surface*	*11-May-22 surface*
Routine	X		X	X	X	X	X	X	X
Total Metals								X	X
Total Mercury								X	X
Dissolved Metals	X	X	X	X	X	X	X		
Dissolved Mercury	X		X	X	X	X	X		
NH3, TKN, COD	X		X	X	X	X	X	X	X
DOC	X		X	X	X	X	X		
BOD	X		X	X	X	X	X		
Oil & Grease								X	X

Table 5.4 Summary of Water Level Monitoring

Piezometer	Unit	Ground Elev (mASL)	Tip Depth (mbgs)	Top of Casing (mASL)	Depth to Water (m btoc) 10-May-22	22-Jun-22	Piezometric El (mASL) 10-May-22	22-Jun-22
BH101*	ox till	569.31	5.8	570.36	2.40		567.96	
BH102	unox till	574.55	9.1	575.69	4.92		570.77	
BH102A	ox till	574.48	5.5	575.68	4.07		571.61	
BH103	ox till	566.48	7.0	567.63	2.48		565.15	
BH204*	ox till	566.33	6.1	567.23	1.54		565.69	
BH204A	unox till	566.51	12.2	567.47	4.69		562.78	
BH205**	ox till	573.11	7.6	574.02	dry		<566.39	
BH206	ox till	578.14	7.6	579.13	dry		<571.54	
BH209*	ox till	572.38	10.7	573.25	10.12		563.13	
BH302**	ox till	579.83	5.2	580.86	dry		<576.75	
BH304	sand 3	574.67	10.2	575.65	5.40		570.25	
BH305	ox till	584.14	5.5	585.29	dry		<589.75	
BH309**	ox till	576.18	4.6	577.21	dry		<571.58	
BH401A	Mid Floral	566.30	51.8	567.48		26.51		540.97
BH401B	unox till	566.18	24.4	567.20		12.87		554.33
West Slough	surface	-	-	-			569.90	
East Slough	surface	-	-	-			565.5***	

Notes: * Pressure transducers installed 28 March 2022 to 10 May 2022. Continuous water level data available for this period.

** Pressure transducers installed 28 March 2022 to 10 May 2022. No water level detected in piezometer during this period.

*** East slough was dry in fall 2021 and fall 2022

Table 5.5 Summary of Hydraulic Conductivity Testing

Piezometer	Hydraulic Conductivity (m/s)
Oxidized Till	
BH101	2.6E-08
BH102A	2.2E-09
BH103	2.1E-08
BH204*	2.7E-06
Geometric Mean	*1.1E-08*
Unoxidized Till	
BH102*	3.6E-08
BH204A	7.8E-10
BH401B	3.4E-10
BH203 (undisturbed)**	1.1E-10
BH301 (undisturbed)**	9.9E-11
Geometric Mean	*2.3E-10*
Lab Remoulded Glacial Till	
BH207**	1.1E-10
BH311**	2.7E-10
Geometric Mean	*1.7E-10*
Sand Unit 3	
BH304	3.4E-07

Notes: * Anomalous response, Geometric mean ignores this data.
** Laboratory tested sample. All other testing done in-situ.

Table 5.6 Summary of Neighbouring Wells and Yard Sites

Land Location	WWDR	Owner	Year	Distance from Site (m)	Elevation (mASL)			Direction	Interpreted Aquifer
					Ground	Water	Well Tip		
NW-32-43-23-2	76387	Madraga	1983	1,170	541.0	538.0	504.4	E (cross-gradient)	Middle Floral
NE-25-43-24-2	112250	Wojcichowsky	2000	2,230	586.7	556.9	513.6	S (upgradient)	Middle Floral
NE-25-43-24-2	201379	Wojcichowsky	2003	2,270	586.7	-	578.2	S (isloated from Project)	Upper Floral
SE-30-43-23-2	43316	Tokarchik	1975	2,310	548.6	515.1	472.4	S (isloated from Project)	Lower Floral
SE-30-43-23-2	23559	Wojcichowsky	1971	2,900	541.0	530.4	480.1	S (isloated from Project)	Lower Floral
NW-25-43-24-2	23729	Orenchuk	1971	3,100	570.0	-	538.9	SW (isloated from Project)	Upper Floral
SW-30-43-23-2	213822	Marko	2008	3,120	563.9	562.4	553.2	S (isloated from Project)	Upper Floral
dditional Occupied Yard Sites & Water Source									
NW 01-44-24-W2M				2,020	Occupied dwelling. Lake adjacent.				
SE 32-43-23-W2M				2,440	Occupied dwelling. Water source unknown. Creek Adjacent. No dugouts or pipelines visible.				
NW 19-43-23-W2M				3,150	No house visible on site.				

5.1.2 Soils and Groundwater

5.1.2.1 Geological & Hydrogeological Mapping

The site's geology and hydrogeology were interpreted from field data and regional mapping. The site is generally underlain by glacial till, a low permeability soil that restricts infiltration and movement of groundwater. Discrete sand deposits occur within the clay soils, which have the potential to function as preferential flow pathways within the subsurface. Cross sections showing the geology interpreted from the attached borehole logs are shown in Drawing WM566.3-12 through Drawing WM566.3-17.

The field investigation identified six (6) discrete sand units in the subsurface. A map of the interpreted extents of sand deposits are shown in Drawing WM566.3-18. Each unit is described briefly below.

- Sand Unit 1 is shallow, unsaturated, and occurs on a portion of the property that is outside the Project footprint. This unit does not represent a primary pathway or a receptor of concern.
- Sand Unit 2 is interpreted as a channelized deposit coinciding with the ridge intersecting the property. Where encountered in boreholes, Sand 2 was described as 'fine sand', with some medium sand and silt inclusions. Groundwater flows northwesterly with an interpreted hydraulic gradient of 0.8% through this semi-saturated deposit, draining into the west slough. This deposit does not constate an aquifer given its limited extent, however it is considered an important groundwater flow pathway on the western part of the site, as discussed in Section 5.1.2.2 below. It is referred to in this report as the 'channelized sand' or 'channelized flow system'.
- Sand Unit 3 was mapped on the southwestern part of the site at elevations lower than Sand Unit 2. It is interpreted that the west slough discharges into Sand Unit 3. Given the limited overlap of this unit with the Project footprint, its significant depth of 10 m to 15 m where it does underlie the Project footprint, its limited thickness of about 1 m, silt and clay content, poor hydraulic properties, and a lack of known or suspected downgradient receptors, this unit is not a primary pathway nor a receptor of concern.
- Sand Unit 4 was encountered in the far southeastern corner of the site. Like Sand Unit 3, this unit is not a primary pathway or a receptor of concern owing to its significant depth of about 12 m, limited extent, and a lack of known or suspected downgradient receptors.

- Saturated sand interpreted to be the Middle Foral Aquifer was encountered at a depth of about 38 m below the site. The aquifer is overlain by a significantly thick deposit of low permeability clay soils which limit vertical infiltration. The significant thickness of the till deposit overlying the aquifer and the consistency of aquifer depth in regional and local mapping rules out the possibility of connectivity with the shallower flow systems identified on site. The aquifer is mapped regionally and has an interpreted northeasterly gradient based on water wells identified in Drawing WM566.3-11 and Table 5.6. There are no downgradient well users within the study area, although wells are present upgradient and cross gradient. The flow system's potential to be impacted by surface activities is assessed in Section 5.1.2.2 below since this represents the shallowest aquifer underlying the site.
- The deeper Lower Floral Aquifer is interpreted to occur at about 68 m below ground surface. Since it is located below the Middle Floral Aquifer and separated by intact glacial till, the Lower Floral Aquifer is effectively hydraulically isolated from the shallow flow system, therefore it is not considered a pathway or receptor of concern.
- A deeper sand unit correlated to the Empress Group Aquifer was encountered at about 145 m below ground surface. Since it is located below the Floral Aquifers, the Empress Group Aquifer is effectively hydraulically isolated from the shallow flow system, therefore it is not considered a pathway or receptor of concern.

Piezometric levels are shown in the cross sections in Drawing WM566.3-13 through Drawing WM566.3-17 and the site's interpreted phreatic surface is illustrated in Drawing WM566.3-19. The phreatic surface reflects the complex groundwater flow patterns interpreted at the site, which are described in the following section.

5.1.2.2 Conceptual Site Model

Four (4) distinct groundwater systems were identified. These areas are depicted conceptually in Drawing WM566.3-20 and are described below.

1) Sand Unit 2: The only active groundwater movement in the shallow subsurface occurs as northwesterly flow in the channelized (Sand 2) deposit. Intrinsic velocity within this flow path is estimated in the order of 1 m/yr to 10 m/yr using the following equation:

$$v = \frac{3{,}153{,}600\ ki}{n}$$

Where v = intrinsic velocity in m/yr;

k = hydraulic conductivity in m/s;

i = hydraulic gradient = Δh/Δl;

Δh = difference in piezometric head between two locations;

Δl = distance between the two piezometric head measurements;

n = porosity; and

3,153,600 = a conversion factor to produce units of m/yr

For this calculation, the hydraulic conductivity is interpreted as being between 10^{-6} m/s and 10^{-5} m/s which is a typical range for clean fine sand. The hydraulic gradient is measured at 0.8% across the site as shown in Drawing WM566.3-19 and the porosity is interpreted to be 0.25 which is typical for clean sand.

This channelized flow system will be susceptible to impacts from the Project since portions of the landfill cells will overlie the deposit. Impacting groundwater quality in the channelized flow system could subsequently impact water chemistry in the west slough. Mitigations to protect the channelized flow system are therefore warranted, as a means of mitigating impacts to the west slough.

Mitigations and expected impacts are discussed in Section 7.2. Baseline groundwater chemistry has not been established for the channelized flow system, however there are provisions in the recommended monitoring program in Section 11.4 to address this data gap.

2) Eastern shallow fractured till: Very slow, northerly groundwater movement with an intrinsic velocity of <0.01 m per year occurs within the shallow, oxidized till on the eastern half of the site. This flow rate assumes a measured hydraulic conductivity of $4x10^{-9}$ m/s, a hydraulic gradient of 0.7% interpreted from the surface depicted in Drawing WM566.3-19 and a porosity of 0.10 which is typical for fractured clay soils.

   The combination of a low hydraulic gradient and a low hydraulic conductivity indicates that there is little recharge in the system and no proximal drainage outlet. This implies two (2) things: 1) that there is little risk that impacted groundwater within the fractured till glow system will migrate offsite, and 2) that impacted fluids that leak into this flow system are likely to be concentrated. The potential for a high concentration plume to persist on site into the post-closure period warrants assessment. In addition, this groundwater system is shallow, and the system likely extends into the neighbouring cropland to the north (downgradient) so the potential for offsite ecological uptake would existing if offsite flow were to occur. These risks are assessed in Section 7.2.

Baseline groundwater chemistry has been established for this flow system and is provided in Appendix J (see piezometers BH103 and BH204). Cadmium occurs at higher than normal background levels in the existing environment.

3) Western fractured till: Elsewhere on the property the shallow soil profile is characterized as unsaturated oxidized till overlying unoxidized till. In other words, lateral flow in the shallow substrate is effectively negligible. In the southwest corner of the site two (2) stagnant, localized pockets of groundwater were interpreted below the two (2) bogs. The oxidized till is unsaturated within 100 m south, west and north of the bogs (at BH302, BH311 and BH306) which contain ponded water in early summer to an elevation of about 573 mASL. This indicates that the surficial oxidized till soils in this area are low permeability, receive a trivial amount of recharge from the bogs, and contribute no groundwater seepage into the bogs. This also implies that the bogs have poor hydraulic connection to the nearby west slough, or to either Sand Unit 2 or Unit 3.

4) Deeper flow system: In terms of groundwater percolating into deeper flow systems, the intrinsic vertical velocity of flow into the shallowest potable water aquifer underlying the site, the Floral Aquifer, is estimated to be in the order of 0.01 m/year. This calculation is based on a vertical hydraulic gradient of 40% measured from water level observations in the unoxidized till and the Middle Floral aquifer piezometers BH401A and BH401B (see Table 5.4 and Drawing WM566.3-17), an established hydraulic conductivity of $2x10^{-10}$ m/s for unoxidized till, and a porosity of 0.35 which is typical for unoxidized till. Based on this very low rate of infiltration and significant depth of the aquifer, impacts from the Project are not likely. Nonetheless, as the shallowest aquifer it warrants an effects assessment which is presented in Section 7.2.

5.1.2.3 Historic RM Landfill

The RM of Invergordon operated a landfill 600 m west of the PSA until 2019 when it was closed. The historic landfill location is shown in Drawing WM566.3-25. The Proponent has no affiliation with this site and has never been affiliated with it. It is discussed here to address the concern that impacts from the historic RM landfill may compound the Project's impacts.

The following remarks support the interpretation that there is no hydraulic connection between the historic landfill site and the Project, and thus no cumulative impact:

- The two (2) properties are located in separate hydrogeologic flow systems;

- A Phase II ESA completed on the RM landfill property (Pinter & Associates Ltd., 2018) identified a northwesterly gradient, diverging from the Project flow system;
- The Project groundwater system primarily flows northeasterly;
- A small component flows northwesterly towards the west slough;
- The west slough forms a hydrogeologic divide with effectively no groundwater interaction between the two (2) sites.

5.1.3 Topography, Drainage, and Surface Water

The eastern and western halves of the site are distinct from each other in terms of topography, land use and drainage. The western half of the site is characterized by high topographic relief, intact bush and forest and drainage primarily directed into a large unnamed slough, referred to herein as the 'west slough' which occurs about 60 m west of the PSA. In contrast, the eastern half of the site is cultivated and slopes gently eastward into network of intermittent and ephemeral wetlands on the eastern edge of the PSA which are referred to collectively herein as the 'east slough'. A topographic plan of the site, generated from LiDAR data and depicting surface water bodies, is presented in Drawing WM566.3-10.

Water bodies identified within the EIA boundaries are described below:

- The west slough is present on the western part of the property within the LSA. Water level occurs at roughly 570 mASL. Groundwater from the channelized Sand Unit 2 deposit is interpreted to discharge into the slough with an estimated intrinsic velocity in the order of 5 m/year, whereas slough water recharges Sand Unit 3, as illustrated in Drawing WM566.3-20, directing groundwater northerly. Baseline water quality was established for the slough and is provided in Appendix J. The west slough straddles the Proponent's property and the adjacent quarter section, which is designated as a Wildlife Habitat Protection Area, which suggests the potential for wildlife watering use of the slough.
- The east slough occupies the eastern edge of the PSA. The ponds were observed to be dry in late summer and fall through both years of field investigation (2021 and 2022). Most of the PSA currently drains into this wetland. The sloughs are a point of groundwater discharge in the south and groundwater recharge in the north for a very slow-moving fractured till flow system as shown in Drawing WM566.3-20. Baseline water quality has been established for the east slough and is provided in Appendix J. Cadmium occurs at higher than normal background levels in the existing environment.

- Bogs occupy two (2) topographic lows in the southwestern quadrant of the property. The bogs have no natural outlets and are interpreted to have small infiltration rates, so accumulated surface water is managed primarily through evaporation. The bogs have very limited hydrogeologic connectivity to the nearby west slough, owing to the proximal location and elevated phreatic surface.
- The west and east sloughs both drain northerly through poorly defined natural drainage networks into a larger, unnamed slough, herein referred to as the Northern Slough, about 800 m north of the property. Connectivity of drainage is not sustained over this distance due to the overall altered nature of the landscape from agricultural development. This Northern Slough subsequently drains northeasterly through a combination of natural drainage paths and man-made ditches into McCloy Creek 15 km northeast of the property then into Waterhen Marsh about 5 km further downstream. Again, stream connectivity is not sustained particularly at higher elevations (i.e. in closer proximity to the Project). These features are depicted in Drawing WM566.3-21.

There are no known surface water users within the regional study (i.e. no reservoirs, dugouts, or yard sites adjacent water bodies). Wetlands and waterbodies as they relate to the ecological environment are characterized further in Section 5.2.2.

Mitigations will be required to avoid adversely impacting water quality in the east and west sloughs, by overland flow and from subsurface flow through the channelized sand deposit described in Section 5.1.2.2. Mitigations will also be required to ensure that drainage is maintained along the eastern edge of the PSA where the perimeter berm will intersect ephemeral and permanent wetlands.

5.1.4 Climate

Regional climate metrics are discussed in this section not because baseline climate conditions are expected to measurably change with the Project, but because they inform some of the engineering and operational mitigations related to runoff containment, leachate generation, and leachate irrigation. The Project is anticipated to have quantifiable impacts on greenhouse gas (GHG) emissions, contributing to global climate change.

Regional climate is approximated from Environment Canada data collected between 1981 and 2010 at a Melfort weather station, roughly 50 km east of the proposed development. Gross evaporation data from PFRA is also available for the Melfort region for the period of 1911 to 2004. The mean annual precipitation for the region is 396 mm, most of which occurs as rainfall between the months

of May to September. Over the course of a typical year, the mean annual precipitation partitions into nominally 291 mm of rainfall and 105 mm of snowfall (water equivalent). The gross annual evaporation is estimated to be 704 mm, nominally 78% higher than the mean annual precipitation. The cumulative net evaporation is 308 mm per year, taken as the difference between gross evaporation and total precipitation. The cumulative flux on a water surface is net upwards (net evaporative) between the months of April and October. The net evaporative flux maximizes between May and August when the evaporation exceeds precipitation by over 65 mm per month. Between the months of November and March, the net cumulative flux on a water surface is downwards (net precipitation), mostly because the gross evaporation is at or near zero through the winter months. For a 25-year return period, the 24-hour duration precipitation amount is 83 mm which increases to 93 mm for a 50-year return period.

Wind data from the Melfort Weather Station between 2017 and 2022 was analysed to characterize the distribution of windspeed and direction. The prevailing wind direction is from the west with secondary prevalence occurring from the south. A seasonal breakdown of the wind identified the west dominant wind is prevalent through all 12 months.

Climate is known to be impacted globally by GHG emissions. GHG emissions are created from a variety of activities and projects that exist in the LSA and RSA. In establishing the baseline environment, it is impractical and unnecessary to quantify existing emissions; rather, the EIA will quantify residual effects by estimating emissions caused by the Project and will consider cumulative effects by determining whether the Project's GHG emissions will offset emissions elsewhere. One exception is land cover changes, which can change the carbon sink potential of the PSA. The existing land cover for the PSA includes 20.2 ha of cropland (49%), 14.3 ha of forest and bush (36%), 6.1 ha of wetland (15%) and 0.7 ha of modified grassland (2%).

5.2 Ecological Environment

5.2.1 Study Overview

X-Terra Environmental Services Ltd. (X-Terra) undertook studies and analysis for the Ecological Environment component of the EA as outlined below. Pertinent federal and provincial regulations, guidelines and policies were reviewed in context to each selected Ecological Environment VC. Using available data collected from a desktop assessment (including HabiSask screening, from which a report is provided in Appendix K), current literature and field assessments, existing conditions are summarized to give better context of potential project-related effects within the PSA

and LSA and also longer term additive effects within the RSA. Ecological survey results are tabulated and shown graphically in Appendix L.

The environmental studies were completed as per MOE Species Detection Survey Protocols between May and August 2023. Consultation with MOE during field planning assisted with scoping the required assessments. The following field assessments were completed to gather information on pre-development conditions and identify potential impacts to vegetation, wildlife, habitat, and species of conservation concern:

- Wetland and Watercourse assessment
- Habitat Ground-Truthing
- Sharp-tail Grouse Surveys
- Raptor Habitat and Nest Surveys
- Visual and Auditory Amphibian Surveys
- Common Nighthawk Surveys
- Breeding Bird Surveys
- Terrestrial and Aquatic Vascular Plant Surveys

Where rare species were identified that may impact the Project review process, MOE was consulted on the requirement for any additional field assessments.

Broadly speaking, the Project is located within the Boreal Transition Ecoregion of the Boreal Plain Ecozone. The Ecoregion is characterized by level to gently sloping plains interrupted by hilly uplands (Acton *et al*. 1998). At a finer scale the Project is located within the Tiger Hills Upland Area characterized hummocky terrain with moderate (5% to 10%) to strong (10% to 15%) slopes. Roughly 70% of the area is cropland with the remnant native habitat generally consisting of trembling aspen stands with tall shrubs in the understory. Surface drainage generally ends up in the small sloughs and lakes across the region, due to its hummocky nature.

5.2.2 Wetlands & Aquatic Life

5.2.2.1 Wetlands and Watercourses

Permanent wetlands are common across the landscape, but most wetlands are temporary, varying greatly among years with the amount of annual precipitation. These relatively small seasonal wetlands provide an important habitat for numerous waterfowl species and amphibians, in addition,

wetlands maintain local water quality by removing excess nutrients through chemical processes that take place in the wetland water. However, many of the wetlands in the RSA have been cultivated and/or are heavily infested with smooth brome grass, Kentucky blue grass, or increasingly abundant agricultural weeds.

The spatial boundary for aquatic wildlife species field assessments was 500m, while the boundary for aquatic plant species field assessments was 30m, as the greatest setbacks for an aquatic wildlife (Northern Leopard frog) and plant species (those tracked by the Saskatchewan Conservation Data Center [SCDC], but not listed under the *Species at Risk Act* [SARA] or *Wildlife Act, 1998*), respectively, likely to be present in the Project area (MOE FWB 2017).

Wetland Assessment Methods

The Project area was assessed for drainage patterns and wetlands, including wetland vegetation and distances from the Project, to inform the associated potential impacts. Wetlands were classified using the Stewart and Kantrud Wetland Classification System (Stewart and Kantrud, 1971). Simplified descriptions of the wetland classes are outlined below:

- Class I – Ephemeral Pond – Typically having water for only short periods of time following snowmelt or storm events. Central zone represented by low prairie vegetation (Kentucky bluegrass, slender wheatgrass, goldenrod, etc.).
- Class II – Temporary Pond – Periodically covered by water for a few weeks following snowmelt or a few days following storm events. Central zone represented by wet meadow vegetation (fine stemmed grasses and sedges with associated forbs; fowl bluegrass, foxtail barley, northern reed grass, etc.).
- Class III – Seasonal Ponds and Lakes – Typically having water until mid-summer. Central zone represented by shallow marsh vegetation (moderately coarse grasses and sedges with associated forbs; awned sedge, American manna grass, creeping spike-rush, slough grass, etc.).
- Class IV – Semi-permanent Ponds and Lakes – Typically having water until fall. Central zone represented by deep marsh vegetation (relatively coarse marsh emergent or associated submerged aquatics; bulrush, cattail, etc.).
- Class V – Permanent Ponds and Lakes – Central zone represented by a permanent open water zone devoid of emergent vegetation. Peripheral zones vegetated by deep marsh and shallow marsh vegetation (bulrush, cattail, foxtail barley, Nuttall's salt-meadow grass, etc.).

- Class VI – Alkali Ponds and Lakes – Typically does not contain permanent deep water, characterized by pH above 7 and a high concentration of salts. Central zone represented by an intermittent-alkali zone (devoid of emergent vegetation; peripheral zones contain salt-tolerant grasses).
- Class VII – Fen Ponds – Typically surface water is not present and may contain floating mats of emergent vegetation. Central zone represented by fen vegetation (fowl-manna grass, water sedge, etc.).

Survey Results

Eleven wetlands were identified within the Project area during the wetland assessment on August 2, 2023. The wetlands include two Class V wetlands and nine Class III wetlands. Wetland 11 is referred to as the west slough in the above sections of the report, and wetlands 5 to 10 are a loosely connected wetland complex referred to as the east slough in the above sections of the report. The wetland areas are detailed below in Table 5.7 and a detailed project map identifying wetland locations and classifications can be found in Appendix L (Figure 1).

Table 5.7 Total and Impacted Wetland Areas in Project Area

Wetland ID	Wetland Class	Wetland Area (ha)	Potentially Impacted Area (ha)	Potentially Impacted Area (%)	Associated Phase	Wetland Description
W1	III	0.46	0.46	100%	I	Graminoid wetland. Dry at time of assessment. Will be impacted during construction by Runoff Pond B.
W2	III	1.53	1.53	100%	I	Graminoid wetland. Standing water present at time of assessment. Will be impacted during construction by Runoff Pond B.
W3	III	1.10	-	-	-	Graminoid wetland. Dry at time of assessment. Avoided.
W4	III	0.26	0.26	100%	I	Shrub wetland. Dry at time of assessment. Will be impacted during construction by Landfill Cell 1.
W5	III	0.14	0.14	100%	I	Shrub wetland. Dry at time of assessment. Will be impacted during construction by Landfill Cell 1.
W6	III	0.27	0.05	18%	I	Shrub wetland. Dry at time of assessment. Will be impacted during construction by Runoff Pond A.
W7	III	0.06	0.02	33%	I	Shrub wetland. Dry at time of assessment. Will be impacted during construction by Runoff Pond A.
W8	III	0.29	-	-	-	Shrub wetland. Dry at time of assessment. Avoided.
W9	III	0.18	0.18	100%	I	Shrub wetland. Dry at time of assessment. Will be impacted during construction by Runoff Pond A.
W10	V	9.45	3.41	36%	I & II	Shrub wetland. Standing water present at time of assessment. Will be impacted during construction by Phase I Runoff Pond A (0.8%) and Phase II Runoff Pond C (35.2%).
W11	V	13.88	-	-	-	Graminoid wetland. Standing water present at time of assessment. Avoided.

No existing channels with defined beds or banks are present within the PSA or LSA. Similarly, there were no waterbodies in the study area that exhibited a defined outlet. There were beaver runs present within the riparian areas surrounding the majority of the larger wetlands which may also

serve to connect nearby wetlands during high water periods. The wetlands along the eastern side of the Project area are likely connected during high water by these beaver runs and other low areas between the defined wetland boundaries which is likely why the surrounding area has not been regularly cultivated. During high periods of snowmelt or rainfall, it is anticipated that drainage may occur from the higher areas of the Project to both Wetlands 10 and 11 via the low area north of the Phase I project footprint, approximately halfway into the Phase II project footprint. However, this potential drainage is primarily annually cultivated and shows no signs of wetland vegetation within the treed portions.

5.2.2.2 Aquatic Life

Desktop review indicates that common amphibians and reptiles in the RSA include the tiger salamander (*Ambystoma tigrinum*), boreal chorus frog (*Pseudacris maculata*), wood frog (Rana sylvatica), Canadian toad (*Anaxyrus hemiophrys*) and red-sided garter snake (*Thamnophis sirtalis*) (Acton et al., 1998). Common fish species include walleye (*Sander vitreus*), northern pike (*Esox lucius*), yellow perch (*Perca flavescens*), and burbot (*Lota lota*) (Acton et al., 1998).

HABISask searches were completed prior to field assessments within the LSA and RSA setbacks from the Project. The Saskatchewan Conservation Data Center (SCDC) evaluates and tracks sensitive species on a provincial level. These species' populations are a concern within the province, even though they may have stable populations on a national or global scale. Additional review of HABISask species in areas nearby the RSA, in addition to our experience from previous surveys in the area, and consultation with MOE on the Project scope, have indicated aquatic species of concern may be present in the area, these species are shown in Table 5.8 below. Setback distances for activities based on level of disturbance as recommended by MOE are also listed for the corresponding species of concern. Species descriptions are included below, for the species identified as potentially occurring in the area.

Table 5.8 Potentially Occurring Aquatic Species of Conservation Concern

Species / Important Area	Scientific Name	SCDC Rank	SARA Status	Feature	Restricted Activity Dates	Setback (m)
Northern Leopard Frog	*Lithobates pipiens*	S3	Special Concern	Breeding and Overwintering Habitat	Year Round	10 – 500
Western Tiger Salamander	*Ambystoma mavortium*	S4	Special Concern	-	-	-

SCDC Rank: S1: Critically Imperiled/Extremely Rare; S2: Imperiled/Very Rare; S3: Vulnerable/Rare-Uncommon; S4: Apparently Secure: S5: Secure/Common; (Modifiers: A:accidental or causal in the province; B: for a migratory species, rank applies to the breeding population; N: for a migratory species, rank applies to the non-breeding population; M: for a migratory species, rank applies to the transient population; H: Historical occurrence without recent verification; U: Status uncertain due to limited or conflicting information; X: Believed to be extinct or extirpated; NR: rank not yet assigned; NA: conservation status not applicable)

Northern Leopard Frog (*Lithobates pipiens*)

Northern leopard frogs are medium sized frog characterized by conspicuous dark dorsal spots bordered by light-coloured rings. The northern leopard frog requires seasonal or semi-permanent waterbodies for breeding. Although this frog has a nearly province-wide distribution (Fung, 1999), it has undergone a widespread contraction of its range in the prairies, particularly in the west, accompanied by increased isolation of its remaining populations. The cause of the range contraction is unknown (COSEWIC, 2002). Leopard frogs were designated as Special Concern by COSEWIC in April 1998 (COSEWIC, 2002). The northern leopard frog has since been added to *Schedule 1* of the Federal *Species at Risk Act*.

Western Tiger Salamander (*Ambystoma mavortium*)

The Western Tiger Salamander is a robust mole salamander that vary in color. Adults have a blotched, barred or reticulate pattern consisting of off white or yellow in color on a dark background of grey, dark brown, or olive green (COSEWIC 2012). They have a wide variety of habitat that includes grasslands, parklands and sub-alpine meadows. Adults are commonly found in grasslands, open woodlands and around semi-permanent to permanent fishless wetlands. Tiger salamanders will inhabit small mammal burrows or underneath rocks and debris for refuge and overwintering. Aquatic breeding habitats must consist of waterbodies that hold water for 3-7 months in order to complete development and metamorphism (COSEWIC 2012). There are currently no provincial activity restrictions that apply to breeding or overwintering habitat.

Both auditory and visual amphibian surveys were completed for the aquatic wildlife field assessments. Review of the Project area, and discussion with MOE did not identify the wetlands as fish bearing, and so no fish or fish habitat assessments were completed. Aquatic rare plant surveys were also conducted on all permanent waterbodies in the immediate project area.

Auditory Amphibian Survey Methods

As specified by the MOE amphibian auditory survey protocols (GOS 2020a), survey stations were placed on appropriate wetland habitat within a 500m setback from the Project area. Three survey rounds are required, which occurred during appropriate conditions between mid April to mid May, during the calling period for northern leopard frogs. All species observed were recorded. The exact timing of the surveys depended on minimum air temperatures; 6°C, 10°C, and 13°C. Each survey station had calls recorded over a 3-minute observation period. Call surveys began 30 minutes before sunset and ended at 1 AM. Species were recorded at each station using the recommended abundance index.

Visual Amphibian Survey Methods

As specified within the Saskatchewan visual amphibian survey protocols (GOS 2020b), the surveys were completed on appropriate wetland habitat within the Project area. Due to the aim of the survey to identify tiger salamanders, visual assessments were timed for egg mass surveys and were completed in the immediate project area. Three survey rounds are required, which occurred during appropriate conditions in May/June, during the breeding / egg laying period. Surveys were conducted one or two weeks apart. Wetlands were surveyed using the Double Observer Dependent Technique, and all egg masses, or any other sign of amphibians, were recorded to species. Surveys were completed between 9am and 3pm during sunny conditions. Surveys were not performed when there was precipitation, or when winds were over level 2 (>13km/h) on the Beaufort scale, or heavy cloud cover which may reduce visibility at the water surface.

Aquatic Rare Plant Survey Methods

The boundary for aquatic plant species field assessments was 30m, as the greatest setback for a plant species (those tracked by the Saskatchewan Conservation Data Center [SCDC] but not listed under the *Species at Risk Act* [SARA] or *Wildlife Act, 1998*) likely to be present in the Project area (MOE FWB 2017). Aquatic rare plant surveys were completed as specified within the Saskatchewan vascular plant survey species protocols (GOS 2021), on both permanent wetlands within the Project area (Wetlands 10 & 11; see attached wetland map). Sample points were placed on the wetlands spaced between 35m to 70m apart, with a minimum of 4 points per hectare of littoral zone (the zone in which plants grow). A mix of both waders and watercraft were used to assess the points based on the water depth. Equipment was decontaminated between wetlands to prevent the transfer of invasive species or pathogens.

Survey Results

During the auditory amphibian surveys, only boreal chorus frogs were identified within 500m of the Project area. Wood frogs were the only species identified by egg mass, however both wood frogs and boreal chorus frogs were seen in the Project area both during the visual amphibian and other surveys. No signs of fish were noted in the area wetlands during the field assessments.

During the rare plant surveys, a single aquatic plant species tracked by the SCDC was observed, Floating Crystalwort (*Riccia fluitans*; SU), within Wetland 10 (see Appendix L, Figure 3). Although the rare plant survey protocol is designed to identify vascular plant species only, the survey teams recorded all species of potential conservation concern, including the non-vascular Floating Crystalwort. Little information is currently available about Floating Crystalwort in Canada, other than its extensive use as an aquarium species. Floating Crystalwort is Unranked in

Saskatchewan (SU), which is described as an uncertain status due to limited or conflicting information (SCDC 2023). A targeted search for Floating Crystalwort within HABISask found that no observations have been uploaded to HABISask within the province. Floating Crystalwort is also currently unranked in Alberta (Alberta Parks 2023) and Manitoba (MCDC 2023). Only three provinces have ranks for Floating Crystalwort in Canada, BC – S3, Ontario – S3, and New Brunswick – S4S5 (NatureServe Explorer 2023a).

Aquatic species of conservation concern observed in the Project area are listed in Table 5.9 and the survey results and a map of the species locations can be found in Table 5.9. Setback distances for activities based on level of disturbance as recommended by MOE are also listed for the corresponding species of concern. Species descriptions are included below for the species of conservation concern identified in the area.

Table 5.9 Identified Aquatic Species of Conservation Concern

Species / Important Area	Scientific Name	SCDC Rank	SARA Status	Feature	Restricted Activity Dates	Setback (m)
Floating Crystalwort	*Riccia fluitans*	SU	-	Occurrence	Year Round	0 – 30

SCDC Rank: S1: Critically Imperiled/Extremely Rare; S2: Imperiled/Very Rare; S3: Vulnerable/Rare-Uncommon; S4: Apparently Secure: S5: Secure/Common; (Modifiers: A:accidental or causal in the province; B: for a migratory species, rank applies to the breeding population; N: for a migratory species, rank applies to the non-breeding population; M: for a migratory species, rank applies to the transient population; H: Historical occurrence without recent verification; U: Status uncertain due to limited or conflicting information; X: Believed to be extinct or extirpated; NR: rank not yet assigned; NA: conservation status not applicable)

Floating Crystalwort (*Riccia fluitans)*

Floating Crystalwort is a non-vascular plant found in wetlands throughout North America, as well as in Eurasia (Illinois Wildflowers 2023). It is a thallose liverwort, with both an aquatic and terrestrial form, which are very similar in appearance. They consist of dichotomously branching thali, often forming mats of Y-shaped segments. The thalli are scaleless, semi-translucent, and are light to medium green in colour. The tips of the branched ends can be either notched or unnotched but are more likely to be notched on the terrestrial form. They are perennial and most commonly reproduce asexually via fragmentation of the thalli or the formation of adventitious branches that become separated. They are commonly found in the water and shoreline of slow-moving water and wet ground such as swamps, marshes and fens, and are more likely to be found in clear water than turbid water. The species is used as an aquarium species, becoming popular in the 1990s, due to its easy care requirements, growth versatility, and vivid colouring and unique look (Fish Laboratory Aquatics 2023). Some states have banned the sale of the species due to the fast-growing, easy propagating nature of floating Crystalwort, and thus its potential to become invasive.

5.2.3 Wildlife & Wildlife Habitat

Desktop review identified that large ungulates commonly found in the Boreal Transition include white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), Moose (*Alces alces*), and Elk (*Cervus canadensis*). Other common mammals include white-tailed jack rabbit (*Lepus townsendi*), eastern cottontail (*Sylvilagus floridanus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), black bear (*Ursus americanus*), beaver (*Castor canadensis*), red squirrel (*Tamiasciurus hudsonicus*), and raccoon (*Procyon lotor*) (Acton et al., 1998). Common birds found in the area include boreal chickadee (*Poecile hudsonicus*), Canada jay (*Perisoreus canadensis*), black and white warbler (*Mniotilta varia*), common loon (*Gavia immer*), and red-necked grebe (*Podiceps grisegena*) (Acton et al., 1998).

HABISask searches were completed prior to field assessments within the LSA and RSA setbacks from the Project. The Saskatchewan Conservation Data Center (SCDC) evaluates and tracks sensitive species on a provincial level. These species' populations are a concern within the province, even though they may have stable populations on a national or global scale. Review of HABISask species in areas nearby the RSA, in addition to our experience from previous surveys in the area, and consultation with MOE on the Project scope, have indicated additional wildlife species of concern which may be present in the area, these species are shown in Table 5.10 below. Setback distances for activities based on level of disturbance as recommended by MOE are also listed for the corresponding species of concern. Species descriptions are included below, for the species identified as potentially occurring in the area. The spatial boundary (LSA) for the surveys completed are based on the setbacks for potential species of conservation concern likely to be present in the Project area (MOE FWB 2017). These include raptor nests (1000m), Sharp-tailed Grouse leks (400m), Common Nighthawk (200m), and for breeding birds Canada Warbler (300m) setbacks were used.

Table 5.10 Potentially Occurring Wildlife Species of Conservation Concern.

Species / Important Area	Scientific Name	SCDC Rank	SARA Status	Feature	Restricted Activity Dates	Setback (m)
Barn Swallow	*Hirundo rustica*	S4B	Threatened	-	-	-
Common Nighthawk*	*Chordeiles minor*	S4B	Special Concern	Breeding Bird	May 1- Aug. 31	0 - 200
Olive-backed Pocket Mouse	*Perognathus fasciatus*	S3	-	-	-	-
Sharp-tailed Grouse*	*Tympanuchus phasianellus*	S5	-	Lek	Mar 15 - May 15	200 - 400
Sprague's Pipit	*Anthus spragueii*	S3B, S3M	Threatened	Breeding Bird	Apr 21 – Aug 31	50 - 250
Turkey Vulture	*Cathartes aura*	S3B	-	-	-	-

SCDC Rank: S1: Critically Imperiled/Extremely Rare; S2: Imperiled/Very Rare; S3: Vulnerable/Rare-Uncommon; S4: Apparently Secure: S5: Secure/Common; (Modifiers: A:accidental or causal in the province; B: for a migratory species, rank applies to the breeding population; N: for a migratory species, rank applies to the non-breeding population; M: for a migratory species, rank applies to the transient population; H: Historical occurrence without recent verification; U: Status uncertain due to limited or conflicting information; X: Believed to be extinct or extirpated; NR: rank not yet assigned; NA: conservation status not applicable)

*Potential habitat and range overlap with project area

Barn Swallow (*Hirundo rustica*)

Barn swallows are a widespread bird across Saskatchewan often found nesting in and on artificial structures such as barns, houses, and bridges. Barn swallows build nests of mud pellet in small loose colonies of up 10 pairs and frequently produce two broods each year starting in mid-May (COSEWIC 2021). Barn swallow have been experiencing widespread population decline throughout North American since the 1980's and were listed as Threatened under SARA in 2017, and Special Concern under COSEWIC in 2021 (GOC 2023). The decline is due to declining populations of insect prey, increasing frequency of severe temperature fluctuations during spring migration and the breeding season, and in some regions, loss of suitable nesting sites. Populations have been stable for the previous decade, with large increases in the Saskatchewan population during this time. This species does not have an associated setback distance as outlined in the Saskatchewan Activity Restrictions Guidelines for Sensitive Species (MOE FWLB 2017). Environment Canada recommends a restricted activity period from May 1st to August 31st.

Common Nighthawk (*Chordeiles minor*)

Common nighthawks are well-camouflaged insectivorous birds in the nightjar family, that are mainly active at dawn and dusk (COSEWIC 2018). They are most commonly observed in flight, identified by their distinct white wing bars and bounding flight pattern, as well as by sound. Common nighthawks lay their clutches of 2 eggs directly on the ground (Brigham *et al.* 2011). Common nighthawks are found in forest clearings, meadows, badlands and lakeshores, as well as in

disturbed and urban habitats. Preferred habitats are Jackpine woodlands in the north and badlands in southern Saskatchewan, but they can be found nesting in a relatively wide variety of habitat types that may occur in the Project area.

Olive-backed Pocket Mouse (*Perognathus fasciatus*)

The Olive-backed Pocket Mouse is a small rodent found throughout the central Great Plains of North America, extending into Alberta, Saskatchewan, and Manitoba (NatureServe Explorer 2023b). The species is secure in the central portions of their range within the United States but has been classified as rare to uncommon in the prairie provinces along the northern edges of its range. The Olive-backed Pocket Mouse is approximately 12 to 14cm long, including its tail that makes up to half or more of its length (Montana Field Guide 2023; iNaturalist 2023). They range from dark olive-brown to pale buff in colour, with white underparts separated by a cream line, and a buff spot behind the ears. They have well-developed legs, and long hind feet enable it to jump. They live in grasslands with sparse vegetation and occasional scattered trees, usually within sandy soils.

Sharp-tailed Grouse (Tympanuchus phasianellus)

Sharp-tailed grouse are medium-large grouse that have spotted brown and white plumage (Cornell 2023). They occupy a wide geographic range, and are present year-round in the majority of Saskatchewan, being most common in the south (South Dakota Birds 2023). Males gather on communal breeding grounds in early spring, called leks, where they display with wings spread and brightly coloured patches on the sides of their necks exposed. They will often return to the same lek year after year (GOA 2013). Sharp-tailed grouse inhabit a wide variety of habitats, with dependence on open grassland and shrubland habitats during the breeding season for leks.

Sprague's Pipit (*Anthus spragueii*)

Sprague's pipits are small, ground-nesting songbirds, which prefer native grassland habitat during breeding. The species is rarely found in cultivated lands, or in areas where native grasses have been replaced with introduced forages (COSEWIC 2010). Sprague's pipits may occur in these open tame pasture areas if the vegetation structure and soil conditions are suitable during breeding. The nests are woven of fine grasses and can have canopies or complete domes, with clutches of 4 to 6 eggs (Robins and Dale 1999). Sprague's pipits were designated as Threatened under Schedule 1 in 2003.

Turkey Vulture (*Cathartes aura*)

The Turkey vulture is a large black scavenger with a long neck, long tail and a small red head. They soar in a V-shape formation with long black wings and grey flight feathers (Cornell 2023). When threatened they have a cat-like hiss that is easily distinguished. Turkey vultures breed in

southern Canada and remain active from May to September where they then migrate in flocks to South America (Audubon 2023). Nesting occurs on cliffs, under rocks, in caves and dense thickets near open areas or shorelines. Turkey vultures feed on dead mammals and decaying vegetation by soaring above using their sense of smell and by tracking the movement of other scavengers.

Raptor nest, Sharp-tailed Grouse lek, Common Nighthawk, and breeding bird surveys were completed for the wildlife field assessments, and habitat ground-truthing occurred concurrently with the surveys. No small mammal surveys were completed due to the fact that the Olive-backed Pocket Mouse observations within the RSA were historical, and the species does not have an activity restriction associated with it. Initial review of the Project area did not identify Sharp-tailed Grouse lek and Common Nighthawk as of potential concern, however following discussions with MOE they were included in the assessments completed for the Project area.

Habitat Ground-Truthing Methods

Habitat ground-truthing generally occurs after an initial general desktop review, to provide field level verification of current environmental conditions and environmental sensitivities. The habitat assessment was combined with the species surveys. During the ground-truthing information is recorded on pre-development landcover, potential of preferred wildlife habitat, and potential habitat for sensitive or species of concern in terrestrial and aquatic habitats.

Raptor Nest Survey Methods

Raptor habitat and nest surveys are proposed to be conducted as outlined within the *Alberta Sensitive Species Inventory Guidelines* (GOA 2013) as Saskatchewan currently uses this as a provincial wildlife survey protocol. Surveys were conducted concurrently with lek surveys, within 1km of the Project. Recorded data included location of active nests, species, number of adults, and number of juveniles (if possible).

Sharp-tailed Grouse Survey Methods

As specified by the MOE Sharp-tailed Grouse survey protocols (GOS 2020c), Sharp-tailed Grouse surveys were completed twice in May. Lek surveys were conducted starting 30 minutes prior to sunrise and ending two to three hours after sunrise, during peak lek activity. Recorded data at each lek included location, habitat, environmental conditions, number of males, and number of females. If a lek was identified, it was observed for a minimum of 15 minutes to increase count accuracy.

Common Nighthawk Survey Methods

As specified by the MOE Common Nighthawk survey protocols (GOS 2020d), Two common nighthawk surveys were carried out in June in the Project area timed approximately 10 days apart.

Survey points were spaced 800 m apart throughout potential breeding habitat within the Project area. A 3-minute passive survey was completed at each point followed by a 3-minute call playback survey. The call playback period consisted of 30 seconds of calling followed by 30 seconds of silence. Surveys were started 30 minutes before and up to 1 hour after sunset.

Breeding Bird Survey Methods

As specified by the MOE forest breeding bird survey protocols (GOS 2020e), point count stations were spaced 250 m apart and were conducted using a 10-minute observation (and recording) period. Point counts began 45 minutes before sunrise and end no later than four hours later. Species, number of individuals, distance, habitat details, site characteristics, wind speed and precipitation were recorded at each point. Surveys were not performed under cold conditions which inhibit calling (< 0°C), when there was precipitation, or when winds were over level 3 (>20km/h) on the Beaufort scale. Breeding bird surveys were completed three times between May 28 to July 5, and surveys spaced 7 to 10 days apart.

Survey Results

During the terrestrial wildlife surveys, no species protected under Provincial or Federal legislation, or tracked by the SCDC were identified; however, during the aquatic vegetation survey a Common Nighthawk was observed flying over the west slough (Table 5.11). Survey results and a map outlining the location of the Common Nighthawk observation can be found in Appendix L. The species description can be found above.

Table 5.11 Identified Wildlife Species of Conservation Concern.

Species / Important Area	Scientific Name	SCDC Rank	SARA Status	Feature	Restricted Activity Dates	Setback (m)
Common Nighthawk	*Chordeiles minor*	S4B	Special Concern	Breeding Bird	May 1- Aug. 31	0 - 200

SCDC Rank: S1: Critically Imperiled/Extremely Rare; S2: Imperiled/Very Rare; S3: Vulnerable/Rare-Uncommon; S4: Apparently Secure: S5: Secure/Common; (Modifiers: A:accidental or causal in the province; B: for a migratory species, rank applies to the breeding population; N: for a migratory species, rank applies to the non-breeding population; M: for a migratory species, rank applies to the transient population; H: Historical occurrence without recent verification; U: Status uncertain due to limited or conflicting information; X: Believed to be extinct or extirpated; NR: rank not yet assigned; NA: conservation status not applicable)

The PSA consists of less than 50% of high-quality wildlife habitat, primarily associated with the treed habitat on the western side of the Project. Land use of the PSA is currently a mix of cultivated land (49%), forest (34%), wetlands (15%) and pockets of non-native grassland (2%). The 1 km LSA contains similar proportions of habitat types, with cultivation being the primary land use (45%), followed by forest (40%), wetlands (12%), and non-native grassland (<1%), with the addition of approximately 3% of existing development, including roads and a yard that comprises the site of the historic RM of Invergordon Landfill. Vegetation

Desktop review identified that the Project is located within the Boreal Transition region. This region is dominantly deciduous boreal forest, with a mixture of forest and farmland (Acton *et al*. 1998). Common species found in the area include trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), needlegrasses, and wheatgrasses. Common shrubs and herbs include prickly rose (*Rosa acicularis*), pasture sage (*Artemisia frigida*), and saskatoon (*Amelanchier alnifolia*). In drier areas grasslands dominated by porcupine grass (*Hesperostipa* sp.), June grass (*Koeleria macrantha*), and dryland sedges occur often mixed with shrubs and trebling aspen, and fescue grasslands dominated by plains rough fescue (*Festuca hallii*) also occurs in the area (Acton *et al*. 1998).

HABISask searches were completed prior to field assessments within the LSA and RSA setbacks from the Project. The Saskatchewan Conservation Data Center (SCDC) evaluates and tracks sensitive species on a provincial level. These species' populations are a concern within the province, even though they may have stable populations on a national or global scale. No plant species were identified in the HABISask searches of the LSA and RSA, so review of HABISask species in areas nearby the RSA, in addition to our experience from previous surveys in similar habitats, and consultation with MOE on the Project scope, have indicated plant species of concern which may be present in the area, these species are shown in Table 5.12 below. Species descriptions are included below, for the species identified as potentially occurring in the area.

Table 5.12 Potentially Occurring Plant Species of Conservation Concern.

Species / Important Area	Scientific Name	SCDC Rank	SARA Status	Feature	Restricted Activity Dates	Setback (m)
Large Yellow Lady's Slipper	*Cypripedium parviflorum var. pubescens*	S2	-	Occurrence	Year Round	30
Small Yellow Lady's Slipper	*Cypripedium parviflorum var. makasin*	S3	-	Occurrence	Year Round	30
Striped Coral-root	*Corallorhiza striata var. striata*	S3	-	Occurrence	Year Round	30
Wild Rye	*Elymus curvatus*	S3	-	Occurrence	Year Round	30
Yellow Touch-me-not	*Impatiens noli-tangere*	S2	-	Occurrence	Year Round	30

SCDC Rank: S1: Critically Imperiled/Extremely Rare; S2: Imperiled/Very Rare; S3: Vulnerable/Rare-Uncommon; S4: Apparently Secure: S5: Secure/Common; (Modifiers: A:accidental or causal in the province; H: Historical occurrence without recent verification; U: Status uncertain due to limited or conflicting information; X: Believed to be extinct or extirpated; NR: rank not yet assigned; NA: conservation status not applicable)

Large Yellow Lady's Slipper (*Cypripedium parviflorum var. pubescens*)

Large yellow lady's slippers are also found throughout Canada and the United States (Sheviak 2020). This species prefers shady, damp, forest floor of mixed deciduous and coniferous forests, and is known to inhabit open meadows and can survive in acidic soils along streams. In Saskatchewan, small yellow lady's slippers are generally found in the eastern Aspen Parkland, and the southeastern Boreal Forest (Harms and Leighton 2011). This species is perennial, flowering in late spring to early summer. Yellow lady's slippers have two varieties which are difficult to distinguish. Large yellow lady's slippers have larger flowers, petals that are generally pale yellowish-green, and more, slightly larger leaves as compared to small yellow lady's slipper.

Small Yellow Lady's Slipper (*Cypripedium parviflorum var. makasin*)

Small Yellow Lady's Slipper can be found throughout Canada and the United States (Sheviak 2020). This species prefers shady, damp, forest floor of mixed deciduous and coniferous forests, and is known to inhabit open meadows and can survive in acidic soils along streams. In Saskatchewan, small yellow lady's slippers are found in the Mixed-grass Prairie, Aspen Parkland, and the southeastern Boreal Forest (Harms and Leighton 2011). This species is perennial, flowering in late spring to early summer. Yellow lady's slippers have two varieties which are difficult to distinguish. Small yellow lady's slippers have smaller flowers, petals that are generally brownish/purplish, and fewer, slightly smaller leaves as compared to large yellow lady's slipper.

Striped Coral-root (*Corallorhiza striata var. striata*)

Striped coral-root is a perennial, mycotrophic, herb that is native to central North America (Magrath and Freudenstein 2002). It has short rhizomes and small bract like leaves and often appears fleshy (Klinkenberg 2020). The flowers are generally reddish-purple with darker stripes, sometimes yellow. They grow in moist coniferous, deciduous, and mixed wood forests, and along lakeshores and swamps. *Corallorhiza* species often have a period of dormancy following a season of flowering, which can last up to several years (LBJ Wildflower Center 2016).

Wild Rye (*Elymus curvatus*)

Wild rye, sometimes referred to as awnless wild rye or short-awned Virginia wild rye, is widespread in North America, occurring from BC and Washington to the northern Great Plains, with Saskatchewan at the northern edge of its range (Leighton and Harms 2014, Barkworth et al. 2007). This species belongs to the genus Elymus of which there are 10 species that occur within Saskatchewan, and in addition to other wild rye species, also includes several species of wheatgrasses (Leighton and Harms 2014). This species of wild rye is stiffly erect, generally between 60 to 120 cm tall. The flowering spike is also erect and are generally 3 to 10 cm long in individuals within

Saskatchewan. It has 2 spikelets per node (similar to other wild rye species in Saskatchewan, while Elymus wheatgrasses generally have 1 spikelet per node). The use of awnless or short-awned in this species name refers to the short-awned or awnless glumes and lemas, as opposed to many of the other Elymus species which have noticeably longer awns. Wild rye was previously included as a variety of Virginia wild rye, and can be difficult to differentiate, however in Saskatchewan the lemma awn length is a reliable feature to identify between the two species. Wild rye has lemma awns up to 4 mm long, while Virginia wild rye has lemma awns between 8 to 20 mm long.

Yellow Touch-me-not (*Impatiens noli-tangere*)

Yellow Touch-me-not, also known as Western jewelweed, is a circumpolar species, that is found in North America from Alaska south to California, and west to Manitoba (NatureServe Explore 2023c). This species is common in BC and Alberta but considered rare in Saskatchewan. The common name "touch-me-not" refers to the seed pods that pop open and eject the seeds when disturbed. It grows in wet habitat such as wetlands and marshy areas within tree stands (SaskWildflower 2023a, Klinkenberg 2020). The species has alternately arranged leaves, that are ovate and coarsely toothed, ranging from 3 to 12 cm long. Yellow touch-me-not is often confused with the more common spotted touch-me-not (*Impatiens capensis*) but differs in their flower morphology. Spotted touch-me-not flowers are yellow to orange and are often spotted in red but can be unspotted, and abruptly narrow to a spur, with the sepal sac portion of the flower approximately 2/3 as wide as long or less, while yellow touch-me-not has yellow flowers without spots, and the sepal sac gradually narrows to the spur, with the sepal sac less than ½ as wide as long (SaskWildflower 2023b).

Terrestrial Rare Plant Survey Methods

Terrestrial rare plant surveys were completed as specified within the Saskatchewan vascular plant survey species protocols (GOS 2021), on all suitable terrestrial habitat types within the Project area. Due to the size of the Project footprint, and the difficult terrain within the treed portions of the Project, the entire project footprint was not census searched during the survey rounds. Rare plant surveys were conducted under the minimum sampling requirement as specified by the Saskatchewan rare plant survey protocols for forested habitat types, with additional transects completed to ensure adequate coverage of the Project area. Project community types and vegetation inventories were recorded at the same time as the rare plant search, and incidental species of conservation concern identified while travelling between survey transects were also recorded.

Rare plant surveys were conducted by teams, with two observers travelling the transects spaced in 2.5 m intervals (5 m per team). Two rounds of terrestrial rare plant surveys were completed to capture

species which flower at different times of the year. The early season assessment was completed May 31, the late season assessment August 2, 2023.

Survey Results

During the vegetation assessment, there was one SCDC listed rare S3 plant identified, Striped Coral-root (*Corallorhiza striata*), within treed habitat in both Phase I and Phase II portions of the Project (see Appendix L Figure 3). Seven distinct habitat/community types were identified in the Project area during the surveys, these community types and the dominant species associated with them are outlined in

Table 5.13 below. The complete vegetation inventory is also attached in Appendix L. Additionally, Canada Thistle (*Cirsium arvense*) and Perennial sow-thistle (*Sonchus arvensis*), both which are listed as noxious under the Schedule II of the Weed Control Act, were identified during the assessment. The noxious weeds were primarily located in low concentrations throughout the field and in patches along roadsides and within ditches. An abundance of smooth brome (*Bromus inermis*) was observed along field edges as well as non-native weed species such as dandelion (*Taraxacum officinale*) and sweet clover (*Melilotus officinalis*).

Table 5.13 Plant Community Types within the PSA

Community Type	Dominant Species
Hayland	Alfalfa, Timothy, Smooth Brome
Tame Pasture	Smooth Brome, Kentucky Bluegrass, Perennial Sow-thistle
Grassland – Tall Shrub	Smooth Brome, Kentucky Bluegrass, American Red Raspberry
Deciduous Treed – Tall Shrub	Trembling Aspen, Beaked Hazelnut, Sarsaparilla
Riparian – Graminoid	Cattail, Awned Sedge, Bluejoint Reedgrass
Riparian – Shrub	Long-beaked Willow, Cattail, Bluejoint Reedgrass
Riparian – Treed	Trembling Aspen, Long-beaked Willow, Bluejoint Reedgrass

Terrestrial plant species of conservation concern observed in the Project area are listed in Table 5.14. Setback distances for activities based on level of disturbance as recommended by MOE are also listed for the corresponding species of concern. The species description can be found above.

Table 5.14 Identified Terrestrial Plant Species of Conservation Concern

Species / Important Area	Scientific Name	SCDC Rank	SARA Status	Feature	Restricted Activity Dates	Setback (m)
Striped Coral-root	*Corallorhiza striata var. striata*	S3	-	Occurrence	Year Round	30

SCDC Rank: S1: Critically Imperiled/Extremely Rare; S2: Imperiled/Very Rare; S3: Vulnerable/Rare-Uncommon; S4: Apparently Secure: S5: Secure/Common; (Modifiers: A:accidental or causal in the province; B: for a migratory species, rank applies to the breeding population; N: for a migratory species, rank applies to the non-breeding population; M: for a migratory species, rank applies to the transient population; H: Historical occurrence without recent verification; U: Status uncertain due to limited or conflicting information; X: Believed to be extinct or extirpated; NR: rank not yet assigned; NA: conservation status not applicable)

5.3 Human Environment

5.3.1 Study Overview

The existing human environment studies are informed by the real or perceived ways in which the Project could directly impact human life, including health and safety, nuisances, and economics. Topics of concern expressed by the public that do not directly relate to the physical and ecological environments are addressed in this section.

The existing environment studies described in the following sections were completed by desktop analysis of publicly available information.

5.3.2 Human Health and Wellbeing

The Project has the potential to impact daily life for workers and local residents if and when they interact directly with the Project. The existing environment is described below as it relates to opportunities for direct human interactions.

5.3.2.1 Human Activity and Establishments

The Project is situated in the RM of Invergordon (430). Crystal Springs is the nearest community to the Project located roughly 5,150 m to the north-northwest and the community of Yellow Creek is located roughly 6,000 m to the east. The Project is located about 0.5 km from the site that was historically used as the RM landfill and then as an RM transfer station. Setbacks are shown graphically in Drawing WM566.3-25.

Croplands occur on the neighboring quarter sections to the north, south and east of the Project. The quarter section immediately north of the Project is owned by the individual who sold the Project site to the developer. The owner of the quarter sections east and south of the Project is aware of the Project. The quarter section west of the PSA contains natural parkland and a large slough. Two quarte sections immediately west of the subject property are designated as a Fish and Wildlife Development Funds (FWDF) lands, which are presumably used by hunters. Sport fishing is not expected to occur since no fish species were identified during the aquatic life surveys. The presence of a relatively large, forested natural habitat west of the project also introduces the possibility of dangerous wildlife (e.g. bears, cougars, wolves, coyotes).

A review of publicly available information and consultation with the RM of Invergordon did identify any significant wildlife management challenges or use of wildlife resources in the area, besides hunting. The RM of Invergordon is not aware of any persistent issues with bears or other dangerous wildlife at its historic landfill, which was located 600 m southeast of the Project and immediately adjacent the FWDF lands, although it was acknowledged that bears sitings do occur in the RM.

Yard sites and wells within 3200 m of the Project footprint are identified in Drawing WM566.3-11 and in Table 5.6. Overall, 16 yard sites and seven (7) withdrawal wells were identified. Ten yard sites appear to be vacant and the remaining six (6) yard sites appear to be used as private residences and/or agricultural staging areas. Of the six (6) occupied yard sites, three (3) are presumed to use well water based on the presence of licensed water wells on the quarter section. The other three (3) have neither licensed water wells nor dugouts on site, although one (1) of these yard sites is adjacent a lake and may utilize surface water.

The nearest occupied yard site is 2,020 m northeast of the project separated by a stand of forest that blocks sightlines to the Project. There is no licensed well associated with this yard site. Several unoccupied yard sites are on closer proximity to the PSA including one site 1,130 m southwest of the Project with a licensed well.

Two (2) wells in the 3,200 m radius are interpreted to be completed in the Middle Floral Aquifer, based on depth to water and screen interval. While these comprise the two (2) water wells nearest to the Project, they are interpreted to be upgradient and cross gradient.

5.3.2.2 Traffic

The Project will be accessed by RM Road 776, which is classified as a Class 5 road according to the MOH 2024 Designated Rural Road Classification Map. No occupied residences exist along

this segment of the RM grid road. The site access point is located less than 200 m east of Highway 20 and about 3.4 km west of Highway 41. Waste hauling trucks will access the site on RM Road 776 via Highway 20, which has an average daily traffic count of 180 according to the MOH *2022 Traffic Volume Map* and has a Secondary Weight Highway classification according to the *Weight Classification 2024* map. Neighbouring roads and highways are depicted in Drawing WM566.3-26.

5.3.2.3 Heritage Resources

Heritage screening identified no concerns with the Project. The Developers' Online Screening identified the quarter section of interest required further screening by the Heritage Conservation Branch. Subsequent screening by Heritage Conservation Branch of Ministry of Parks, Culture and Sport indicated that *"no known archaeological sites are located in direct conflict with the proposed development. Development will occur on cultivated land and on terrain judged to have a low heritage potential. Therefore, our office has no further concerns with the subdivision proceeding as planned."* Documentation is provided in Appendix M.

5.3.3 Socioeconomics

Waste management has economic implications which can affect the quality of living conditions in the area. The existing socioeconomic environment as it relates to local and regional waste management is described below, with a focus on the regional solid waste management market as MOE has indicated that impacts to the market should be addressed.

5.3.3.1 RM of Invergordon Waste Management

The RM of Invergordon Landfill reached capacity and was subsequently closed in 2021. The landfill was located about 600 m southwest of the proposed new landfill site. Following the landfill closure, the RM's waste management plan included a transfer station at the site of the historic landfill before moving to a discounted yard site pickup service rate offered by Greenland Waste for any ratepayer located in the RM. Ratepayers also have the option of hauling waste to a landfill outside of the RM.

5.3.3.2 Regional Solid Waste Management Market

There are 18 operating landfills in the RSA (that is, in the GWSA which is depicted with a blue line in Drawing WM566.3-6), based on information obtained from the MOE *Sask Interactive* web application. They are listed below in Table 5.15 and shown in Drawing WM566.3-27. The RM of Rosthern and the RM of Leask both operate municipal landfills outside of the GWSA but portions

of their respective RMs occur within the GWSA thus they are included in the assessment, producing a total of 20 landfills considered in the existing environment characterization.

Table 5.15 Open Landfills in the Greenland Waste Service Area

Landfill	Distance from Project (km)	Rate Structure & Waste Acceptance
RM of Hoodoo (REACT)	29	Defined Membership, no waste accepted from non-members
City of Melfort	47	Dual rate structure, higher rate for non-residents
City of Prince Albert	61	Dual rate structure, higher rate for non-members
RM of Rosthern	72	No waste accepted from non-residents
RM of Leroy (REACT)	83	Defined Membership, no waste accepted from non-members
Tisdale Regional	87	Defined Membership, no waste accepted from non-members
RM of Leask	92	unknown
Boreal Area Regional Waste Authority (Nipawin)	109	Defined Membership, no waste accepted from non-members
Candle Lake	110	Dual rate structure, higher rate for non-members
RM of Torch River (Garrick North)	114	unknown
Highway 55 WMC	118	Dual rate structure, higher rate for non-members
RM of Bjorkdale (Peesane)	119	unknown
RM of Lakewood (McPhee Lake)	129	unknown
Central Regional Landfill (Wadena)	129	Defined Membership, no waste accepted from non-members
City of Wynyard	130	unknown
RM of Bjorkdale (Chelan)	134	unknown
Parkland Regional	193	Dual rate structure, higher rate for non-members
Town of Hudson Bay	202	unknown
Town of Sturgis	211	unknown
Sled Lake	227	unknown

Of the 20 landfills considered in this characterization; 12 are municipal landfills and eight (8) are regional landfills, or landfills with member rates for a regional waste management corporation. Regional waste management authorities and their respective members were identified from a 2021 Annual Report by the Association of Regional Waste Management Authorities of Saskatchewan Inc. (ARWMAS).

The membership and fee structure details of the regional and municipal landfills are summarized in Table 5.15. Of the 20 landfills, six (6) have a defined membership and do not accept waste from non-members, and five (5) have a defined dual rate fee structure for non-members, and the remaining nine (9) landfills have unknown acceptance and fee structures. Commercial and industrial waste generators are part of a free-market group that is potentially subject to dual rate structures within much of the LSA region. No current landfill has exclusive rights to the commercial and industrial waste generators unless they are under contract. At expiration of any agreement all landfill operators may compete for ongoing waste management services. This is relevant to the characterization since the primary target for waste collection for the proposed Project is those entities within the LSA that are not members of a municipal or regional landfill as well as commercial and industrial waste generators.

As Drawing WM566.3-27 illustrates, there are several RMs within the RSA that are not members of a landfill or a regional waste authority that receives member rates at a landfill, including several near the Project. The most recent census data (2021) indicates that the rural population of these non-member RMs is 19,680. The census data indicates that the ratio of town and village population to RM population is 1.1:1 on average in the province, suggesting a total population in the RSA of about 40,000. Conservatively assuming a ratio of town and village population to RM population that is half of the province's average, the total population would be over 29,000. A population of 29,000 translates to approximately 19,000 tonnes of household solid waste generated annually by non-member households in RMs, villages and towns assuming a waste generation rate of 0.67 tonnes/year/household which was determined from waste acceptance rates at a nearby landfill. A portion of this non-member waste stream would form the foundation the Project's input waste, which has targets in the order of 12,000 tonnes per year, perhaps up to 15,000 tonnes per year. The above waste generation rate is only from non-member households and does not include free market commercial and industrial waste generators across the entire RSA.

It is important to note that the number of landfills in the province is dynamic and generally decreasing; between 2016 and 2020, the number of municipal landfills in Saskatchewan dropped from 500 to 186. Data on the MOE *Sask Interactive* web application indicates that while there are currently 20 open landfills in the RSA there were historically 128 sites in the same area. This trend of landfill closures is expected to continue as a deliberate consequence of the Province's Solid Waste Management Strategy, which encourages regional collaboration as discussed in Section 1.2. This historic trend would indicate a likelihood of closure of some smaller, municipal landfills within the assessment area in the coming years as regionalization continues. Larger, regionalized landfills will be the most likely to benefit from market redistribution in the case of a landfill closure. Recent or planned expansions have been confirmed at the City of Melfort Landfill, City of Prince Albert landfill, Tisdale Regional Landfill, and Boreal Area Regional Waste Authority. The lifespan of the other landfills could not be identified by a review of news and other literature.

Membership within regional authorities is also dynamic and competitive pricing and efficient service is required for regional authorities to maintain membership volumes. It is a members' prerogative to leave their regional authority if they are not satisfied. If a member choses to leave their authority, a number of different outcomes could ensue, including a private waste service provider securing the work and taking the waste to the landfill of their choice. In other words, the risk of losing members exists in the current environment, as it should in a free market industry.

Another dynamic trend in the waste services industry is the relatively recent adoption of a service strategy that increases the amount of solid waste hauled to landfills from rural sources. Recently,

RMs have begun to contract with a waste service provider to provide service to every ratepayer within that RM. In these scenarios, a waste container is delivered to every farm site within the RM and serviced as required, typically every month or two. The costs are either split between the RM and the ratepayer or borne by the ratepayer wholly. This arrangement results in a greater percentage of waste being hauled to a regional landfill rather than being disposed of improperly (buried in ground or improperly burned). This is directly in line with the goals of MOE and provincial waste management strategies. This development has largely occurred in the southern portion of the province as shown in Drawing WM566.3-28. If this trend continues northward in the province, the amount of collected waste in the GWSA, and specifically from RMs within the GWSA that are not a member of a regional landfill, will increase even further.

6.0 VALUED COMPONENTS

'Valued Components' (VCs) are fundamental elements of the physical, ecological, or socio-economic environment that have scientific, economic, social, or cultural significance and that may be impacted by the Project. In selecting relevant VCs for the Project, the following criteria were considered:

1) the social and ecological value or significance of the VC informed by professional judgement as well as public interest or concern;
2) the degree to which the VC will interact with the Project in terms of space, duration, and intensity,
3) the degree to which the VC has been adversely impacted by other projects or developments in the area; and,
4) whether the VC is rare, endangered, protected or regulated.

The VCs identified for the Project are tabulated in Table 6.1 below.

Table 6.1 Valued Components of the Environment and Rational for Inclusion in EA

VC	Rationale
Groundwater Quality	Stagnant till flow system on east side of PSA has potential for ecological uptake if offsite impacts occur
	Channelized sand unit in the PSA provides a preferential subsurface flow pathway to the west slough
Surface Water Quality & Availability	West slough is located downslope of PSA and is interpreted to be downgradient of preferential subsurface flow pathway underlying site
	East slough is located adjacent to PSA
Climate	Solid waste degradation generate methane, a potentent GHG
	Vehicle and equipment use during construction and operation will generate GHG emissions
	Land cover changes will result in changes in carbon sequestration potential
Wetlands & Aquatic Life	Wetland removal and alteration in the PSA will result in some aquatic habitat destruction or loss
	Surface water drainage alterations may result in changes to wetland flow and cause aquatic habitat destruction or loss in the PSA and LSA
	Species of Conservation concern may be impacted by alterations to wetlands and drainage in the PSA
Wildlife & Habitat	Loss and disturbance of forest in PSA will result in some wildlife habitat loss and degradation
	Loss and disturbance of forest the PSA may result in some disturbance to nesting and breeding bird species including species of conservation concern
	Exposure to increased traffic and impacted fluids may increase risk of mortality or illness of some wildlife species
Vegetation	Land cover changes will result in loss and disturbance of some vegetation including a species of conservation concern
	Increased traffic and activity on site introduces the risk of weeds introduction or proliferation
Human Health & Wellbeing	Workplace safety issues include potential exposure to impacted soils and water, interaction with heavy equipment and fire risk
	Sensory outputs including noise, odour and light have the potential to affect quality of life for those exposed
	Windblown debris may escape the PSA
Socioeconomic Factors	Changes to traffic may impact infrastructure longevity
	Development will have a significant positive socioeconomic benefits for RM and individual residents
	Some waste will be diverted from existing landfills, which may have cost implications

7.0 EFFECTS ASSESSMENT

7.1 Assessment Approach

The assessment presented in the following Sections uses a VC (valued component)-centered approach to determine potential effects of the Project. The approach is guided by the requirements in the *Guidelines for the Terms of Reference and Environmental Impact Statement*, the *Technical Guidance for Assessing Cumulative Effects* document under the Canadian Environmental Assessment Act, 2012 (replaced by the Impact Assessment Act, CEA Agency 2021), and *Operational Policy Statement, Assessing Cumulative Environmental Effects* under the Canadian Environmental Assessment Act, 2012 (CEA Agency, 2018).

The assessment approach involves the following:

- Identification of VCs based on Project-specific risks, baseline environment studies and input from stakeholders (see Section 6.0);

- Scoping spatial and temporal boundaries for each VC identified (see Section 4.1 and 4.2 respectively);
- Description of baseline (pre-Project) conditions (see Section 5.0);
- Identification of potential interactions between the Project and each VC;
- Identification of mitigation measures to limit or eliminate the risk of adverse effects of the Project on VCs;
- Determination of residual effects (if any) on each VC expected after the implementation of mitigation measures;
- For each VC expected to experience residual effects, identify the cumulative impacts resulting from the Project in combination with environmental effects of other physical activities that have been or will be carried out; and,
- Identify any follow-up actions or monitoring plans to manage the risks associated with anticipated project effects.

The first three (3) items have been discussed and defined earlier in this document. The latter five (5) items are discussed below:

Potential Interactions

The Project's potential interactions with each VC are identified in terms of the mode of interaction and the spatial and temporal extent. In other words, the specific ways in which the Project could affect the VC are defined. Potential interactions are identified and discussed in the existing environment section (Section 5.0) and are reiterated for clarity in the sections below. The main focus of this assessment is to identify adverse interactions or impacts; however, some advantageous interactions are also listed since, in some cases, the impacts may be positive to the VC and may offset negative interactions.

The potential impacts to the ecological environment include both direct impacts from physical disturbance of habitat, as well as indirect impacts from construction and operations such as habitat loss, invasive species introduction, sensory disturbance, edge effects, barriers to wildlife movement, as well as unexpected events such as spills or sedimentation.

Mitigating Measures

If the potential interactions can be minimized or offset, then specific mitigation measures are defined and discussed. Mitigating measure vary in terms of effort and complexity but they all have aim to provide a reasonable solution to offset adverse Project impacts.

Residual Effects

Residual effects of the Project are defined as the specific and expected impacts of the Project after mitigation measures are implemented. For each VC the residual effects of the Project are defined in terms of mode and magnitude, risk, reversibility, and spatial and temporal extent.

Risk of each residual effect is evaluated in terms of severity (insignificant, minor, significant, major, severe) and likelihood (rare, unlikely, moderate, likely, certain).

Cumulative Effects

The assessment of residual impacts of the Project will potentially involve multiple elements, and multiple scales of impact that may be compounding or offsetting when considered holistically. A cumulative effects discussion for each VC will be provided to rationalize the full-scale impact on each VC.

The cumulative effects assessment also considers the impacts of the Project in combination with residual impacts from other projects and activities that will overlap spatially and temporally with the Project. As discussed in Section 9.0, no ancillary projects have been identified with this Project. No significant industrial or commercial projects have been proposed or identified in the immediate region, apart from a closed landfill that existing about 600 m southeast of the Project. No other new landfills are known to have been proposed in the province that are undergoing an EA screening.

If no other interfering projects or activities are identified and no other Project effect identified as compounding or offsetting, then the cumulative effects are essentially the same as the residual effects. Cumulative effects assessment will apply to VCs where residual effects are defined. If the residual effects are identified to be negligible, then cumulative effects for that VC will be nil.

Each cumulative effect will be characterized in terms of duration, magnitude, frequency, geographic extent, and reversibility.

Monitoring & Follow-Up

Once the residual and cumulative effects have been identified, they will be assessed in terms of their significance and relative risk to the environment. If the effects can be monitored, then these measures will be identified and a commitment for implementing these measures will be outlined.

7.2 Groundwater Quality

7.2.1 Potential Interactions

The potential for leachate to contaminate groundwater resources is one of the main environmental concerns with a landfill development. Landfill leachate typically contains elevated concentrations of dissolved organic matter, inorganic macro-components, heavy metals, and xenophobic organic compounds that can have adverse effects on the environment. For the proposed Project, point sources of leachate contamination will comprise the base of the landfill cells where leachate accumulates, and the leachate pond where it is stored. The assessment of the existing environment in Section 5.1.2.2 identified three pathways and receptors that the impacts assessment should consider, both potentially occurring during the operating, decommissioning, and post-closure stages of the Project's lifespan:

- A channelized flow system (Sand Unit 2) underlying a limited portion of the proposed landfill cells could act as a pathway through which impacted water could reach the west slough which extends off the property to the west into Fish and Wildlife development lands. Siting the landfill cell over a sand deposit deviates from the Alberta Standards that are generally accepted in Saskatchewan. Deviations from the standards are acceptable, as an Alternative Solution, if justification is provided using scientific rationale (i.e. if it can be demonstrated that the proposed siting poses negligible risk to the environment). Given this pathway's potential for offsite impacts and the deviation from the accepted standards, it warrants thorough mitigation and risk analysis which are provided in the following sections. The flow system has been interpreted in Section 5.1.2.2 as having northwesterly flow in the order of 1 m/yr to10 m/yr and a discharge into the west slough as little as 400 m from the landfill cells, within the LSA. The slough provides habitat and water source for plants and animals. Baseline water chemistry for the west slough is documented in Appendix J. Baseline water chemistry for the Sand Unit 2 flow system will be established prior to the Project being commissioned, as discussed in the Project's monitoring plan in Section 11.4.
- Shallow groundwater in the stagnant till flow system on the eastern edge of the PSA is susceptible to the formation of a highly concentrated, but stagnant plume in the vicinity of the landfill sumps. Ecological uptake could occur in the post-project environment if impacted groundwater occurs within 3.0 m of ground surface. The flow system was interpreted in Section 5.1.2.2 as having a northerly gradient and flow rates less than

0.01 m/year offsite migration is not likely to occur. Baseline groundwater chemistry has been established for this flow system and is provided in Appendix J.

- Deep seated groundwater impact to the underlying Floral Aquifer was identified as a possibility that should be assessed since this represents the shallowest regional aquifer identified below the site. The aquifer was interpreted in Section 5.1.2.2 as having a northeasterly gradient with no downgradient well users in the 3.2 km radius study area, however the potential for future wells exists. Advective vertical flow through dozens of meters of overlying unoxidized till was interpreted to be in the order of 0.1 m/yr suggesting that the environment provides significant separation of surface water from the regional aquifer.

The Project will not alter groundwater flow system dynamics or extract any groundwater resources, therefore there is no concern that the Project could impact access to groundwater; only quality of groundwater.

7.2.2 Mitigating Measures

Siting and design of the landfill cells and leachate pond is critical for managing the risks of impacting groundwater quality. The proposed Phase I Project proposal will include extensive and robust engineering controls and operational controls. At a minimum, similar design principals and operational strategies will apply to the Phase II Project when it is constructed.

General factors that will mitigate against groundwater impacts involve strong regulatory oversight, as outlined in Section 1.4, and early planning to site the Project away from shallow aquifers.

Specific mitigation measures that apply to the proposed Project's design and operations include:

- Compacted clay liners and leachate collection systems within each landfill cell that will focus leachate at the base of the cell into a sump where it can be readily monitored and removed as necessary to minimize driving head on the liner system;
- A key element of the above noted liner system noted above, involves the collection and direction of accumulated leachate away from potential receptors (i.e. channelized sand). Vertical leachate infiltration will be intercepted on the base of the liner that will be sloped to the east. The base of the cell will have a highly permeable Leachate Drainage Layer that will direct water easterly to the low point in the cell, the Leachate Sump. The cell design limits the opportunity for leachate buildup to occur over the extents of the channelized sand. The sump will be located off of the channelized sand extents and have no risk of impact to the sand, or other sensitive water bearing units.

- A dual liner and leachate collection system for the leachate pond which includes (in descending order) an HDPE liner, a leachate collection system and a compacted clay liner;
- Maintaining the base of the landfill cell (including sumps) at elevations above the phreatic surface to avoid generating excess leachate from groundwater seepage; and,
- A leachate management plan that will involve monitoring leachate levels in the leachate collection sumps, removal of leachate from the sumps when action levels are achieved, and a strategy to evaporate or otherwise dispose of leachate.

These four (4) mitigation measures are discussed in more detail below.

Leachate Containment & Collection: Landfill Cells

Engineering containment in the landfill cells is designed to 1) optimize the competency (i.e. reduce hydraulic conductivity) of the confining layer of the basal soils, 2) to minimize the driving head allowed to form on the base of the cell, and 3) limit the opportunity for any fluid buildup on the base of landfill cell where it overlies the channelized Sand 2 deposit. Design components of the leachate containment and collection systems for the landfill cells are shown conceptually in Figure 7.1 and detailed designs are provided in Drawing WM566.3-D6 in Appendix D.

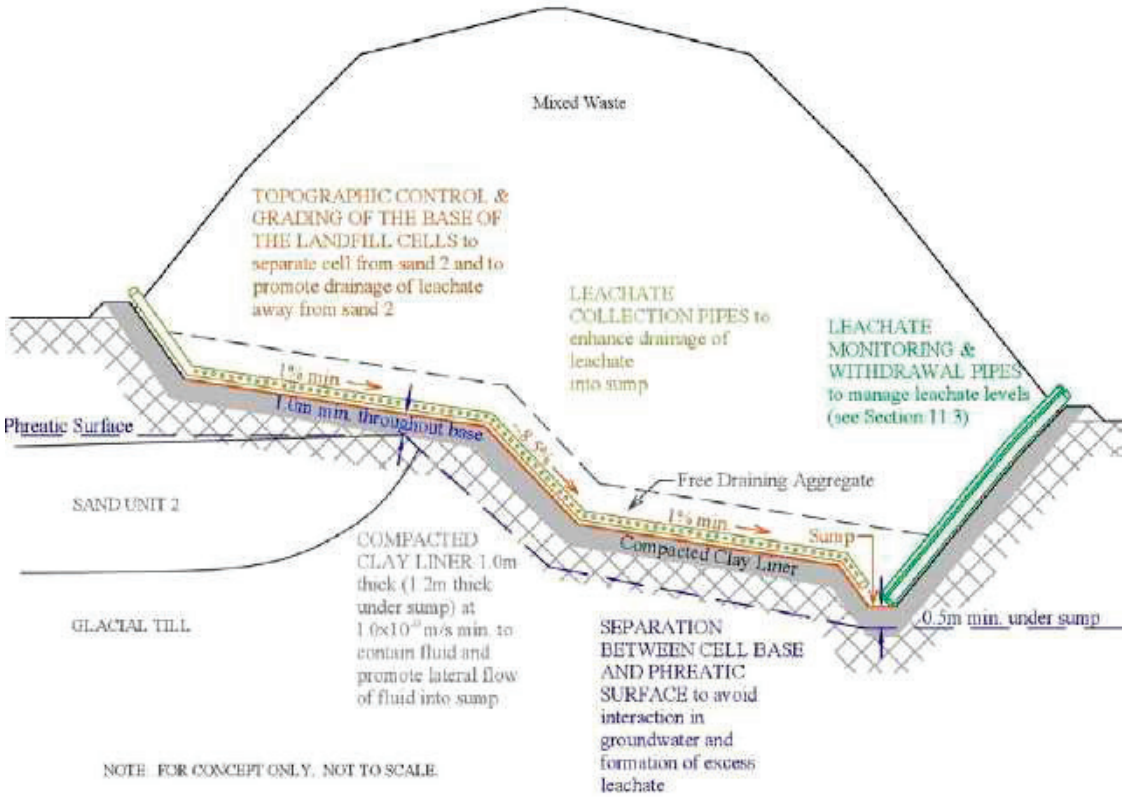


Figure 7.1 Proposed Leachate Collection and Containment in Landfill Cells

Landfill cells will be constructed with a 1.0 m thick compacted clay engineered liner underlaying the entire footprint of each landfill cell. The maximum specified value for the compacted clay liner is $1x10^{-9}$ m/s or lower. Evidence suggests that this objective should be easily achieved and likely exceeded by an order of magnitude since remoulded bulk samples achieved hydraulic conductivities in the order of $1x10^{-10}$ m/s to $2x10^{-10}$ m/s (see Table 5.5). The engineered liner in the vicinity of the leachate collection sump will be thickened to 1.2 m to account for increased risk based on accumulated fluid at this location. These are standard liner thicknesses for modern landfills.

As a contingency the designer considered specifying a lower maximum hydraulic conductivity for the compacted clay liner since it was demonstrated that local sediments can achieve values in the order of 30 times (1.5 orders of magnitude) less than 10^{-9} m/s specification. It was decided that maintaining the minimum specified hydraulic conductivity at $1x10^{-9}$ m/s would be reasonable to account for small-scale construction variations that can occur on a large earthworks project. A specification that clay lifts be compacted to at least 98% of the maximum dry density with moisture between -2% and +3% of optimum moisture will ensure that the hydraulic conductivity of the liner at scale is much lower than the maximum specified value, likely by a factor of at least 1 order of

magnitude. This adds a significant factor of safety to the impacts assessment presented in Section 7.2.4.

Another contingency that was considered was a thickened liner for the portion of the landfill cell that overlies the channelized sand deposit. The channelized sand pathway arguably represents the most sensitive pathway for offsite impacts, and it is necessary to demonstrate that siting the landfill over the sand will not result in impacts to the West Slough. Numerical modelling presented in Section 7.2.4 demonstrates that the standard 1.0 m thick liner provides adequate containment by a significant margin, so it was determined that a thickened liner was not required.

Risk of damage to the liner by desiccation or frost heave will be controlled during construction and operations, monitored with routine inspections, and remediated promptly if detected. The risk of desiccation can be controlled by maintaining moisture in the compacted clay liner. This will naturally occur when the liner is covered by waste or drainage aggregate but exposed clay surfaces may dry out, especially on hot sunny days. Irrigating the exposed clay surfaces may be necessary to avoid desiccation. The risk of frost heave will be controlled by maintaining moisture below 3% of optimum moisture content during construction (as per the construction specifications), and by grading the liner systems to limit the area over which leachate can pond and increase moisture content in the liner. As an added contingency, initial landfilling will prioritize placement of waste in the eastern parts of Cell 1 and Cell 2 to insulate the liner where it is most likely to be saturated to further reduce the risk of frost heave.

The landfill cells have a tiered base which varies by about 7 m between the eastern and western edges of the landfill cell footprints. This varying cell base was designed to optimize waste storage volumes while maintaining separation from the interpreted phreatic surface. The higher phreatic surface on the western part of the cell footprint is associated with the channelized sand groundwater flow system and also corresponds to a topographic high. This tiered configuration makes accumulation of fluid over the western extent of the landfill cell virtually impossible at scale, thus limiting vertical infiltration into the underlying Sand Unit 2.

The clay liner is designed to slope toward three parallel drainage swales per cell, which in turn slope toward the east with a minimum grade of 1.0% (with the mid-sections graded up to 9.0%). This configuration will promote the drainage of any ponded fluid toward the sump and, importantly, away from the portion of the landfill cells overlying Sand 2.

A leachate collection system, located at the eastern limits of the landfill cells, will enhance drainage of leachate into the sump. The leachate collection system will consist of perforated HDPE pipes installed in the drainage swales, providing a preferential flow pathway to the sump where fluids

will be collected, monitored, and ultimately withdrawn. The leachate collection pipes will be embedded in drainage aggregate across the entire base of the cell to avoid any impediment to drainage.

A leachate monitoring and withdrawal system will minimize hydraulic pressures on the base of the landfill cell by allowing fluid levels to be monitored and leachate to be withdrawn. A leachate monitoring pipe consisting of HDPE pipe with perforations at the base will be installed on the side slope of the cell adjacent the sump to interpret the depth of fluid accumulated within each landfill sump. An HDPE leachate withdrawal pipe will extend along the same side slope to permit removal of fluids from the sump with the use of a submersible pump and hose. Leachate withdrawal will be triggered when fluid levels reach the sump's specified Action Level, as discussed in Section 11.3.

Leachate Containment & Collection: Leachate Pond

A dual-liner system is specified for the leachate pond. A geosynthetic liner will comprise the primary containment layer, overlying a leachate collection & withdrawal system comprised of pipes and aggregate, in turn overlying a compacted clay liner that comprises a secondary containment layer. Design components of the leachate containment and collection systems for the leachate pond are shown conceptually in Figure 7.2 and detailed designs are provided in Appendix F.

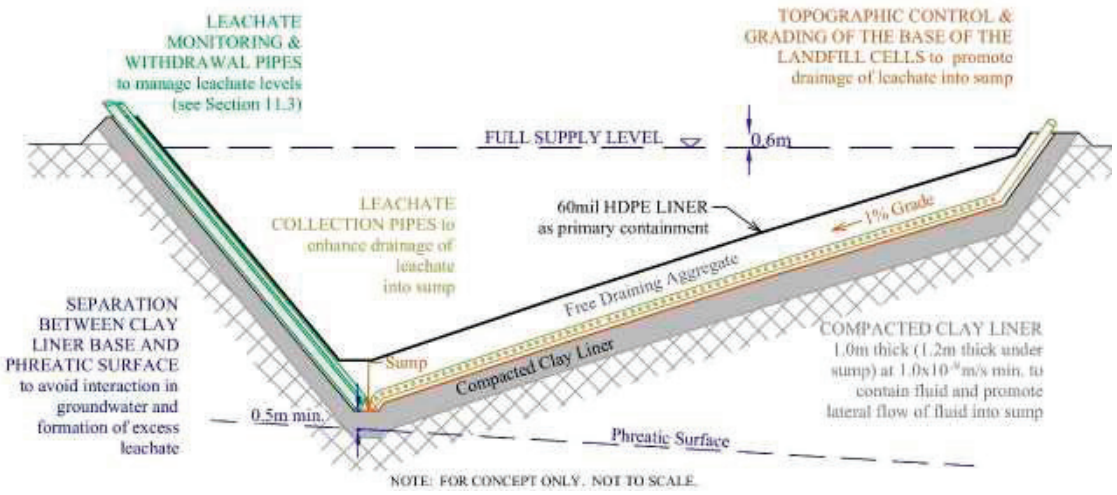


Figure 7.2 Leachate Containment and Collection in Landfill Cells

The secondary (deeper) liner will consist of 1.0 m thick compacted clay underlying the entire footprint of the pond. The performance objective for the compacted clay liner is $1x10^{-9}$ m/s or lower. Evidence suggests that this objective should be easily achieved and likely exceeded by an order of magnitude since remoulded bulk samples achieved hydraulic conductivities in the order of $1x10^{-10}$ m/s to $2x10^{-10}$ m/s (see Table 5.5). The engineered liner in the vicinity of the leachate

collection sump will be thickened to 1.2 m to account for increased risk based on accumulated fluid at this location. The clay liner will be graded to slope toward a central drainage swales per cell, which in turn slope toward the west with a minimum grade of 1.0% (with some sections graded up to 9.0%). This configuration will promote the drainage of any ponded fluid toward the sump.

A leachate collection system will be constructed over the compacted clay liner and underneath the primary liner to drain leaked fluid into the sump. The leachate collection system will consist of perforated HDPE pipes installed in drainage swales constructed in the underlying soil, providing a preferential flow pathway to the sump where fluids will be collected, monitored, and ultimately withdrawn. The leachate collection pipes will be embedded in drainage aggregate across the entire base of the pond to avoid any impediment to drainage.

A leachate monitoring and withdrawal system will minimize hydraulic pressures on the compacted clay liner by allowing fluid levels to be monitored and leachate to be withdrawn. A leachate monitoring pipe consisting of HDPE pipe with perforations at the base will be installed on the side slope of the cell adjacent the sump to interpret the depth of fluid accumulated within the sump. An HDPE leachate withdrawal pipe will extend along the same side slope to permit removal of fluids from the sump with the use of a submersible pump and hose. Leachate withdrawal will be triggered when fluid levels reach the sump's specified Action Level, as discussed in Section 11.3.

The primary containment layer will consist of a geosynthetic liner. A 60 mil HDPE liner has been specified to provide coverage of the entire pond surface. This is a standard liner material that is widely used in the province for waste containment. Standard safeguards are specified for the liner installation, including leaving slack in the liner to account for liner shrinkage in cold temperatures and quality assurance field and lab testing of the liner material and all welds. Use of a perimeter fence to minimize the potential for damage by wildlife is an effective tool.

Design Elevations with Respect to Phreatic Surface

The Phase I landfill cell and leachate pond designs maintain a minimum 0.5 m separation between the base of the leachate collection systems (i.e. the clay liner surface underlying the landfill cells and leachate pond) and the phreatic surface in the underlying soil to avoid groundwater seepage into or out of the cell and the generation of excess leachate. The same design constraint would apply to leachate collections sumps designed for the Phase II facility.

The separation between the base of the compacted clay liners and the interpreted phreatic surface will be much greater than 0.5m over much of the footprint of the landfill cells and leachate pond.

Leachate Management Strategy

A leachate management strategy is required to ensure that driving head within the cells and sumps is monitored and maintained below a maximum allowable leachate level. Controlling the driving head in the sumps will limit the opportunity for leachate to infiltrate into underlying soils. An Action Level of 0.3 m of fluid depth on the landfill sump is specified in the Phase I design with a Maximum Allowable Level of 0.8 m. With a 0.5 m deep sump, this Maximum Allowable Level will correspond to no more than 0.3m fluid depth on the main cell liner, as per the accepted standards. The leachate monitoring program is outlined in Section 11.3.

The strategy will also involve management or disposal of leachate after it is withdrawn from the sumps to avoid a build-up of excess leachate on site. Average annual leachate generation for the site is estimated to be about 7,900 m^3/y based on precipitation distribution data. The primary disposal method will be irrigation onto the active landfill surface. Conservatively assuming one (1) weekly application of 15 cm leachate over 5 months of the year on half the Phase I landfill footprint it is estimated that 10,000 m^3 of fluid could be evaporated in an average climatic year.

The leachate pond will primarily serve as a staging area for leachate and will also provide an average 2,000 m^3/y of passive evaporation. This leachate management strategy can manage all the anticipated leachate production with significant buffer capacity. With a more intensive application effort, the volume of leachate managed through evaporation could increase significantly.

Seasonality is an important consideration for this management plan as evaporation through irrigation will largely occur from May through September with peak evaporation in the hot summer months. Successful implementation of the leachate management strategy will rely on drawing down fluid levels in the sumps and leachate pond during the summer months to allow for available storage in late fall for accumulation through the winter and early spring seasons. It is also acknowledged that leachate will be generated at faster rates during non-frozen months, which is reflected in a more stringent leachate monitoring schedule between May and October (outlined in Section 11.3).

A contingency plan for leachate management involves discharge of leachate offsite to a municipal domestic wastewater lagoon for treatment. An agreement has been reached with the RM of Invergordon for the use of their lagoon for this purpose. Documentation is provided in Appendix Q. Discharge of leachate offsite to a domestic wastewater lagoon for treatment is a viable option and is used in many operating landfills.

Summary

Mitigations as they relate to potential impacts to surface water quality are summarized below in Table 7.1.

Table 7.1 Mitigation Measures to Minimize Impacts to Groundwater Quality

ID	Potential Interaction	Mitigation Measures
1	Contamination of west slough via channelized groundwater system on west-central part of the PSA (Sand Unit 2)	Siting landfill cells and leachate pond away from interpreted extents of channelized sand deposit as much as practical
		1m thick compacted clay liner on the base of the landfill cells with min. performance objective of 1x10-9 m/s
		Where landfill cells overlie the channelized sand deposit, grade the base of the cell away from sand deposit by 1% (min) to prevent ponding of leachate on the base
		Leachate collection pipes in on base of landfill cells to ehance drainage of leachate and minimize buildup of leachate on the base of the landfill cells
2	Contamination of fractured till flow system on eastern edge of PSA	1m thick compacted clay liner on the base of the landfill cells and leachate pond thickened to 1.2m under sumps with min. performance objective of 1x10-9 m/s
		Graded base of landfill cells and leachate pond to direct leachate into collection sumps where the fluid can be collected, monitored, sampled and withdrawn
		Leachate collection pipes on base of landfill cell and overlying leachate pond compacted clay liner to enhance drainage of leachate and minimize buildup of leachate on the liner systems
		Leachate monitoring and withdrawal pipes to manage fluid levels and limit buildup of fluid on the compacted clay liner systems
		Leachate management plan that limits the driving head on the sumps to 0.5 m (maximum) and the driving head on the lower (easternmost) part of the landfill base to 0.2 m (maximum). Action levels will be set to remove leachate when fluid in the sump reaches 0.3 m depth.
3	Contaminiation of Floral Aquifer by vertical infiltration	All mitigation measures listed for previous item apply

7.2.3 Monitoring Mitigation Outcomes and Follow-Up

Groundwater Quality

The development will be subject to a routine groundwater monitoring program, which is a standard condition of an operating landfill in Saskatchewan. Details of the proposed monitoring program are discussed in Section 11.4. In brief, piezometers will be established and monitored in the two (2) pathways of concern; that is, in the channelized sand deposit and in the shallow oxidized till. For each pathway, one (1) piezometer will be installed upgradient of leachate point source locations (i.e. the leachate pond and landfill cells) and two (2) piezometers will be installed downgradient of the leachate point source locations.

During the operational stage, groundwater will be monitored twice per year and analyzed at a certified laboratory. The results will be reviewed and analyzed for spatial and temporal trends a

qualified person and reported annually to MOE. This approach will allow for a quantitative assessment of impacts, if they are detected.

Saskatchewan Environmental Quality (SEQG) guidelines will be used as measurable and objective targets for groundwater and surface water monitoring. An endpoint selection evaluation will be presented in the Environmental Monitoring Plan. Briefly, it is expected that Natural land use/Coarse soil type/Aquatic Life &Wildlife Watering endpoints will be relevant for the channelized sand pathway and Agricultural land use/ Fine soil type/ Ecological Contact endpoint will be applicable for the oxidized till pathway. If a particular analyte exceeds the relevant SEQG guideline, it is termed a 'substance of potential concern' (SOPC). The metrics that will be used to evaluate the success of Project's mitigation efforts for groundwater quality are as follows:

- Channelized sand system: Successful mitigation will be defined by an ongoing monitoring program that does not identify SOPCs in the flow system that correspond to analytes associated with landfill leachate. The following contingency plan will be initiated if SOPCs associated with landfill leachate are identified in the channelized sand downgradient of the landfill cells:
    - A field investigation program will first be undertaken to identify the extent of impacted groundwater and refine estimates of the groundwater flow rates and pathway. At a minimum this will consist of a drilling, piezometer installation, and water sampling program undertaken by a qualified professional to characterize the flow system and interpret the environmental risks, if any, and appropriate remedial measures, if required.
    - Remedial measures, if they are required, may include pumping impacted water out of the flow system which would not only intercept impacted water, but it would also lower the piezometric surface in the flow system and induce a non-saturated sand layer within the vertical migration pathway which would conceptually have significant benefits to natural attenuation.
- Oxidized till: Project-related SOPCs may be identified in the oxidized till system if the monitoring piezometer is close to the leachate collection sumps. Successful mitigation will be defined by either:
    - Ongoing monitoring that does not identify SOPCs; or
    - Plume migration speed is less than 0.4 m/yr for Phase I, calculated as the distance between the piezometer and nearest leachate collection sump divided by the

number of years it took for SOPCs to be detected at the piezometer. At this speed, it would take over 1,000 years for offsite migration from Phase I to occur during which time significant natural attenuation will occur. Actual speeds are expected to be much lower than 0.4 m/yr. A similar assessment will be done for Phase II to determine the maximum allowable migration speed to prevent offsite impacts.

- It is important to note that naturally occurring glacial till often has elevated mineralization due to the ample available minerals in the soil and slow-moving groundwater. Determination of SOPC characterization will include comparing downgradient concentrations from those naturally occurring at the site.

Liner Condition

The exposed portions of the compacted clay and HDPE liners will be inspected routinely for signs of damage. If damage is detected or suspected, it will be documented and promptly repaired under the supervision of a qualified professional to achieve the performance objectives outlined in this EIS and permitting documents.

Damage to the HDPE liner may appear as visible tears in the liner, likely caused by either impact or puncture, a faulty weld, or tension in the liner. A damaged HDPE liner may also be detected by excess leakage into the underlying leachate collection system (monitoring of this system is discussed in Section 11.3). Repair of the liner will require specialized equipment and personnel.

Damage to the compacted clay liner will appear as visible cracks in the clay likely caused by either desiccation or frost heave. Shallow cracks on the surface of the liner are unavoidable, easily healed by the addition of moisture, and generally inconsequential. However, cracks exceeding 6 cm in depth should be reported as damage and will require moisture conditioning and recompaction. Placement of a thin loose soil or waste layer would protect the underlying compacted clay liner from desiccation and associated cracking if needed.

7.2.4 Residual Effects

The anticipated impacts of the Project on the underlying groundwater flow systems were estimated quantitatively using a pseudo 3-dimensional contaminant transport model. Modelling worksheets are provided in Appendix N and the results are discussed below.

Impacts to West Slough via Channelized Sand Deposit

Leachate migration from the base of the landfill cell (source) into the channelized sand flow system (pathway) and subsequently into the west slough (receptor) was modelled for the most conservative

plausible scenario. Details are provided in worksheet N.1 in Appendix N. This scenario makes a series of conservative assumptions about the flow path based on factors that are difficult to precisely define to bracket the maximum impact that could occur at the receptor. While each of the assumptions is plausible on their own, the likelihood of these extreme conditions collectively occurring is highly unlikely, so the results of the model are considered to be conservative. Nonetheless, this model is useful to determine the magnitude of impact that will not plausibly be exceeded based on the commitments outlined in this report.

The model makes the following assumptions:

- The model assumes a constant ponding of 0.1 m of leachate on the base of the landfill on 30% of the surface area that overlies the channelized sand deposit to account for the possibility of minor construction deficiencies creating nominal collection points. This scale of ponding is unlikely to occur given that the landfill base will be sloped a minimum 1% to the east, with three (3) drainage swales, and a layer of drainage aggregate with leachate collection piping. Actual ponding size and depth is expected to be less, thus providing the above analysis as a conservative estimate.
- The model assumes a hydraulic conductivity of $1x10^{-9}$ m/s for the compacted clay liner which is the maximum specified value. While this value reflects the minimum design commitment, the compaction testing specified for liner construction will ensure that a much lower hydraulic conductivity, likely in the order of 30 times (1.5 orders of magnitude) lower, could be achieved at full scale as indicated by geotechnical testing discussed in Section 5.1.1. Modelling the liner's performance at the maximum specified hydraulic conductivity of $1x10^{-9}$ m/s adds a significant factor of safety to the model, again providing a conservative estimate.
- The model assumes a hydraulic conductivity of $1x10^{-5}$ m/s for the channelized sand pathway which is typical for a medium to coarse sand although drilling results indicate that it is likely that silt and clay are prevalent in portions of the channelized sand pathway.
- Finally, the model assumes 0.6 m of oxidized till separating the compacted clay liner and the saturated sand deposit. If sand is encountered during the landfill cell excavation, construction specifications require a minimum 0.6 m over-excavation and placement of clay soils below the compacted clay liner, resulting in a minimum 0.6 m thick separating layer with similar hydraulic conductivity as oxidized till, which is conservatively assumed in the model to be $1x10^{-8}$ m/s.

Key modelling parameters and results are illustrated conceptually in Figure 7.3

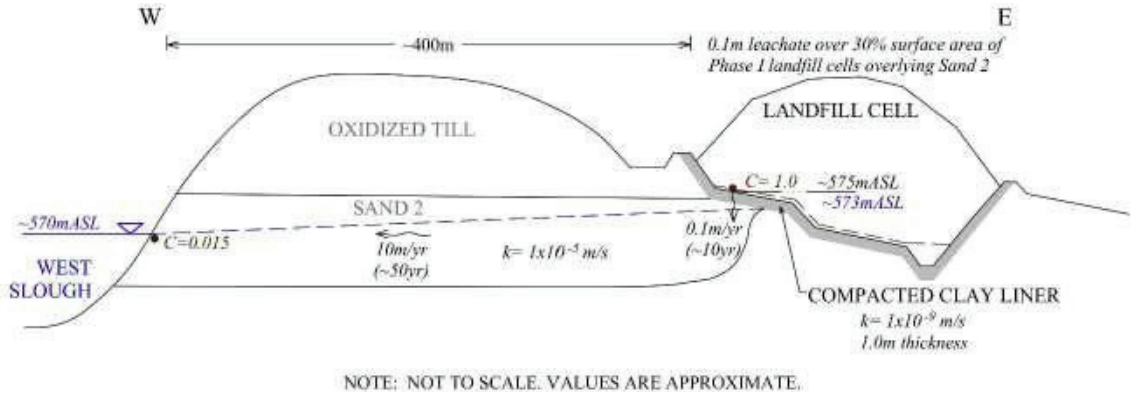


Figure 7.3 Worst-Case Flow from Proposed Landfill Cell into Channelized Flow System and Subsequently into West Slough

This model of the worst-case scenario predicts that slug breakthrough from the channelized sand pathway at the outlet to the west slough receptor would occur after about 60 years with a concentration of 1.5% source term concentration.

To contextualize what a 1.5% source term concentration means relative to environmental water quality guidelines, an analysis detailed in Appendix O compared 1.5% of actual leachate ("source term") chemistry to Saskatchewan Environmental Quality Guidelines (SEQG) Tier 1 guidelines which represent a conservative water quality guideline that considers all possible exposure pathways. Source term chemistry was conservatively defined in this analysis by using measured landfill cell leachate geochemistry from multiple landfill cells in Saskatchewan. The analysis identified three (3) analytes where a 1.5% source term chemistry would exceed a Tier 1 standard; iron, manganese, and toluene. Detailed evaluation of the relevant source term, water quality standards and exposure pathways is provided below for each of the exceedances listed above, culminating in a conclusion that these analytes will not adversely impact the environment:

- Dissolved iron concentrations range between about 400 mg/L and 2 mg/L in the analyzed landfill leachate and the concentration appears to be a function of the age of the cell. Initially, elevated iron concentrations as high as 400 mg/L are measured in the first season (i.e. Cell 3's in Appendix O), however once the leachate has been managed through irrigation (i.e. Cells 1 & 2 in Appendix O) the iron concentrations decline rapidly to values typically less than 6 mg/L. This decline would be associated with fluid oxidation of the iron minerals making them less soluble at the source. Long termed source concentrations of 6 mg/L produces a theoretical worst-case breakthrough concentration of 0.09 mg/L (1.5% of source term) within the channelized sand pathway. These concentrations are well

below the Tier 1 SEQG guidelines (0.3 mg/L) and would likely be much lower than naturally occurring iron concentrations.

- Dissolved manganese concentrations range between about 17 g/L and 0.06 mg/L in the analyzed landfill leachate and, like iron, the concentration appears to be a function of the age of the cell with a declining concentration associated with leachate irrigation making manganese less soluble at the source through oxidation. With this rationale, long termed source term concentrations as high as 2.5 mg/L are estimated for manganese within the leachate. This source term concentration would produce a theoretical worst-case breakthrough concentration of 0.04 mg/L (1.5% of source term) within the channelized sand pathway which would exceed the Tier 1 SEQG standard of 0.02 mg/L. There are two (2) considerations provided below to rationalize why this breakthrough concentration of manganese is not expected to adversely impact the environment:
    - The SEQG Tier 1 standard for manganese was established for the protection of potable water. In this case, neither the pathway nor receptor represent a potable water resource so the potable water standard is an excessively conservative standard for evaluating Project effects. Exposure to aquatic life and wildlife in the slough (receptor) are more appropriate exposure vectors to consider. There are no SEQG manganese standards established for aquatic life or wildlife watering endpoints. In other words, the guidelines provide no indication that a contribution of 0.04 mg/L manganese would adversely affect ecological life in the slough.
    - Manganese is naturally occurring in soils and easily dissolved. Background manganese concentrations measured in shallow groundwater at the site range from 0.1 mg/L to 1.3 mg/L. At a concentration of 0.04 mg/L, the Project's contribution to the overall manganese reaching the receptor would be small and undetectable relative to natural processes.
- Toluene concentrations vary widely between the leachate samples considered in the analysis, ranging from 2 ug/L to 2,660 ug/L with higher toluene concentration associated with a landfill that accepted hydrocarbon impacted soils. Without considering natural degradation, the maximum source term concentration would produce a theoretical worst-case breakthrough concentration of 40 ug/L (1.5% of source term) within the channelized sand pathway which would exceed the Tier 1 SEQG standard of 21 ug/L. Natural degradation is, however, a significant factor in the fate of toluene that was not considered in the 1.5% breakthrough analysis. Degradation of toluene in groundwater is sited to occur

in the order of a few percent per week (Government of Canada, 1992). At this rate a source term concentration of 2,660 ug/L would degrade below the Tier 1 limit in less than 40 months. Since slug flow is projected to take several decades to reach the West Slough, this analyte will effectively be completely naturally degraded prior to breakthrough. This rationale demonstrates that toluene is not expected to cause adverse impacts to the environment.

It is worth noting that the 1.5% source term prediction is for groundwater before it discharges into the slough (i.e. within the main pathway, not at the receptor) and does not take into account natural attenuation, nor does it account for dilution in the slough. Even without accounting for these, groundwater quality at slug breakthrough is not expected to adversely impact the slough and it follows that adverse impacts are also not expected elsewhere in the slough including beyond the property boundary 150 m from the discharge location.

It should be reiterated that the actual impacts to the channelized sand and slough are expected to be much less that those modelled, likely resulting in slug breakthrough below 0.5%. The model presented above represents an extreme scenario culminating from a series of conservative assumptions that is very unlikely to occur but allow for higher magnitude impacts to be confidently ruled out. Overall, the modelling provides confidence that adverse impacts to the slough (i.e. the receptor) are not expected to occur.

The evaluation presented above provides scientific rationale to justify the siting of landfill cells over the channelized sands as an alternative to the accepted Alberta landfill standards, providing that a compacted clay liner is constructed with: a) a minimum 1.0 m thickness, b) a maximum hydraulic conductivity of $1x10^{-9}$ m/s and c) a surface that is sloped to the east.

A plan to monitor the mitigations is proposed in Section 7.2.3 to allow for the predictions outlined above to be verified. A contingency plan has also been proposed in the same report section for the unlikely scenario where the monitoring results fail to verify the predicted outcomes described above.

Given the predicted timelines for breakthrough, impacts if they occur would be expected during the Project's operational period, continuing some time into the post-closure phase. The risk is considered to be non-reversible since the buried waste and landfill infrastructure will be permanent in the subsurface, although decommissioning the landfill cells will reduce the source term fluid and the risk will eventually dissipate.

Impacts to Oxidized Till Flow System on East Side of PSA

Migration from the various leachate collection sumps into the stagnant shallow groundwater in surrounding till soils was modelled (worksheet N.2 in Appendix N). The modelling conservatively assumes a constant 0.8 m driving head of leachate in the sumps which is associated with the maximum allowable fluid levels specified for the sump which implies that the actual fluid levels will be maintained below this level. It assumes a 1.2 m thick compacted clay liner with an average hydraulic conductivity of $1x10^{-9}$ m/s which is the maximum specified value although it is likely that much lower hydraulic conductivity will be achieved. It assumes a hydraulic conductivity of $4x10^{-9}$ m/s for the oxidized till based on field measurements. Key modelling parameters and results are illustrated conceptually in Figure 7.4.

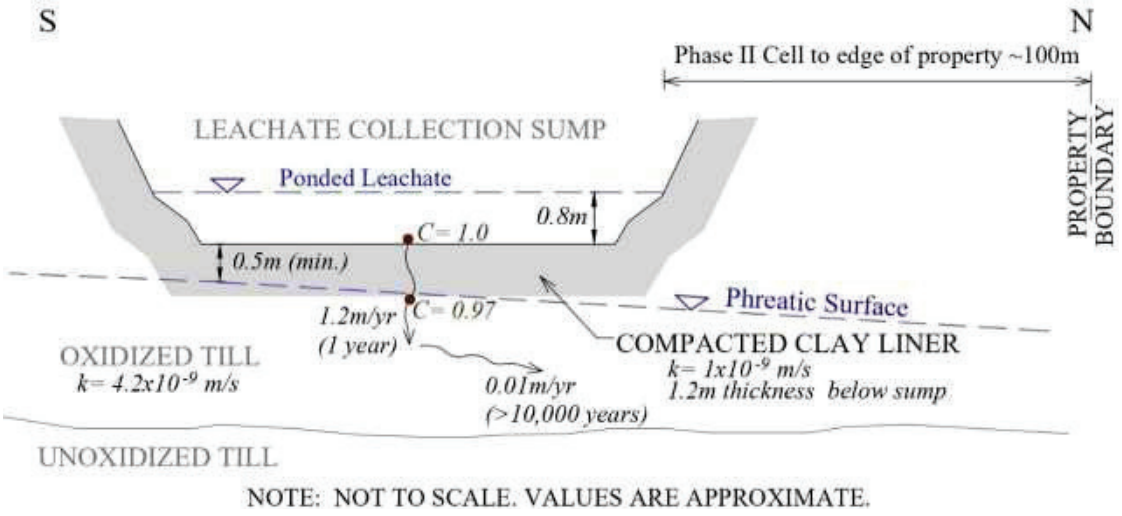


Figure 7.4 Theoretical Flow from Proposed Landfill Cell into Stagnant Till-Based Flow System

The modelling suggests that a concentrated but stagnant plume is likely to develop below the sumps. Lateral migration from advective flow is estimated to be in the order of 0.01 m/year, which is likely undetectable in the Project's lifespan and indicative that offsite migration is not a risk even for the Phase II cells near the northern property boundary. The concentration of these plumes are modelled at 97% of the source term concentration, reflecting the of the lack of flow through the system to provide dilution. This value does not consider natural attenuation, which will reduce the concentration of many analytes over time.

It is important to note that groundwater in clay flow systems tend to have naturally elevated geochemistry as a result of low hydraulic conductivities (i.e. high residency time for dissolution and little background flow to dilute). Impacts to this type of flow system will not necessarily be

cumulative, as chemical reactions will take place and establish a new equilibrium between the source term, soil chemistry, and groundwater chemistry.

The modelled scenario is conservative and uses the maximum specified hydraulic conductivity for the clay liner, even though the constructed liner will likely be a half to full order of magnitude lower. Any reasonable variation of environment and design assumptions result in a similar outcome of a highly concentrated, barely-moving plume in the fractured till soil. It also assumes a constant driving head of 0.8 m in the sump although in practice 0.8 m represents the maximum allowable fluid depth and leachate levels will be maintained below this level.

This plume is not problematic while the site is operating but it is expected to persist in the post-closure phase and carries risks or limitations for future land use post-decommissioning since shallow, impacted groundwater can be a pathway for ecological uptake. The implications are generally limited; shallow glacial till groundwater is typically highly mineralized with limited mobility. Nominal changes in the geochemistry are expected but is not expected to adversely impact any receptors and is limited to the PSA footprint. The Project's post-closure monitoring period will likely be defined by the duration of time that it takes natural processes to reduce the plume's concentration to below applicable guidelines. This type of impact is not unique to this Project, rather it is an unavoidable and direct result of any landfill sited in competent clay soils.

The concentrated, stagnant plume is expected to occur during the operational, decommissioning, and post-closure Project phases. The risk is not considered to be reversible for all analytes although natural processes such as attenuation and dilution will reduce the magnitude of effects over time.

Impacts to the Floral Aquifer

Vertical migration of leachate into the Floral Aquifer was modelled (worksheet N.3 in Appendix N). The modelling conservatively assumes a constant 0.8 m driving head of leachate in the sumps which is associated with the maximum allowable fluid levels specified for the sump which implies that the actual fluid levels will be maintained below this level. It assumes a 1.2 m thick compacted clay liner with an average hydraulic conductivity of $1x10^{-9}$ m/s which is the maximum specified value although it is likely that much lower hydraulic conductivity will be achieved. It assumes 7.8 m of oxidized till with a hydraulic conductivity of $4x10^{-9}$ m/s and 29 m of unoxidized till with a hydraulic conductivity of $2x10^{-10}$ m/s based on drilling logs and field measurements. Modelling parameters and results are depicted in Figure 7.5.

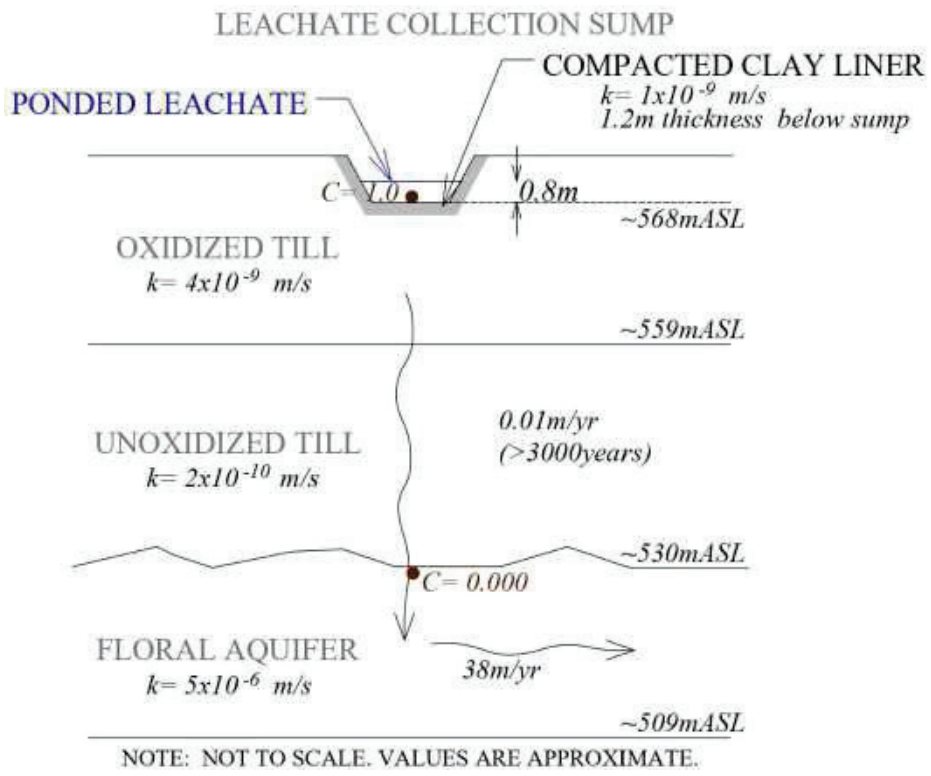


Figure 7.5 Theoretical Flow from Leachate Collection Sump into Floral Aquifer

The model predicts that it would take several thousand years for leachate to percolate into the aquifer, during which time significant natural attenuation would occur. This is unsurprising as the soils underlying the site function equivalent to a 38 m thick compacted clay liner. The modelling definitively demonstrates that the Floral Aquifer is isolated from Project impacts.

Summary

The Project's anticipated residual impacts on groundwater quality are summarized in Table 7.2.

Table 7.2 Effects Assessment for Groundwater Quality

ID	Potential Interaction	Residual Effect	(with mitigation)		PSA	LSA	RSA	Con.	Op.	Decom.	P.C.	Reversible	Cumulative Effects Consideration
GROUNDWATER QUALITY													
1	Contamination of west slough via channelized groundwater system on west-central part of the PSA (Sand Unit 2)	Effects of <0.15% source term concentration in groundwater pathway after several decades not accounting for natural attenuation	rare	minor	X				X	X	X	-	Impacts from nearby historic landfill will not compound with the Project's residual impacts
2	Contamination of fractured till flow system on eastern edge of PSA	Concentrated by barely moving plume expected in the viscitnity of the leachate collection sumps on the eastern side of the PSA. Groundwater flow rate estimated ~0.01 m/yr. No risk to neighbouring landusers, but potential for ecological uptake post-project where groundwater is shallow.	likely	minor	X				X	X	X	no	-
3	Contamination of Floral Aquifer by vertical infiltration	No effects expected. Thousands of years to reach aquifer at <0.01%	rare	insignificant								-	-

7.2.5 Cumulative Effects

There are no known projects that will offset or worsen the effects described in the previous section or interference between the Project effects identified. The potential for the nearby historic RM landfill to compound groundwater was previously ruled out in Section 5.1.2.3. Cumulative effects to groundwater quality therefore equate to the residual Project effects.

The Project's effects on groundwater are assessed in terms of their potential interaction with proximal surface water features in Section 7.3.

7.3 Surface Water Quality and Accessibility

7.3.1 Potential Interactions

Surface water largely originates as precipitation and accumulates in topographic lows across the region. Surface water management is a major consideration of the Project design. In Phase I, there are four (4) runoff catchment areas: Runoff Pond A, Runoff Pond B, leachate pond, and landfill cells. These features are shown in Drawing WM566.3-E2 in Appendix E. The first two (2) ponds collect the majority of surface water runoff occurring across the site. This water will not interact with waste material or landfill leachate and thus will not be impacted. Nonetheless, this 'clean' surface water will be stored and managed on site, as is standard practice with landfill facilities in Saskatchewan. The runoff ponds require containment, control and management. The latter two (2)

collection points are internally drained sources that will contain water that has been in contact with landfilled wastes or leachate and thus will be impacted. These latter two (2) surface water sources have higher risks associated with them and management and control is more critical although the landfill cell sumps are buried and thus are not considered surface water until the fluid is extracted.

The potential for leachate to contaminate surface water features is a main environmental concern with a landfill development. Landfill leachate typically contains elevated concentrations of dissolved organic matter, inorganic macro-components, heavy metals, and xenophobic organic compounds that can have adverse effects on the environment. For this assessment, any water that comes in contact with landfill waste is be considered leachate. Point sources for leachate will conform to the footprint of the landfill cells and leachate pond. There are three (3) pathway-receptor scenarios to consider:

- Overland flow of out of the PSA would drain into either into the west slough or east slough, both within the LSA. Receptors would be plants and wildlife consuming or inhabiting the water. The risk of this interaction is limited to the Project's operation stage when potentially contaminated surface water will occur at surface on site. In an extreme event of overland flow release, water quality could conceptually be affected in water bodies and channels downstream of the east and west sloughs.
- Landfill leachate could conceivably flow offsite in a channelized (Sand 2) flow system with hydraulic connectivity to the west slough, ultimately affecting water quality in the slough. Again, the receptors would be plants and wildlife consuming and inhabiting the slough. This interaction could occur during the Project's operation, decommissioning or post-closure stage. This potential interaction is discussed and assessed in Section 7.2 since groundwater flow is the mechanism of concern.
- Finally, the creation of a leachate holding pond creates an opportunity for receptors such as plants and animals to consume impacted fluid.

The Project also has the potential to impact surface water availability, albeit on a small scale. By segregating onsite and offsite drainage there will be minor changes in the amount of runoff reaching adjacent wetlands. The construction of the perimeter berm through the ephemeral and permanent wetlands (i.e. the east slough) on the eastern edge of the PSA also has the potential to alter drainage on the eastern boundary of the PSA if not mitigated.

The Project has the potential to impact other aspects of surface water, as they relate to the ecological and human environments. Potential effects on wetland habitat and drainage are discussed in Section 7.5.

7.3.2 Mitigating Measures

Mitigation measures broadly include a surface water management plan to control overland flows and engineering controls to protect groundwater that is hydraulically connected to the adjacent wetland. Surface water quality mitigations are discussed in detail below in terms of: 1) sitewide surface water runoff control, and 2) leachate containment and management.

Surface Water Management: Clean Runoff

A sitewide surface water management plan will be implemented including the following:

- A perimeter embankment around the landfill site with specific objectives of:
    - preventing run-on from entering the landfill site. This will ensure that surface water outside of the embankment will not come in contact with the landfill site and thus will limit the amount of on-site surface water that needs to be managed; and,
    - preventing run-off leaving the site. All runoff generated internally will be contained, monitored, and managed.
- A site grading plan to direct clean on-site runoff into two runoff holding ponds. It is important to note that on-site runoff is expected to be effectively fresh, unimpacted water. This fresh water must be internally drained and stored on site to minimize the risk of inadvertent impact of surface water outside the PSA.
- Design of the runoff holding ponds will include volumetric storage requirements to ensure minimal capacity to handle the regulatory requirements of a 25-year 24 hour return storm. The proposed design makes provisions for a 50-year 24 hour return storm event for added contingency.
- Although engineering containment will not be specified, the runoff ponds will be situated in low-permeability till soils that provide adequate natural containment with insitu hydraulic conductivities nearly as low as those specified for compacted clay liners.
- Excess water management is permitted through the direct discharge of clean surface water to adjacent offsite wetlands (i.e. the east slough), however controls include water quality testing to confirm that release objectives are met. Also, notification and approval by MOE and notification to the RM and adjacent landowners is required to remain transparent with stakeholders.

Surface Water Management: Leachate

Management of leachate is also required for the Project. The leachate will be managed in two (2) locations, namely the leachate pond and the landfill cell footprint. Mitigation features of these two (2) elements are as follows:

- Landfill cell design and operational procedures will be established to ensure all water in contact with waste is contained within the landfill cells and managed as leachate.
    - Nominal berms are specified around the perimeter of the landfill cells to separate runoff generated on and off the landfill cell footprint.
    - Waste placement procedures specified in the Operating Plan will form a runoff collection ditch at the base of the landfill mound, inside the nominal berm as shown in Figure 2.1. This trench will readily infiltrate collected surface water through the loosely placed wastes on the side slopes, and excess surface water will drain toward in the northeastern corner of the cell which is the lowermost point of the cell footprint. Infiltration will be enhanced in this location using drainage aggregate specified along the entire side slopes in the northeast (downslope) corners of each cell as shown in Drawing WM566.3-D6 in Appendix D.
    - Infiltrated fluids that will accumulate in landfill cell sumps will be managed to reduce the driving head on the base of these cells as discussed in 7.2.2. Leachate will be withdrawn and stored in the leachate pond, evaporated from free water surfaces, or irrigated on the landfill mound to reduce fluid volume.
- The leachate pond will have sustained impacted water occurring on surface, which carries the risk of exposure to wildlife. Mitigation efforts to reduce exposure include:
    - The perimeter of the PSA will include a fence restricting access of animals. A secondary fence may be placed around the leachate pond as supplementary protection to protect the geosynthetic liner from damage from unwanted animal access.
    - Maintaining a corridor of unaltered parkland adjacent the West Slough so that wildlife access to water bodies is not impeded outside of the PSA. The prevalence of wetlands and waterbodies in the LSA, along with two runoff ponds within the PSA will conceptually mitigate against wildlife consuming fluid from the leachate pond as there are an abundance of more remote and accessible local water sources.

- The lack of vegetation on the internal side slope of the leachate pond would deter animals from accessing the ponded water surface.

Several siting and design considerations have been incorporated into the design of the Phase I facility. Phase II design will be subject to the same design principals at a minimum. Engineering containment to protect groundwater quality was previously described in Section 7.2.2.

Drainage and Water Balance in LSA

Offsite drainage impacts will be mitigated with external ditches incorporated in the perimeter berm along the eastern PSA boundary where required to maintain northerly drainage of the ephemeral wetlands abutting the Phase I development and to connect the east slough with its northern drainage pathway in Phase II. This simple measure will ensure that downstream surface water availability impacts are minimized.

Periodic and controlled releases of clean runoff from the site into the east and west sloughs will minimize the already small changes to water balance in the LSA's caused by retention of on-site runoff. Post-closure, Ponds A and C will be re-integrated into the natural drainage network to restore the water balance in the region.

Summary

Mitigation measures to safeguard surface water quality are summarized below in Table 7.3.

Table 7.3 Mitigation Measures to Minimize Effects on Surface Water Quality

ID	Potential Interaction	Mitigation Measures
4	Contamination of adjacent water bodies in LSA by overland flow	Perimeter embankment around the PSA to prevent run-on from entering the landfill site and to prevent runoff from leaving the site
		Site grading plan to direct clean on-site runoff into two runoff holding ponds
		Design and operational procedures to ensure that all water in contact with waste is contained within the landfill cells and managed as leachate
		Leachate pond sizing and leachate management procedures to ensure fluid levels are maintained at suitable levels (minimum 0.6 m below crest) to prevent overtopping
5	Contamination of adjacent water bodies in LSA by subsurface flow	Siting landfill cells and leachate pond away from interpreted extents of channelized sand deposit as much as practical
		1m thick compacted clay liner on the base of the landfill cells with min. performance objective of 1x10-9 m/s
		Where landfill cells overlie the channelized sand deposit, grade the base of the cell away from sand deposit by 1% (min) to prevent ponding of leachate on the base
		Leachate collection pipes in on base of landfill cells to ehance drainage of leachate and minimize buildup of leachate on the base of the landfill cells
6	Creation of impacted surface water body on the PSA (leachate pond)	Perimeter fence around PSA limiting access of wildlife onto the site as a whole, and by extension limiting exposure of wildlife to impacted surface water on site
		Maintaining a corridor of unaltered parkland adjacent the West Slough so that wildlife access to water bodies is not impeded outside of the PSA
		HDPE lined surface will inhibit inhabitation of the pond by plants and animals
7	Reduced accessablity to groundwater	Project siting away from water bodies or water coures used as a water source
		External ditching on perimeter berm to maintain offsite drainage, particularily on the project's eastern edge where the perimeter berm will intersect a wetland.

7.3.3 Monitoring Mitigation Outcomes and Follow-Up

The development will be subject to a routine surface water monitoring program, which is a standard condition of an operating landfill in Saskatchewan. Details of the proposed monitoring program are discussed in Section 11.4. In brief, surface water will be sampled, analyzed for chemistry by a certified laboratory, subject to trend analysis and comparison to baseline conditions by a qualified person, and reported annually to MOE. Standard landfill operation requires that water bodies in the PSA be monitored; in this case, all runoff holding ponds and leachate ponds. In addition, water quality in the west slough and east slough will be monitored and reported. This will provide assurance that the landfill is not inadvertently impacting water quality in either of the nearby water bodies and by extension the downstream wetlands in the LSA and RSA.

7.3.4 Residual Effects

Contamination of Offsite Water Bodies by Overland Flow

The Project is not expected to have any effect on offsite water quality from overland flow.

The facility design will include physical barriers that will eliminate virtually all opportunity for surface water to escape the PSA as overland flow, although this will require proper monitoring and management of fluid levels in the leachate pond as well as maintenance of the physical structures. Leachate management and monitoring are discussed in Sections 7.2.2 and 11.3 and will be further detailed in the facility's Site Operating Plan as a standard condition of permitting. Standard regulatory oversight by MOE will include approval of the constructed facility to ensure that site grading conforms with the surface water management objectives outlined in this document.

Contamination of Offsite Water Bodies by Subsurface Flow

The Project is not expected to have any effect on offsite water quality from subsurface flow.

Impacts to groundwater were discussed above in Section 7.2.4. In brief, the Project will possibly create a plume of impacted groundwater within the stagnant fractured clay flow system immediately underlying the landfill cell and leachate pond sumps, all of which will be situated on the eastern half of the property in both Phase I and Phase II. The flow velocity in this system is estimated to be in the order of 1 cm/yr, with a northerly gradient and no permanent surface water in the downgradient direction for over a kilometer. Based on these parameters the groundwater plume, if it develops, will have no potential to impact surface water.

The west slough is likely downgradient of the channelized sand deposit that was identified in Section 7.2.4 as having a low chance of being measurably affected by the Project. Modelling indicated that even for an unexpected worst-case scenario, breakthrough of landfill leachate into the channelized flow system would not occur for decades and concentration in the groundwater flow system is estimated at 1.6% of the source term concentration. Even for this extreme scenario, the impact in the slough itself would be much lower and almost certainly undetectable. With the added considerations of natural attenuation and dilution in the west slough, the risk of measurably impacting water chemistry in the west slough is negligible.

During the post-closure period the structure of the clay liner at the base of the landfill cells and the leachate collection system will continue to contain leachate and direct subsurface fluid to the eastern part of the site. In other words, even through the post-closure stage there is virtually no risk of excessive leachate ponding over the channelized sand deposit so risks to the groundwater flow system and the downgradient slough remain negligible.

Impacted Water Body (Leachate Pond)

Within the PSA, contaminated surface water will be limited to the leachate pond where leachate levels and chemistry will be routinely monitored. The mitigation measures will limit the exposure risk to receptors, which may include wildfowl, rodents, amphibians, and insects. The exposure risk

is reversible; the decommissioning and reclamation strategy involves removal of the impacted fluids, HDPE liner, and impacted soils surrounding the pond, and conversion of the topographic low into a wetland that is integrated into the east slough drainage network.

Offsite Impacts to Surface Water Accessibility

There are no known users of surface water in the LSA, however impacts to the water balance are addressed to account for the potential for future development.

Existing drainage networks outside of the PSA will be unaltered due to the construction of external ditching on the perimeter berm. The segregation of on-site and off-site runoff will result in a small reduction of runoff reaching the off-site collection points (namely the west slough and the east slough) however this impact will be small considering the relatively large catchment area of these two surface water features and periodic releases of clean runoff from the site (with approvals from MOE) further minimize water balance impacts.

Summary

The Project's anticipated residual effects are summarized in Table 7.4 below.

Table 7.4 Residual Project Effects on Surface Water Quality

ID	Potential Interaction	Residual Effect	Likelihood	Severity	Spatial Scope			Project Phase				Reversible	Cumulative Effects Consideration
			(with mitigation)		PSA	LSA	RSA	Con.	Op.	Decom.	P.C.		
4	Contamination of adjacent water bodies in LSA by	No effects expected	rare	insignificant								-	-
5	Contamination of adjacent water bodies in LSA by	No effects expected	rare	insignificant								-	-
6	Creation of impacted surface water body on the PSA (leachate pond)	Leachate pond(s) containing fluid with eleveated concentrations of dissolved organic matter, inorganic macro-components, heavy metals, and xenophobic organic compounds. Total surface areas are expected to be 4,950 m2 (Phase I) and 11,000m2 (Phase II). Leacahte Pond will be reclaimed post-closure as wetland.	certain	insignificant to minor	X				X	X		yes	-
7	Reduced accessablity to groundwater	No effects expected	rare	minor									

7.3.5 Cumulative Effects

The only residual effect on surface water quality is expected to be the formation of a leachate pond (potentially two (2) over the lifespan of the Project) that constitutes an impacted surface water body localized in nature and limited to the operations and early decommissioning stages of the Project.

There are no known projects that will offset or worsen the effects associated with this risk. Cumulative effects for surface water quality therefore equate to the residual Project effects.

7.4 Climate & Air Quality

7.4.1 Potential Interactions

There are four main ways in which the Project could impact GHG emissions:

- The Project will generate GHG through anaerobic decomposition of waste. Landfill gas is comprised primarily of carbon dioxide and methane. Landfill gas emissions are expected to occur during the operations stage and for a lag period post-closure, as the landfilled waste continues to decompose.
- The Project will cause vehicular GHG emissions from construction equipment and waste hauling trucks throughout the construction, operations, and decommissioning stages of the Project respectively.
- The Project will offset landfill gas vehicular emissions at other landfills in the region through waste diversion.
- The Project will alter the square footage of land cover that act as carbon sinks. Since plants and water sequester carbon, land cover such as wetland, forest, and grassland benefit the climate more than well drained, unvegetated surfaces. Given the Project's inherent need for roads, well drained surfaces, and an active landfilling surface area, there is a potential to alter the carbon sequestration capacity of the PSA. Existing land cover is summarized in Section 5.1.4.

7.4.2 Mitigating Measures

Minimizing GHG Emissions

Mitigation measures that could reduce GHG emissions associated with the Project broadly include waste diversion practices to minimize the amount of organic waste being landfilled, waste hauling efficiencies, and landfill design and layout.

A key target of the Province's *Solid Waste Management Strategy* is to divert organic waste from landfills to reduce the overall rate of landfill gas generation in the province. Waste segregation and diversion is not directly within the scope of the Project, however any future campaign to segregate waste prior will nonetheless reduce the overall amount of organic waste in the landfilled material over the lifespan of the Project. Any waste diversion will likely result in a measurable decrease in

the rate of GHG emissions per tonne of landfill waste. To remain conservative this effect was not considered at this stage when quantifying estimated rates of landfill gas generation.

Standard engineering practices to mitigate landfill gas emissions include venting systems to capture landfill gas in the subsurface and flaring the captured gas to convert it into a less potent GHG. These systems are typically applied in larger landfills and have not been proposed for the Project. However, it is acknowledged that regulations are likely to come into effect during the Project's lifespan that will mandate that these systems be incorporated into the design. Standard landfill permitting process will ensure that the Project remains in compliance with federal and provincial landfill gas mitigation requirements.

Conceptually it is possible to reduce the overall rate of GHG emissions from vehicular traffic by optimizing waste hauling routes. Improving hauling route efficiencies is a constant practice, as there are strong economic incentives for implementing haul size and distance efficiencies. This incentive was a key factor in selecting a site that is centrally located within the GWSA. Effectively, the development of the Project will have little to no effect on the waste transportation GHG emissions; whether hauling to established landfills or the newly developed Project, the central location of the Project suggests total haulage distances would not substantially change from current practices.

Minimizing Carbon Sequestration Losses from Land Cover Alteration

Several measures are proposed to mitigate the net change in carbon sinks from land use.

- The Project has an optimized footprint that does not contain any unnecessary land clearing. The Project design specifies a) maintaining as much forest, wetland and vegetated surfaces as practical within the PSA, and b) planting a windrow around the unforested perimeter of the site. These measures will have several benefits, one of which is enhancing the PSA carbon sink.
- Reclamation of the PSA will include planting vegetation, likely forage crops, across the land surface that had previously been designated as landfill cells, roads, and the operations staging area. In this sense, the potential for carbon sequestration in plants and soil will be improved in the post-closure stage, reversing or mitigating the change in land use that will occur during the construction and operation stages.
- Staged construction and decommissioning will minimize the duration of time that portions of land within the PSA is in a sub-optimal state. For example, the Phase II footprint will remain in agricultural production until the Phase I facility is nearing

capacity. Once Phase II is commissioned, portions of the Phase I landfill mound, or possibly the entire mound, can be decommissioned and reclaimed into a parkland vegetative state to improve the site's capacity to sequester carbon.

Summary

Mitigations as they relate to potential impacts are summarized below in Table 7.5.

Table 7.5 Mitigation Measures to Minimize Impacts on Climate

ID	Potential Interaction	Mitigation Measures
8	GHG emissions from anaerobic decomposition of waste (i.e. Landfill Gas)	Organic waste diversion over the lifespan of the project will likely result in measurable decrease in the rate of GHG emissions per tonne of landfill waste
		Landfill gas monitoring, capture and destruction likely to be a regulated requirement in Project's lifespan
9	GHG emissions from vehicles	Project sited in a central location within the waste collection area
		Optimized haul routes
10	Reduced carbon sequestration capacity of land primarily through loss of wetlands and forest	Project siting to limit the destruction of wetlands and forest
		Planting windrows around the unforested perimeter of the PSA
		Reclamation of carbon sequestering land cover including planting vegetation and creating permanent wetlands during decomissioning
		Staged construction and decommissioning to limit the duration of time that portions of the site are unvegetated
11	Reduced GHG emissions (landfill gas and vehicular emissions) at other landfills within the RSA due to waste diversion	Unmitigated positive impact

7.4.3 Monitoring Mitigation Outcomes and Follow-Up

In adherence to standard landfill permit requirements, the Project will submit annual site operating reports to MOE documenting the total tonnes or cubic meters of waste in place. This parameter can be used to model landfill gas generation. A qualified person will conduct routine analyses (likely on a bi-annual basis for the first several years) to estimate the amount of landfill gas generated at the facility so that the reporting requirements outlined below are met.

Environment and Climate Change Canada (ECCC) requires that all facilities emitting more than 10,000 CO_2 equivalent tonnes of GHG submit an annual report documenting the estimated GHG emissions of the facility. Annual CO_2 equivalent emissions are estimated for the Project's lifespan in the residual effects assessment in Section 7.4.4. The facility is expected to exceed the reporting threshold in the second decade of landfill operation.

New regulations have been proposed for monitoring and mitigating methane generation from landfills. The regulations are likely be adopted soon. The Proponent is aware of the proposed regulations and the general implications for this Project. The proposed regulations outline a staged

program whereby larger landfills will require annual assessments of methane production and after a threshold is crossed (proposed threshold is >10,000 tonnes/year waste acceptance & >100,000 tonnes waste in place), annual surface gas monitoring until a second threshold is exceeded (proposed threshold is 664 tonnes/year methane), and subsequent gas collection systems and methane destruction facilities.

7.4.4 Residual Effects

Considering the RSA and the full lifespan of the Project, the net residual effects of the Project on climate are limited to the reduced capacity of the land to sequester carbon due to land use alteration. This effect is somewhat temporary as it can be somewhat reversed in the post-closure stage of the Project when the affected land will be revegetated and turned into parkland. The Project will result in a permanent reduction of 9.0 ha of forest, 20.2 ha of cropland, and about 0.4 ha of wetland and a net gain of 29.6 ha modified grassland when the project is fully decommissioned.

The estimated GHG emissions from the Project are summarized in Table 7.6 with totals in the order of 3,000 CO_2 equivalent tonnes per year. Considering the RSA and the full lifespan of the Project, GHG emissions generated by the Project are expected to be offset by reduced GHG emissions elsewhere. The Project's estimated emissions are summarized in Table 7.6 and discussed below.

Table 7.6 Estimated Greenhouse Gas Emissions from the Proposed Project

Greenhouse Gas	Chemical Formula	CO_2 Equivalent[1]	tonnes/year						
			a) Landfill Gas [2]	b) Vehicular Emissions			c) Emissions at other Landfills in GWSA	d) Land Use Alteration	Net Effects from a), b) and c)
				Const[3]	Hauling[4]	Decom.[4]			
		Spatial Scope	*PSA*	*PSA*	*RSA*	*PSA*	*RSA*	*PSA*	*RSA*
		Temporal Scope [5]	*Op & PC*	*Con*	*Op*	*Decom*	*Con, Op, Decom & PC*	*Con & Op*	*Con, Op , Decom & PC*
Carbon dioxide	CO_2	1	2,071	211	149	317	-2,749	See Table 7.7 (tonnes/year not quantified)	0
Methane	CH_4	25	755	0	0	0	-755		0
Nitrous oxide	N_2O	298	0	40	29	60	-128		0
CO_2 eq			**20,946**	**12,086**	**8,648**	**18,129**	**-59,809**		**0**

NOTES:

[1] Government of Saskatchewan, Technical Proposal Guidelines 2021

[2] Peak annual landfill gas estimated using BC's Landfill Gas Generation Assessment Procedure (BC Ministry of Envrionment, 2009)

[3] assumes 1180 L/month gasoline & 8800 L/month diesel for 8 month construction period or 12 month decomissioning period

[4] assumes 490 L/month gasoline & 4200 L/month diesel

[5] Con = Construction stage, Op = Operations stage, Decom = Decomissioning, PC =Post-Closure stage

Landfill Gas

Landfill gas production was estimated for the proposed project, considering the entire lifespan of the Project. Details of the analysis are provided in Appendix P. A peak annual methane production of about 755 tonnes was calculated for the facility, equivalent to 21,282 CO_2 equivalent tonnes, using a conversion rate of 25 CO_2 equivalent tonnes per methane tonne (Government of Saskatchewan, 2021). The peak annual methane production from the Phase I facility was calculated to be about 610 tonnes. Results of the landfill gas generation calculations are shown graphically in Figure 7.6.

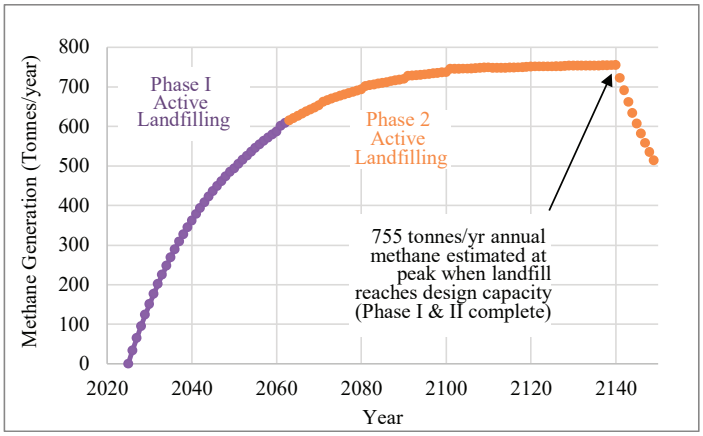


Figure 7.6 Plot of Estimated Methane Gas Production Rate for the Proposed Landfill Using the BCMOE Landfill Gas Model (2009).

With a long-termed waste acceptance rate of 12,000 tonnes per year, annual methane production peaks at about 755 tonnes per year after about 115 years of operation. This calculation was made using conservative estimates, therefore actual methane production generation may be less.

Vehicle Emissions

Emissions from vehicular traffic were estimated based on expected fuel consumption. Total fuel consumption during construction was estimated by the Proponent using monthly consumption rates for a similar project. Annual fuel consumption during operation was estimated by the Proponent based on Greenland Waste's existing hauling operations, which are likely to be optimized with the Project.

Greenland Waste is currently active in the RSA as a hauler of solid waste. The central location of the Project in the GWSA is expected to present the opportunity for more efficient hauling by Greenland Waste, which could have the impact of lowering total fuel consumption for existing hauling contracts and subsequent GHG emissions. Hauling routes and contracts have not been

finalized for the Project's operation period but it is likely that the cumulative effect in the RSA will be negligible.

Offset Emissions

The residual GHG emissions from the Project's construction will result in a net increase in GHG emissions for that early stage of the Project in the LSA and RSA. However, over the lifetime of the Project, other landfills in the RSA would expand at a slower rate than they would without the Project so the net GHG emissions from landfill construction in the RSA will be zero.

Likewise, the residual GHG emissions from the Project's operation period will result in a net increase in the LSA but negligible net effects in the RSA. There are two main sources of GHG emissions during the operating period: fuel consumption by hauling trucks and landfill gas emissions from decomposing waste. The Project will not increase the overall volume of waste being hauled and landfilled in the LSA or the RSA, it will simply alter hauling routes and divert waste from other existing and future landfills in the RSA. Since the Project will not increase the overall volume of waste being landfilled in the RSA, any GHG generated at the Project site will be directly offset by reductions at other landfills in the RSA. In other words, there will be zero net effect in the RSA for GHG emissions from landfill gas and hauling over the lifespan of the Project.

Land Cover Alterations

A breakdown of land cover within the PSA with and without the Project is provided in Table 7.7.

Table 7.7 Estimated Land Use Alterations from the Proposed Project

	Phase I Land Cover (ha)			PhaseI & II Land Cover (ha)		
Land Type	Existing	Post-Construction	Post-Closure	Existing	Post-Construction	Post-Closure
Wetland	2.7	3.2	3.2	6.1	6.0	6.0
Forest	8.2	4.3	4.3	14.4	5.4	5.4
Cropland	10.2	0.0	0.0	20.2	0.0	0.0
Modified Grassland	0.7	0.0	14.4	0.7	0.0	30.0
Total	21.9	7.5	21.9	41.3	11.3	41.3

The Project will result in a permanent reduction of 9.0 ha of forest, 20.2 ha of cropland and little change to the overall wetland area. When the Project is decommissioned, it will add a net 29.3 ha of modified grassland to the landscape. Staged construction, progressive decommissioning, and constructing primarily on previously disturbed land will mitigate this impact even through the operations phase.

Summary

The Project's anticipated residual effects are summarized in Table 7.8 below.

Table 7.8 Residual Project Effects on Climate and Air Quality

ID	Potential Interaction	Residual Effect	Likelihood	Severity	Spatial Scope			Project Phase				Reversible	Cumulative Effects Consideration
			(with mitigation)		PSA	LSA	RSA	Con.	Op.	Decom.	P.C.		
8	GHG emissions from anaerobic decomposition of waste (i.e. Landfill Gas)	Estimated peak annual CO2eq output of 26,135 tonnes/year	certain	significant	X				X	X	X	no	Offset by decreased emissions elsewhere
9	GHG emissions from vehicles	Estimated 30,725 CO2eq. tonnes total for construction & decomissioning & 8,650 CO2eq. tonnes/yr for routine waste hauling	certain	minor	X	X	X	X	X	X		yes	Offset by decreased emissions elsewhere
10	Reduced carbon sequestration capacity of land primarily through loss of wetlands and forest	a) Temporary (~35 year) loss of 0.4 ha wetland b) Permanent loss of 9.0 ha forest, 20.2 ha of cropland c) Post Closure net increase 29.3 ha of modified grassland	certain	minor	X			X	X	X	X	partial	-
11	Reduced GHG emissions (landfill gas and vehicular emissions) at other landfills within the RSA due to waste diversion	*Reduced GHG emissions elsewhere in the GWSA, equal in magnitude to GHG emissions from landfill gas and vehicular emissions from the Project*	*certain*	*significant*	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*no*	*Offsets local GHG emissions*

7.4.5 Cumulative Effects

When the full temporal and spatial scopes are considered, the Project would conceptually offset landfill gas and vehicular emissions that would otherwise be emitted from landfills within the RSA. Fundamental to this assertion is the fact that the Project will not increase the amount of waste that will be hauled or landfilled in the RSA; rather the hauling, construction and landfilling activities associated with solid waste management will be redistributed spatially and temporally.

With this consideration, the only cumulative effect of the Project on climate is the change in carbon sequestration potential associated with land cover changes as the PSA is altered over the long term to have about 9.0 ha less forest, 20.2 ha cropland, roughly the same area of wetland and a net gain of 29.3 ha of modified grassland. Any GHG emissions by the Project, in terms of landfill gas or vehicular emissions will be offset by a reduction in landfill gas or vehicular emissions elsewhere in the GWSA.

7.5 Wetlands & Aquatic Life

7.5.1 Potential Interactions

The potential impacts of the Project on the wetlands and aquatic life could include wetland removal & alteration during construction resulting in habitat degradation or loss, impacting drainage and flows, influencing the abundance of species of conservation concern, and the degradation of aquatic habitat. In terms of Project timeline impacts to wetlands and aquatic life has potential for effects during the construction, operation, decommissioning and post-closure stages.

Wetland Drainage

The Phase I potential impacts to wetlands are primarily associated with removing wetlands from the landscape drainage systems. Multiple wetlands will be removed from the landscape and natural drainage system as the facility is constructed and through its operational lifespan. Of the approximately 21.9 ha Phase I footprint, approximately 2.7 ha are associated with wetland habitat, making up 13% of the Phase I footprint. Potential future impacts associated with Phase II are associated with separation of parts of Wetland 10 from the natural drainage system during construction of Runoff Pond C (future). Unmitigated, this would remove large portions of these wetlands from the natural drainage system through the operational lifespan of the facility.

Species of Potential Concern

While the wetlands within the proposed project area contain numerous plant and wildlife species, only a single aquatic species of potential conservation concern was identified within the Project area. The largest observation of this tracked species, Floating Crystalwort, was observed falling within both the Phase I and Phase II project footprints. The eastern most observation was outside of both the Phase I and Phase II footprints and contained 8 individuals which were observed during the aquatic rare plant surveys. The larger observation to the west was observed while crossing a beaver run during the terrestrial rare plant surveys and consisted of an estimated 1500 individuals within the beaver run. The southern half of the beaver run falls within the Phase I boundaries, with the northern half of the observation within the Phase II portion of the Project footprint. Thus, the direct impact of the currently planned Phase I portion of the Project is anticipated to effect approximately half of the identified individuals.

Habitat Degradation and Loss

The removal of the wetlands within the proposed project will result in habitat degradation or loss. Of the 27.6 ha of wetlands identified within the PSA and LSA approximately 6.1 ha falls within the

Project footprint of both Phase I and II, and less than 3.0 ha of that wetland area will be impacted by Phase I. The surrounding habitat is full of prairie pothole wetlands that persist in the landscape, both those within cultivation and those within treed habitat, similar to those within the proposed project.

7.5.2 Mitigation Measures

The Project was designed to reduce impacts to native wetland habitat where possible, and changes to water flow is limited, due to the placement of the Project within areas containing smaller self-contained wetlands, and the avoidance of large wetland complexes and drainage systems. Changes to water quality will occur within the ponds that will be constructed as part of the proposed project. However, with the mitigations described above in Section 7.3, not only will the exposure of aquatic species to the leachate pond be reduced via separation of the internal water systems from natural drainage systems and site fencing, but also the surrounding wetlands will be monitored for changes to water quality to ensure they are not impacted by inadvertent release of water from on-site.

As Floating Crystalwort was a tracked, unranked species, MOE was consulted after they were identified due to the potential that the species observations may impact the Project review process. The MOE response indicated that the requirement for any additional field assessments was at the discretion of the proponent, and that justification should be provided within the proposal. Thus, following the identification of the species within the Project area, a review of available literature regarding the distribution and conservation ranking of Floating Crystalwort was completed to determine if the species may be sensitive enough to require additional field assessments to determine if there were additional observations within the Project area. It is likely that small aquatic species, especially non-vascular species such as Floating Crystalwort without a survey protocol, are easily overlooked and thus unrecorded during species surveys within the province, which contributes to its unranked status. However, its presence in many countries around the world, its ease of propagation/growth, its use as an aquarium species, and its potential to become invasive in the right conditions, all indicate that the Floating Crystalwort are unlikely to be a highly sensitive species, and that with the number of individuals observed outside of the Phase I project footprint they are unlikely to be significantly negatively impacted by Phase I. Additionally, it is anticipated that the Floating Crystalwort observations will not require special mitigations to ensure their persistence in the Project area, other than those typically done to prevent wetland impacts off site, which will also reduce impacts to other aquatic species in the Project area.

The primary mitigation to reduce the impacts on wetlands and aquatic life was planning the Project to avoid large wetlands where possible, and to prevent changes to water quality within the

surrounding wetlands. Proposed mitigations for project construction include reducing disturbance around wetlands where possible, retaining a buffer between the Project and the large wetland to the west, constructing during dry or frozen ground conditions, and immediate reclamation of impacted areas surrounding the perimeter embankments (including surface recontouring, erosion control where necessary, and revegetation).

Mitigation measures are also proposed to deter aquatic life in the onsite constructed runoff ponds since routine pond maintenance and sensory disturbance will render these ponds poor-quality habitat. Routine removal of riparian plants on the margins of Pond A and Pond C (see Drawing WM566.3-4) will be a part of annual maintenance if vegetation becomes established. Vegetation control will not apply to Pond B which will offer higher-quality aquatic habitat since it will be situated in a largely undisturbed, natural topographic low surrounded by undisturbed bush line and somewhat removed from site activities.

Specific mitigation incorporated into the Project to minimize impacts on wetlands and aquatic life are outlined in Table 7.9.

Table 7.9 Mitigation Measures to Minimize Impacts on Wetlands & Aquatic Life

ID	Potential Interaction	Mitigation Measures
12	Wetland Removal	Planning the Project within previously disturbed land and avoiding large wetlands where possible.
		Removal of project components and impacted soils during reclamation, and creation of a wetland connected to the project area drainage to the east
13	Wetland Alteration	Large wetlands were avoided wherever possible.
		Earthworks construction will occur under stable or frozen ground conditions, which will reduce impacts to adjacent undisturbed wetland areas
		Erosion prevention and control measures (seeding, environmental matting, hydro-mulch, silt fencing, geo-ridges as required)
		Natural vegetation recovery will be used in areas surrounding wetlands.
		Internal site drainage to isolate on-site runoff from natural drainage systems in LSA, reducing risk of impacts to wetlands due to spills or leaks
		Emergency Response Plan will be in place during operation and decomissioning
14	Surface Drainage Alteration	Sititng Project in an area with primarily self-contained wetlands and limited drainage out of PSA
		Ditching along the easterm edge of the Project to avoid impacting the natural drainage system (W10 or 'east slough')
		Internal site drainage to isolate on-site runoff from natural drainage systems in LSA, preventing runoff from flowing offsite
		Culverts installed to direct surface runoff under roads, and ditches surrounding the facility to maintain natural drainage around the site, as necessary.
		Removal of project components and impacted soils during reclamation, and creation of a wetland connected to the project area drainage to the east.
15	Impact to the abundance of species of conservation concern	Conducted auditory and visual amphibian, and aquatic rare plant surveys.
		- A single tracked species, Floating Crystalwort (SU) was identified in the project area. This species is present throughout North American and is ranked as S3 or higher in other provinces. Approximately half of the observations are avoided by the Phase I project, and standard wetland mitigations to reduce impacts off site will protect the remaining observations.
		Ongoing communication with MOE regarding mitigations should sensitive species be identified during construction or operations.
16	Habitat Degradation or Loss	Routine removal of riparian vegetaion in constructed runoff ponds (Pond A and Pond C) to deter aquatic life from settling in these poor-quality aquatic habitats
		Mitigations outlined above to prevent wetland removal and alteration will reduce the impacts on aquatic life habitat degradation and loss.
17	Wetland flow Alteration	The mitigations outlined above to prevent surface drainage alteration will reduce the impacts on aquatic life via flow alteration.
18	Degradation of Water Quality	Facility design to prevent surface water run-off into surrounding habitat.
		Monitoring the two large wetlands (W10 & W11) to ensure no changes to water quality due to the Project occur.
		Removal of project components and impacted soils during reclamation.

7.5.3 Monitoring Mitigation Outcomes and Follow-Up

No additional field surveys are planned prior to Phase I development. Prior to the construction of the Phase II portion of the Project, it is recommended that supplemental wetland and aquatic life assessments be completed on the wetlands surrounding the Project area. These investigations will

be undertaken in about 35 years when the site will encroach on the wetlands along the Project's eastern edge with the following objectives:

- Determine the potential impacts of the additional construction phase;
- Determine whether the existing Phase I mitigations to reduce impacts to wetlands and aquatic habitat were effective; and
- Confirm whether Floating Crystalwort persists in the Project area if it remains a tracked species at the time of Phase II construction.

7.5.4 Residual Effects

The residual effects during the construction phase primarily includes unavoidable alteration to wetlands and drainage patterns within the facility boundaries. The residual effects during operation are anticipated to be minor and will be tracked by monitoring the effectiveness of the mitigation measures in place to prevent impacts off-site (see Sections 7.2.2 and 7.3.2). The residual effects after decommissioning are also anticipated to be minor, as project components and impacted soils will be removed from the area, and a wetland created to provide additional wetland habitat and reconnect the wetland to the Project area drainage to the east.

The Project's anticipated residual effects are summarized in Table 7.10 below.

Table 7.10 Residual Project Effects on Wetlands and Aquatic Life

ID	Potential Interaction	Residual Effect	Likelihood	Severity	Spatial Scope			Project Phase				Reversible	Cumulative Effects Consideration
			(with mitigation)		PSA	LSA	RSA	Con.	Op.	Decom.	P.C.		
12	Wetland Removal	Net loss of 0.6 ha wetland in Phase I; net gain of 0.1 ha wetland in Phase II/ post closure	certain	minor	X			X				yes	-
13	Wetland Alteration	Parts of the Eastern Slough in LSA intersected by perimeter berm; water levels somewhat altered in two bogs in south western part of PSA. Runoff holding ponds and reclaimed leachate pond restored to natural wetland environments post-closure.	certain	minor	X	X		X		X		yes	-
14	Surface Drainage Alteration	Alterations to drainage in PSA to manage runoff internally and separate clean runoff from leachate. Natural drainage largely restored post-closure with slight modifications assoiciated with a permanent mound in the middle of the site.	moderate	insignificant	X			X		X		partial	-
15	Impact to the abundance of species of conservation concern	Potential loss of individual Floating Crystalwart plants but unlikely to significantly impact population since it is not beleived to be a highly sensitive species and appears to be pervasive accross all wetland environments encountered.	moderate	minor	X			X		X		partial	-
16	Habitat Degradation or Loss	Alteration & loss of wetlands in PSA. Net loss of 0.6 ha wetland. During Phase II wetland area will be restored to pre-development area with the creation of Phase II runoff holding pond. Runoff holding ponds and Leachate Pond(s) will be restored or remain as wetlands post-closure.	certain	minor	X			X		X		partial	-
17	Wetland flow Alteration	Alterations to flow in PSA to manage runoff internally and separate clean runoff from leachate. Natural flow largely restored post-closure.	moderate	insignificant	X			X		X		yes	-
18	Degradation of Water Quality	Formation of an impacted surface water body on site (leachate pond) introduces an inherent but very small risk of contimination of clean onsite or off site water bodies in an extreme weather event (e.g. tornado). Risk is removed post-closure.	rare	minor	X				X	X		yes	-

7.5.5 Cumulative Effects

While there will be certain impacts to wetlands and aquatic life during construction, with the mitigations described above, the impacts will be limited to the Project footprint, and additional

impacts are anticipated to be negligible during operations. Additionally, during decommissioning and reclamation a wetland will be created, following the removal of pond liners and impacted soils, to create wetland habitat within the Project footprint. Thus, with similar levels of disturbance to wetlands in the larger project area, primarily due to agricultural activities, and the creation of wetland habitat after decommissioning, the contribution of the Project to cumulative effects on wetlands and aquatic life were determined to be non-significant.

7.6 Wildlife & Wildlife Habitat

7.6.1 Potential Interactions

The potential impacts of the Project on wildlife and wildlife habitat could include impacting the abundance of species of conservation concern, habitat disturbance and loss, nesting and breeding disturbance, sensory disturbance, edge effects / habitat fragmentation, and increased mortality. In terms of Project timeline impacts to wildlife and wildlife habitat has potential for effects during the construction, operation, decommissioning and post-closure stages.

The placement of the facility components on previously disturbed lands where possible significantly reduces the potential for impact to wildlife and wildlife habitat, limiting the direct impacts to the treed habitat within the PSA. Of the approximately 21.9 ha associated with the Phase I footprint, wildlife habitat lost will include approximately 9.0 ha of forest and grassland and riparian edges, which is approximately 36% of the Phase I footprint. Habitat quality is moderate to low in this area due to the continuous native habitat located to the west of the proposed project, immediately adjacent to high levels of agricultural activity.

Impacts to species of conservation concern is expected to be negligible, as only a single protected wildlife species was observed in the Project area during the field assessments, Common Nighthawk, which was not observed presenting behaviours that could indicate breeding, as it was flying over the area during the aquatic vegetation surveys. Thus, potential impacts to species of conservation concern are expected to be limited, following mitigation.

Sensory disturbance resulting from operational noise, light pollution, and ongoing traffic may affect species using adjacent habitats for the long term. Chronic noise can influence the pairing and breeding success of bird species by distorting mating songs and calls, resulting in decreased density of females responding and thus influencing pairing success (Habib et al. 2007: Bayne et al. 2008). Sensory disturbance due to construction is expected to be moderate, as there is a high level of agricultural activity ongoing in the area. Traffic will contribute to disturbance effects into adjacent habitats and potential avoidance of the surrounding area for the duration of the Project. Although

increased traffic will be present throughout the Project's life, it is anticipated that sensory disturbance due to traffic will be the highest during construction and decommissioning.

The facility will add to the level of light emissions in the area, which may impact both nocturnal and diurnal wildlife species (Longcore and Rich 2004, Wise 2007) and can influence or disorient migrating birds, resulting in disorientation and 'trapping' of flocks within the lighted area (Ogden 1996). Bright artificial lights have also been shown to influence breeding behavior, such as causing birds to begin singing earlier in the day and subsequently sing for a longer period (Miller 2006). These responses may potentially lead to indirect effects such as increased predation risk and energy expenditure. Ultimately, the resulting disturbance will be specific to the species, disturbance type, frequency of disturbance, noise levels, visual stimuli, and associated changes to habitat.

Barriers to movement may also result from project activities, including the landfill footprint itself and increased traffic in the area. Disturbances associated with the different phases of the Project may cause some wildlife species to favor or avoid areas adjacent to the landfill. Edge sensitive species may avoid areas near new disturbances and corridors due to increased noise levels associated with vehicle traffic or changes in habitat composition. Generalist species, i.e., species that use several habitats in the landscape although they may differ in suitability, may increase in abundance within disturbed heterogeneous landscapes (Andren 1994). The population density of generalist species is a function of total landscape composition (Andren 1994), as such highly disturbed and fragmented habitat will result in increased generalist species.

Edges are often characterized by abrupt changes in vegetative structure and composition between two contiguous landscape features. These disturbances in continuous habitat can act as barriers to distribution and dispersal patterns of birds and mammals (Yahner 1988). Species sensitive to human activity may also show a decreased abundance in areas where human activity is common (Miller *et al.* 1998, Botsch *et al.* 2018). Some avian predators may become more common near forest edges, increasing predation rates in adjacent habitat. Laudenslayer (1986) suggested productivity of certain songbird species can be reduced near edges due to increased incidences of predation and nest parasitism.

However, in direct contrast to those species that may be deterred by human development, the potential presence of organic waste may serve as an attractant to other species despite the increased human activity in the Project area. A meta-analysis of the impact of landfills on vertebrate species indicated the possibility of both positive and negative impacts on wildlife (Plaza and Lambertucci 2017). Potential positive effects, should animals be able to forage on organic waste, include increased survival and reproductive success through improved body condition, and may even serve as sources of sustenance for species of conservation concern. These potential positive impacts also

apply to invasive species, such as wild boar (Mayer *et al.* 2021). However, landfills often also serve as places with increased risk of spreading pathogens, mortality through accidental poisoning and reduced health status due to nutritional issues, as well as increased human-wildlife conflicts and human caused mortality (Plaza and Lambertucci 2017). In some cases, while reproductive success might increase, species fitness may actually be decreased by the associated increase in mortality and the potential introduction of suboptimal individuals to the breeding population (Plaza and Lambertucci 2017, Newsome and Eeden 2017). Additionally, predator-prey dynamics can be altered, by creating an easily available prey source of species attracted to the landfill, in turn bringing in predatory species, or alternatively, creating a high concentration of predatory species that were attracted to the landfill, and thus increasing predation stress on nearby species (Plaza and Lambertucci 2017, Newsome and Eeden 2017).

7.6.2 Mitigation Measures

To reduce the impact to wildlife habitat, the Project design includes the conservation of as much wildlife habitat as feasible within the PSA and planting windrows around the unforested perimeter of the site, which will serve to both provide a visual barrier, while also serving as wildlife habitat for some species. Additionally, the forested buffer which will remain between the Project and the west slough will allow for continued movement of wildlife along the eastern side of that wetland.

Operational strategies will be implemented as a mitigative strategy to reduce the sensory disturbance to wildlife species. The Project is proposed to operate during regular hours, thus limiting traffic, light and noise to primarily daytime hours, generally Monday through Friday. While this will continue to potentially impact species during the day, limiting these disturbances to daytime hours reduces the impacts to nocturnal species.

During the species surveys only a single wildlife species of conservation concern was identified, Common Nighthawk. The individual was observed as an incidental fly-by just outside of the species setback distances outlined in the *Saskatchewan Activity Restrictions Guidelines for Sensitive Species* (ARGs). The Common Nighthawk ARG outlines a 200 m setback in effect from May 1 to August 31 and applies to all individuals breeding. As we know that the species are in the Project area, although not currently breeding in the PSA, there is the potential that individuals may begin breeding in the area the following season. Thus, with appropriate mitigation measures to complete the removal of suitable breeding and nesting habitat outside of their breeding and nesting season (May 1 to August 31), or completing wildlife sweeps if completed during the ARG, it is anticipated that the impact to species of conservation concern will be limited.

The primary mitigations for preventing wildlife from accessing the landfill as a potential food source and to prevent direct mortality is to fence off the site and prevent the release of impacted waters off site. Additionally, the amount of organic waste within the landfill, and thus potentially serving as an attractant, may be reduced by Saskatchewan's *Solid Waste Management Strategy*, which stresses the importance of composting facilities to prevent the inclusion of organic waste in landfills. Composting has the potential to significantly reduce the potential for wildlife attempting to access landfills for food, as municipal waste can be made up to 40 – 50% organic waste. While diversion of organic waste is not within the scope of this project, it is anticipated that with the provincial strategy in effect, that the amount of organic waste will be reduced throughout the life of the Project.

The primary mitigation to reduce the impacts on wildlife and wildlife habitat was planning the Project to fall within cultivation where possible with the removal of wildlife habitat limited to existing habitat edges, engineering the facility to prevent the release of impacted waters outside of the Project, and barriers to prevent wildlife from accessing impacted waters and the landfill cells. Specific mitigation incorporated into the Project to minimize impacts on wildlife and wildlife habitat are outlined in Table 7.11.

Table 7.11 Mitigation Measures to Minimize Impacts on Wildlife & Wildlife Habitat

ID	Potential Interaction	Mitigation Measures
19	Impact the Abundance of Species of Conservation Concern	Conducted raptor nest, sharp-tailed grouse lek, common nighthawk, and breeding bird surveys.
		- A single protected species, Common Nighthawk (S4B, Special Concern) was identified in the project area.
		- While breeding activity was not observed within the PSA, it is anticipated that the initial project construction activities, such as mulching or soil stripping, within native habitat will be completed outside of the Common Nighthawk ARG (May 1 to August 31).
		- In the event that these construction activities need to be completed within Common Nighthawk ARG, a wildlife sweep will be completed no more than 7 days prior to construction.
		Ongoing communication with MOE regarding mitigations should sensitive species be identified during construction or operations.
20	Habitat Disturbance	Reducing total area of potential wildlife habitat disturbance through Project siting and design to primarily occupy develop cultivated areas
		Project siting adjacent existing roads to further reduce impacts to wildlife habitat.
		Conservation of wildlife habitat where possible within the PSA.
		Internally drained site design to avoid interaction with natural drainage systems and prevent habitat disturbance through the release of impacted waters to surrounding habitats
21	Habitat Loss	Reducing total area of potential wildlife habitat disturbance through Project siting and design to primarily occupy develop cultivated areas
		Conservation of wildlife habitat as feasible within the PSA, including planting windrows around the unforested perimeter of the site.
22	Nesting and Breeding Disturbance	Reducing total area of potential wildlife habitat disturbance through Project siting and design to primarily occupy develop cultivated areas
		Initial project construction activities, such as mulching or soil stripping, within native habitat to occur outside the peak breeding season for migratory birds for the area, between April 25 to August 25 (ECCC 2023). This will allow bird species to successfully fledge and avoid impacting active nests.
		- In the event that these construction activities need to be completed within the migratory bird breeding window a wildlife sweep will be completed no more than 7 days prior to construction.
		Ongoing communication with MOE regarding mitigations should nesting or breeding species be identified within the Project during construction or operations.
23	Sensory Disturbance	The placement of project components was planned to avoid undisturbed areas where possible.
		Operations will primarily be limited to daylight hours, Monday to Friday/Saturday, to reduce sensory disturbance due to traffic, light, and noise.
		The forested buffer maintained between the Project and the Western Slough will reduce the potential impact of the project on barriers to movement.
24	Edge Effects and Habitat Fragmentation	The locations of the project components were selected primarily within cultivation, with impacts to native habitat primarily associated with existing edges along cultivation.
		The project was placed adjacent to existing roads to reduce edge effects creation by the access road.
25	Increased Mortality	Facility design to prevent surface water run-off into surrounding habitat.
		Barrier fencing will be present around the perimeter of the PSA to limit and deter wildlife access to the site.
		Operations will primarily be limited to daylight hours, Monday to Friday/Saturday, to reduce potential traffic related wildlife mortality.
		Removal of project components and impacted soils during reclamation.

7.6.3 Monitoring Mitigation Outcomes and Follow-Up

There are no additional species detection surveys planned prior to the construction of Phase I, however, wildlife sweeps will be conducted in the native portions of the Project, and within its immediate vicinity, should mulching or soil clearing occur during the migratory breeding bird period (April 25 to August 25) or within the Common Nighthawk ARG (May 1 to August 31). Initial project construction activities, such as mulching and soil stripping, within the treed habitat will occur during bat overwintering period (September 1 to April 31). Bat surveys were not part of the species detection survey scope, so precautionary measures will be taken as a contingency measure to avoid disturbing potential bat habitat.

Prior to the construction of the Phase II portion of the Project, it is recommended that supplemental wildlife assessments be completed on the native wildlife habitat in the surrounding the Project area. These investigations will be undertaken in about 35 years when the site will encroach on the wetlands along the Project's eastern edge with the following objectives:

- Determine the potential impacts of the additional construction phase;
- Determine whether the existing Phase I mitigations to reduce impacts to wetlands and aquatic habitat were effective; and
- Confirm whether any species of conservation concern exist in the PSA or within specified survey setback distances in the LSA.

7.6.4 Residual Effects

Proposed mitigations for project construction include project planning to place the Project components primarily on cultivation, reducing the amount of wildlife habitat removed where possible within the PSA, and completing the initial site construction activities outside of ARGs and migratory nesting periods, or conducting nest sweeps if work will occur within the setback / breeding periods (April 25 to August 31). The residual effects due to the construction of the Project primarily includes unavoidable habitat disturbances/loss within the facility boundaries. The residual effects during operations are anticipated to be low, and are mainly mitigated by limiting operations traffic, light, and noise impacts to daylight operating hours, retaining wildlife habitat buffers around the PSA and planting windrows on open side of the site, preventing migration of impacted waters off-site, and fencing off the landfill to reduce wildlife access to the landfill cells and ponds. The residual effects after decommissioning are anticipated to be low, as project components and impacted soils will be removed from the ponds, and the landfill cells will be capped and seeded with the resulting land use anticipated to be recreational or forage. While the treed wildlife habitat

present pre-construction will be reduced, after decommissioning the sensory disturbance associated with the landfill operations will be eliminated and allow for wildlife species who prefer more open habitats to move back into the area.

The Project's anticipated residual effects are summarized in Table 7.12 below.

Table 7.12 Residual Project Effects on Wildlife & Wildlife Habitat

ID	Potential Interaction	Residual Effect	Likelihood (with mitigation)	Severity (with mitigation)	Spatial Scope			Project Phase				Reversible	Cumulative Effects Consideration
					PSA	LSA	RSA	Con.	Op.	Decom.	P.C.		
19	Impact the Abundance of Species of Conservation Concern	Potential disturbance to individual Common Nighthawks in PSA & LSA, but unlikely to impact population through mitigations to avoid direct breeding disturbance. Risk of impact is removed post-closure.	rare	minor	X	X		X	X	X		partial	-
20	Habitat Disturbance	Sensory disturbance to forest surrounding Runoff Pond B during construction and decomissioning.	moderate	minor	X			X	X			yes	-
21	Habitat Loss	Net loss of 5.2 ha of forest and 0.6 ha modified grassland in Phase I. Additional loss of 3.5 ha forest and 0.9 ha modified grassland in Phase II. Net gain of 29.2 ha modified grassland post-closure.	certain	minor	X			X				partial	-
22	Nesting and Breeding Disturbance	Minor disturbance to forest surrounding Runoff Pond B during construction and decomissioning.	unlikely	minor	X			X	X			yes	-
23	Sensory Disturbance	Alterations to noise, light and odour in natural habitat in and around Pond B and on margins of natural forest surrounding western half of PSA. Sensory disturbance removed post-closure.	certain	minor	X	X		X	X	X		yes	-
24	Edge Effects and Habitat Fragmentation	Sensory disturbance and on the edges of natural habitat surrounding the PSA. No habitat fragmentation. Risk is removed post-closure.	unlikely	minor	X			X	X	X		yes	-
25	Increased Mortality	Potential impacts to small wildlife from exposure to impaced fluids in leachate pond and increased vehicle traffic on PSA. Risks are removed post-closure.	unlikely	minor	X			X	X	X		yes	-

7.6.5 Cumulative Effects

While there will be a moderate impact on wildlife and wildlife habitat during construction through both habitat loss and sensory disturbance, with the mitigations described above, the impacts will be largely limited to the Project footprint and immediately surrounding area, and impacts are anticipated to be lower during operations with the operational hours in effect. Additionally, during

decommissioning and reclamation the Project area will be returned to a mix of wetland and forage habitat, which will provide wildlife habitat for species who prefer more open habitats. Thus, with the Project being placed primarily on cultivation, and reducing potential edge effects by project placement on existing edges associated with agricultural operations, and the preventative measures during operations to reduce wildlife mortality due to access to potentially dangerous waste and increased human interactions, along with the creation of forage and wetland habitat after decommissioning, the contribution of the Project to cumulative effects on wildlife and wildlife habitat were determined to be non-significant.

7.7 Vegetation

7.7.1 Potential Interactions

The potential impacts of the Project on vegetation could include impacting the abundance of species of conservation concern, habitat disturbance and loss, and weed species introduction and spread. In terms of Project timeline impacts to vegetation has potential for effects during the construction, operation, decommissioning and post-closure stages.

A single terrestrial plant species of conservation concern was identified in the Project footprint, Striped Coral-root. A total of 56 individuals were observed in three areas on the western half of the Project. Of these, 52 fall within Phase I, in Landfill Cells 1 & 2, while the remaining 4 individuals were observed in the Phase II Landfill Cell B. Thus, the Project has the potential to impact the Striped Coral-root populations in the Project area, through the removal of the identified individuals within the Phase I footprint. And while the risk of impacting other species of conservation concern that were not identified during the surveys exists, it is considered negligible, since the other potential species identified during the desktop review in the greater project area are primarily associated with wetlands, such as the two S2 species listed above in the Existing Environment Section. And with the number of aquatic surveys completed around all of the wetlands in the Project area throughout the spring and summer, it is anticipated that both of the S2 species, Large Yellow Lady's Slipper and Yellow Touch-me-not, would have been observed as an incidental in the area due to their showy flowers.

The same potential impacts on habitat loss are present for vegetation as they were for wildlife and wildlife habitat. The placement of the facility components on previously disturbed lands where possible significantly reduces the potential for impact to vegetation habitat loss. Of the approximately 21.9 ha associated with the Phase I footprint, native vegetation habitat lost will include approximately 9.0 of forest and grassland and riparian edges, which is approximately 36%

of the Phase I footprint. Habitat disturbance will be largely limited to the direct habitat loss during construction, but the potential for habitat disturbance outside of the Project exists due to unexpected events, such as leaks and spills. There is a possibility that weedy species may also be introduced or spread further within the Project area due to the habitat disturbance during construction, or seeds or other propagules being brought into the landfill as waste.

7.7.2 Mitigation Measures

To reduce the impact to native habitat, the Project was placed primarily within disturbed habitats, and the design includes the conservation of as much habitat as feasible within the PSA. These remnant patches of native habitat will also serve as a windrow, in addition to the planting of windrows in areas of the Project without natural tree/shrubs. These windrows, in addition to fencing, will assist in reducing the impact of the Project off-site, by reducing the litter, and potentially associated weed propagules, that is blown off site during wind events. These wind guards include litter fencing around the active face as well as along the perimeter of the active landfill cells, and perimeter fencing and the windrow around the property line. Cover will also be placed over exposed waste to reduce wind-blown debris associated with the active face. Additionally, the Project will be inspected for weeds annually, including the exterior berms, and any identified weed infestations of noxious or prohibited weeds will be controlled to reduce the likelihood of their spread off-site into native habitats. These inspections will be outlined in the Site Operating Plan.

The risk of impacting surrounding vegetation with contaminated waters will be reduced with the above-described mitigations in Section 7.3. Not only will the exposure of off-site species to the leachate pond be reduced via separation of the internal water systems from natural drainage systems and site fencing, but also the surrounding wetlands will be monitored for changes to water quality to ensure they are not impacted by inadvertent release of water from on-site.

Following the observation of Striped Coral-root in the Project area, MOE was consulted due to the potential that the species observations may impact the Project review process. The MOE response indicated that additional field surveys to identify populations of the species off site would not be required, but that justification should be provided within the proposal. Thus, following the identification of the species within the Project area, a review of available literature regarding the distribution and conservation ranking of Striped Coral-root was completed to determine the potential impact of the species on the Project.

Striped Coral-root is native to North America, broadly distributed across western North America, as well as an eastern distribution into northern US and southeastern Canada. It is found across most

of Canada, ranging from secure in BC, to Vulnerable across the prairie provinces, and Apparently Secure in Ontario (NatureServe Explorer 2023d). While this species is considered Vulnerable / Rare – Uncommon (S3) in Saskatchewan, the number of observations within the assessed transects indicates that this species may be common in the Project area. Using the observed individuals and area assessed, it can be extrapolated that up to 570 individuals of Striped Coral-root may be present within the Phase I footprint, and 360 individuals within the Phase II footprint, and that upwards of 4000 individuals of Striped Coral-root could be present within 500 m of the Project within suitable habitat to the west. Even if a conservative estimate using 6 individuals observed was used for the estimates (assuming that the large 50 individual observation was an anomaly), the number of individuals would be 61 in Phase I, 39 in Phase II, and over 500 in the 500 m buffer. This, coupled with the fact that Striped Coral-root undergoes a dormancy period, of up to several years, following flowering (LBJ Wildflower Center 2016), indicates that there are likely much higher numbers of Striped Coral-root in the suitable habitat to the west of the Project, than within the suitable habitat within the Project footprint itself. Thus, it is anticipated that the Project will not significantly impact the Striped Coral-root population in the Project area.

The risk of weed introduction and proliferation will be mitigated by visual inspection of construction equipment entering the site during the construction and decommissioning stages of the Project and visual inspections for prohibited and noxious weeds as part of routine site inspections. Criteria for these inspections will be outlined in the Site Operating Plan.

The primary mitigation to reduce the impacts on vegetation was planning the Project to fall within cultivation where possible with the removal of native habitat limited to existing habitat edges, engineering the facility to prevent the release of impacted waters outside of the Project, and barriers to prevent litter from leaving the site. Specific mitigation incorporated into the Project to minimize impacts on vegetation are outlined in Table 7.13.

Table 7.13 Mitigation Methods to Minimize Impacts on Vegetation

ID	Potential Interaction	Mitigation Measures
26	Impact the Abundance of Species of Conservation Concern	Conducted terrestrial rare plant surveys.
		- A single tracked species, Striped Coral-root (S3) was identified in the project area. This species is present throughout North America, and most of southern Canada. It is estimated that there are significantly higher numbers of Striped Coral-root present in the suitable native habitat to the west of the Project, and thus it is anticipated that the Project will not significantly impact the species.
		Ongoing communication with MOE regarding mitigations should sensitive species be identified during construction or operations.
27	Habitat Disturbance	The locations of the project components were selected primarily within cultivation to minimize disturbing native forest, grassland, wetlands, and remnant native areas where possible; reducing the total area of native vegetation disturbed by the Project.
		Reducing the removal of native habitat where possible within the PSA, including planting windrows around the unforested perimeter of the site, and site fencing to prevent litter from moving off-site.
		Design the site to create internal site drainage, separate from natural drainage systems, to prevent habitat disturbance through the release of impacted waters to surrounding habitats.
28	Habitat Loss	The locations of the project components were selected primarily within cultivation to minimize disturbing native forest, grassland, wetlands, and remnant native areas where possible; reducing the total area of native habitat lost due to the Project.
		Conservation of as much native habitat as feasible within the PSA.
29	Weed Introduction/ Spread	Prevent spread of noxious species by avoiding disturbance of weeds, cleaning vehicles, and inspecting for weeds prior to accessing native areas.
		During operation of the facility, weed management activities will be conducted on a yearly basis should noxious or prohibited weeds be identified.

7.7.3 Monitoring Mitigation Outcomes and Follow-Up

Prior to the construction of the Phase II portion of the Project, it is recommended that supplemental vegetation assessments be completed on the native habitat in the Project area. These investigations will be undertaken in about 35 years when the site will encroach on the wetlands along the Project's eastern edge with the following objectives:

- Determine the potential impacts of the additional construction phase;
- Determine whether the existing Phase I mitigations to reduce impacts to wetlands and aquatic habitat were effective; and
- Confirm whether striped coral-root persists in the Project area if it remains a tracked species at the time of Phase II construction.

7.7.4 Residual Effects

Residual effects on vegetation are anticipated to be low to moderate. Proposed mitigations for project construction include project planning to place the Project components primarily on cultivation, reducing the amount of native habitat removed where possible within the PSA, and

ensuring construction equipment is clean of weeds prior to entering native habitats. The residual effects due to the construction of the Project primarily includes unavoidable habitat disturbances/loss within the facility boundaries. The residual effects during operations are anticipated to be low and are mainly mitigated by fencing and planting windrows on open side of the site to prevent the spread of litter off-site, preventing migration of impacted waters off-site, and controlling any noxious or prohibited weed infestations identified within the Project boundaries. The residual effects after decommissioning are anticipated to be low, as project components and impacted soils will be removed from the ponds, and the landfill cells will be capped and seeded with the resulting land use anticipated to be recreational or forage.

The Project's anticipated residual effects are summarized in Table 7.14 below.

Table 7.14 Residual Project Effects on Vegetation

ID	Potential Interaction	Residual Effect	Likelihood (with mitigation)	Severity (with mitigation)	Spatial Scope			Project Phase				Reversible	Cumulative Effects Consideration
					PSA	LSA	RSA	Con.	Op.	Decom.	P.C.		
26	Impact the Abundance of Species of Conservation Concern	Potential loss of individual Striped Coral Root plants but unlikely to significantly impact population since there is an abundance of similar and suitable habitat for this species in the forested land west of the PSA.	unlikely	minor	X			X				partial	-
27	Habitat Disturbance	Minor disturbance to forest surrounding Runoff Pond B during construction and decomissioning.	moderate	minor	X			X				yes	-
28	Habitat Loss	Net loss of 8.7 ha forest and 20.5 ha cropland, net gain of 0.1 ha wetland and 29.2 ha modified grassland.	certain	minor	X			X				partial	-
29	Weed Introduction/ Spread	Inherent risk with the introdution of construction and operational vehicles on site. Risk is removed post-closure.	unlikely	minor	X	X		X	X	X		yes	-

7.7.5 Cumulative Effects

While there will be a low to moderate impact on vegetation during construction through habitat loss and removal of the identified Striped Coral-root individuals, with the mitigations described above, the impacts will be largely limited to the Project footprint, and impacts are anticipated to be lower during operations with the mitigations to reduce impacts off-site. Additionally, during decommissioning and reclamation the Project area will be returned to a mix of wetland and forage habitat, which will provide space for the movement of native plants into the area. Thus, with the Project being placed primarily on cultivation, and the preventative measures during operations to reduce impacts off-site due to litter or impacted water migration, along with the creation of forage

and wetland habitat after decommissioning, the contribution of the Project to cumulative effects on vegetation were determined to be non-significant.

7.8 Human Health, Safety & Wellbeing

7.8.1 Potential Interactions

Landfills have the potential to impact human health and safety, and to disrupt or inconvenience life for individuals in the following forms:

- Adverse human health impacts from consumption of contaminated water. This is perhaps the highest consequence potential impact of a landfill project. A variety of serious health issues can be caused by acute exposure to chemicals found in leachate including, but not limited to lead, mercury, cadmium, phenols, and benzene. The potential for this type of impact applies to the operations and post-closure stages of the Project. There are two exposure pathways to consider:
    - Exposure through environmental contamination. The Floral Aquifer comprises the only water resource likely to be used for human consumption in the existing environment characterization. Human exposure through this pathway was assessed in the evaluation of groundwater impacts in 7.2.4, where it was determined that the risk of impact to the Floral Aquifer is negligible owing to the fact that the aquifer is overlain by 35 m to 40 m of competent clay soil with containment properties on par with an engineered liner.
    - Exposure to leachate by landfill workers through uncontrolled contact with leachate during landfill during site operations. This type or exposure risk is inherent to landfills since leachate is an unavoidable byproduct of landfilling that requires management.
- Off-site safety risks and nuisance resulting from increased traffic on haul routes during the Project's operational stage, and to a lesser extent the construction and decommissioning stages;
- On-site safety risks associated with stray ammunition originating from hunting activities in the FWDF lands west of the site;
- On- and off-site safety risks associated with dangerous wildlife including bears, coyotes, wolves and cougars which could become habituated to attractants at the landfill;

- Various annoyance and inconveniences, including:
    - Unpleasant odours during the Project's operational stage;
    - Increased dust on unpaved hauling routes during the Project's operational stage;
    - Noise and light pollution from on-site activities during the Project's construction and operational stages;
    - Unpleasant visual aesthetics during the Project's operational stage and, to a lesser degree, the post-closure stage; and,
    - Windblown debris escaping the site boundaries and littering neighbouring properties.

7.8.2 Mitigating Measures

Impacts to human health and wellbeing will be mitigated by using previously discussed measures to protect the physical environment, along with safety measures to protect workers, mindful traffic routing, and various design and operational strategies to minimize impacts to daily life of the nearby population.

Risks to Human Safety

Adverse impacts to human health from offsite exposure will be mitigated by siting the landfill away from potable water sources and implementing engineering and operational controls that will minimize the risk of landfill leachate migrating or otherwise impacting off site receptors. Specific mitigation measures were discussed in Sections 7.2.2 and 7.3.2 for groundwater and surface water respectively. It was demonstrated that these measures are expected to remove the risk of the Project impacting any potable water sources. In addition, site access will largely be restricted to the general public, although there will likely be provisions for a short weekly drop off period on Saturdays to benefit RM ratepayers.

Worker safety will be managed in accordance with Occupational Health and Safety legislation, and details of the site safety plan will be included in the Site Operating Plan, which will require review and approval by MOE prior to commencing operation. Specifically, the operating plan will specify when the use of PPE is required, what type of PPE is acceptable, sanitation requirements, onsite traffic management, workers rights and responsibilities, safety documentation requirements, training and certification requirements, safe job procedures and emergency response planning.

On-site safety risks associated with stray ammunition originating from hunting activities west of the site will be mitigated by placing signage at entrance points to the FWDF area to alert hunters of the development and the presence of human activity.

A chain link permitter fence will mitigate against dangerous wildlife being habituated to attractants at the landfill. An electric fence is not expected to be required to achieve this objective, based on a lack of incidents at the historical landfill sited in the forested area nearby.

Traffic

The site access route was selected in consultation with MOH to avoid the use of access from Highway 41, which has an acutely angled intersection and no turning lanes. Instead, waste trucks will access the site from Highway 20 west of the PSA at a right-angle intersection with turning lanes. This route has the added benefit of minimizing use of RM Road 776 which will mitigate dust generation and road maintenance costs incurred by the RM (road maintenance costs are discussed further in Section 7.9). Given the low traffic safety risk of the selected access route, MOH has indicated that the Project will not be subject to a Transportation Impact Assessment. Correspondence is provided in Appendix R.

Annoyances and Nuisances

Many of the nuisances described in the previous section can be mitigated by siting the landfill in a location where odours, alterations to the landscape, noise, light and road dust are unlikely to impact individuals. The Project site was selected with these benefits in mind.

Mitigation in the design phase includes maintaining trees and forest around the perimeter wherever practical and planting windrows in other locations to create a visual barrier.

Operational strategies can also limit the potential to cause nuisances. The Project is proposed to operate during regular hours, thus limiting traffic (to a large degree), light and noise to daytime hours generally through the normal work week of Monday through Friday, with provisions for a short period of public assess on Saturdays. Odor and windblown debris will be mitigated with the use of daily soil cover on the active landfill to minimize the are of the working face. The Site Operating Plan will also specify routine site inspections including cleanup of any debris that has scattered out of the landfill cell.

Summary

Mitigations as they relate to potential impacts are summarized below in Table 7.15.

Table 7.15 Mitigation Methods to Minimize Impacts on Human Health and Wellness

ID	Potential Interaction	Mitigation Measures
30	Adverse health impacts to the public from exposure to contaminated water	Various project siting, detailed design and operational procedures to limit the chance of landfill contaminating groundwater or surface water including:
		• Strong regulatory oversight of Project design, operation and closure;
		• Leachate containment measures outlined in Table 7.1
		• Surface water containment measures outlined in Table 7.3
		• Routine monitoring of groundwater and surface water.
31	Standard workplace hazards associated with employment at landfill	Worker safety measures including training and certification requirements, personal protective equipment, sanitation, onsite traffic management, emergency respose plans will be outlined in the Site Operating Plan which is subject to the approval of MOE
32	Safety risks associated with increased traffic	Waste hauling trucks will access the site from Highway 20 which has a right-angle intersection and turning lanes
33	Safety risks associated with dangerous wildlife	Perimeter fence around PSA limiting access of wildlife onto the site
		Use daily soil cover to limit the size of the active landfill face and manage odor as an attractant
34	Safety risks associated with hunting on adjacent lands	Display signage at entrance to hunting lands notifying hunters of the development
35	Increased noise and dust resulting from increased traffic on haul routes	Haul routes will optimize the use of paved highways to minimize dust and RM road maint. costs
		The landfill approach will be on an RM gravel road that does not have any permanent residences
36	Unpleasant odours	Landfill is sited far away from occupied dwellings and there is a very limited number of people and duration of time that the adjacent lands are occupied
		Use daily soil cover to limit the size of the active landfill face
37	Noise and light pollution	Maintain trees and forest around the perimeter of the Project wherever practical
		Plant windrows on the unforested perimeter of the landfill
		Limit normal landfill operations to daytime hours
38	Undesirable landscape aesthetics	Landfill is sited far away from occupied dwellings, the nearest of which is 1.9 km away with no sight lines to the proposed landfill
		Maintain trees and forest around the perimeter of the Project wherever practical (about half of the perimeter)
		Plant windrows on the unforested perimeter of the landfill
39	Windblown debris	All mitigation measures listed for previous item apply
		Three (3) tiered debris management strategy including fencing around active face of landfill, perimeter fencing and windrows on exterior of PSA.
		Routine site inspections and clean up of any escaped debris, which will be mandated in the Landfill Operating Plan

7.8.3 Monitoring Mitigation Outcomes and Follow-Up

Human exposure through environmental contamination will be monitored with a groundwater and surface water monitoring plan which is discussed in Sections 7.2.3, 7.3.3 and 11.4.

Safety risks associated with standard landfill employment, dangerous wildlife and proximity to hunting areas will be monitored and any minor incidents, near misses, or expressions of concern from employees and other site occupants will be documented in an annual report and addressed

accordingly. Serious incidents, if they occur, will be managed in accordance with *the Occupational Health and Safety Regulations, 2020*.

A sign at the landfill entrance on the RM road will provide contact information for the landfill as an ongoing channel for concerns and feedback to be relayed to the Proponent. Written records of concerns or feedback from individuals or communities will be maintained and documented so that any widespread concerns can be identified and addressed.

7.8.4 Residual Effects

Residual effects on human health, safety and wellbeing relate to standard workplace hazards, safety risks associated with modest increase in traffic, sensory disturbance to neighbouring land users, and the potential for windblown debris. Safety risk from dangerous wildlife exposure and hunting on adjacent land is expected to be negligible with mitigations in place. Residual effects are discussed below.

Standard Workplace Hazards

Workplace health hazards for landfill workers will be present during the construction, operation and decommissioning phases and will be managed through workplace safety procedures which are well established for landfill facilities. The main risks to worker safety are associated with interactions with heavy machinery, landfill gas or flammable waste fire, and exposure to contaminated fluids. With the mitigation measures in place, there will conceptually be low or manageable risk to worker safety.

Increased Traffic

Increased heavy traffic in the LSA is an unavoidable effect of the Project. About six (6) trucks per day will haul waste to the proposed landfill, generally travelling along Highway 20 via Highway 41 and accessing the site by RM Road 776 as shown in Drawing WM566.3-26. There are three (3) permanent residents on the segment of Highway 20 that will be used and no permanent residents on the segment of RM Road 776 that will be used.

This route was selected in consultation with the MOH to minimize the safety hazard associated with the additional traffic entering the site. The existing environment characterization identified Highway 20 as having 180 vehicles per day and Highway 41 as having about 1,245 vehicles per day. An increase of 6 vehicles per day is associated with an increase of 3% and 0.5% on these highways, respectively, an otherwise imperceptible increase of less than 1 vehicle per hour on average.

Waste hauling is expected to be exclusively contracted to Greenland Waste for the foreseeable future. Greenland Waste's hauling trucks will vary but are expected to have between 2 and 6 axels with primary gross vehicle weights between 9,100 kgs and 47,000 kgs. It is acknowledged that the contracted waste hauling trucks accessing the site will need to comply with all road bans and with the limiting weight restrictions outlined by the Ministry of Highways for Secondary Highway use (Government of Saskatchewan, 2014) and the RM of Invergordon for use of Road 776.

The increase in heavy traffic will be partially offset by a small reduction in small vehicle traffic in the LSA resulting from the closure of the transfer station and the introduction of a household waste pick-up program, both of which have already taken place. The Project will also have an offsetting impact with the RSA since the increased traffic in the LSA will be redirected from other landfills, therefore those roadways will be reduced by an equivalent traffic count. It is worth noting that the waste pick-up service is a tangible benefit to RM members.

Safety risks associated with the waste hauling trucks will occur primarily during operation. Mobilization and demobilization of construction equipment during the construction and decommissioning stages will also increase traffic but the safety impacts associated with those stages is negligible.

The financial implication of increased local traffic is discussed in Section 7.9.4.

Sensory Disturbances

Besides traffic, the Project will produce some undesirable sensory outputs associated with the site's construction, operation and decommissioning. Given the relatively remote location of the Project and the localized nature of odours, dust, noise, and light pollution, we do not expect these nuisances to have an imposing effect on any neighboring land users or residents, nor will the Project impose an unsightly view to anyone at their permanent residence. The land neighboring the PSA is either designated parkland or used for crop production, and there are no occupied yard sites or other developments present within 1.9 km. There is a low risk of windblown debris temporarily escaping the PSA, but with mitigations, offsite litter is not expected to be pervasive or persistent.

These sensory impacts will all occur in the operating and decommissioning stages of the Project and will be limited to the PSA and the area immediately surrounding the site boundary. They will be removed in the post-closure stage. The exception is the permanent alteration to the landscape that the enduring landfill mound will cause. The final landfill mound is expected to be about 25 m high measured from the lowest parts of the site, and 15 m above the highest parts of the site. It will be covered and vegetated during the decommissioning which will assist in offsetting undesirable

landscape aesthetics. Although the mound will be visible, the mound will to a degree blend in with the regional topography which has significant relief.

Summary

The Project's anticipated residual effects are summarized in Table 7.16 below.

Table 7.16 Project Effects on Human Health and Wellbeing

ID	Potential Interaction	Residual Effect	(with mitigation)		PSA	LSA	RSA	Con.	Op.	Decom.	P.C.	Reversible	Cumulative Effects Consideration
30	Adverse health impacts to the public from exposure to contaminated water	No effects expected. See Item 3.	rare	minor									-
31	Standard workplace hazards associated with employment at landfill	Effects not likely	rare	minor to signifiant									-
32	Safety risks associated with increased traffic	Increased traffic (~6 trucks/day). Risk is removed post-closure.	certain	minor	X	X			X			yes	-
33	Safety risks associated with dangerous wildlife	Effects not likely	unlikely	minor to signifiant									
34	Safety risks associated with hunting on adjacent lands	Effects not likely	unlikely	minor to signifiant									
35	Increased noise and dust resulting from increased traffic on haul routes	Increased traffic (~6 trucks/day). Risk is removed post-closure.	moderate	minor	X	X		X	X			yes	-
36	Unpleasant odours	Potential for neighbouring land users to detect odours, particularily if land use changes since current neighbouring properties are very infrequently occupied. Risk is removed post-closure.	unlikely	minor	X	X			X	X		yes	-
37	Noise and light pollution	Potential for neighbouring land users to detect noise and light, particularily if land use changes since current neighbouring properties are very infrequently occupied. Risk is removed post-closure.	unlikely	minor	X	X		X	X	X		yes	-
38	Undesirable landscape aesthetics	Permanent formation of an above-grade mound which will have a small working face (where waste is exposed) and will be progressively decomissioned so that as the mound aggrades and grows laterally, the majority of the surface will be reclaimed as modified grassland.	moderate	minor	X	X			X	X	X	partial	-
39	Windblown debris	Potential for windblown debris to temporarily escape the site and accumulate on the margins of the PSA. This risk is removed post-closure.	unlikely	minor		X			X	X		yes	-

7.8.5 Cumulative Effects

The previous section identified standard occupational health risks to landfill workers, modest safety concern associated with increased traffic, and a low risk of various nuisances including noise, dust, odours, light, windblown debris and undesirable landscape aesthetics to local residents. There are no known projects that will worsen or offset these residual effects, therefore cumulative effects equate to the residual Project effects.

7.9 Socioeconomics

7.9.1 Potential Interactions

A landfill project has the potential for adverse economic effects, along with the potential to provide positive economic benefits to the local community. The Project's potential financial impacts to communities and individuals in the LSA include:

- Costs to upgrade RM Road 776 if required due to increased heavy traffic on this roadway;
- Increased revenue for the RM during the operational stage. A gross profit royalty agreement has been agreed to in principle between the RM of Invergordon and the Proponent;
- Increased job prospects for local community members during the construction and operating stages. Jobs directly related to the construction and operation of the Project will be created and indirect positive economic activity in the service industry (i.e. hotels, restaurants, gas stations) will also emerge from increased traffic during these project stages; and,
- Derated waste disposal fees for RM of Invergordon stakeholders;
- Potential decrease in waste disposal fees for households, communities, and commercial entities as a natural consequence of free market competition in the regional solid waste management market.

The Project will also have the potential to impact neighbouring landfills. A formal request to participate in community engagement and explore the impacts to neighbouring municipal and regional landfills was sent via email directly to REACT waste authority (stakeholder who sent a letter of concern to the MOE), City of Prince Albert, City of Melfort and the Town of Tisdale in August 2024. Zero responses were received, and zero participants attended the public forum.

Reduced waste intake at existing landfills within the LSA could have effects that may be viewed as both beneficial and adverse. Specific effects of waste diversion from existing facilities could include:

- Waste diversion will cause an extension in the lifespan of existing landfill infrastructure. Existing landfill infrastructure provides a finite amount of storage for solid waste and when a landfill reaches capacity a large capital investment is required to decommission the landfill and potentially construct a new landfill in a new location or footprint. Many landfill entities, particularly public ones, would welcome a moderate diversion of waste as means to extend the lifespan of their current infrastructure and delay capital investment and footprint expansion.
- Lower profitability of existing landfills due to:
    - Reduced income due to reduced annual waste intake.
    - The need to offer more competitive tipping fees in order to maintain the current waste collection base. While this effect is not desirable to existing WMFs, the trade-off is more cost-effective waste management options for users within the GWSA, which is widely accepted as a strategic goal for any economic region.

7.9.2 Mitigating Measures

Profit Sharing with RM of Invergordon

The only potential adverse socioeconomical effect identified for the community is the potential for the RM to incur nominally higher road maintenance costs for Road 776 over the lifespan of the Project. In addition to road maintenance fees that will be paid according to The Municipalities Act, the impact will be mitigated with a profit-sharing agreement that will generate annual income for the RM that will vastly offset modest costs incurred for road maintenance.

A gross profit royalty agreement will be established between the RM of Invergordon and the Proponent. This agreement will involve annual distribution of a percentage of gross Project revenues to the RM.

Targeting Waste from Non-Member Entities

The only potential adverse socio-economic effect identified for neighbouring landfill facilities is the potential for lower annual profitability. The main mitigation factor for this impact will be a business model that does not involve active pursuit of members of any existing landfill development. The target waste stream involves RMs that are not active members of an existing

landfill organization, and commercial and industrial organizations that are not members of existing landfills. All of these entities are currently subject to dual rate fee structures at established landfill facilities. The analysis of the existing waste management market presented in Section 5.3.3 demonstrates that there is ample capacity in the market for a new regional landfill to service non-member households and entities without targeting members of existing landfills. The estimated potential solid waste volume from non-member households was estimated to be 19,000 tonnes per year, not including commercial waste streams, while the Project aims to accept about 12,000 tonnes of solid waste per year.

Summary

Mitigations as they relate to potential impacts are summarized below in Table 7.17.

Table 7.17 Mitigation Methods to Minimize Impacts on Socioeconomics

ID	Potential Interaction	Mitigation Measures
40	Increased maintenance costs for RM Road 776	Profit sharing agreement whereby developer pays RM a percentage of annual gross Project profits
41	Increased revenue for the RM	Unmitigated positive impact
42	Increased job prospects	Unmitigated positive impact
43	Improved service or decreased fees due to increased competition in waste management market	Unmitigated positive impact
44	Extended life of existing landfill infrastructure	Unmitigated positive impact
45	Lower annual profitability of existing landfills	Target and primarily serve communities and commercial entities who do not receive member-pricing at existing landfills

7.9.3 Monitoring Mitigation Outcomes and Follow-Up

There are no monitoring or follow-up activities planned to address the socio-economic effects of the Project since impacts are either positive or minimally negative.

7.9.4 Residual Effects

Adverse residual Project effects on economic factors are anticipated to be minor and should be considered in balance with the positive socioeconomic impacts which are significant. The net effect of the Project on socioeconomic factors is expected to be positive.

Financial Benefits to RM of Invergordon

The financial benefits for the RM of Invergordon will be significant. The RM is expected to receive in the order of $50,000/year, based on a percentage of annual gross profits and offset slightly by road maintenance costs. These financial benefits will apply throughout the operational period of the Project.

Financial Benefits to Individual Community Members

The Project will create 8 full time construction jobs and 2-3 full time operational jobs. There may also be indirect economic benefits to community members including more competitive pricing for waste disposal for RM of Invergordon residents and the potential for more competitive pricing for waste disposal for neighboring RMs, towns and villages resulting from healthy market competition, however these benefits are relatively small and have not been quantified. Also, there will be benefits to the service industry in the LSA through the construction, operation and decommissioning phases of the Project.

Impacts to Neighbouring Landfill Facilities

As demonstrated in Section 5.3.3.2 there is capacity for an additional WMF to operate in the region without the disruption of existing membership agreements. Nonetheless, there will be a modest diversion of non-member waste from certain regional landfills. The financial effects on neighbouring landfills will be directly related to the amount of waste being diverted from existing landfills into the proposed facility. Based on the current GWSA, GW current customer listing and GW current routing, approximate impacts to each regional landfill noted in Table 5.15 is identified in Table 7.18.

Table 7.18 Estimated Waste Diversion from Existing Landfills

Landfill	Tonnage Impact	Notes
RM of Hoodoo (REACT)	negligible	GW does not utlize this landfill. Non-member waste not permitted
City of Melfort	3,500	Based on routing efficiencies, impact estimated to be 3,000 to 4,000 tonnes annually
City of Prince Albert	3,500	Based on routing efficiencies, impact estimated to be 3,000 to 4,000 tonnes annually
RM of Leroy (REACT)	negligible	GW does not utlize this landfill. Non-member waste not permitted
Tisdale Regional	negligible	GW hauls member waste to this landfill. Non-member waste not permitted
Boreal Area Regional Waste Authority (Nipawin)	negligible	GW does not utlize this landfill. Non-member waste not permitted
Candle Lake	negligible	GW does not utlize this landfill
RM of Torch River (Garrick North)	negligible	GW does not utlize this landfill
Highway 55 WMC	negligible	GW hauls member waste to this landfill. Due to distance, revised routing not feasible.
RM of Bjorkdale (Peesane)	negligible	GW does not utlize this landfill
RM of Lakewood (McPhee Lake)	negligible	GW hauls member waste to this landfill. Seasonal site.
Central Regional Landfill (Wadena)	negligible	GW hauls member waste to this landfill. Non-member waste not permitted
City of Wynyard	negligible	GW does not utlize this landfill
RM of Bjorkdale (Chelan)	negligible	GW does not utlize this landfill
Parkland Regional	negligible	GW does not utlize this landfill
Town of Hudson Bay	negligible	GW does not utlize this landfill
Town of Sturgis	negligible	GW does not utlize this landfill
Sled Lake	negligible	GW does not utlize this landfill
RM of Rosthern	negligible	GW does not utlize this landfill
RM of Leask	negligible	GW does not utlize this landfill

Modest cumulative waste diversion in the order of 7,000 tonnes/year is expected to occur from the City of Prince Albert and the City of Melfort Landfills.

The City of Prince Albert landfilled 56,233 m^3 of waste in 2023 (City of Prince Albert, 2023), equating to about 33,740 tonnes of waste. A diversion of 3,500 tonnes/year from this facility equates to a 10% loss. A 2024 news report on Melfort's need for a new landfill indicates that the facility landfilled 43,400 tonnes of waste in 2023 (Goldsworthy, 2024). A diversion of 3,500 tonnes/year from this facility equates to an 8% loss at this site.

The remaining 5,000 tonnes/year or so is expected to be sourced from newly contracted commercial and industrial entities in additional to newly contracted municipal customers and impacts to existing landfills is expected to be dispersed such that a very low percentage of waste will be diverted. Predicting new customers in the private sector is difficult if not impossible, however based on Greenland Waste's current growth it is very reasonable to project that an additional 5,000 tonnes will emerge from new waste sources over the initial few years of operation. New waste sources include any entity producing non-hazardous waste that does not currently utilize the services of Greenland Waste. This can include a new business or industry, an entity using the services of a competitor whose contract has expired, or an entity that is currently managing their own waste, however, is not limited to those categories. Greenland Waste, the entity from which waste will primarily be received, currently hauls nearly 30,000 tonnes of waste with annual increases of in excess of 10% over the previous 5 years through organic growth and developing new customers within the Greenland Waste service area. At this rate, an additional 5,000 tonnes of waste could occur within a few years.

Summary

The Project's anticipated residual effects are summarized in Table 7.19 below.

Table 7.19 Residual Project Effects on Socioeconomics

ID	Potential Interaction	Residual Effect	(with mitigation)		PSA	LSA	RSA	Con.	Op.	Decom.	P.C.	Reversible	Cumulative Effects Consideration
40	Increased revenue for the RM	Financial benefit to RM estimated to be in the order of $50,000 per year, slightly offset by increased road mainenance costs	certain	significant		X			X			yes	-
41	Increased maintenance costs for RM Road 776		moderate	minor		X			X			yes	
42	Increased job prospects	8 full time construction jobs, 2-3 full time operational jobs	certain	minor		X		X	X	X		yes	-
43	Improved service or decreased fees due to increased competition in waste management market	Economic competitiveness of regional private enterprises will increase, encouraging innovation and efficiency within the market	certain	minor		X			X			yes	-
44	Extended life of existing landfill infrastructure	Directly proportional to the volume of waste diverted from any given existing facility	certain	minor		X			X			yes	-
45	Lower annual profitability of existing landfills	Reduced income associated with 8-10% diversion of non-member waste from two (2) neighbouring landfills	likely	minor		X			X			yes	Likelihood of future WMF closures is high, thus offseting impacts to remaining facilities. (i.e. expected increase in overall waste tonnage to regional landfills in future)

7.9.5 Cumulative Effects

Market trends suggest that adverse residual impacts felt by neighbouring regional landfills will likely be offset by future closure of smaller landfills as solid waste is diverted to existing regional facilities as a deliberate consequence of the Province's Solid Waste Management Strategy. It is worth noting that the regional landfill that expressed concern with the proposed competitive facility has the second largest population base of any regional authority and is among those most likely to benefit from ongoing regionalization trends.

There are currently 20 landfills in the LSA (including two on the outskirts that are included in the assessment), down from 118 historic landfill sites. The existing landfills have significantly benefited from this consolidation of the landfilling industry. Assuming the number of active landfills in the LSA reduces from 21 (including the Project) to 19 in the coming decades (a reasonable and conservative assumption considering the current rate of landfill closures) the market redistribution would increase waste acceptance by 10.5% at all remaining WMFs, if equally distributed across the GWSA. This is contrasted with a normalized market share loss of 4.7% across the industry by increasing the number of landfills in the region from 20 to 21 as a residual impact of the Project.

8.0 POTENTIAL ACCIDENTS AND MALFUNCTIONS

Unplanned impacts can occur as a result of human error, equipment breakdown, or acts of nature. The potential for these types of incidents to occur will be assessed. The following potential accidents and malfunctions have been identified:

- Vehicular collisions;
- Landfill fires;
- Equipment malfunction including leachate pumps and leachate irrigation equipment; and,
- Human error including documentation errors and mismanagement of leachate levels and volumes.

Risks of vehicular collisions will be mitigated with a Traffic Management Plan that will be incorporated into the Site Operating Plan. The Traffic Management Plan will specify traffic direction and traffic restrictions on site for waste trucks, workers and the public and on-site signage requirements. Risk to the public will be managed by limiting access to RM of Invergordon ratepayers and only for a limited period one day per week.

Landfill fires occur when combustible landfill gas ignites. This can occur through spontaneous combustion, the introduction of a spark, or an electrical current in a battery. Emergency response measures to extinguish, monitor, and document landfill fires will be included in the site's Emergency Response Plan. Landfill fires are typically extinguished using soil cover to starve the fire of oxygen so maintaining a stockpile of soil will be a key management strategy. On site and offsite wetlands will provide an abundance of water if required. Furthermore, the site will be occupied and monitored during operational hours and equipped with a video monitor to allow for monitoring during non-operational periods.

Rerouting truck access to a 90-degree intersection with turning lanes and locating the landfill on a stretch of road that does not have permanent residences are key Project details designed to minimize vehicular incident potential. It is important to note, risk of unplanned vehicular accidents will remain and be consistent with existing risk across the province of Saskatchewan with or without the Project.

Equipment malfunction is likely to occur periodically over the lifespan of the Project. Pumps for managing fluid levels in the landfill cell and leachate pond sumps, and in the runoff and leachate ponds could result in excess pressure head in the sumps or overtopping of pond berms. This risk can be mitigated by maintaining a backup pump on site. Irrigation equipment breakdown could result in excess leachate buildup in the leachate pond. Again, this risk can be mitigated by

maintaining backup irrigation equipment on site and routinely monitoring the active equipment during routine site inspections. Breakdown or damage to other site infrastructure such as the weigh scale, perimeter fence, culverts, can be repaired prompt using local contractors.

Human errors cannot be ruled out. The sound operation of the landfill will rely on routine monitoring and management of fluid levels, including leachate and runoff, by landfill personnel. Mismanagement of fluid levels could result in excess pressure head in the landfill cell or leachate pond sumps or overtopping of pond berms. To mitigate this risk, training protocols and standardized processes will be developed for landfill personnel to ensure that they recognize the objectives of monitoring and management and the risks of mismanagement. The risk management education, training protocols and standardized monitoring processes will be included in the Site Operating Plan.

9.0 ANCILLARY PROJECTS

No other ancillary projects are anticipated as a result of the Project, with the possible exception of offsite power line routing to service the site. Utility servicing was previously discussed in Section 2.4 and summarized in Table 2.1.

The Project will require servicing by SaskPower to provide an estimated 7200 kwh per year primarily to service the administrative buildings and weigh scale. Onsite, the power service line can be routed within the Project footprint. If SaskPower does not currently maintain a distribution line at the property boundary, then a service line will be required to bring power onto the property. This service line would be routed within the easement for RM Road 776, with little to no impacts or cumulative effects to the environment.

10.0 EFFECTS OF THE ENVIRONMENT ON THE DEVELOPMENT

The facility's design, mitigation measures and management strategies will control environmental liability by considering the Project's interaction with extreme climate and weather events. Extreme precipitation, extreme wind, and wildfires have the potential to adversely impact the Project.

During construction extreme precipitation and wildfire have the potential to delay work tasks, which may have implications for the Project schedule. These construction delays will likely have limited adverse effects aside from construction delays as previously noted.

During operation extreme precipitation has the potential to generate excess leachate and clean runoff, which would increase exposure risk to surface and groundwater quality by overtopping ponds and excessive leachate buildup in the lower parts of the landfill base. These risks are

managed in the design stage by 1) sizing holding ponds and landfill sumps for an extreme precipitation event and 2) designing the landfill cell bases to concentrate fluid away from the underlying channelized sand deposit. Runoff ponds are designed for a 50-year return 24-hour duration rainfall event, which far exceeds regulatory requirements of capacity for a 25-year return storm event. Runoff Pond B is naturally occurring and oversized; as such, there is opportunity to transfer collected runoff from Pond A into Pond B if excess runoff accumulation occurs across the site. Prudent management of leachate will be necessary to minimize environmental impact and liability. This will involve regular monitoring of leachate levels in sumps and the leachate pond and actively managing accumulated fluids as they develop. This will be critical year-long however the majority of leachate will be generated in spring, summer, and fall so monitoring frequencies are increased between May and October. The proposed leachate management methods have the potential to evaporate more fluid than would typically occur on a normal season.

During operation extreme wind has the potential to generate and distribute excess litter on and off the site. This risk can also be managed with a combination of design and management. Litter fencing is specified to be constructed around the active face as well as at the perimeter of the active landfill cell(s). Perimeter fencing and a tree guard will offer a last line of debris collection at the property line. Daily cover is required to be placed over exposed waste to minimize the working face during operations and eliminate the working face in off-hours. Debris management may include manually collecting wind-blown debris if a storm event causes litter migration off site.

Wildfires have the potential to interrupt operations, damage buildings and equipment, and impact air quality with the release dioxins and furans. Provisions for fire on site will be included in the ERP, including evacuation procedures and action plans for a fire on site.

11.0 MONITORING

11.1 General

Various monitoring programs will be established for the Project, all of which meet or exceed the minimum requirements of landfill operation, including:

- Construction monitoring to ensure compliance with environmental mitigation commitments and to provide engineering quality assurance and quality control;
- Monitoring fluid levels in the leachate pond, leachate collection sumps, and runoff holding ponds as a routine part of landfill operations to allow for the proper management of fluids and avoid excess buildup of fluids;

- Monitoring groundwater and surface water before and during operation, decommissioning and post-closure to detect and characterize impacts to the physical environment if they occur;
- Monitoring the site throughout operation, decommissioning and post-closure to detect and rectify any conditions that are unsafe, environmentally unsound, or non-conforming with commitments outlined in this EIS or in subsequent permitting documents; and,
- Monitoring the volume or tonnage of waste in place and annual waste acceptance rates which will, at sufficient volume, trigger the requirement for surface gas monitoring if proposed legislation comes into effect.

These monitoring programs are discussed in the following sections.

11.2 Construction Monitoring

11.2.1 Engineering Control

Engineering control will be required through the construction of the development for quality assurance, quality control and documentation. Construction monitoring will include, at a minimum:

- An initial site survey which lays out the limits of construction by a qualified survey technician and follow-up site visits to establish second grade staking as the excavation approaches the rough grade surface.
- A topographic survey of rough grade surfaces (landfill cells and leachate pond) prior to compacted clay liner construction to allow for confirmation that proper thickness of compacted clay liner is achieved;
- Inspection of the rough grade surface by a qualified geotechnical engineer. The rough grade surface will be proof rolled to confirm the engineered liner is founded in competent clay soils. Any sandy, wet, soft or spongy soils will be over-excavated by a depth of 1 m and replaced with competent clay rich glacial till soils compacted to the specification of the clay liner;
- Moisture-density testing throughout the construction of the compacted clay. A minimum testing frequency of one (1) test per 800 m^2-lift, equivalent to testing on a 30 m grid for each soil lift to ensure that the liner achieves minimum 98 % of optimum dry density between 2% dry of optimum to 3% wet of optimum moisture content;

- A survey of the completed compacted clay liner surface by a qualified survey technician. The thickness of the compacted clay liner will be confirmed to ensure the design standards are achieved;
- Collection and testing of two (2) undisturbed soil samples for hydraulic conductivity testing from each landfill cell and one (1) from the leachate pond, supervised by a qualified field technician. This information, in addition to the moisture-density testing data, will be used to confirm the hydraulic performance of the compacted clay liner meets the design performance (i.e. $<1x10^{-9}$ m/s). The voids created from obtaining the Shelby Tube undisturbed soil samples will be backfilled with high quality sodium bentonite chips, hydrated in place;
- An inspection and survey of the leachate collection and withdrawal piping by a qualified technician after installation and prior to covering with drainage aggregate. The inspection will confirm the location, and orientation of all piping ensuring the design objectives are achieved;
- Placement of the drainage aggregate will be inspected by a qualified engineer and the thickness verified by a qualified survey technician. It is recommended that grade staking be completed across the base of the landfill cell to assist in placement of aggregate. Establishing second grade markers in aggregate is difficult, thus preserving the initial grade stakes until final grades are achieved is important in the efficient placement of aggregate.
- The HDPE liner testing will conform to industry standard testing protocol with respect to liner seam leak and tear resistance. This testing will be performed by qualified field-testing technicians using appropriate equipment. Materials and welded seams that do not achieve accepted standards will be removed and replaced. A document certifying the installation and testing will be provided.
- Following construction, an As-Built engineering report will be prepared and submitted to the MOE documenting the construction process, any variances that may have occurred from design and justification for variance, quality assurance and quality control measures undertaken, and the final site topography including capacity of all ponds and landfill cells, the dimensions of liner systems, the layout of leachate collection and withdrawal piping, and the layout, dimensions, and specification of other linear infrastructure on site including roads, culverts and fencing.

11.3 Leachate Monitoring

Leachate monitoring will be an important aspect of site operations. An approved Leachate Management Plan is a regulatory requirement of an operating landfill in Saskatchewan and includes provisions for monitoring fluid levels and chemistry where leachate is collected and stored. Leachate monitoring is described conceptually in this document and a detailed plan will be specified in the Project's Leachate Management Plan which will be submitted to MOE for approval as a part of the application for a Permit to Operate.

Leachate monitoring and management will be critical year-round however the majority of leachate will be generated during the spring, summer and fall season when the site is thawed. For this reason, monitoring frequencies are higher in spring, summer, and fall and reduce through the winter.

Leachate monitoring will involve the following:

- Measuring and recording leachate levels in the leachate collection sumps (in landfill cells and leachate pond) and the leachate pond on a weekly basis from May through October and a bi-weekly basis from November through April. The leachate collection and withdrawal systems described in Section 7.2.2 will include piping that will extend from ground surface into the leachate collection sumps to provide access to the sump for monitoring purposes. This system is illustrated conceptually in Figure 11.1.

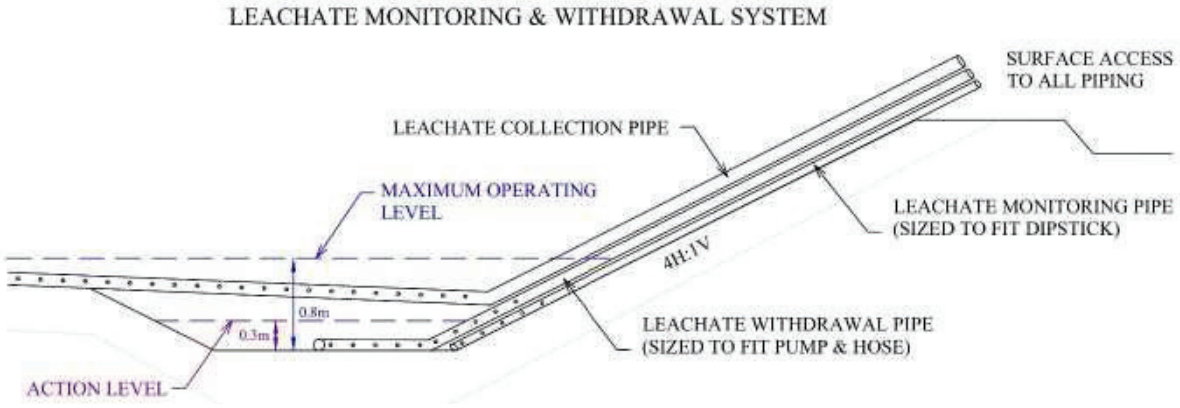


Figure 11.1 Conceptual Leachate Monitoring System

- When leachate levels within the sumps meet or exceed a specified Action Level, leachate withdrawal and disposal will be required. Proposed Action Levels for the leachate collection sumps are listed below in Table 11.1. Withdrawn leachate will be pumped into the leachate pond, which will function as a staging area for disposal as discussed below.

Table 11.1 Action Levels for Leachate Collection Sumps

Sump	Sideslope (design)	Action Level (m)		Maximum Operating Level (m)		
		Fluid depth in sump [1]	Wetted length [2]	Fluid depth on liner	Fluid depth in sump*	Wetted length**
Landfill Cell 1	4.0H:1.0V	0.3	1.20	0.3	0.8	3.20
Landfill Cell 2	4.0H:1.0V	0.3	1.20	0.3	0.8	3.20
Leachate Pond [3]	4.0H:1.0V	0.3	1.20	0.3	0.8	3.20

Notes: [1] measured vertically above base of sump

[2] measured along length of leachate monitoring dipping pipe

[3] in the leachate collection sump, not to be confused with ponded leachate on surface

- A Maximum Operating Level of 0.8 m fluid depth in the sump is specified for Landfill Cells 1 and 2 and for the sump underlying the Leachate Pond. With a sump depth of 0.5 m, this maximum fluid level corresponds to a maximum fluid depth of 0.3 m on the main liner which aligns with the accepted standards.

- Monitoring of fluid levels in the leachate pond is important because when the full supply level (FSL) 0.6 m below the pond crest is reached then no additional leachate may be added to the evaporation pond until levels decline. For this reason, it is critical that leachate in the pond be progressively disposed. It is particularly important to minimize stored fluid in the pond in late summer and fall to provide capacity for leachate accumulation in the pond in late winter and spring when the primary leachate disposal strategies cannot be employed. Disposal will primarily be managed through evaporation by two different methods:

    - The primary method will be irrigation onto active landfill mounds to facilitate evaporation of the fluid. Climate data for the site indicates that there is a net positive evaporation potential in the order of 308 mm/year. The Leachate Management Plan will specify minimum rates of irrigation to manage fluids. It will be important to actively irrigate through the evaporative season (May through September) to lower fluid levels in the leachate collection pond so that there is capacity for buildup through the winter season. This method as the primary means of leachate disposal has been successfully implemented at other large landfills in the province.

    - The second method will be passive evaporation from the pond, which represents a smaller but non-trivial potential for volumetric reduction of leachate.

  - As a contingency plan, the proponent has an agreement with the RM of Invergordon for disposal of landfill leachate within their domestic lagoon. This option is not expected to be required but provides a framework for disposal of leachate in the event of consecutive years of extreme precipitation correlating with reduced evaporation, for example. Documentation of the agreement is provided in Appendix Q.

- Annual sampling of fluid from each of the leachate collection sumps and from the leachate pond, subsequent laboratory testing, and analysis and reporting of fluid chemistry. This monitoring will supplement the groundwater and surface water monitoring program (described in Section 11.4) and trend analysis by characterizing point source chemistry. The frequency of leachate sampling may be reduced after several years, pending approval by MOE, once the chemical profile of leachate is adequately established.

11.4 Environmental Monitoring

An approved Environmental Monitoring Plan is a requirement of an operating landfill in Saskatchewan. The Environmental Monitoring Plan is described conceptually in this document and a detailed plan will be prepared and submitted to MOE for approval as a part of the application for a Permit to Operate.

Broadly, the Environmental Monitoring Plan will involve routine monitoring of groundwater and surface water for piezometric levels and chemistry and annual reporting by a Qualified Person to MOE of raw data, trend analysis, and identification of substances of potential concern (SOPCs) in accordance with the *Endpoint Standard Selection* document if they are detected.

The Environmental Monitoring Plan will include the following information:

- General information such as site plans, piezometer locations and details, and water quality standards used in the analysis. A conceptual monitoring network proposed for the site is shown in Drawing WM566.3-29.

- A short-termed strategy for site monitoring including:

  - Routine piezometric measurements and sampling of groundwater from select piezometers on site to document the baseline (upgradient/cross gradient) and downgradient groundwater chemistry, and subsequent analysis of spatial and temporal trends. Two (2) baseline piezometers are proposed in the oxidized till and channelized flow system and four (4) downgradient piezometers (two in oxidized till and two in channelized sand). The proposed piezometer network and

sampling locations are shown in Drawing WM566.3-29. Semi-annual (twice per year) sampling is recommended for at least five years after the landfill begins operation to establish trends. Baseline (pre-development) groundwater chemistry has been established for the stagnant till flow systems as discussed in item 2) in Section 5.1.2.2. Baseline chemistry will be established for the channelized Sand 2 flow system prior to operation.

- A surface water monitoring program, which will involve routine water level measurements and sampling of water within Runoff Pond A, Runoff Pond B, and the west and east sloughs to document chemistry and analyze spatial and temporal trends. An annual sampling frequency is recommended for at least five years after the landfill begins operation to establish trends. Baseline (pre-development) surface water chemistry has been established for the west and east sloughs as discussed in Section 5.1.3.

- A medium-termed strategy for site monitoring. Routine sampling of groundwater and surface water will occur throughout the Project's life and modifications to the monitoring program can be proposed at any time, a formal review of the program is recommended after 5 years of operation to optimize the program (i.e. less frequent monitoring could be proposed if variation in water chemistry is found to be small).
- A long-termed strategy for site monitoring, which will outline the monitoring program in a post-landfill closure environment. Conceptually, post closure monitoring will include routine sampling and analysis until the water impacted by the Project is shown to have concentrations below all applicable endpoint standards. The term of monitoring is dependent upon the geochemical trends; however, a minimum period of 25 years is a reasonable expectation for planning purposes.
- A discussion of approved laboratories, field quality assurance and quality control measures and annual reporting requirements.

11.5 Site Conditions Monitoring

The Site Operating Plan will specify the frequency, scope, and documentation and reporting requirements for routine site inspections that will involve visually inspecting the site for workplace hazards, liner conditions, noxious weeds, windblown debris, and other unsafe or environmentally problematic issues.

Operational observation documentation forms will be maintained on site and summaries will be provided to MOE in an Annual Operations Report, which must be completed as a permitting requirement for landfills in Saskatchewan.

11.6 Waste Volume Monitoring

Volumes of landfilled waste will be documented and reported annually to MOE in an Annual Operations Report, which must be completed as a permitting requirement for landfills in Saskatchewan. Waste acceptance will be documented, both in terms of annual volume or tonnage and as total in-place volume or tonnage.

New legislation has been proposed which, if accepted, will specify threshold volumes of in-place waste and annual waste acceptance volumes that would trigger the requirement to report estimates of landfill gas generation on an annual basis. If the estimates are sufficiently high, then a program to monitor air composition on the landfill mound surface would be required.

12.0 SUMMARY AND CONCLUSIONS

A VC-centered approach was used to identify and evaluate the potential effects of the Project. The full effects assessment results are summarized in Appendix T. The main effects are discussed below by VC.

Groundwater Quality

Landfill leachate will be an unavoidable byproduct of the Project that will require engineering controls for containment and management. With all landfills there is an inherent but mitigatable risk of leachate migrating into underlying flow systems and subsequently impacting the physical, ecological or human environment through adverse exposure.

Mitigation measures broadly include:

- project siting primarily in competent clay rich soils isolated from regional aquifers;
- use of compacted clay liners in areas where leachate will collect (landfill cells and leachate pond);
- grading the clay liners to drain leachate toward collection sumps, minimizing contact time;
- enhancing leachate drainage with leachate collection piping embedded in drainage aggregate;

- separation of the liner surface from the phreatic surface to avoid excess generation of leachate;
- leachate monitoring and withdrawal systems to manage leachate levels in the collection sumps; and,
- design of a dual-lined system in the more sensitive leachate pond; including an HDPE liner on surface underlain by a secondary system of drainage aggregate, leachate collection piping, and compacted clay liner.

The Project's expected impacts on groundwater quality include:

- Nominal leakage into the channelized flow system underlying a portion of the landfill cell, at a magnitude that is not likely to be detectable. The most extreme plausible scenario was bracketed at 1.5.% of the source term concentration if several environmental and engineering factors converge at their least ideal extreme, which is unlikely and unexpected. It is very likely that the actual impacts will be much less since there is significant factor of safety built into the worst-case modelling scenario. Even in this worst-case scenario the groundwater will be only mildly impacted and is not expected to have any concentrations that exceed the SEQG standards for aquatic life or wildlife watering. In other words, West Slough water quality is not expected to be impacted. A plan to monitor water quality in the channelized flow system is proposed for the operational, decommissioning, and post-closure periods of the Project, which correspond to the periods of time during which this very low risk impact could occur. The risk is considered to be non-reversible since the buried waste and landfill infrastructure will be permanent in the subsurface, although decommissioning the landfill cells will theoretically reduce the source term fluid and the risk will eventually dissipate. The potential for cumulative effects from the historic RM landfill 150 m west of the west slough were evaluated, and it was determined that no cumulative effect would occurs since groundwater underlying the historic landfill flows away from the slough.
- A leachate plume below each leachate collection sump is expected to develop even with mitigation measures in place. The plumes are expected to be concentrated (97% source term) but stagnant (<0.01 m/yr). The very low mobility of the plumes suggests that migration will likely be undetectable in the Project's lifespan and indicates that offsite migration is not a risk even for the Phase II cells near the northern property boundary. These plumes will not be problematic while the site is operating since there is effectively no risk of exposure to the broader environment but the plumes are expected to persist in the

post-closure phase and carries risks or limitations for future land use post-decommissioning since shallow, impacted groundwater can be a pathway for ecological uptake (i.e. the affected area may have limited productivity and should not be used for crop growth). It must be noted that this same mechanism for concentrating groundwater in fractured clay is the reason the natural fractured clay groundwater is highly mineralized. Cumulative impacts of the landfill are not expected to be significant. A plan to monitor water quality in the shallow till flow system is proposed for the operational, decommissioning, and post-closure periods of the Project, which correspond to the periods of time during which this very low risk impact could occur. The risk is considered to be non-reversible since the buried waste and landfill infrastructure will be permanent in the subsurface, although decommissioning the landfill cells will theoretically reduce the source term fluid and the risk will eventually dissipate. Natural attenuation, which was not considered in the modelling, will reduce the concentration of many analytes over time.

Surface Water Quality

Landfill leachate will be an unavoidable byproduct of the Project that will require containment and management. With all landfills there is an inherent but mitigatable risk of leachate adversely impacting water quality on site or offsite. Mitigation measures to protect clean onsite runoff and all offsite waterbodies and water courses broadly include a surface water management plan to control overland flows, and engineering controls to protect groundwater that could flow offsite. With the proposed mitigation measures in place, no offsite impacts to water quality are expected and no impacts to onsite runoff accumulated in the holding ponds are expected either.

The Project's only expected impact on surface water quality will be the formation of a contaminated surface water body on site (leachate pond). Fluid levels and chemistry will be routinely monitored for the pond and site fencing will limit uncontrolled exposure risk to receptors, including wildlife for the Project's operational duration. The abundance of wetlands in the area and the undisturbed corridor west of the PSA should further deter animal entry to the site. The exposure risk is reversible; during the decommissioning stage, fluid will be removed, the HDPE liner, piping, and impacted soils surrounding the pond will be removed and the topographic low will be converted into a wetland that is integrated into the east slough drainage network. There are no factors in the region that are expected to compound or offset this impact, therefore no cumulative effects are expected.

Climate and Air Quality

The Project will generate GHG emissions and will change the carbon sequestration potential of the land through land cover changes. It is important to note that the Project will not increase the amount of GHG generated regionally, since the Project will not alter the amount of landfilling that occurs in the region. When these offsetting effects are considered, there will be a net zero impact to GHG emissions from landfill gas and vehicle use.

The net residual effect of the Project on climate will be the reduced capacity of the land to sequester carbon due to land use alteration. This effect is somewhat temporary as it can be partially reversed in the post-closure stage of the Project when the affected land will be revegetated and turned into parkland. The Project will result in a permanent reduction of 9.0 of forest and 20.2 ha of cropland. Wetland surface area will nominally increase during Phase I although wetland area during Phase II and the post-closure stage will be similar to the pre-development area. When the Project is decommissioned, there will be a net gain of about 29.3 ha. Staged construction, progressive decommissioning, and constructing primarily on previously disturbed land will mitigate this impact even through the operations phase.

Wetlands and Aquatic Life

Project siting and layout to avoid wetland disturbance, mitigation during construction to limit sedimentation, ditching to avoid changes to drainage in the LSA, and previously discussed measures to avoid impacts to surface water will mitigate against impacts to wetlands and aquatic life. Several impacts to wetlands and aquatic life were identified, all of them insignificant to minor in severity. They relate to un-avoidable alteration to wetlands and drainage patterns within the facility boundaries and along the edges of the PSA during the construction phase. Wetlands and aquatic habitat will be disturbed again during the decommissioning stage, although this work will result in the permanent creation of reclaimed wetlands that will provide additional wetland habitat and reconnect the wetland to the Project area drainage to the east.

A single tracked species, Floating Crystalwort (SU) was identified in the Project area. This species is present throughout North America and is ranked as S3 or higher in other provinces. The impacts assessment identified that the Project will potentially result in the loss of individual Floating Crystalwort plants but that it is unlikely to significantly impact population since it is not believed to be a highly sensitive species and appears to be pervasive across all wetland environments encountered.

The impacts described above are not expected to be compounded or offset to generate cumulative effects.

Wildlife and Wildlife Habitat

Project siting and layout to minimize habitat disturbance, mitigation during construction to avoid breeding bird disturbance, maintaining an undisturbed land corridor between the Project and the west slough, site fencing, and measures to prevent impacts to surface water quality will mitigate against impacts to wetlands and aquatic life. Several residual impacts to wildlife and wildlife habitat were identified, all of them minor in severity. The residual effects during the construction phase relate to the un-avoidable disturbance and loss of wildlife habitat within the PSA, with sensory disturbance also affecting parts of the LSA. Sensory disturbance will occur throughout the Project's operational and decommissioning stages as well. No impacts are expected in the post-closure environment.

A single protected species, Common Nighthawk (S4B, Special Concern) was identified in the Project area. While breeding activity was not observed within the PSA, initial Project construction activities, such as mulching or soil stripping, within native habitat will be completed outside of the Common Nighthawk ARG (May 1 to August 31) or wildlife sweeps will be completed if completed during the ARG. To account for potential bat habitat use in the PSA and LSA (which has not been verified or ruled out), initial project construction activities within treed habitat will be completed within the overwintering period (September 1 to April 31) when bats will not be in the project area. With these mitigation measures it is anticipated that the impact to potential species of conservation concern will minor.

The impacts described above are not expected to be compounded or offset to generate cumulative effects.

Vegetation

Project siting and layout to minimize the disturbance of native vegetation, planting windrows on open side of the site, preventing migration of impacted waters off-site, ensuring equipment is clean of weeds prior to entering native habitats, and controlling any noxious or prohibited weed infestations identified within the PSA will mitigate against impacts to vegetation. Several residual impacts to vegetation were identified, all of them minor in severity. The residual effects during the construction phase relate to the un-avoidable disturbance of vegetation in the PSA. The risk of the introduction and spread of noxious species was identified as a risk that will persist from construction through the decommissioning effort and will extend to the LSA. No impacts are expected in the post-closure environment.

A single tracked species, Striped Coral-root (S3) was identified in the Project area. This species is present throughout North America, and most of southern Canada. It is estimated that there are

significantly higher numbers of Striped Coral-root present in the suitable native habitat to the west of the Project, and thus it is anticipated that the Project will not significantly impact the species.

The impacts described above are not expected to be compounded or offset to generate cumulative effects.

Human Health and Wellbeing

Mitigations to safeguard groundwater and surface water quality and traffic routing mindful of public safety will mitigate against risk to the broader public. Worker safety protocols will provide protection for landfill workers from workplace hazards. The Project's siting away from communities, households, occupied lands, and busy roads will limit the amount of exposure, and therefore risk of impact, that individuals will have with the Project. Several residual impacts to human health and wellness were identified, all of them minor in severity. The residual effects will occur during the construction, operation and decommissioning stages and are related to mitigated by unavoidable aspects of landfill developments. Specific impacts will include:

- Increased safety risk associated with increased traffic (6 trucks/day Monday – Friday) along Highway 41, Highway 20, and RM Road 776 during the operational stage of the Project, mitigated by routing the waste trucks through right-angled intersections with turning lanes.
- Increased noise and dust associated with the modest increase traffic as noted above pertaining to the operational stage of the Project. There are no residents on Road 776 where these impacts will be greatest.
- Unpleasant odours, noise and light pollution from onsite activities during construction, operation and decommissioning stages, and impacting only neighbouring land users which are very limited.
- Permanent alteration to the landscape caused by an aggrading landfill mound. The final Phase 1 landfill mound is expected to be about 20 m high above natural grade. The Phase II cell could conceptually be 30 m high. It will be covered and vegetated during the decommissioning which will assist in offsetting undesirable landscape aesthetics.

Socioeconomics

Adverse residual Project effects on economic factors are anticipated to be minor and should be considered in balance with the positive socioeconomic impacts which are significant. The net effect of the Project on socioeconomic factors is expected to be positive. The socioeconomic impacts are described below.

- The RM is expected to receive in the order of $50,000/year, based on a percentage of annual gross profits and offset slightly by road maintenance costs. These financial benefits will apply throughout the operational period of the Project.
- The Project will create 8 full time construction jobs and 2-3 full time operational jobs.
- There may also be indirect economic benefits to community members including more competitive pricing for waste disposal for RM of Invergordon residents and the potential for more competitive pricing for waste disposal for neighboring RMs, towns and villages resulting from healthy market competition, however these benefits are relatively small and have not been quantified. Also, there will be minor benefits to the service industry in the LSA through the construction, operation and decommissioning phases of the Project.
- There will be a modest diversion of non-member waste from existing regional landfills during the Project's operation. The financial effects on neighbouring landfills will be directly related to the amount of waste being diverted to the proposed facility. Based on the current GWSA, GW current customer listing and GW current routing, it is expected that between 3000 tonnes to 4000 tonnes per year will be diverted from both the City of Prince Albert Landfill and the City of Melfort Landfill. In both scenarios, the landfills remain profitable when 2023 budget figures are analyzed (City of Prince Albert, 2023 & City of Melfort, 2023). The remaining 5,000 tonnes/year or so is expected to be sourced from commercial and industrial entities that are not under existing waste management contract and are therefore potential customer. The main mitigation factor for this impact will be a business model that does not involving active pursuit of members of any existing landfill development. The analysis of the existing waste management market demonstrates that there is ample capacity in the market for a new regional landfill to service non-member households and entities without targeting members of existing landfills.

  Market trends suggest that adverse residual impacts felt by neighbouring regional landfills will likely be offset by the future closure of smaller (likely insecure) landfills as solid waste is managed by more regional facilities as a deliberate consequence of the Province's Solid Waste Management Strategy. In other words, the adverse financial impacts to impacted facilities are likely to be reversed by market forces.

13.0 CONDITIONS MANAGEMENT

The successful and environmentally sound implementation of the Project will be measured against specific and objective conditions that are committed to in this document. A comprehensive

Commitments Register is provided in Appendix S detailing the commitments included in the EIS along with measurement methods and specific targets.

This Commitments Register will be a living document that is updated as new information arises or new commitments are made (e.g. through additional permitting processes). Effective Conditions Management for the Project will rely on the Proponent's attentiveness to update and maintain the Commitments Register, and to communicate the commitments contained in the Commitments Register to Project team members responsible for the supervision and implementation of the specified activities. The Proponent has extensive experience with the permitting, development and operation of similar Projects in the province and is committed to the Conditions Management process that will be involved with the proposed development, including internally tracking Project commitments, communicating with Project team members, and maintaining ongoing communication with the regulators with respect to conditions. The Commitments Register is expected to be an efficient and effective means of communicating, implementing, and tracking the Project's commitments to avoiding, minimizing or mitigating against impacts to the environment.

14.0 QUALIFIED PERSONS CREDENTIALS

The Project leads for this EA include Anna Gagnon, P. Eng, and Kirsten Allen, M.Sc., P. Biol. Their qualifications are discussed below.

Anna Gagnon is a Senior Geological Engineer at Watermark Consulting Ltd. with over 13 years experience consulting in geo-environmental engineering disciplines. Anna was the lead project engineer for the Project's site suitability studies (including geological, hydrogeological and hydrological characterization) and detailed design of the proposed facility. She was also a lead author of the Project's Technical Proposal and this EIS. Anna has consulted as a project engineer on several municipal and private landfill developments in Saskatchewan including licensing, design, monitoring, decommissioning, and development of operating plans, emergency response plans and decommissioning and reclamation plans including for regional landfills such as Whitewood Landfill and Tisdale Regional Landfill along with several smaller landfills. Through these projects Anna has developed an excellent understanding of the solid waste regulatory environment, risk management, engineering best practices and novel mitigation measures. Anna's background in hydrogeology and waste containment has also provided her with an excellent understanding of local soils, groundwater flow mechanisms, and contaminant transport. Anna is familiar with the EA process through previous project work and course work, including a certificate program in Canadian Environmental Law and Compliance. Anna was the lead coordinator of the

EA the lead author of all sections of this document except for the ecological environment content, as discussed below.

Kirsten Allen is a Biologist and Manager of Environmental Assessment at X-Terra Environmental Services Ltd. with over 13 years of experience in terrestrial ecology and hydrology, including 11 years in the field of environmental consulting. She has been managing environmental assessment and monitoring projects for X-Terra since 2017, specializing in large scale EA projects. As a biologist and project manager Kirsten has worked on numerous environmental assessment projects, and completed work in a variety of jurisdictions, including private land, Federal and Provincial Crown Land, crossing Provincial/Federal borders under the Canadian Energy Regulator (CER), First Nations Land (IOGC & ISC), and within other environmentally sensitive areas. As part of this work, she has completed both technical proposals and environmental impact assessments. She has been involved in all stages of project approvals from the initial desktop screenings to designing and implementing the biophysical field programs in compliance with applicable legislation, and writing, reviewing and submitting project proposals to regulators, as well as post-approval tasks such as providing environmental monitoring for projects in the construction phases and assisting in the design and staff scheduling for post-construction biophysical monitoring programs. Kirsten planned and managed the Project's ecological field assessments and was the primary author for the impact and mitigation reporting for the Ecological Environment portions of the Project's Technical Proposal. She will also author the Ecological Environment portions for the Project's EIA.

15.0 REFERENCES

- Acton, D.F., G.A. Padbury and C.T. Stushnoff. 1998. The Ecoregions of Saskatchewan. Saskatchewan Environment and Resource Management. Canadian Plains Research Center. University of Regina.
- Alberta Parks. 2023. Element Occurrence Data: List of Alberta Mosses and Liverworts Elements in the ACIMS Database - June 2022. URL: https://www.albertaparks.ca/albertaparksca/management-land-use/alberta-conservation-information-management-system-acims/download-data/#trackedWatch. Accessed: September 5, 2023.
- Andren, H. 1994. Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. OIKOS. 71: 355-366.
- Association of Regional Waste Management Authorities of Saskatchewan Inc (ARWMAS) 2021. *Annual Report 2021*.

- ASTM International. 2018. *Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and other Devices for Environmental Activities*. Designation: D5299/D5299M-18. Current edition approved 15 Nov. 2018.
- Audubon. 2023. Guide to North American Birds: Turkey Vulture. URL: https://www.audubon.org/field-guide/bird/turkey-vulture Accessed: September 7, 2023.
- Barkworth M.E., J.J.N. Campbell, and B. Salomon. 2007. Elymus curvatus. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico [Online]. 22+ vols. New York and Oxford. Vol. 24. http://floranorthamerica.org/Elymus_curvatus. Accessed September 28, 2023.
- Bayne, E.M., L. Habib, and S. Boutin. 2008. Impacts of Chronic Anthropogenic Noise from Energy-Secot Activity on Abundance of Songbirds in the Boreal Forest. Conservation Biology. 22(5): 1186-1193.
- Botsch, Y., Z. Tablado, D. Scherl, M. Kery, R.F. Graf, and L. Jenni. 2018. Effects of Recreational Trails on Forest Birds: Human Presence Matters. Frontiers in Ecology and Evolution. 12
- Brigham, R. M., J. Ng, R.G. Poulin and S.D. Grindal. 2011. Common Nighthawk (Chordeiles minor). In The Birds of North America, No. 213 (A. Poole, ed.). The Birds of North America Online, Ithaca, New York.
- British Colombia Ministry of Environment. 2009. Landfill Gas Generation Assessment Procedure Guidelines. Prepared pursuant to Section 4 of the Landfill Gas Management Regulation.
- City of Melfort 2023. *2023 Landfill Operations*. Accessed 24 November 2024 at: https://melfort2020.municipalwebsites.ca/ckfinder/connector?command=Proxy&lang=en&type=Files&currentFolder=%2FDocuments%2FFinance%2F2022%20Budget%2F&hash=c245c263ce0eced480effe66bbede6b4d46c15ae&fileName=2022%20Landfill%20Budget.pdf
- City of Prince Albert 2023. The *City of Prince Albert Sanitation Fund Budget for Year Ending December 31,* 2023. Accessed 24 November 2024 at: https://www.citypa.ca/en/city-hall/resources/Documents/2022-Sanitation-Fund-Budget-Document-FINAL.pdf

- Cornell. 2023 All About Birds: Sharp-tailed Grouse. URL: https://www.allaboutbirds.org/guide/Sharp-tailed_Grouse/overview Accessed: September 7, 2023.
- Cornell. 2023. The Cornell Lab of Ornithology: All About Birds: Turkey Vulture. URL: https://www.allaboutbirds.org/guide/Turkey_Vulture Accessed: September 7, 2023.
- COSEWIC. 2002. COSEWIC assessment and update status report on the Northern Leopard Frog Lithobates pipiens, Rocky Mountain population, Western Boreal/Prairie populations and Eastern populations, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Vii = 69 pp.
- COSEWIC. 2010. COSEWIC assessment and update status report on the Sprague's Pipit Anthus spragueii in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 34 pp.
- COSEWIC. 2012. COSEWIC assessment and status report on the Western Tiger Salamander Ambystoma mavortium in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xv + 63 pp.
- COSEWIC. 2018. COSEWIC assessment and status report on the Common Nighthawk Chordeiles minor in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 50 pp.
- COSEWIC. 2021. COSEWIC assessment and status report on the Barn Swallow Hirundo rustica in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 60 pp.
- Environment and Climate Change Canada (ECCC). 2023. Migratory Birds: Avoiding harm to Migratory Birds: General nesting periods of migratory birds in Canada: Nesting periods. URL: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html
- Environment Canada, Climatic Norms for Melfort, SK. 1981 to 2010.
- Environment Canada, Rainfall Intensity-Duration and Frequency data for Melfort, SK 1974 to 2017
- Fish Laboratory Aquatics. 2021. Riccia Fluitans (Crystalwort Moss): Ultimate Care Guide. URL: https://www.fishlaboratory.com/fish/riccia-fluitans/. Accessed: September 6, 2023.

- Goldsworthy, N. 2024. *Melfort needs a new landfill cell.* Published on SaskToday.ca website 21 May 2024. URL: https://www.sasktoday.ca/highlights/melfort-needs-a-new-landfill-cell-8772143. Accessed: November 24, 2024.
- Fung, K. I. 1999. Atlas of Saskatchewan. University of Saskatchewan. 336 pp.
- Government of Alberta (GOA). 2013. Sensitive Species Inventory Guidelines. Environment and Sustainable Resource Development-Wildlife Management.
- Government of Canada. 1992. *Canadian Environmental Protection Act Priority Substances List Assessment Report No. 4 Toluene*. ISNB 0-662-19950-2. DSS cat. No. En40-215/4E.
- Government of Canada. 2023. Species Profile. Species at Risk Public Registries. URL: https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html
- Government of Saskatchewan. 2014.*A Guide to Saskatchewan Weight and Dimension Regulations.* First Edition.
- Government of Saskatchewan. 2020a. Species Detection Survey Protocol: 1.0 Amphibian Auditory Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020b. Species Detection Survey Protocol: 2.0 Amphibian Visual Surveys. January 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020c. Species Detection Survey Protocol: 11.0 Sharp-tailed Grouse Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020d. Species Detection Survey Protocol: 15.0 Common Nighthawk Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020e. Species Detection Survey Protocol: 10.0 Forest Birds Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020f. Occupational Health and Safety Regulations.

- Government of Saskatchewan. 2021. Species Detection Survey Protocol: 20.0 Vascular Plant. June 2021 Update. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan.
- Government of Saskatchewan. 2024. *Guidelines for the Terms of Reference and Environmental Impact Statement*. Accessed July 2024 from: https://www.saskatchewan.ca/business/environmental-protection-and-sustainability/environmental-assessment/does-my-project-need-an-environmental-assessment
- Habib, L., E.M. Bayne, and S. Boutin. 2007. Chronic industrial noise affects pairing success and age structure of ovenbirds *Seiurus aurocapilla*. Journal of Applied Ecology. 44: 176-184.
- Harms, V.L., and A. L. Leighton. 2011. Lilies, Irises and Orchids of Saskatchewan. Flora of Saskatchewan Fascicle 2.
- Illinois Wildflowers, 2023. Crystalwort family (Ricciaceae): Floating Crystalwort *Riccia fluitans*. URL: https://www.illinoiswildflowers.info/mosses/plants/fl_crystalwort.html. Accessed: August 3, 2023.
- iNaturalist. 2023. Olive-backed Pocket Mouse (Perognatus fasciatus). URL: https://www.inaturalist.org/taxa/44154-Perognathus-fasciatus#cite_note-Manning-3 Accessed: September 7, 2023.
- Klinkenberg, Brian. (Editor) 2020. E-Flora BC: Electronic Atlas of the Plants of British Columbia [eflora.bc.ca]. Corallorhiza striata Lindl. striped coralroot. Orchidaceae (Orchid family). Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver. URL: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Corallorhiza%20striata%20var.%20striata&noTransfer=0 Accessed August 28, 2023.
- Klinkenberg, Brian. (Editor) 2020. E-Flora BC: Electronic Atlas of the Plants of British Columbia [eflora.bc.ca]. Corallorhiza striata Lindl. striped coralroot. Orchidaceae (Orchid family). Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver. URL: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Corallorhiza%20striata%20var.%20striata&noTransfer=0 Accessed September 5, 2023.
- Klinkenberg, Brian. (Editor) 2020. E-Flora BC: Electronic Atlas of the Plants of British Columbia [eflora.bc.ca]. Impatiens noli-tangere L. common touch-me-not (western touch-

me-not) Balsaminaceae (Touch-me-not family). Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver. URL: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Impatiens%20noli-tangere. Accessed September 29, 2023.

- Lady Bird Johnson (LBJ) Wildflower Center. 2016. Plant Database: Corallorhiza striata. Retrieved from https://www.wildflower.org/plants/result.php?id_plant=cost19. Accessed September 5, 2023.
- Laudenslayer, W.F. Jr. 1986. Summary: predicting effects of habitat patchiness and fragmentation. Pp. 331-333. In J. Verner, M. Morrison, and C. Ralph (eds). Wildlife 2000: modelling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison.
- Leighton, A. L., and V. L. Harms. 2014. Grasses of Saskatchewan. Flora of Saskatchewan Fascicle 4.
- Longcore, T., and C. Rich. 2004. Ecological Light Pollution. Frontiers in Ecology and the Environment. 2 (4): 191-198.
- Magrath, L.K., and Freudenstein. 2002. Corallorhiza striata. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico [Online]. 22+ vols. New York and Oxford. Vol. 26. http://floranorthamerica.org/Corallorhiza_striata. Accessed September 5, 2023.
- Magrath, L.K., and Freudenstein. 2020. Corallorhiza striata. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico [Online]. 22+ vols. New York and Oxford. Vol. 26. http://floranorthamerica.org/Corallorhiza_striata. Accessed August 28, 2023.
- Manitoba Conservation Data Center (MBCDC). 2023. Plant List MBCDC 2021-Nov. URL: https://www.gov.mb.ca/nrnd/fish-wildlife/cdc/index.html. Accessed: September 5, 2023.
- Mayer, J.J., T.B. Edwards, J.E. Garabedian, and J.C. Kilgo. 2021. Sanitary Waste Landfill Effects on an Invasive Wild Pig Population. Journal of Wildlife Management. 85(5): 868-879.
- Miller, M.W. 2006. Apparent effects of light pollution on singing behaviour of American Robins. The Condor. 108: 130-139.

- Miller, S.G., R.L. Knight, and C.K. Miller. 1998. Influence of Recreational Trails on Breeding Bird Communities. Ecological Applications. 8(1): 351-358.
- Montana Field Guide. 2023. Olive-backed Pocket Mouse — Perognathus fasciatus. Montana Field Guide. Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. URL: https://FieldGuide.mt.gov/speciesDetail.aspx?elcode=AMAFD01010 Accessed: September 7, 2023.
- NatureServe Explorer. 2023a. Riccia Fluitans: Floating Crystalwort. URL: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.1035334/Riccia_fluitans Accessed September 5, 2023.
- NatureServe Explorer. 2023b. Perognathus fasciatus: Olive-backed Pocket Mouse. URL: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.105335/Perognathus_fasciatus Accessed: September 7, 2023.
- NatureServe Explorer. 2023c. Impatiens noli-tangere: Western Jewelweed. URL: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.149328/Impatiens_noli-tangere#:~:text=Impatiens%20noli%2Dtangere%20is%20a,Columbia%2C%20Alberta%2C%20and%20Alaska.
- NatureServe Explorer. 2023d. *Corallorhiza striata*: Striped Coralroot. URL: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.142272/Corallorhiza_striata Accessed: September 29, 2023.
- Newsome, T.M., and L.M. Eeden. 2017. The Effects of Food Waste on Wildlife and Humans. Sustainability. 9(7): 1269.
- Odgen, L.J.E. 1996. Collision Course: The Hazards of Lighted Structures and Windows to Migrating Birds. Internet Center for Wildlife Damage Management, Fatal Light Awareness Program (FLAP), University of Nebraska – Lincoln. 53 pp.
- Plaza, P.I., and S.A. Lambertucci. 2017. How are garbage dumps impacting vertebrate demography, health, and conservation? Global Ecology and Conservation. 12: 9-20.
- Pinter & Associates Ltd. 2018. *Landfill Environmental Site Assessment Rural Municipality of Invergordon No. 430*. Prepared for: RM of Invergordon No. 430.
- Robbins, M. B., and B. C Dale. 1999. Sprague's Pipit (Anthus spragueii). In The Birds of North America, No. 439 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

- Saskatchewan Conservation Data Center (SCDC). 2023. Species Rankings. URL: http://biodiversity.sk.ca/ranking.htm. Accessed: August 3, 2023.
- Saskatchewan Ministry of Environment, Fish and Wildlife Branch (MOE FWB). April 2017. Saskatchewan Activity Restriction Guidelines for Sensitive Species. Regina, Saskatchewan.
- Saskatchewan Ministry of Environment. 2016. Saskatchewan Environmental Code – Endpoint Selection Standard, dated 17 Jun 2016.
- Saskatchewan Research Council. 1990. Geology and Groundwater Resources of the Melfort Area (73A), Saskatchewan. Prepared by Millard, M.J., Saskatchewan Research Council. SRC Publication No. R-1210-6-E-90, August 1990.
- SaskWildflower 2023a. Saskatchewan Wildflowers: Impatiens noli-tangere (Western Jewelweed) - photos and description. URL: https://www.saskwildflower.ca/nat_Impatiens-noli-tangere.html. Accessed September 29, 2023.
- SaskWildflower 2023b. Saskatchewan Wildflowers: Impatiens capensis (Jewelweed) - photos and description. URL: https://www.saskwildflower.ca/nat_Impatiens-capensis.html. Accessed September 29, 2023.
- Sheviak C.J. 2002. Cypripedium parviflorum. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico [Online]. 22+ vols. New York and Oxford. Vol. 26. http://floranorthamerica.org/Cypripedium_parviflorum. Accessed August 16, 2023.
- South Dakota Birds. 2023. Sharp-tailed Grouse Tympanuchus phasianellus. URL: https://www.sdakotabirds.com/species/sharp_tailed_grouse_info.htm Accessed: September 7, 2023.
- WaterMark Consulting Ltd., 2023. Technical Proposal Proposed Industrial Landfill SW 06-44-23-W2M RM of Invergordon (430), Saskatchewan. Prepared for 102138921 Sask Ltd. Internal File no. WM566.2. 12 December 2023.
- WaterMark Consulting Ltd., 2024. Terms of Reference for Environmental Impact Assessment, Proposed Industrial Landfill, SW 06-44-23-W2M, RM of Invergordon (430), Saskatchewan. Engineering report prepared for 102138921 Sask Ltd., dated 24 September 2024 (file WM566.3).

- WaterMark Consulting Ltd., 2024a. Environmental Impact Statement, Proposed Industrial Landfill, SW 06-44-23-W2M, RM of Invergordon (430), Saskatchewan. Engineering report prepared for Invergordon Landfill Inc., dated 11 December 2024 (file WM566.3).
- Wise, S. 2007. Studying the ecological impacts of light pollution on wildlife: amphibians as models. In Marin C., Jafari J., eds. StarLight: a Common Heritage. StarLight Initiative La Palma Biosphere Reserve, Instituto De Astrofisica De Canarias, Government of The Canary Islands, Spanish Ministry of The Environment, UNESCO - MaB, pp 107–116.
- Yahner, R.H. 1988. Changes in Wildlife Communities Near Edges. Conservation Biology. 2(4): 333-339.

16.0 CLOSURE

The information within this report was prepared for the exclusive use of the Developer. Any use of this report by a third party, without the consent of the Developer, WaterMark Consulting Ltd. or X-Terra Environmental is prohibited.

The methods used in this report follow accepted engineering standards and practices. The conditions experienced at the site may vary. If any additional information becomes available which impacts the findings of this investigation, please forward it to us so that we may re-evaluate our conclusions and recommendations.

If you have any questions or comments, please do not hesitate to call.

Yours truly,

WaterMark Consulting Ltd.

Anna L. Gagnon, P. Eng

David. J. Tratch, M.Sc., P.Eng.

X-Terra Environmental

Kirsten Allen, M.Sc., P. Biol.

Association of Professional Engineers & Geoscientists of Saskatchewan

CERTIFICATE OF AUTHORIZATION

Watermark Consulting Ltd.

Number C1203

Permission to Consult held by:

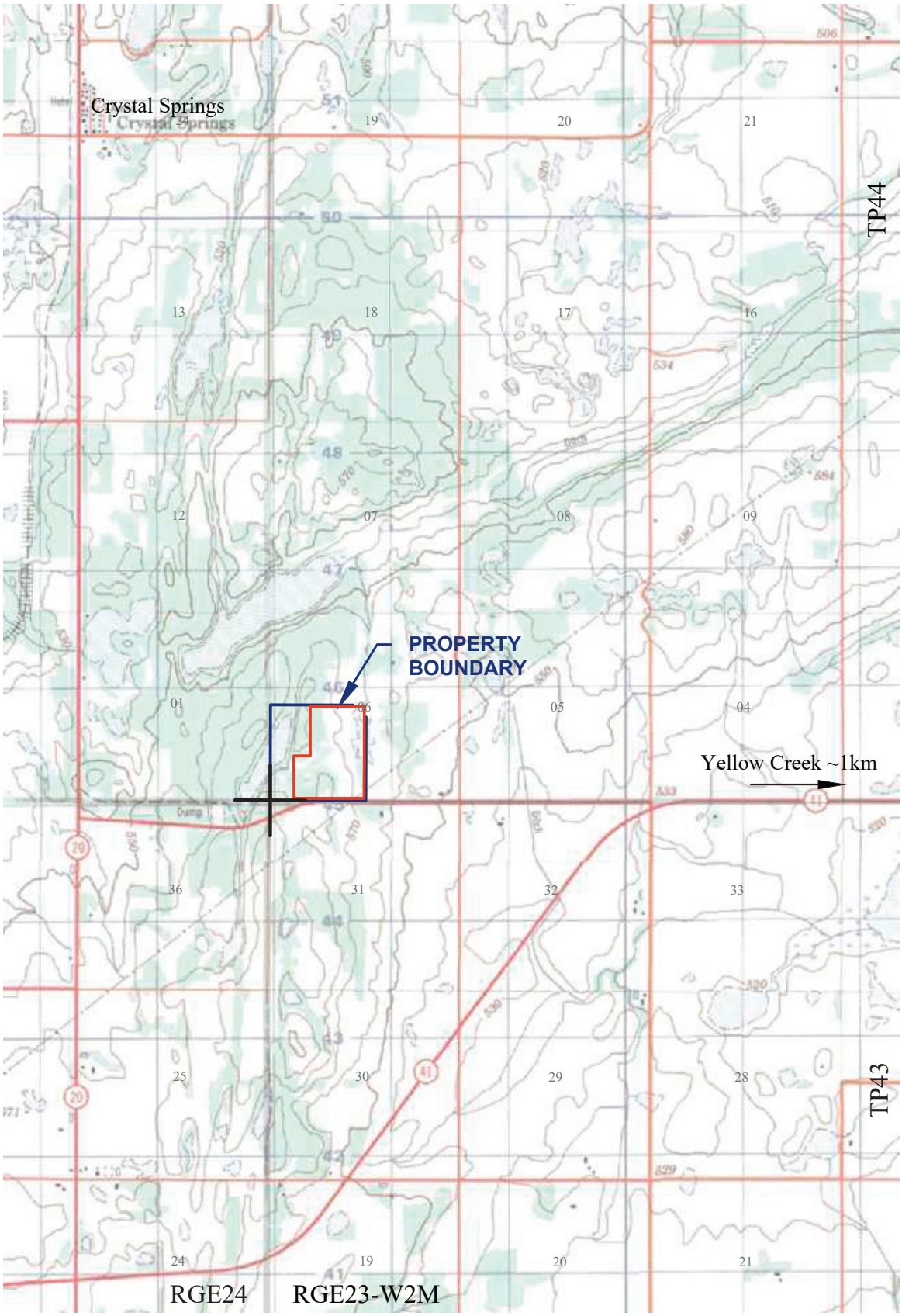
Discipline	Sk. Reg. No.	Signature
Environmental	23846	

DRAWINGS

WaterMark CONSULTING LTD.

X-TERRA Environmental Services Ltd.

WM566.3 Site Plan Feb 2024 EIS.dwg



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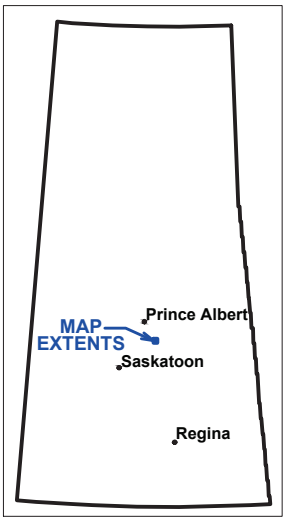

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LEGEND

PROJECT FOOTPRINT

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	AS NOTED	WM566.3	WM566.3-1

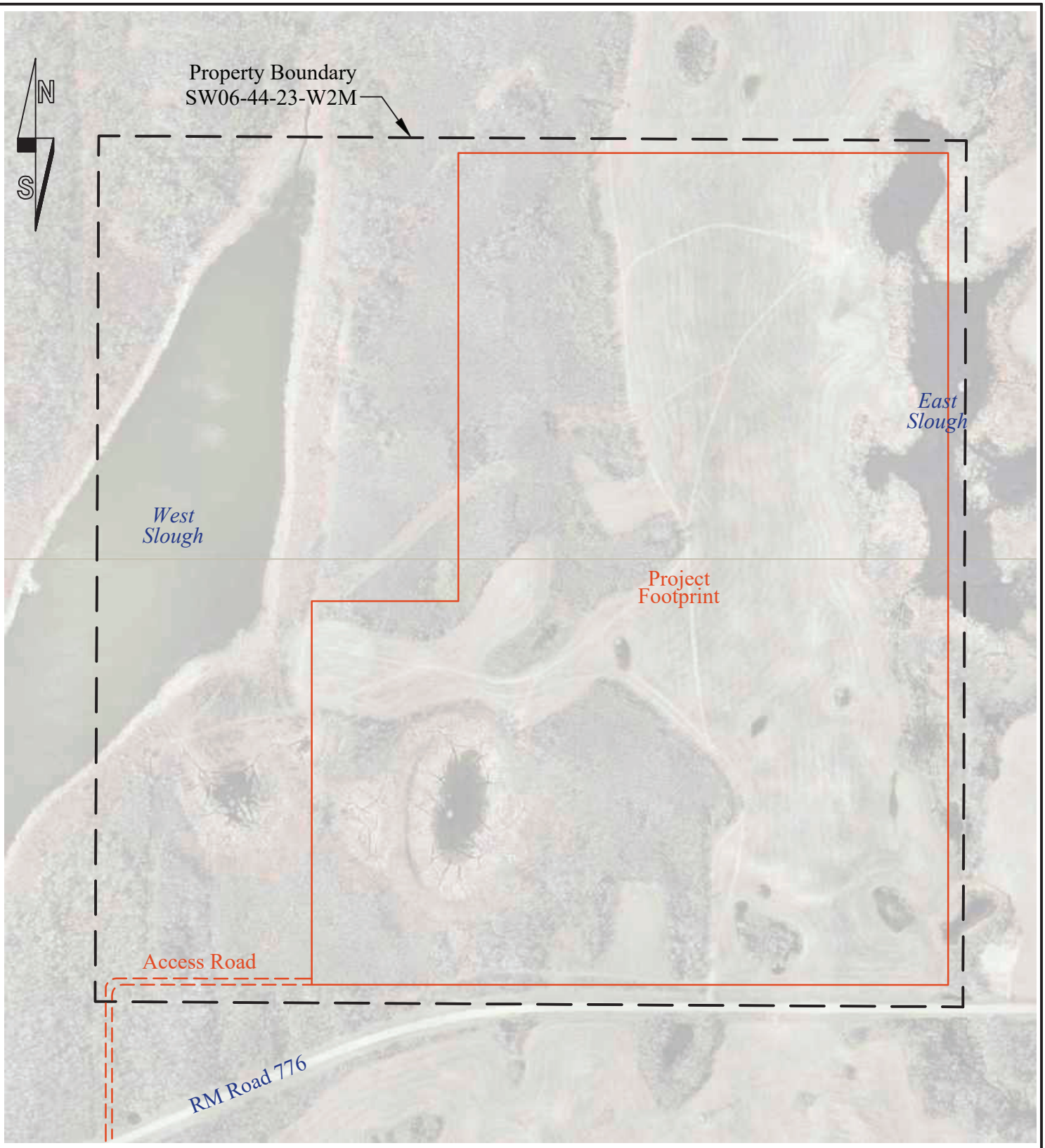
WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: REGIONAL SITE PLAN

WM566.3 Site Plan Feb 2024 EIS.dwg



NOTE: ORTHOIMAGE FROM LIADAR SURVEY

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:5,000	WM566.3	WM566.3-2

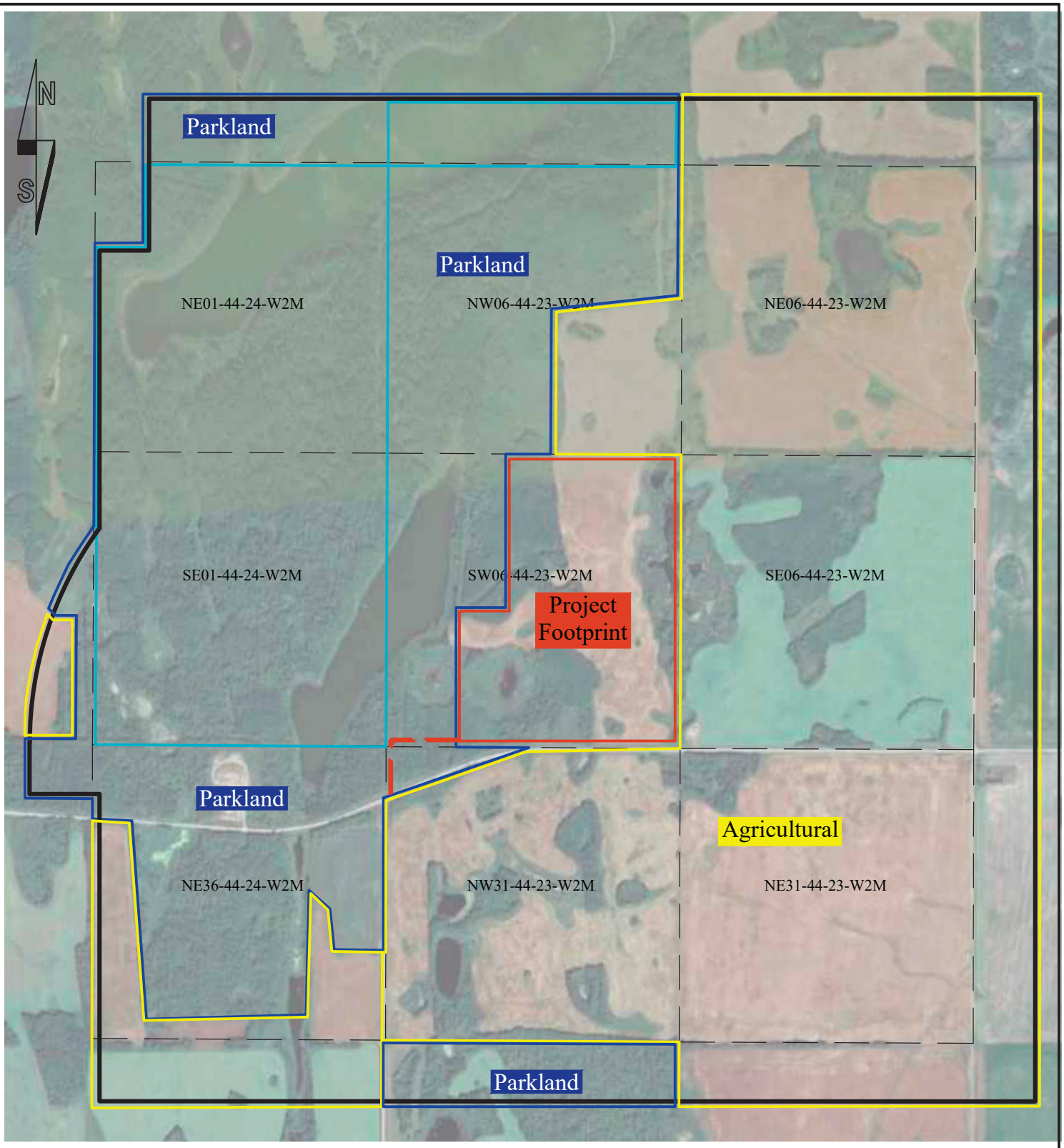
WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: LOCAL SITE PLAN

WM566.3 Site Plan Feb 2024 EIS.dwg



NOTE: IMAGE FROM GOOGLE EARTH

LEGEND

1km BUFFER FROM PROJECT FOOTPRINT

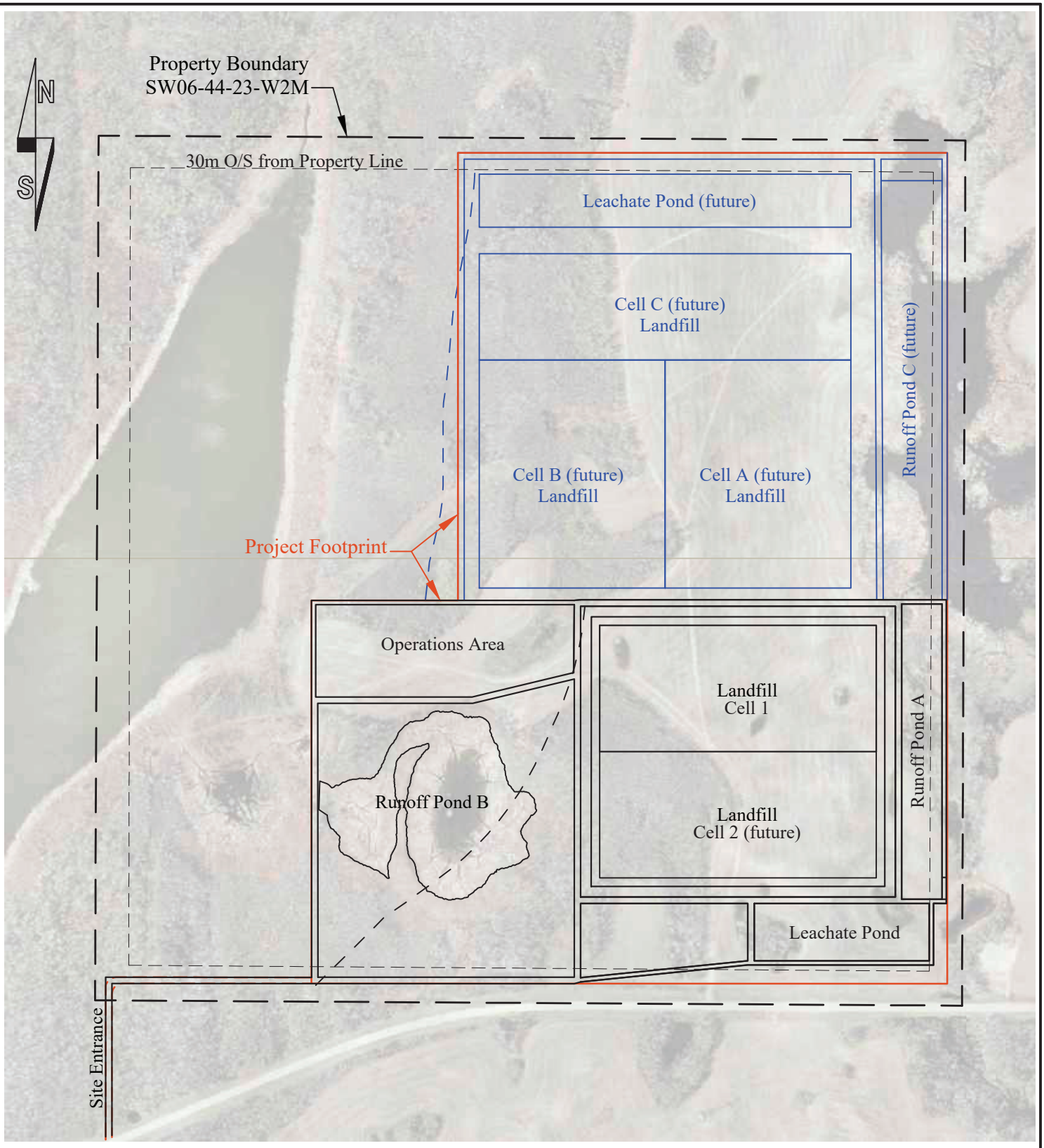
FISH & WILDLIFE DEVELOPMENT FUNDS LANDS

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:15,000	WM566.3	WM566.3-3

WaterMark CONSULTING LTD.

CLIENT:	INVERGORDON LANDFILL INC.
PROJECT:	ENVIRONMENTAL IMPACT ASSESSMENT
TITLE:	EXISTING LAND USE 1KM FROM PROJECT

WM566.3 Site Plan Feb 2024 EIS.dwg



NOTE: ORTHOIMAGE FROM LIADAR SURVEY

LEGEND

- PHASE I
- 300m OFFSET FROM SLOUGH
- PHASE II
- 150m OFFSET FROM SLOUGH

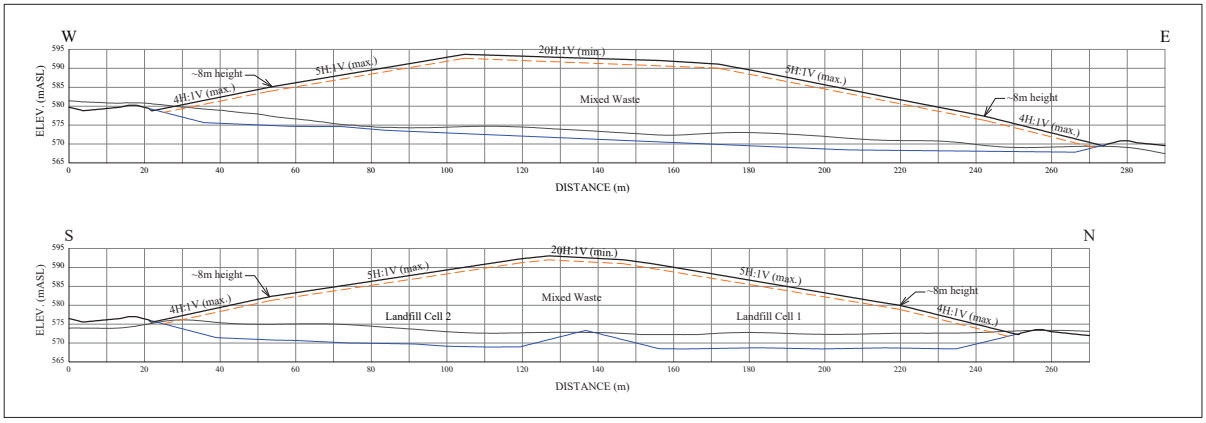
DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:5,000	WM566.3	WM566.3-4

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

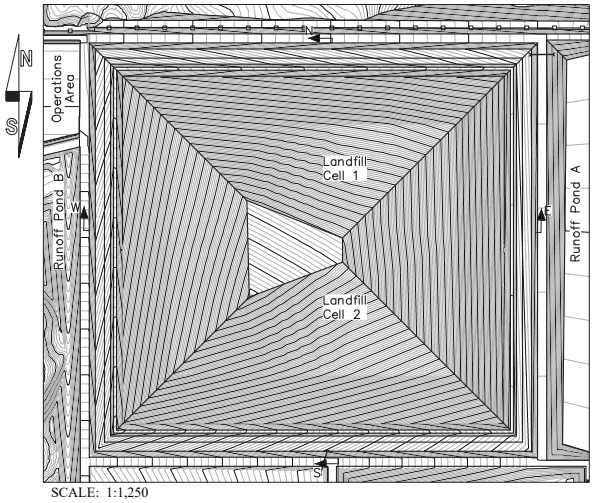
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED SITE LAYOUT



LEGEND

- FINAL ENGINEERED COVER SURFACE
- FINAL WASTE SURFACE
- ENGINEERED LINER SURFACE
- ORIGINAL GROUND



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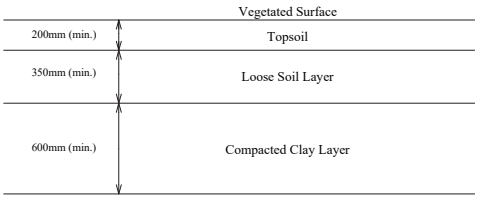
ENGINEERED COVER PROFILE



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LEGEND

—— FINAL MOUND SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.25m)

WaterMark CONSULTING LTD.

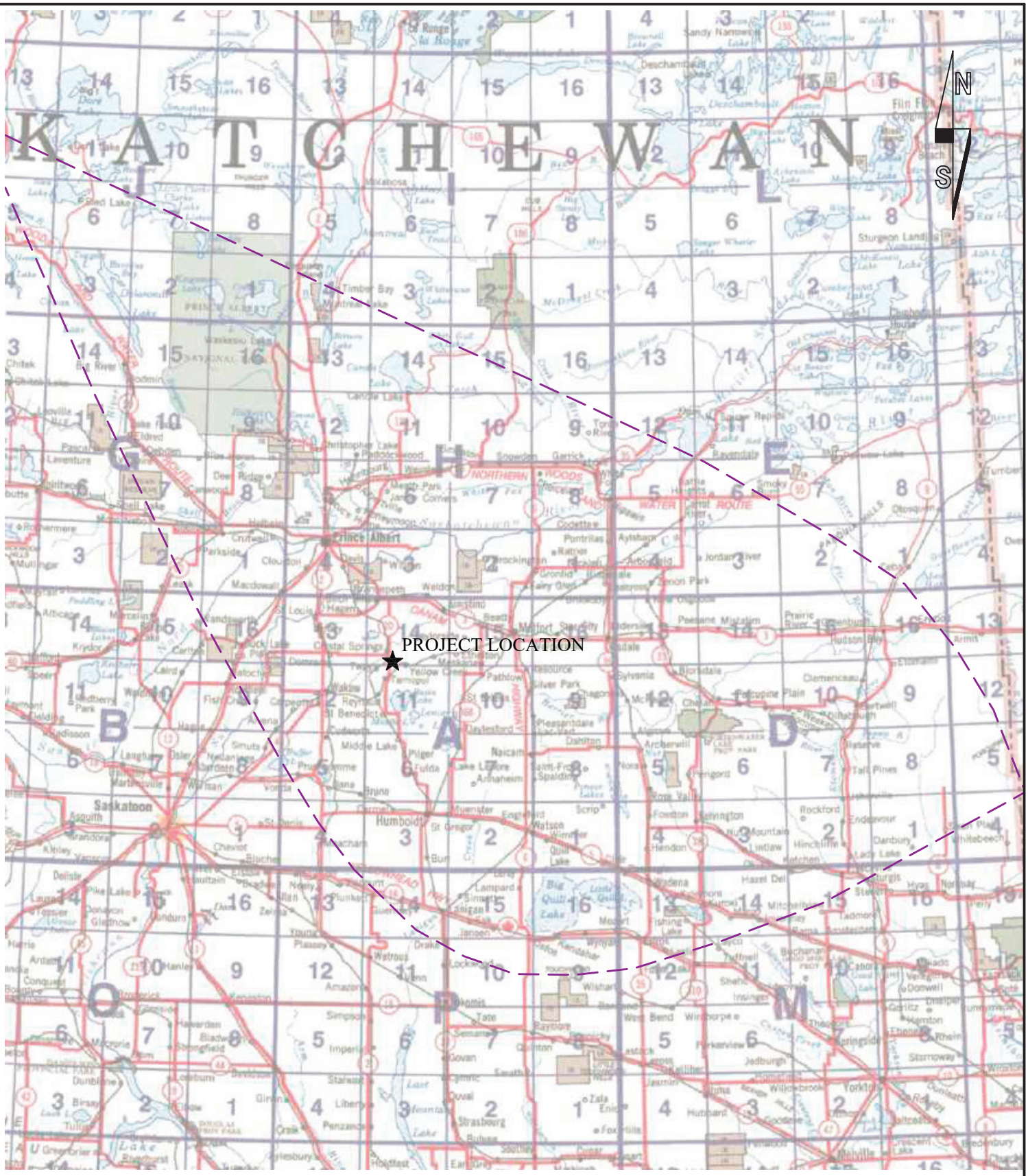
DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
AS NOTED	WM566.3	WM566.3-5

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PHASE I FINAL MOUND TOPOGRAPHIC PLAN

WM566.3 Site Plan Feb 2024 EIS.dwg



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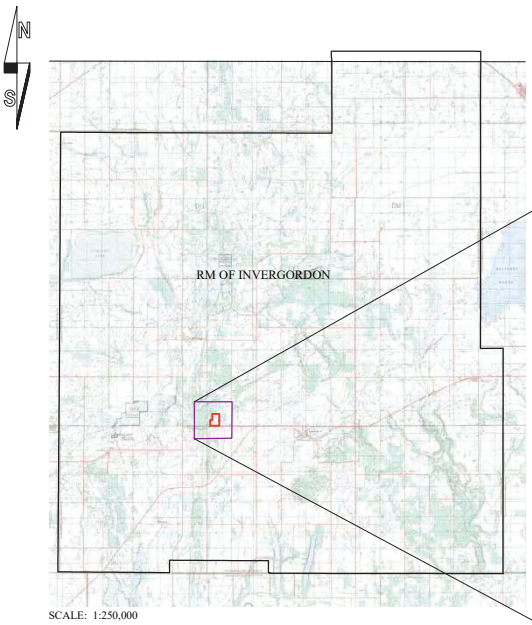
25 NOV 24	WMB	ALG	1:2,000,000	WM566.3	WM566.3-6

WaterMark CONSULTING LTD.

CLIENT:	INVERGORDON LANDFILL INC.
PROJECT:	ENVIRONMENTAL IMPACT ASSESSMENT
TITLE:	GREENLAND WASTE SERVICE AREA (GWSA)



SCALE: 1:250,000

SCALE: 1:15,000

Valued Component (VC)	Local Study Area (LSA)	Symbology
Effect Assessment: Physical Environment		
Groundwater Quality	Neighbouring quarter sections	
Surface Water Quality	Neighbouring quarter sections	
Climate & Air Quality	RM of Invergordon	
Effect Assessment: Ecological Environment		
Wetlands & Aquatic Life	500 m (see Table 4.1 for survey setback distances)	
Terrestrial Habitat && Wildlife	1 km (see Table 4.1 for survey setback distances)	
Vegetation	30 m (see Table 4.1 for survey setback distances)	
Effect Assessment: Human Environment		
Human Health & Wellbeing	RM of Invergordon	
Socioeconomics	RM of Invergordon	
Heritage Resources	PSA	
Economic Viability of Neighbouring SWM Facilities	GWSA	See Drawing WM566.2-3

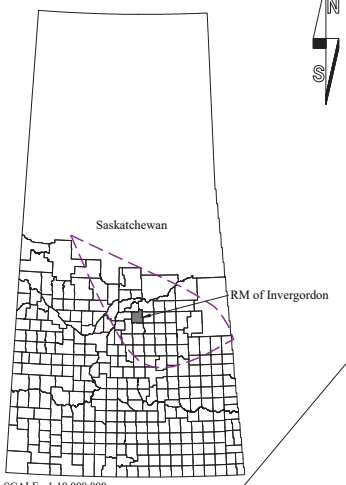
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
AS NOTED	WM566.3	WM566.3-7

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: LOCAL STUDY AREAS (LSA)



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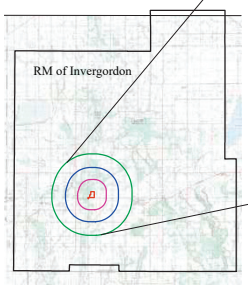

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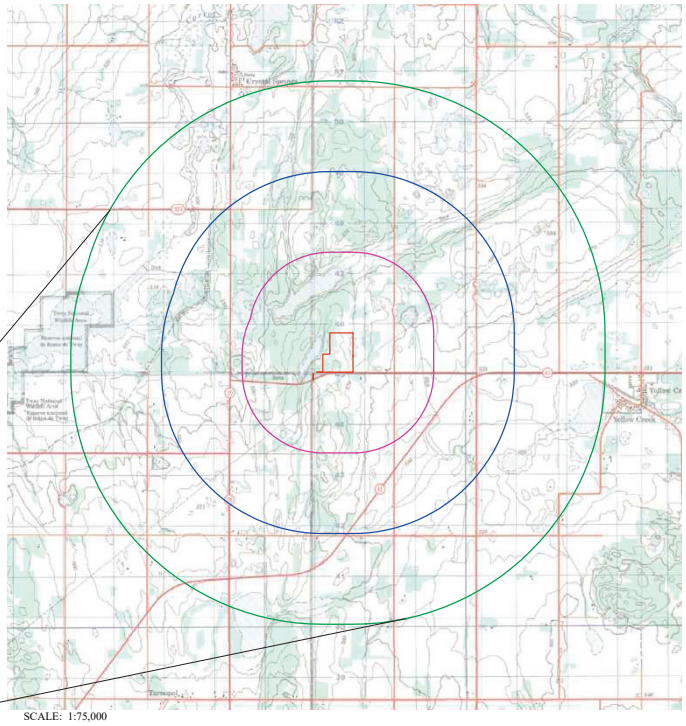

SCALE: 1:75,000

Valued Component (VC)	Regional Study Area (RSA)	Symbology
Effect Assessment: Physical Environment		
Groundwater Quality	3.2 km	
Surface Water Quality	1.6 km	
Climate & Air Quality	GWSA	
Effect Assessment: Ecological Environment		
Wetlands & Aquatic Life	5 km	
Terrestrial Habitat && Wildlife	5 km	
Vegetation	5 km	
Effect Assessment: Human Environment		
Human Health & Wellbeing	GWSA	
Socioeconomics	GWSA	
Heritage Resources	PSA	
Economic Viability of Neighbouring SWM Facilities	Province of Saskatchewan	

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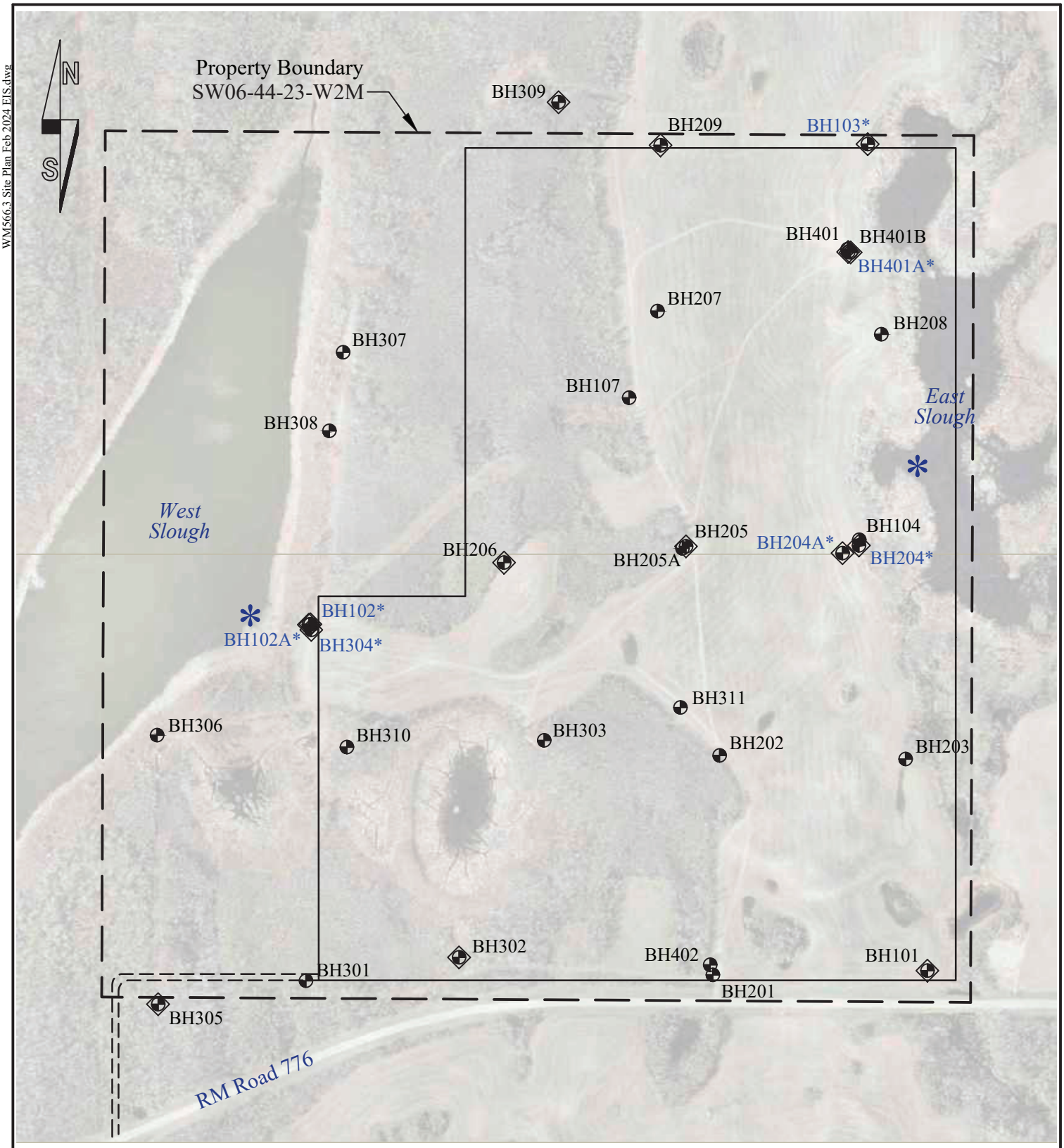
DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
AS NOTED	WM566.3	WM566.3-8

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: REGIONAL STUDY AREAS (RSA)

WM566.3 Site Plan Feb 2024 EIS.dwg



NOTE: ORTHOIMAGE FROM LIADAR SURVEY

LEGEND

- BOREHOLE LOCATION
- PIEZOMETER LOCATION
- BH102* GROUNDWATER SAMPLE LOCATION
- SURFACE WATER SAMPLE LOCATION

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:5,000	WM566.3	WM566.3-9

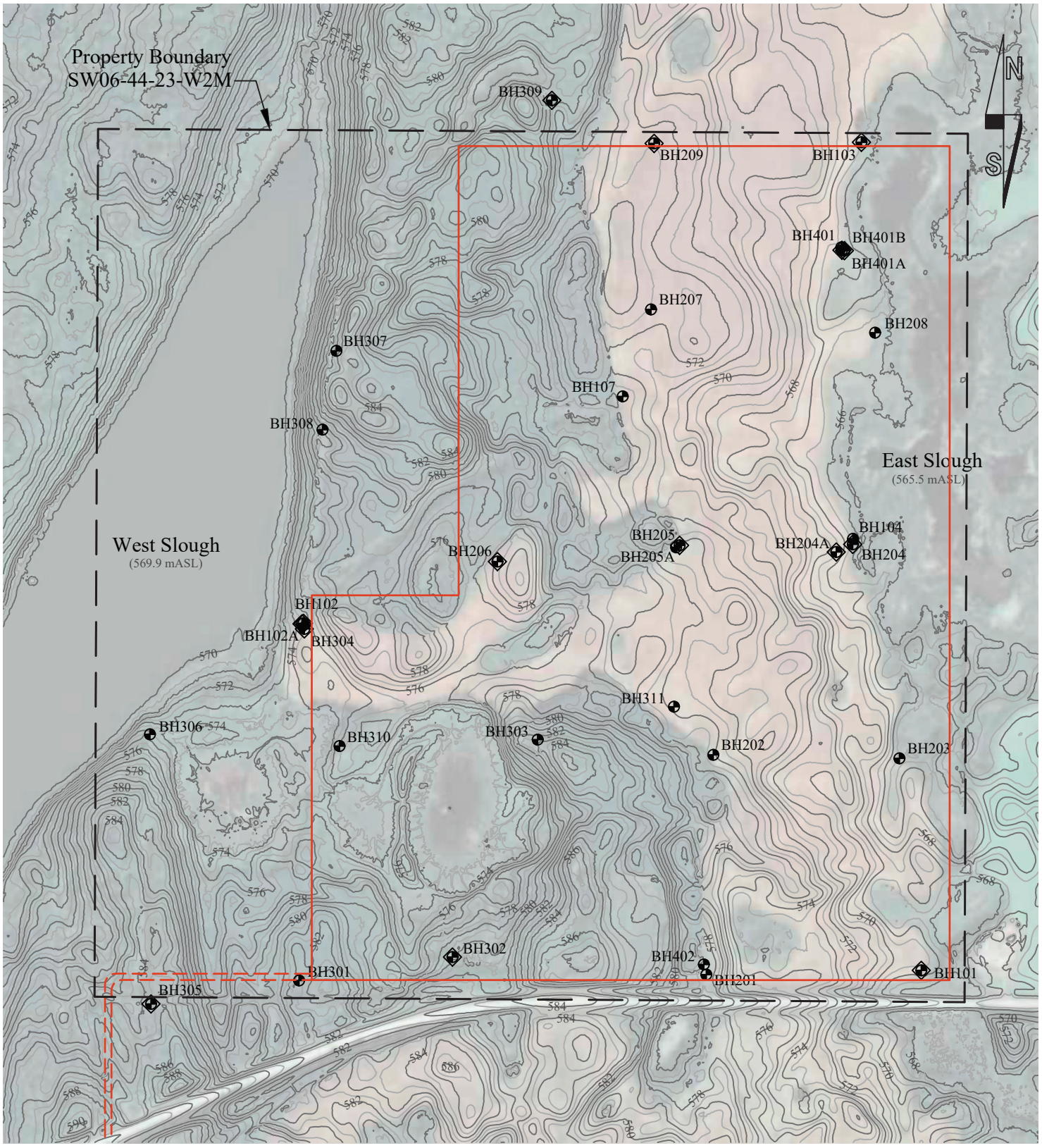
WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PHYSICAL ENVIRONMENTAL FIELD INVESTIGATION

WM566.3 Site Plan Feb 2024 EIS.dwg



NOTE: ORTHOIMAGE FROM LIADAR SURVEY

LEGEND

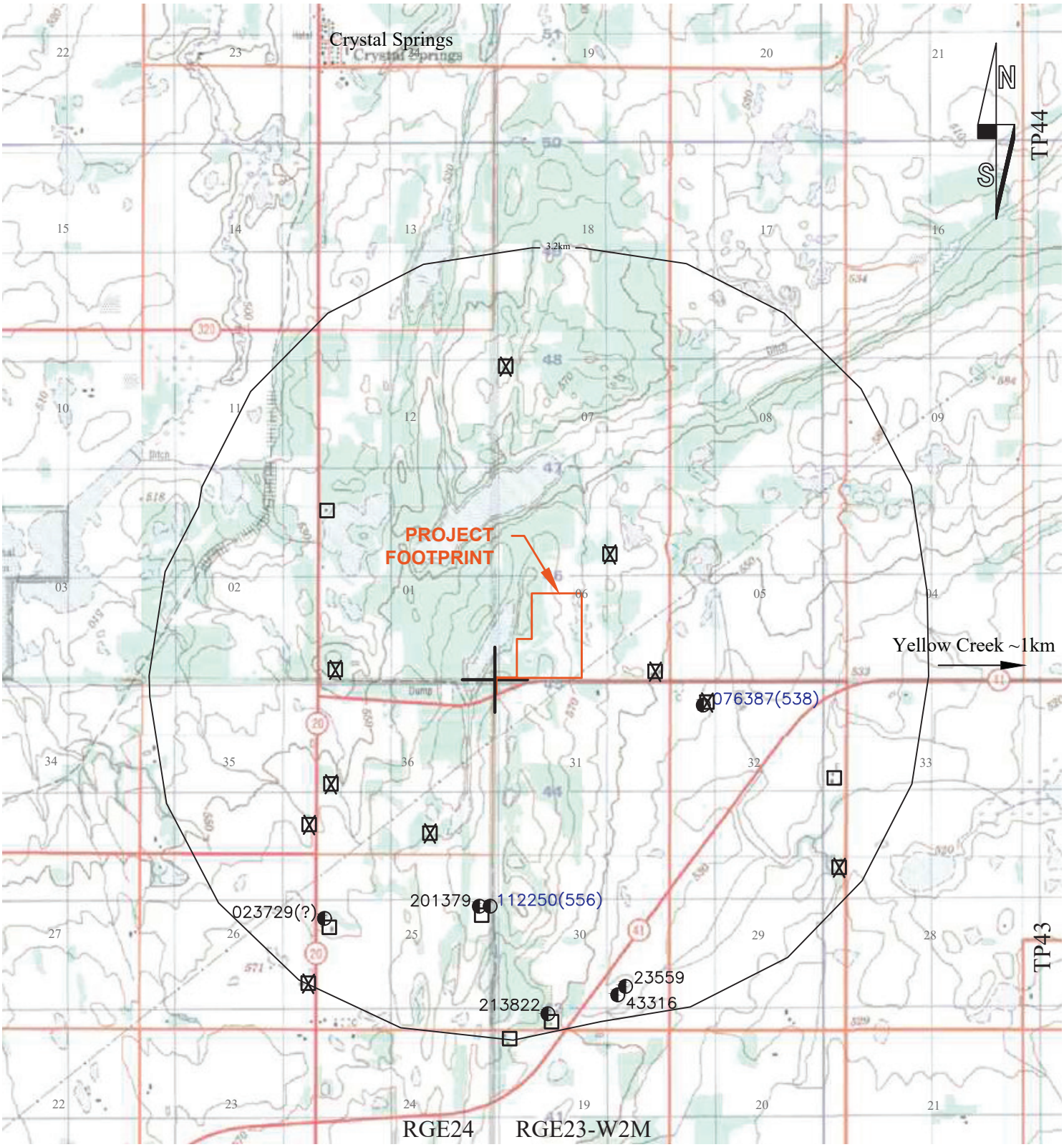
- BOREHOLE LOCATION
- PIEZOMETER LOCATION
- GROUND TOPOGRAPHY (C.I.=0.5m)

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:5,000	WM566.3	WM566.3-10

WaterMark CONSULTING LTD.

CLIENT:	INVERGORDON LANDFILL INC.
PROJECT:	ENVIRONMENTAL IMPACT ASSESSMENT
TITLE:	EXISTING SITE TOPOGRAPHY

WM566.3 Site Plan Feb 2024.dwg



LEGEND

- PRIVATE WELL LOCATION
- WWDR#(piezo level mASL) MIDDLE FLORAL AQUIFER
- WWDR# SHALLOW SAND AQUIFER
- EXISTING YARDSITE
- VACANT YARDSITE

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:50,000	WM566.3	WM566.3-11

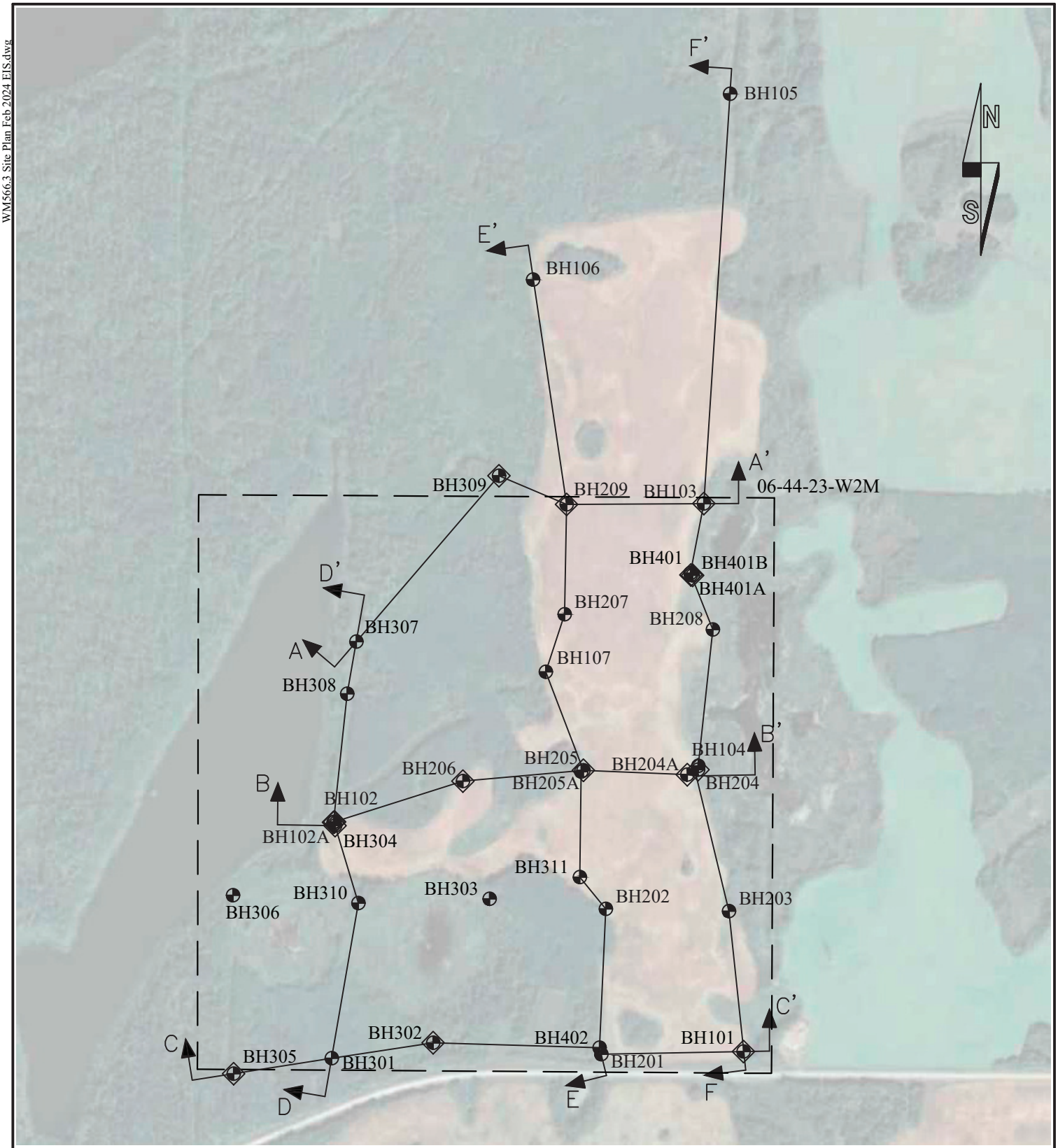
WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIROMENTAL IMPACT ASSESSMENT

TITLE: NEIGHBOURING PRIVATE WELLS

WM566.3 Site Plan Feb 2024 EIS.dwg



NOTE: AIRPHOTO FROM GOOGLE EARTH

LEGEND

- BOREHOLE LOCATION
- PIEZOMETER LOCATION

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:7,500	WM566.3	WM566.3-12

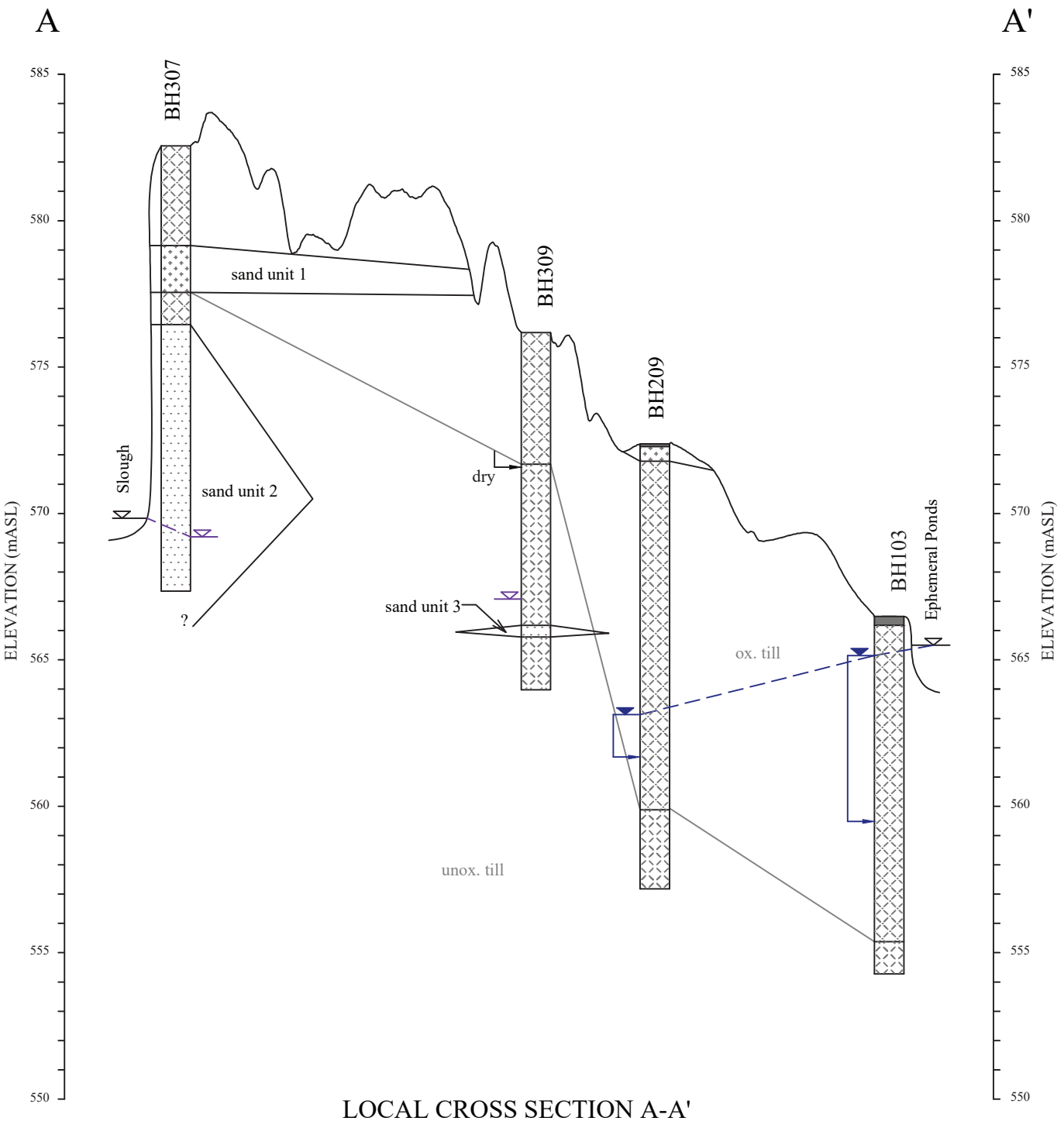
WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: LOCAL CROSS SECTION PLAN

WM566.3 Site Plan Feb 2024 EIS.dwg



LOCAL CROSS SECTION A-A'

HORIZONTAL SCALE: 1:5,000
VERTICAL SCALE: 1:200

LEGEND

- PIEZOMETER WATER LEVEL
- OPEN HOLE WATER LEVEL
- OXIDIZED TILL
- UNOXIDIZED TILL
- SILT/SAND

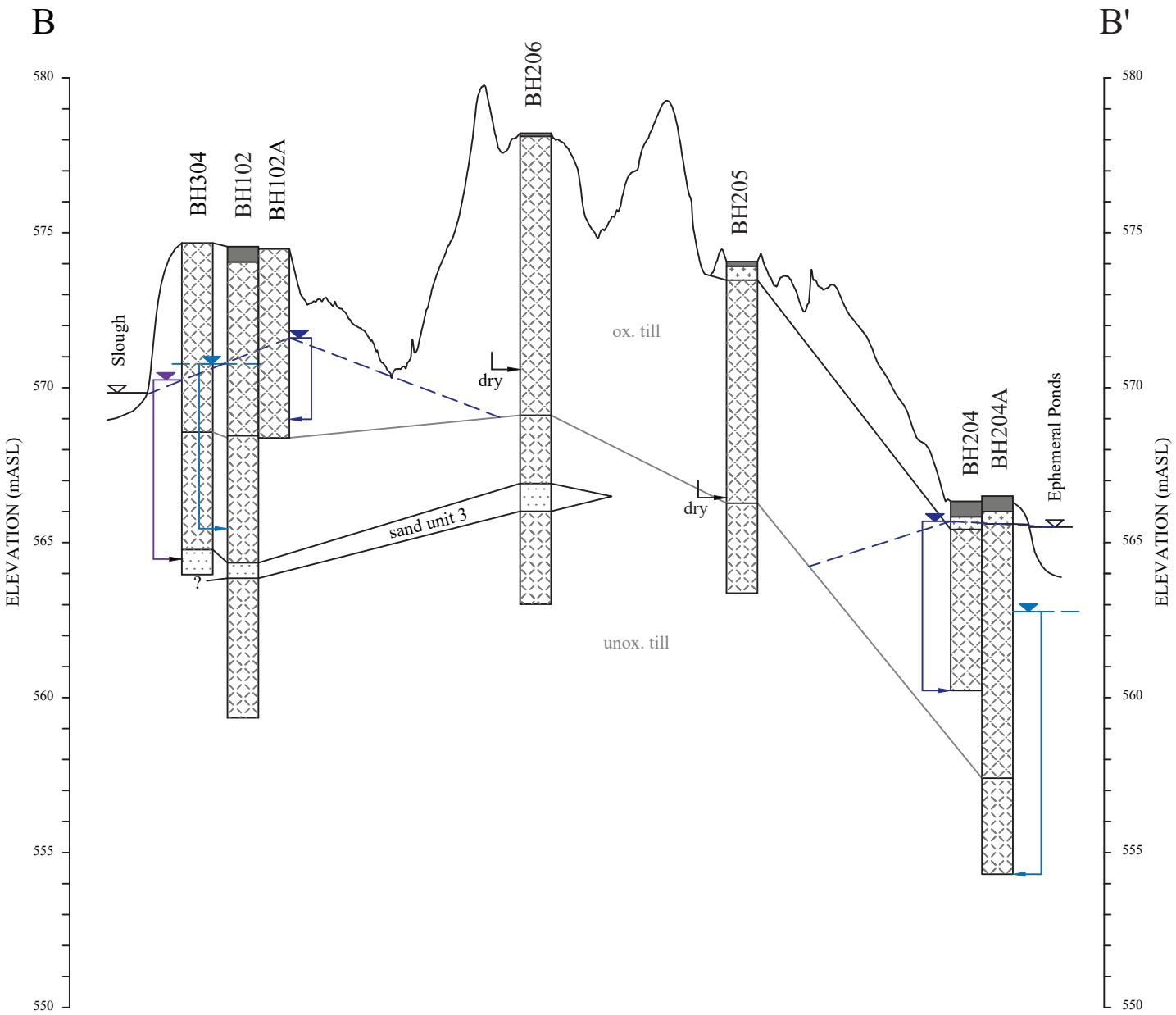
NOTE: CONTACTS BETWEEN GEOLOGIC UNITS HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BOUNDARIES HAVE BEEN INTERPRETED FROM GEOLOGIC EVIDENCE AND MAY BE SUBJECT TO ERROR BETWEEN BORE HOLES.

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	AS NOTED	WM566.3	WM566.3-13

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT
TITLE: LOCAL CROSS SECTION A-A'

WM566.3 Site Plan Feb 2024 EIS.dwg



LOCAL CROSS SECTION B-B'

HORIZONTAL SCALE: 1:5,000
VERTICAL SCALE: 1:200

LEGEND

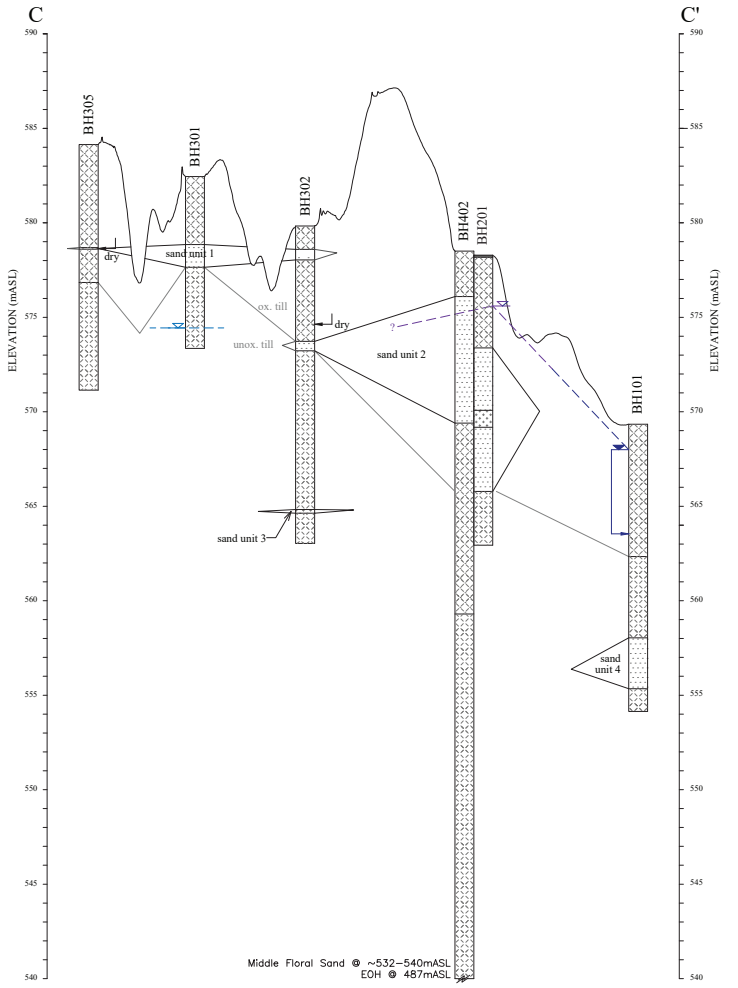
- PIEZOMETER WATER LEVEL
- OPEN HOLE WATER LEVEL
- OXIDIZED TILL
- UNOXIDIZED TILL
- SILT/SAND

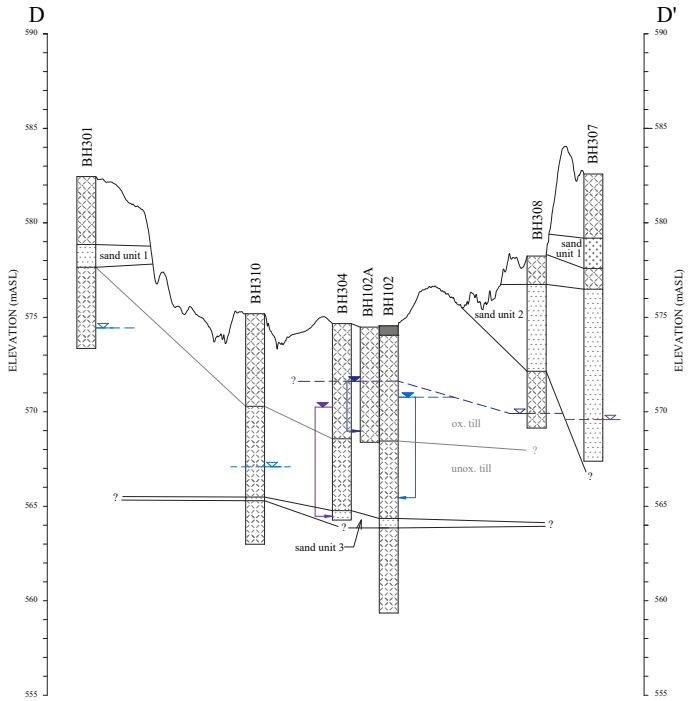
NOTE: CONTACTS BETWEEN GEOLOGIC UNITS HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BOUNDARIES HAVE BEEN INTERPRETED FROM GEOLOGIC EVIDENCE AND MAY BE SUBJECT TO ERROR BETWEEN BORE HOLES.

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	AS NOTED	WM566.3	WM566.3-14

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT
TITLE: LOCAL CROSS SECTION B-B'





LOCAL CROSS SECTIONS C-C' & D-D'

HORIZONTAL SCALE: 1:5,000
VERTICAL SCALE: 1:200

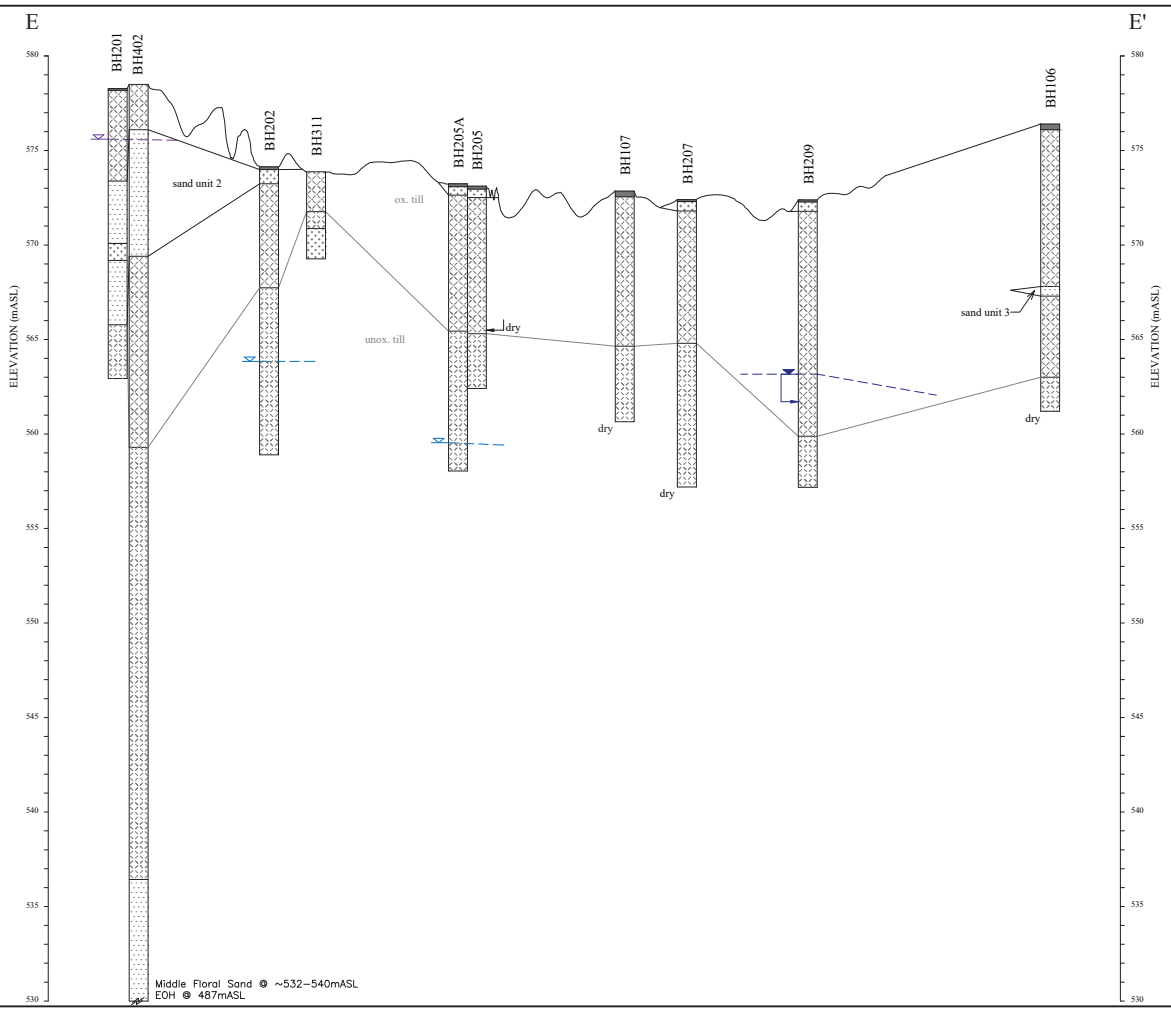
LEGEND
- PIEZOMETER WATER LEVEL
- OPEN HOLE WATER LEVEL
- OXIDIZED TILL
- UNOXIDIZED TILL
- SILT/SAND

NOTE: CONTACTS BETWEEN GEOLOGIC UNITS HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BOUNDARIES HAVE BEEN INTERPRETED FROM GEOLOGIC EVIDENCE AND MAY BE SUBJECT TO ERROR BETWEEN BORE HOLES.

WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE: AS NOTED	FILE NO: WM566.3	DRAWING NO: WM566.3-15

CLIENT: INVERGORDON LANDFILL INC.
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT
TITLE: LOCAL CROSS SECTIONS C-C' & D-D'



LOCAL CROSS SECTION E-E'
HORIZONTAL SCALE: 1:5,000
VERTICAL SCALE: 1:200

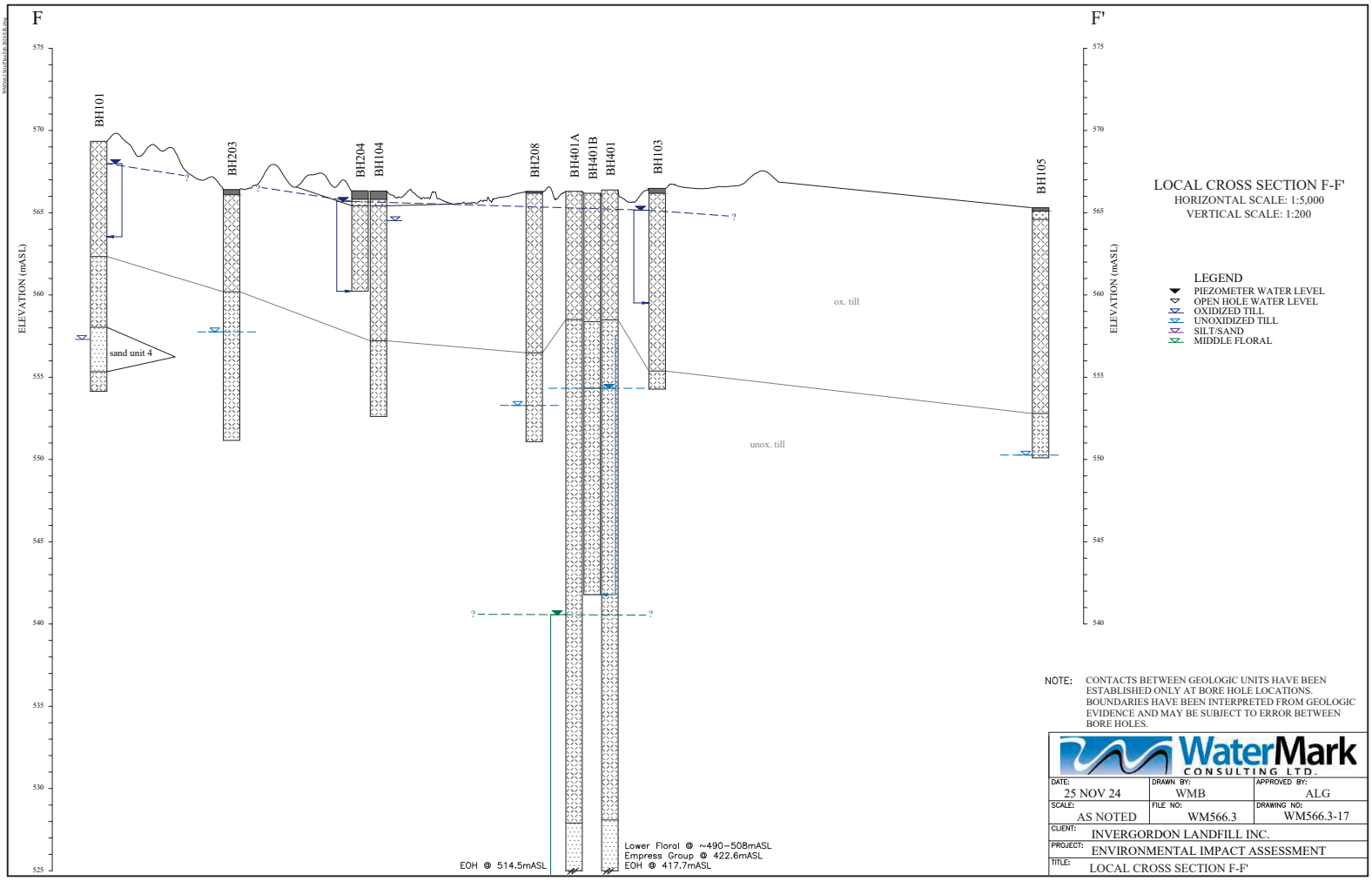
LEGEND
- PIEZOMETER WATER LEVEL
- OPEN HOLE WATER LEVEL
- OXIDIZED TILL
- UNOXIDIZED TILL
- SILT/SAND

NOTE: CONTACTS BETWEEN GEOLOGIC UNITS HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BOUNDARIES HAVE BEEN INTERPRETED FROM GEOLOGIC EVIDENCE AND MAY BE SUBJECT TO ERROR BETWEEN BORE HOLES.

WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
AS NOTED	WM566.3	WM566.3-16

CLIENT: INVERGORDON LANDFILL INC.
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT
TITLE: LOCAL CROSS SECTION E-E'



LOCAL CROSS SECTION F-F'

HORIZONTAL SCALE: 1:5,000

VERTICAL SCALE: 1:200

LEGEND

- PIEZOMETER WATER LEVEL
- OPEN HOLE WATER LEVEL
- OXIDIZED TILL
- UNOXIDIZED TILL
- SILT/SAND
- MIDDLE FLORAL

NOTE: CONTACTS BETWEEN GEOLOGIC UNITS HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BOUNDARIES HAVE BEEN INTERPRETED FROM GEOLOGIC EVIDENCE AND MAY BE SUBJECT TO ERROR BETWEEN BORE HOLES.

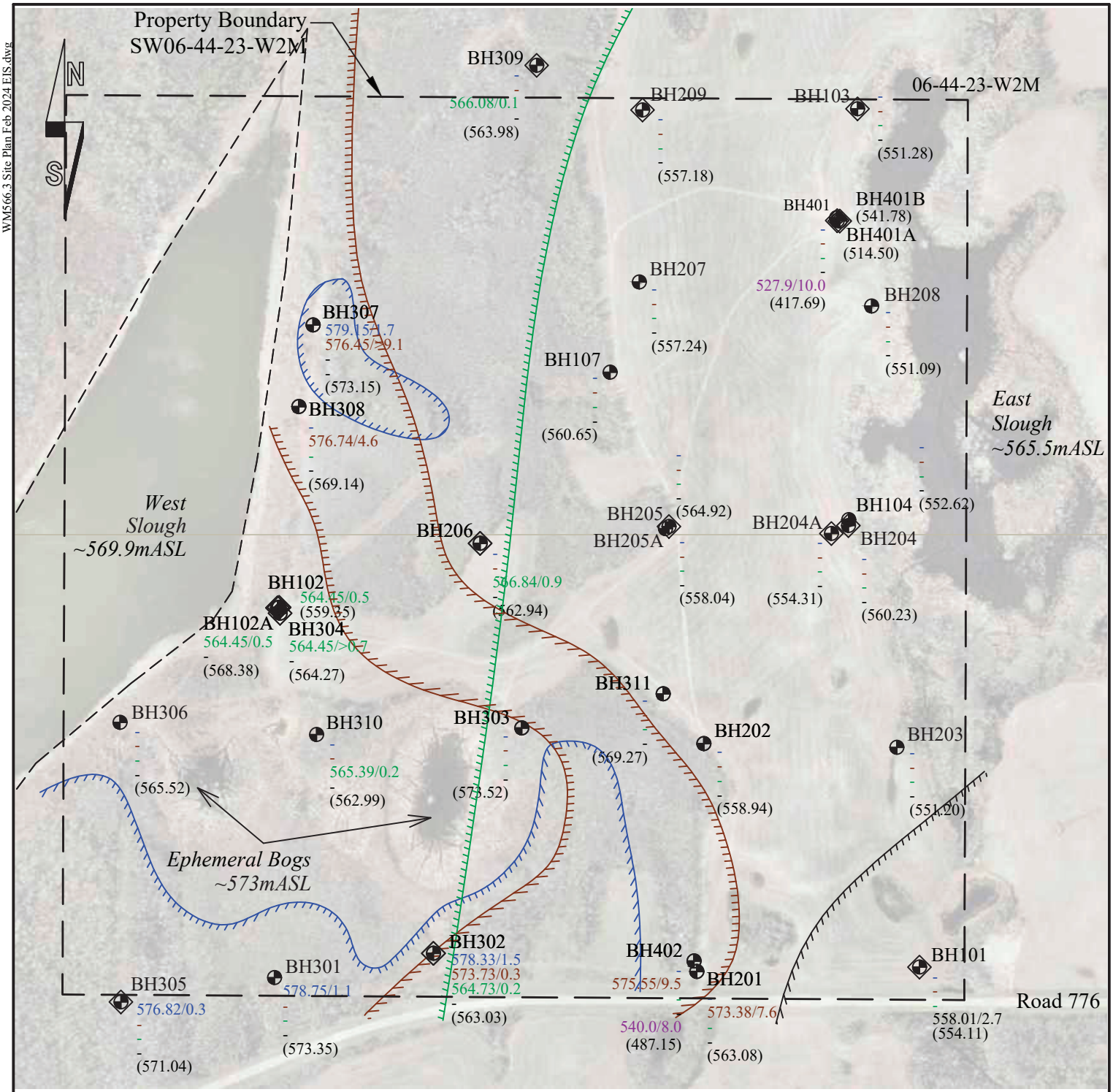
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
AS NOTED	WM566.3	WM566.3-17

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: LOCAL CROSS SECTION F-F'



NOTE: ORTHOIMAGE FROM LIADAR SURVEY

LEGEND

BOREHOLE LOCATION	
PIEZOMETER LOCATION	
576.82/0.3	ELEV. / THICKNESS - SAND UNIT 1 (m)
573.73/0.3	ELEV. / THICKNESS - SAND UNIT 2 (m)
565.39/0.2	ELEV. / THICKNESS - SAND UNIT 3 (m)
558.01/2.7	ELEV. / THICKNESS - SAND UNIT 4 (m)
527.9/10	ELEV. / THICKNESS - FLORAL AQUIFER (m)
(568.38)	BOTTOM OF BOREHOLE (m)
-	NOT PRESENT

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:5,000	WM566.3	WM566.3-18

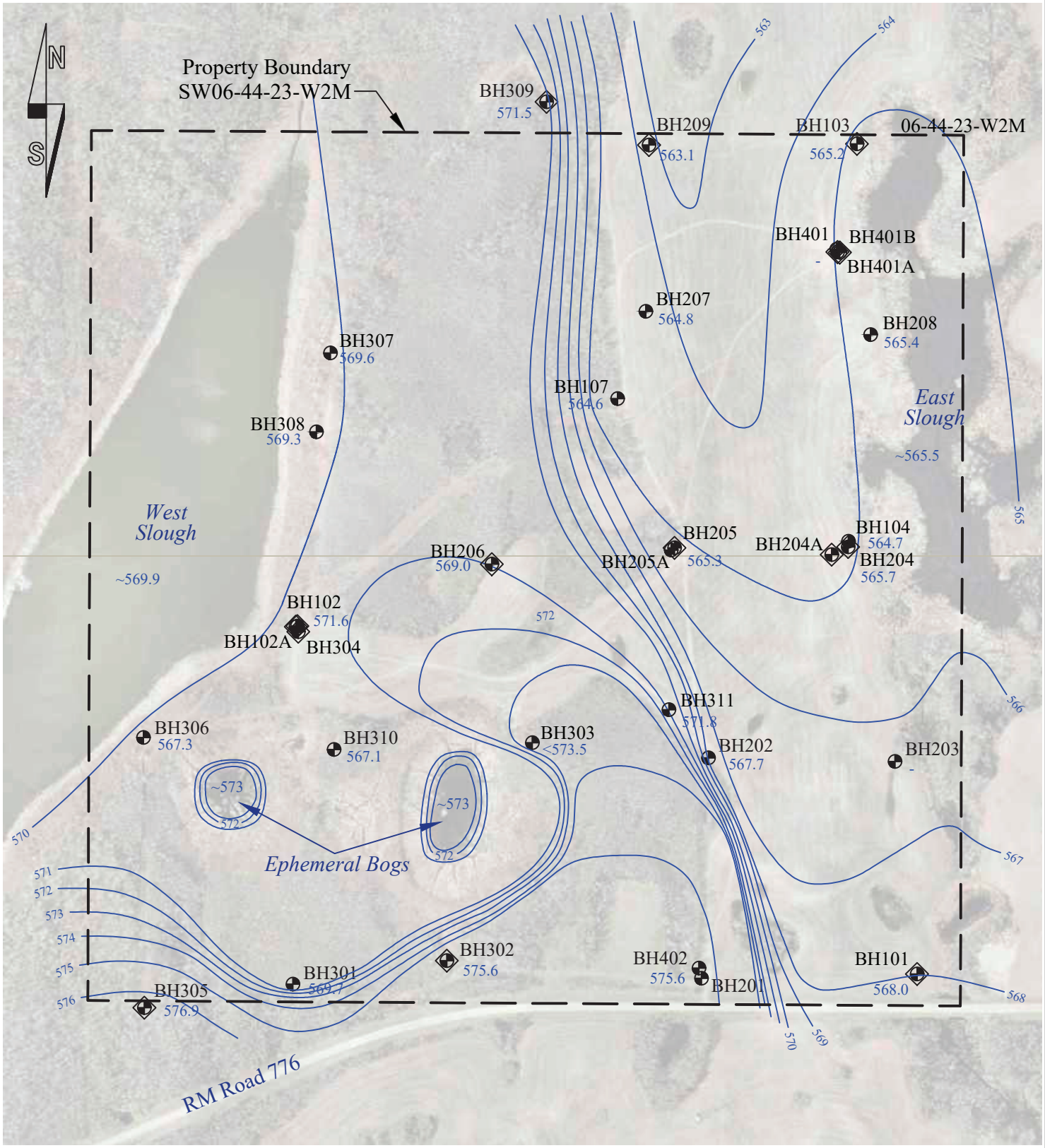
WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: SAND DISTRIBUTION PLAN

WM566.3 Site Plan Feb 2024 EIS.dwg



NOTE: ORTHOIMAGE FROM LIADAR SURVEY

LEGEND

- BOREHOLE LOCATION
- PIEZOMETER LOCATION
- 569.7 PHREATIC POINT ELEVATION (mASL)
- PHREATIC SURFACE CONTOUR (C.I.=1.0m)

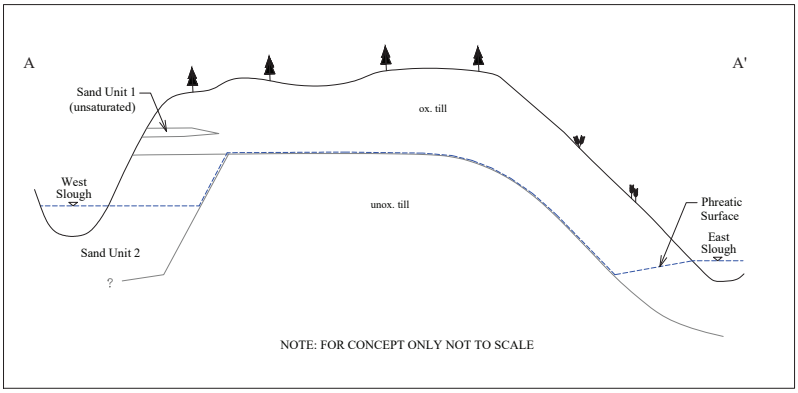
DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:5,000	WM566.3	WM566.3-19

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

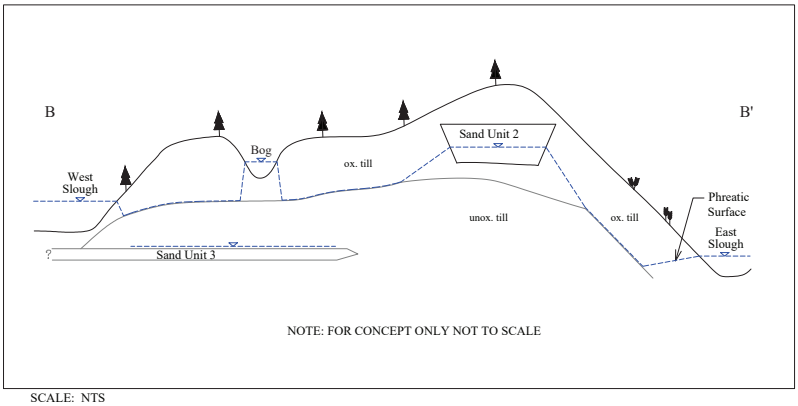
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: EXISTING PHREATIC SURFACE



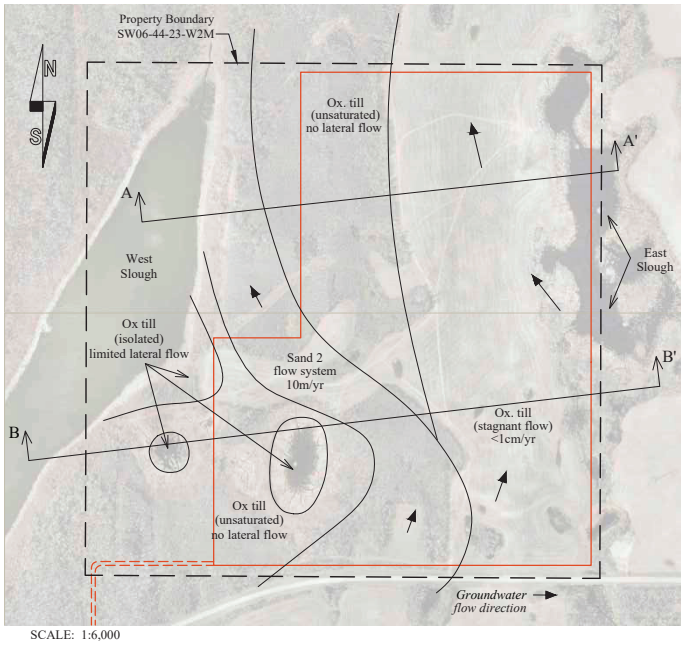
NOTE: FOR CONCEPT ONLY NOT TO SCALE

SCALE: NTS



NOTE: FOR CONCEPT ONLY NOT TO SCALE

SCALE: NTS



SCALE: 1:6,000

LEGEND

PROJECT FOOTPRINT

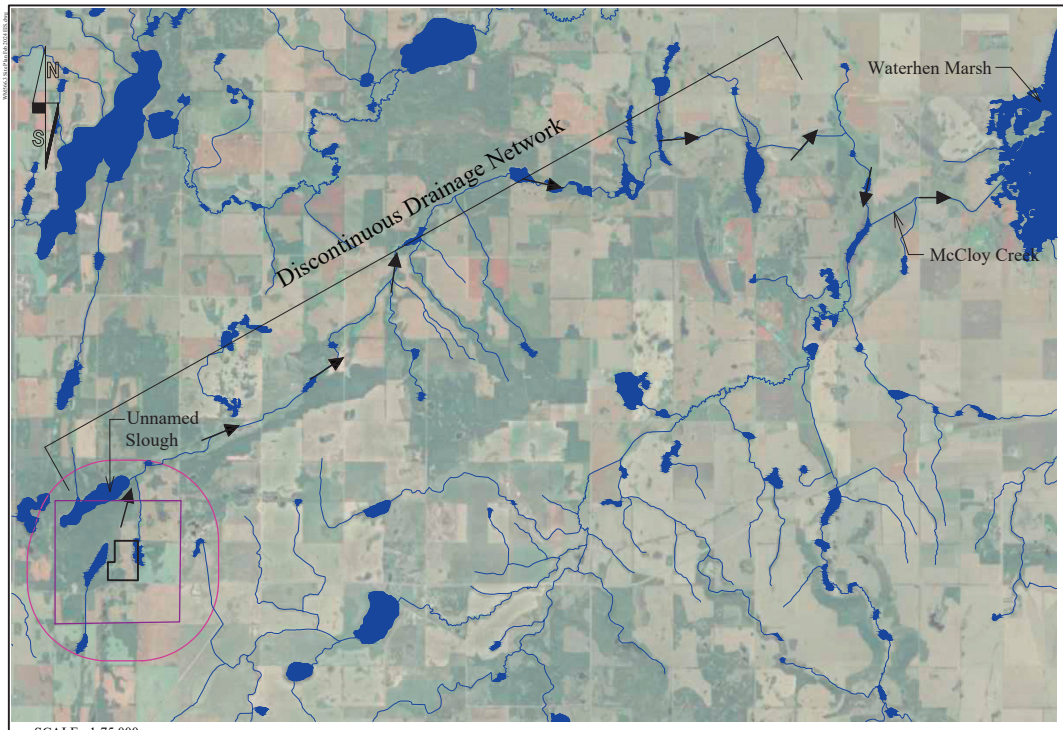
WaterMark CONSULTING LTD.

DATE: 25 NOV 24	DRAWN BY: WMB	APPROVED BY: ALG
SCALE: AS NOTED	FILE NO: WM566.3	DRAWING NO: WM566.3-20

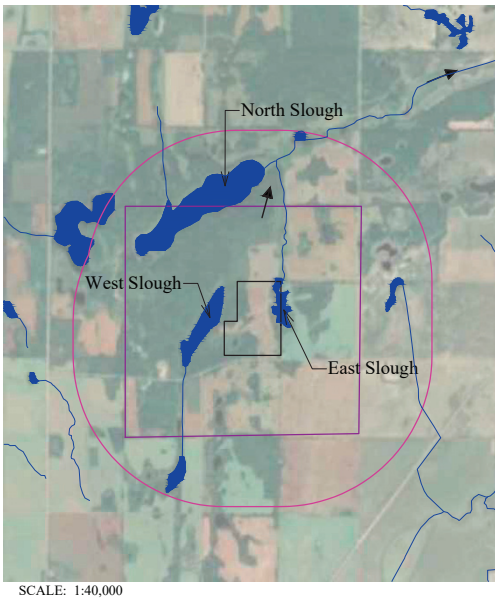
CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: CONCEPTUAL SITE MODEL



SCALE: 1:75,000



SCALE: 1:40,000

LEGEND

- PROJECT FOOTPRINT
- GENERAL DRAINAGE DIRECTION
- REGIONAL STUDY AREA - SURFACE WATER QUALITY
- LOCAL STUDY AREA - SURFACE WATER QUALITY

WaterMark CONSULTING LTD.

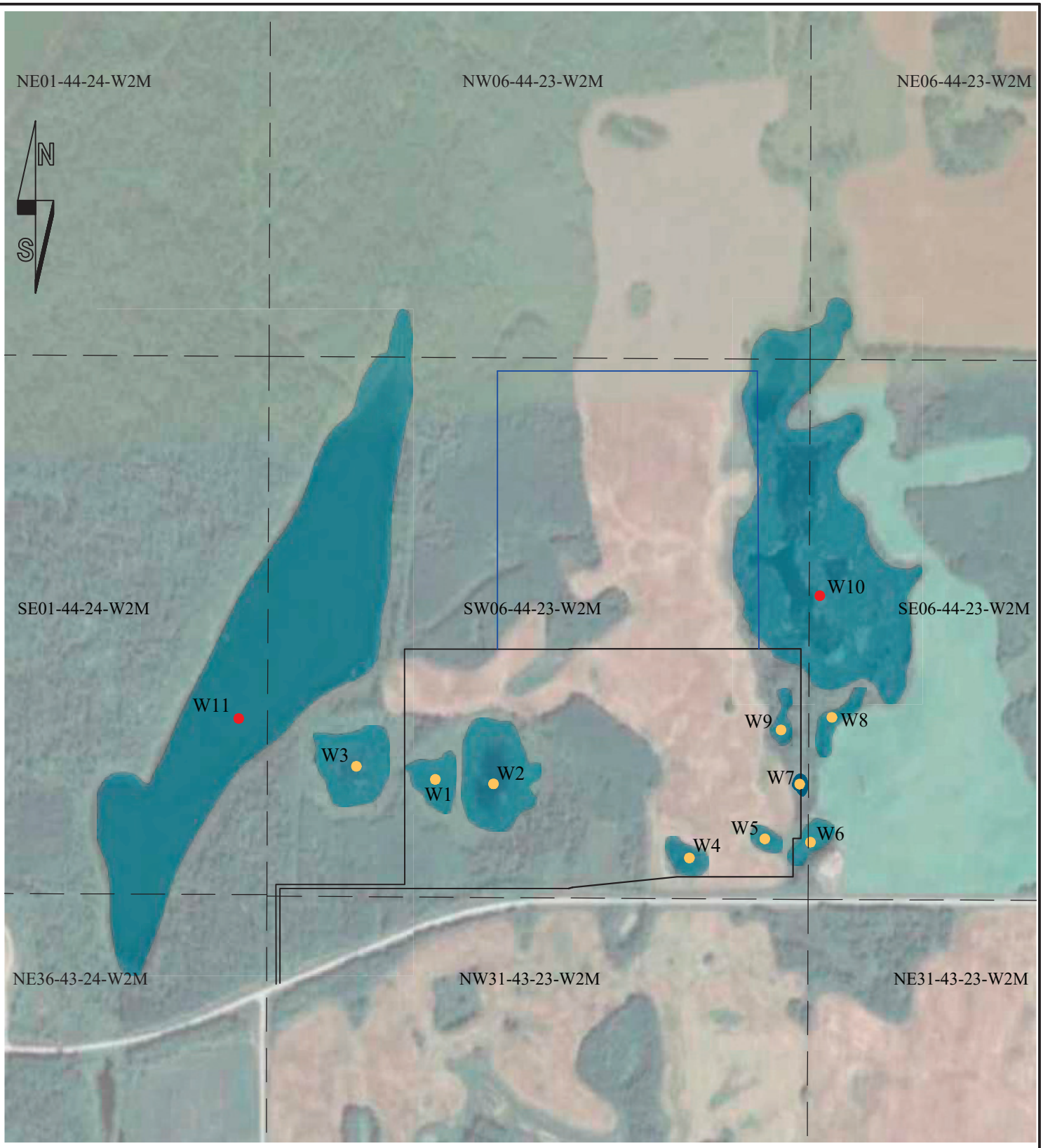
DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
AS NOTED	WM566.3	WM566.3-21

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: REGIONAL DRAINAGE FEATURES

WM566.3 Site Plan Feb 2024 EIS.dwg



NOTE: IMAGE FROM GOOGLE EARTH

LEGEND

- PHASE I
- PHASE II
- WETLAND BOUNDARY
- CLASS III
- CLASS V

X-TERRA Environmental Services Ltd.

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:8,000	WM566.3	WM566.3-22

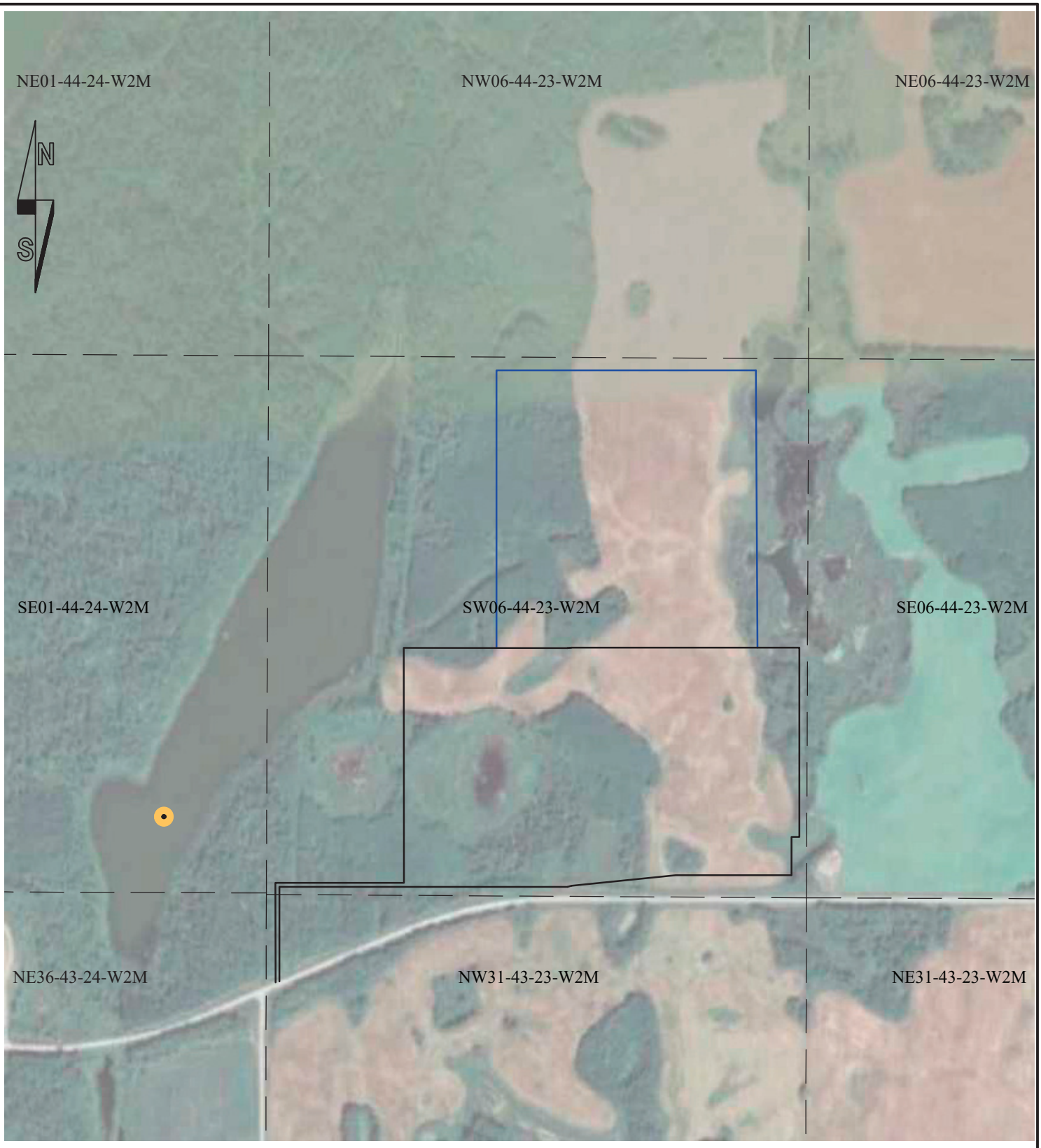
WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: WETLANDS

WM566.3 Site Plan Feb 2024 EIS.dwg



NOTE: IMAGE FROM GOOGLE EARTH

LEGEND

- PHASE I
- PHASE II
- COMMON NIGHTHAWK

X-TERRA Environmental Services Ltd.

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:8,000	WM566.3	WM566.3-23

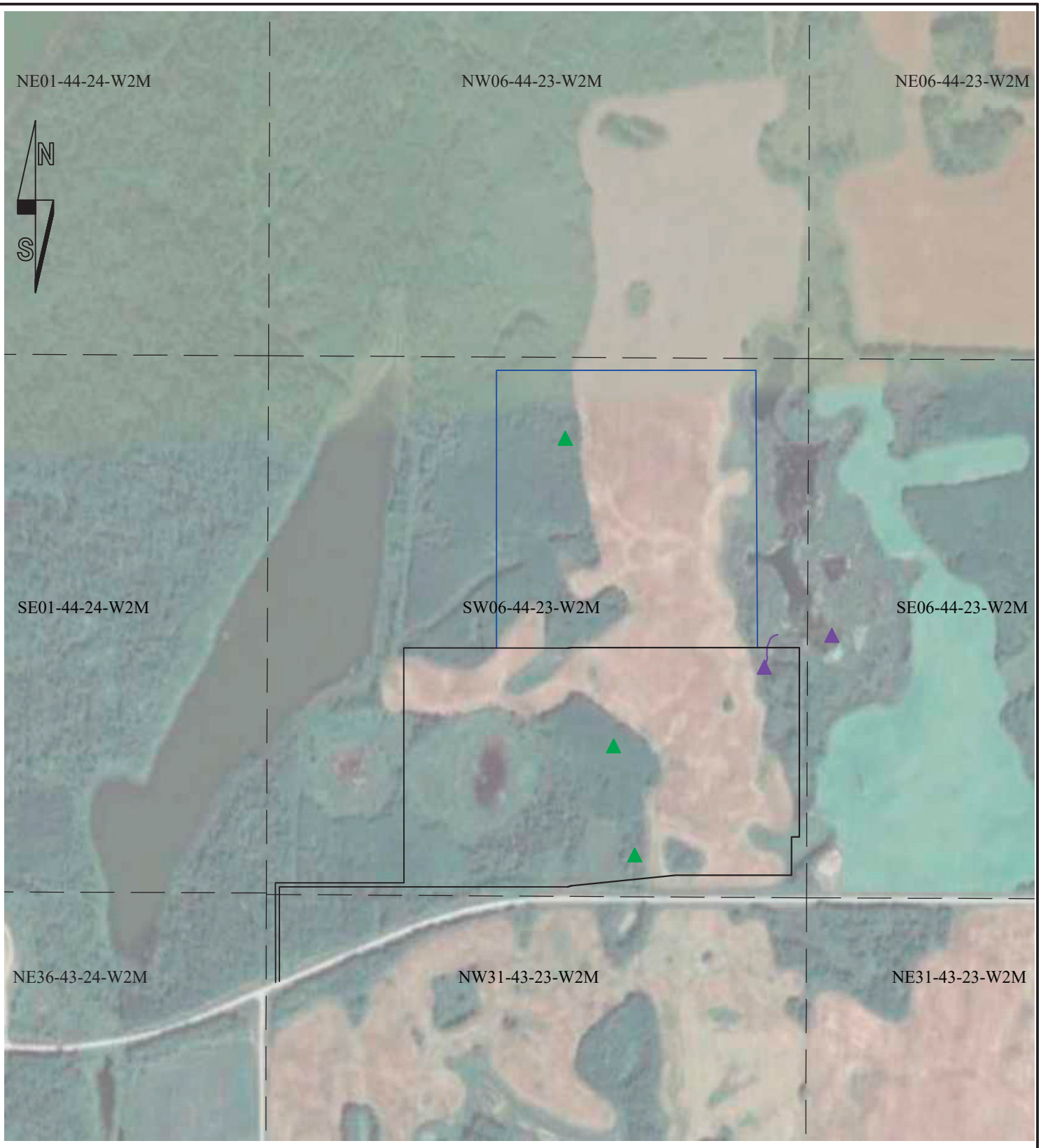
WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: WILDLIFE OBSERVATIONS

WM566.3 Site Plan Feb 2024 EIS.dwg



NOTE: IMAGE FROM GOOGLE EARTH

LEGEND

- PHASE I
- PHASE II
- STRIPPED CORAL-ROOT
- FLOATING CRYSTALWORT
- FLOATING CRYSTALWORT CLUSTER

X-TERRA Environmental Services Ltd.

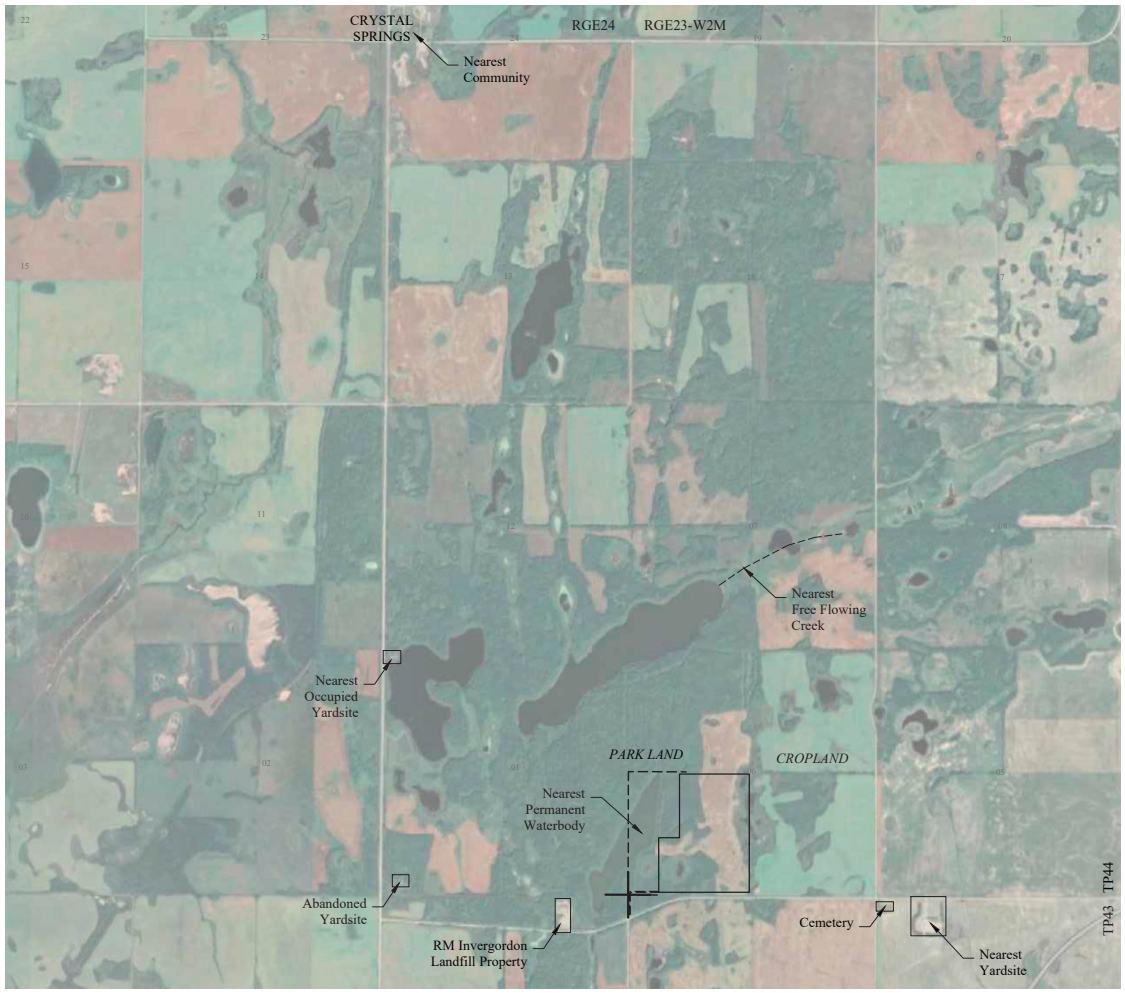
DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:8,000	WM566.3	WM566.3-24

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: VEGETATION OBSERVATIONS



Setback Distance to	Landfill Site Boundary
Cemetery	830 m
Nearest Yardsite	1080 m
Nearest Occupied Yardsite	2050 m
Abandoned Yardsite	1645 m
Nearest Permanent Waterbody	60 m
Nearest Free Flowing Creek	1345 m
Urban Community	5150 m
RM Invergordon Landfill Property	600m

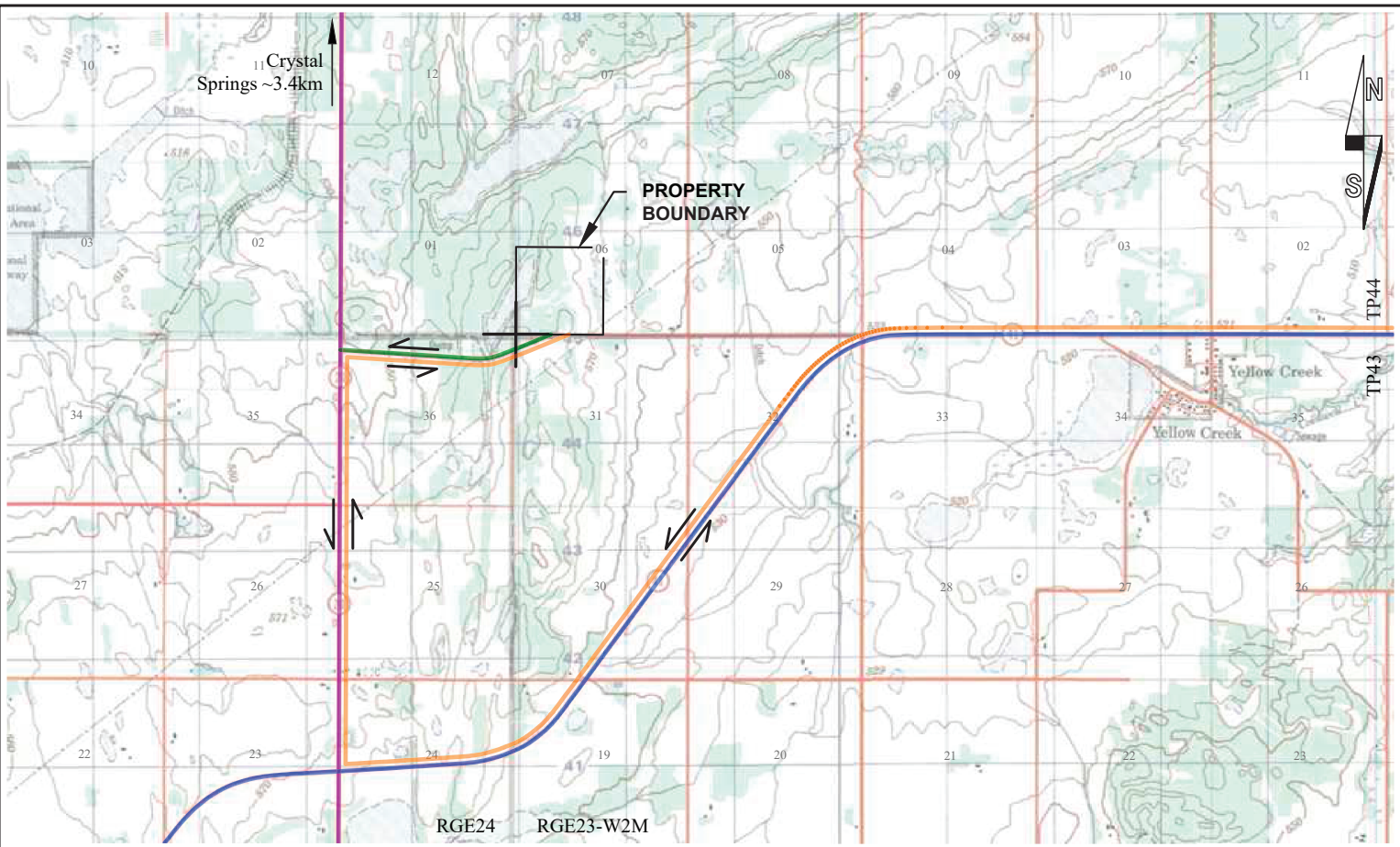
LEGEND
- – – QUARTER SECTION BOUNDARY
- —— PROPOSED LANDFILL SITE BOUNDARY

WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:25,000	WM566.3	WM566.3-25

CLIENT: INVERGORDON LANDFILL INC.
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT
TITLE: SETBACKS TO YARD SITES, COMMUNITIES & PUBLIC FACILITIES

WM566.3 Site Plan Feb 2024 EIS.dwg



LEGEND

- PROJECT FOOTPRINT
- RM ROAD 776
- HIGHWAY 20
- HIGHWAY 41
- HAULING ROUTE

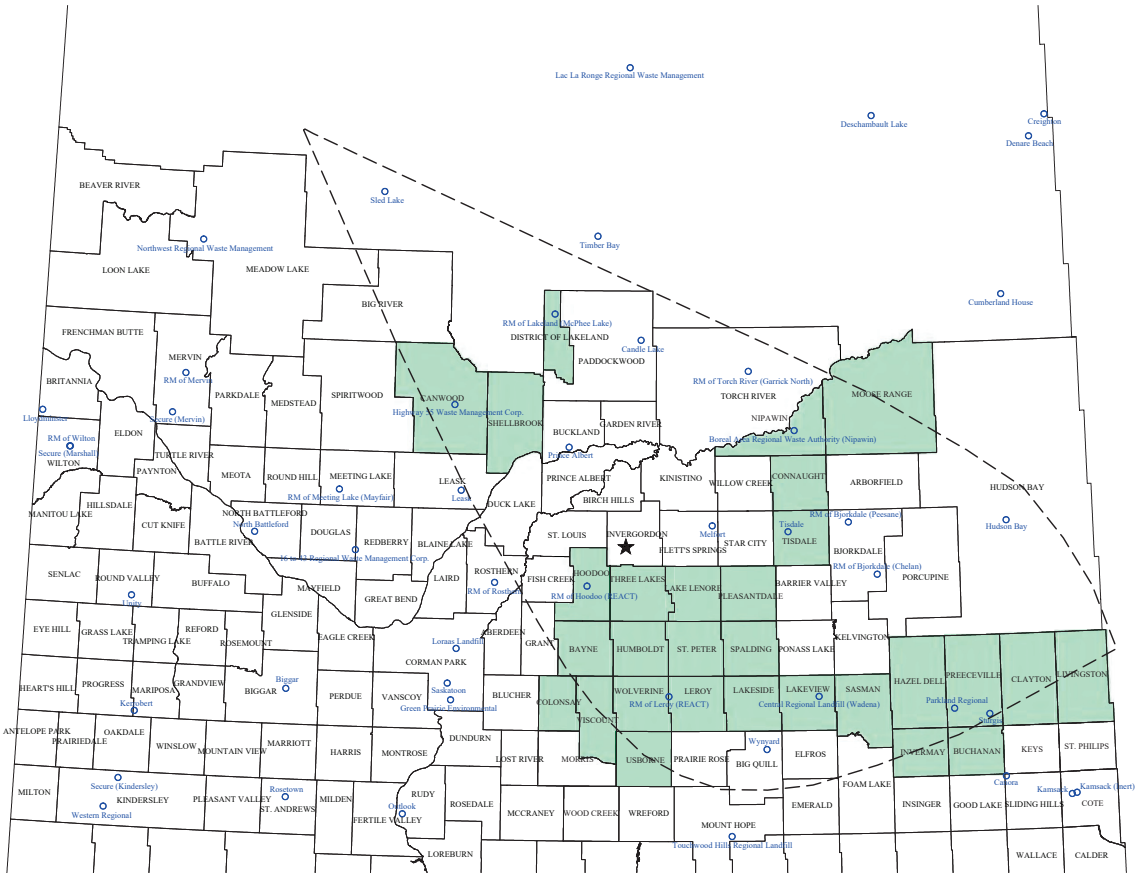
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:25,000	WM566.3	WM566.3-26

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: NEIGHBOURING ROADS AND HIGHWAYS



LEGEND

- GWSA
- SASKATCHEWAN RURAL MUNICIPALITIES (RM) BOUNDARIES
- PROJECT LOCATION
- EXISTING LANDFILLS
- RMs WITHIN THE GWSA MEMBERS OF EXISTING REGIONAL LANDFILLS

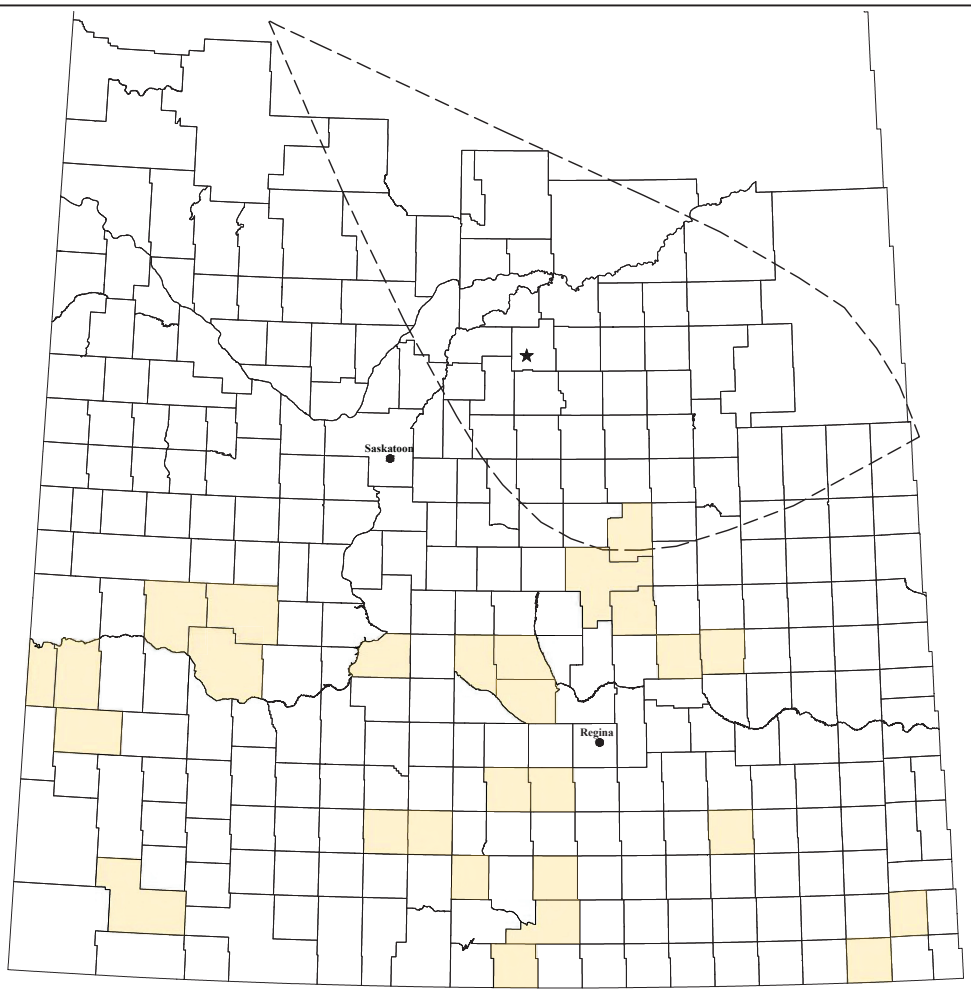
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:2,000,000	WM566.3	WM566.3-27

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: EXISTING LANDFILL MEMBERS IN THE GWSA



N
S

LEGEND

- GWSA
- SASKATCHEWAN RURAL MUNICIPALITIES (RM) BOUNDARIES
- PROJECT LOCATION
- RMs WITH WASTE SERVICE AGREEMENTS

WaterMark CONSULTING LTD.

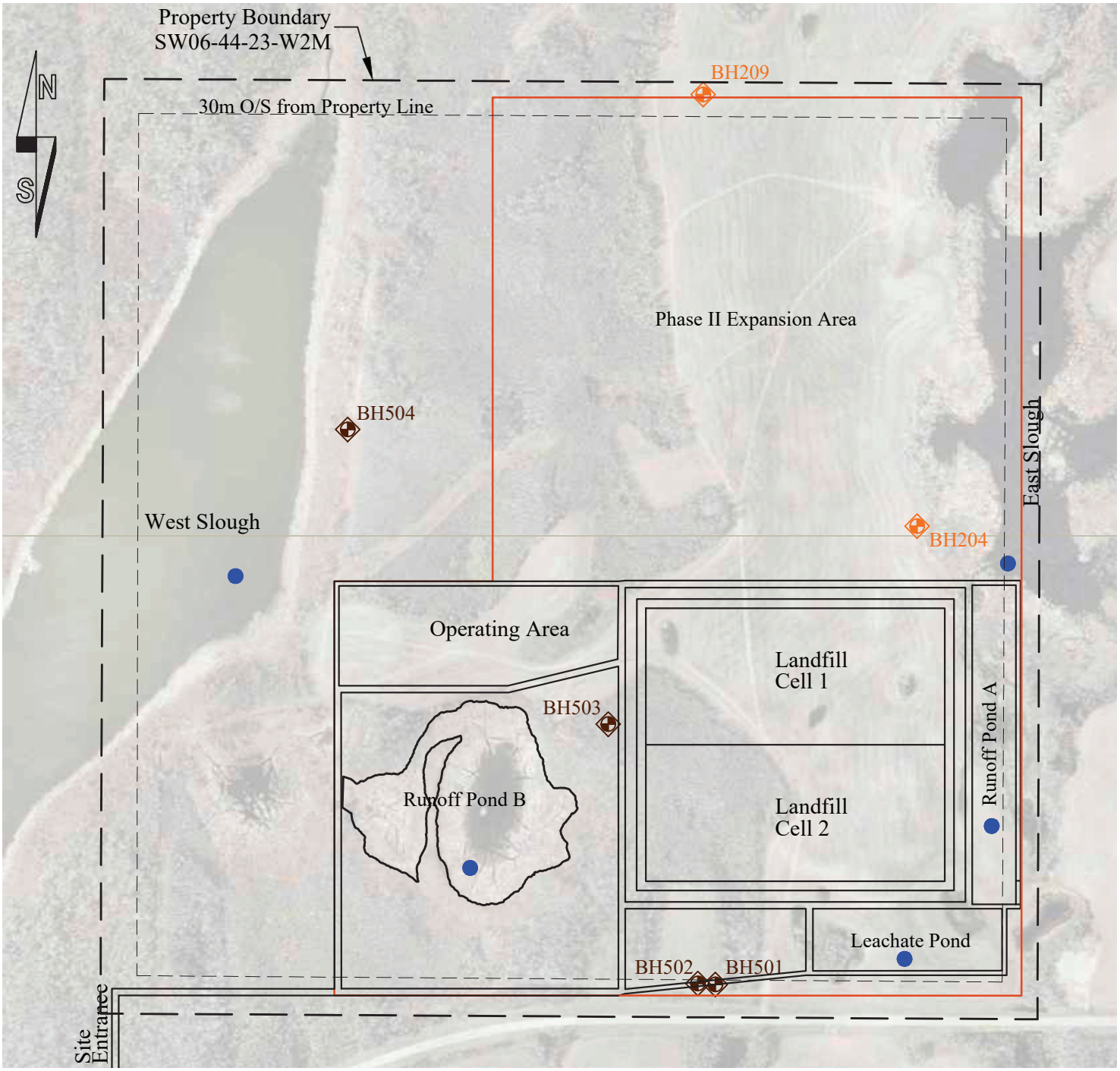
DATE: 25 NOV 24	DRAWN BY: WMB	APPROVED BY: ALG
SCALE: 1:2,500,000	FILE NO: WM566.3	DRAWING NO: WM566.3-28

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: RMS WITH WASTE SERVICE AGREEMENTS

WM566.3 Site Plan Feb 2024 EIS.dwg



NOTE: ORTHOIMAGE FROM LIADAR SURVEY

LEGEND

- PIEZOMETER TO BE RETAINED
- NEW PIEZOMETER TO BE INSTALLED
- SURFACE WATER SAMPLE LOCATION
- PROJECT FOOTPRINT

PROPOSED GROUNDWATER MONITORING PIEZOMETER NETWORK

PEIZOMETER	COMPLETION	LOCATION
BH501	ox. till	UP GRADIENT
BH204	ox. till	DOWN GRADIENT
BH209	ox. till	DOWN GRADIENT
BH502	sand 2	UP GRADIENT
BH503	sand 2	DOWN GRADIENT
BH504	sand 2	DOWN GRADIENT

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	1:5,000	WM566.3	WM566.3-29

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PHASE I PIEZOMETER MONITORING NETWORK

APPENDIX A ISC CORPORATE PROFILE FOR INVERGORDON LANDFILL INC.

Saskatchewan Corporate Registry

Profile Report

Entity Number: 102138921

Entity Name: INVERGORDON LANDFILL INC.

Report Date: 21-Aug-2024

Entity Details

Entity Type	Business Corporation
Entity Subtype	Saskatchewan Corporation
Entity Status	Active
Incorporation Date	24-Nov-2021
Annual Return Due Date	31-Dec-2024
Nature of Business	Holding companies
MRAS indicator	No

Registered Office Addresses

Physical Address	620 MCLEOD STREET, REGINA, Saskatchewan, Canada, S4N 4Y1
Attention To	CURTIS WEST
Mailing Address	INVERGORDON LANDFILL INC., 2042 CORNWALL STREET, REGINA, Saskatchewan, Canada, S4P 2K5

Directors/Officers

CURTIS WEST (Director) — **Effective Date:** **24-Nov-2021**

Physical Address:	620 MCLEOD STREET, REGINA, Saskatchewan, Canada, S4N 4Y1
Mailing Address:	620 MCLEOD STREET, REGINA, Saskatchewan, Canada, S4N 4Y1

CURTIS WEST (Officer) — **Effective Date:** **24-Nov-2021**

Physical Address:	620 MCLEOD STREET, REGINA, Saskatchewan, Canada, S4N 4Y1		
Mailing Address:	620 MCLEOD STREET, REGINA, Saskatchewan, Canada, S4N 4Y1	Office Held:	PRESIDENT

Shareholders

Shareholder Name	Mailing Address	Share Class	Shares Held

102087017 SASKATCHEWAN LTD.	2042 CORNWALL STREET, REGINA, SASKATCHEWAN, CANADA, S4P 2K5	CLASS A COMMON SHARES	33.4
CARMAN LORAAS TRUST 2020 #4	2042 CORNWALL STREET, REGINA, SASKATCHEWAN, CANADA, S4P 2K5	CLASS A COMMON SHARES	66.6

Articles

Minimum Number of Directors: 1 **Maximum Number of Directors:** 6

Share Structure:

Class Name	Voting Rights	Authorized Number	Number Issued
CLASS A COMMON SHARES	Yes	Unlimited	100
CLASS B COMMON SHARES	Yes	Unlimited	
CLASS C COMMON SHARES	Yes	Unlimited	
CLASS D COMMON SHARES	Yes	Unlimited	
CLASS E COMMON SHARES	No	Unlimited	
CLASS F COMMON SHARES	No	Unlimited	
CLASS G PREFERRED SHARES	No	Unlimited	
CLASS H REFERRED SHARES	No	Unlimited	
CLASS I PREFERRED SHARES	No	Unlimited	
CLASS J PREFERRED SHARES	No	Unlimited	
CLASS K PREFERRED SHARES	No	Unlimited	
CLASS L PREFERRED SHARES	No	Unlimited	

Previous Entity Names

Type	Name	Effective Until
Registered Name	102138921 SASKATCHEWAN LTD.	21-Aug-2024

Event History

Type	Date
Business Corporation - Amend Articles with Name Change	21-Aug-2024
Business Corporation - Annual Return	29-Dec-2023
Business Corporation - Annual Return	16-Jan-2023

Notice of Shareholders	24-Nov-2021
Business Corporation - Incorporation	24-Nov-2021

APPENDIX B CORRESPONDENCE WITH WATER SECURITY AGENCY

Aquatic Habitat Protection Permit Application

It is an offence under section 84 (1) of EMPA, 2010 to knowingly provide false or misleading information when applying for an Aquatic Habitat Protection Permit.

SECTION 1 – APPLICANT INFORMATION

APPLICANT MAILING ADDRESS					
First Name	Curtis	Last Name	West		
Company, Organization or Municipality (if applicable)	Invergordon Landfill Inc.				
Street or PO Box #	1626 Wascana Highlands	Apartment/Unit #			
City	Regina	Province	SK	Postal Code	S4V 2K6
Phone	306-535-2517	Fax			
Email	cwest@greenlandwaste.ca				

TECHNICAL CONTACT (CONTRACTOR/CONSULTANT) MAILING ADDRESS (if applicable)					
First Name	Anna	Last Name	Gagnon		
Company	WaterMark Consulting Ltd.				
Street or PO Box #	1601B McAra Street	Apartment/Unit #			
City	Regina	Province	SK	Postal Code	S4N 6H4
Phone	306-565-0091	Fax	306-565-0092		
Email	agagnon@watermarkconsulting.net				

FUNDING ORGANIZATION CONTACT MAILING ADDRESS (if applicable)					
First Name		Last Name			
Organization					
Name of Funding Program					
Street or PO Box #		Apartment/Unit #			
City		Province		Postal Code	
Phone		Fax			
Email					

SECTION 2 – NAME OF AFFECTED WATERCOURSE/WATER BODY

WATERCOURSE/WATER BODY
Please provide the name of watercourse(s) / water body(ies) that may be affected by the proposed work or development:
Unnamed water body on the east margin of the site. The existing water body collects drainage from an approximate 280 ha area within 3 km south of the site, draining northerly and eventually draining into McCloy Creek about 15 kilometers northeast of the site. Ponds south of the water body are ephemeral and have been observed to be dry in late summer and fall.

SECTION 3 – LOCATION OF PROPOSED PROJECT

GEOGRAPHIC COORDINATES DATUM USED - NAD 83 ☐ WGS84 ☐ OTHER ☐ (PLEASE					
Latitude		N	Longitude		W

OR

UTM COORDINATES DATUM USED - NAD 83 ☐ WGS84 ☐ OTHER ☐ (PLEASE LIST)_____					
UTM Zone		Easting		Northing	

OR

LEGAL LAND DESCRIPTION (please add an appendix if more space is required)									
¼ Section or LSD	SW	Section	06	Township	44	Range	23	Meridian	W2M

OR

LEGAL LOT DESCRIPTION ***Mandatory for Cottage Developments***					
Lot		Block or Parcel		Registered Plan #	
Street Name and Number					
Subdivision/Hamlet or Beach Name			Municipality		

SECTION 4 – REGISTERED LANDOWNER

Is the Applicant the registered landowner of the proposed project site?			YES ☒	NO ☐
IF NO, LANDOWNER'S NAME AND CONTACT INFORMATION				
First Name		Last Name		
Company Name (if applicable)				
Phone		Email		
Is the proposed work occurring on Municipal land or Crown land or other Public land?	YES ☐	NO ☒	Name of Crown Ministry/ Agency/Municipality/Other	
You are required to obtain the permission of the Landowner or Crown or Municipality of the proposed work to occur on their land. Proof of Crown, Municipality or Landowner consent for the applicant to conduct the proposed work is attached to this application?			YES ☐	

Note: Land information will be verified, and it is the proponent's responsibility to have authorization to conduct the proposed project.

SECTION 5 – DESCRIPTION OF PROPOSED WORK

EMERGENCY WORK		
Is this project in response to an emergency circumstance related to public safety or protection of public or private infrastructure?	YES ☐	NO ☒
Explanation:		

WORK DESCRIPTION
Please explain why this proposed work is required.
We are planning a regional landfill for portions of the proposed quarter section. As part of the proposed development we are planning a perimeter embankment along the eastern edge of the property that may influence natural drainage within the wetland adjacent that edge. The proposed work would ensure that the wetland drainage to the north is maintained. All drainage work would be contained within the subject property boundaries and not influence adjacent properties. 60m of permeter embankment will intersect with the wetland. The work is not considered a 'drainage works' as defined by Water Security Agency (i.e. "...any action taken, or intended, for the removal or lessening ofthe amoung or water from land"). The proposed work would maintain drainage, not alter it, and not lessen the amount of water held on the land.

Provide a detailed description of the work you are proposing to do including, the materials and equipment used and the order of construction activities.

Broadly, the relevant work will include the construction of a perimeter berm using non-organic soil from the (on site) runoff pond excavations. Dtching will be constructed as needed on the external toe of the eastern perimeter embankment where the embankment has restricted drainage of the ephemeral ponds. We expect the extent of ditching to be minimal. A proposed location plan showing the perimeter berm, holding pond, and conceptual ditching locations is attached.

The proposed scope of scope is as follows:
- bush will be cleared and grubbed within the project footprint, including riparian vegetation, trees and shrubs in the ephemeral ponds that coincide with the perimeter berm.
- the topsoil of the project's footprint will be stripped using a track hoe and stockpiled separately, away from the naturally occuring ponds. This includes stripping the footprint of the perimeter berm.
- Locally derived clay rich soils will be used as the perimeter berm material. The soil will be hauled and placed in the proposed location using a bulldozer, track hoe and rock truck. The soils have been characterized as glacial till clay soil with low in-situ permeability.
- the berm will be constructed in soil lifts not exceeding 200 mm compacted in place with a sheepsfoot packer or equivalent until the top of the berm reaches the designed elevation. The berm will mantain a sideslope of approximately 4H:1V.
- portions of the east ephemeral ponds are coincident with the proposed berm location. A ditch will be excavated along the east (external) edge of the perimeter berm to maintain the shallow, ephemeral wetland environment and avoid the formation of isolated ponds. The ditches will be excavated using a track hoe or similar.
- The proposed shape and depth of the drainage ditch is roughly 2 m wide and likely not deeper than roughly 1 m below maximum water level.

Check one or both boxes that describe the construction equipment you will be using:
☐ Hand Tools (e.g. shovel, wheelbarrow, chainsaw)
▪ Heavy Equipment (e.g., track hoe, skid steer)

What are the proposed start and end dates of construction?					
Start Date:	Month March	Year 2025	End Date:	Month March	Year 2026

A sketch of the site plan or design plan for proposed work is required as an attachment to this application. Graph paper for sketch is provided in Appendix A	ATTACHED x

Photos of the proposed project area (including the shoreline and upstream and downstream views) with the project area clearly identified are required as an attachment to this application.	ATTACHED x

Does this proposed project include the construction of a drainage works?	YES ☐	NO ▪
If yes, have you submitted an approval to Construct and Operate a Drainage Works to the WSA regional office?	YES ☐	NO ▪

SECTION 6 – PROPOSED STABILIZATION MEASURES

PROTECTION MEASURES FOR AQUATIC HABITAT AND AQUATIC ORGANISMS
Please indicate the specific habitat protection measures that will be put in place to minimize effects on aquatic organisms and their habitat. Specific details are required on how and where these protection measures will be installed. See instruction form for examples.
Pre-construction: - Bush clearing and construction of the berm adjacent the wetlands will be planned for fall and winter seasons to avoid potential disturbance of nesting and/or spawing. - Contractors will utilize machinery in good working order and that arrives onsite clean.

During construction:

- Ditches will be excavated along the eastern, external edge of the perimeter berm to maintain a shallow, ephemeral wetland environment and avoid the formation of isolated ponds.
- Heavy equipment will operate from inside the construction site to avoid disturbing any additional habitat in the adjacent areas.

Post construction:

- The berm's external side slopes adjacent wetland habitat will receive a nominal topsoil treatment and will be seeded to promote vegetative growth and minimize soil erosion. These areas are shown in the attached drawing.
- Silt fences will be place along the exterior toe of the perimeter berm to limit excess sediments from entering the water bodies.

SECTION 7 – SIGNATURE

By clicking the check box, I confirm that all data and information submitted are truthful and accurate and that no material fact has been omitted. I also acknowledge that an approval granted here does not release me from the responsibility of obtaining any other approvals that may be required under federal, provincial or municipal legislation. ☑

27 November 2024

_____ _____

Signature Date

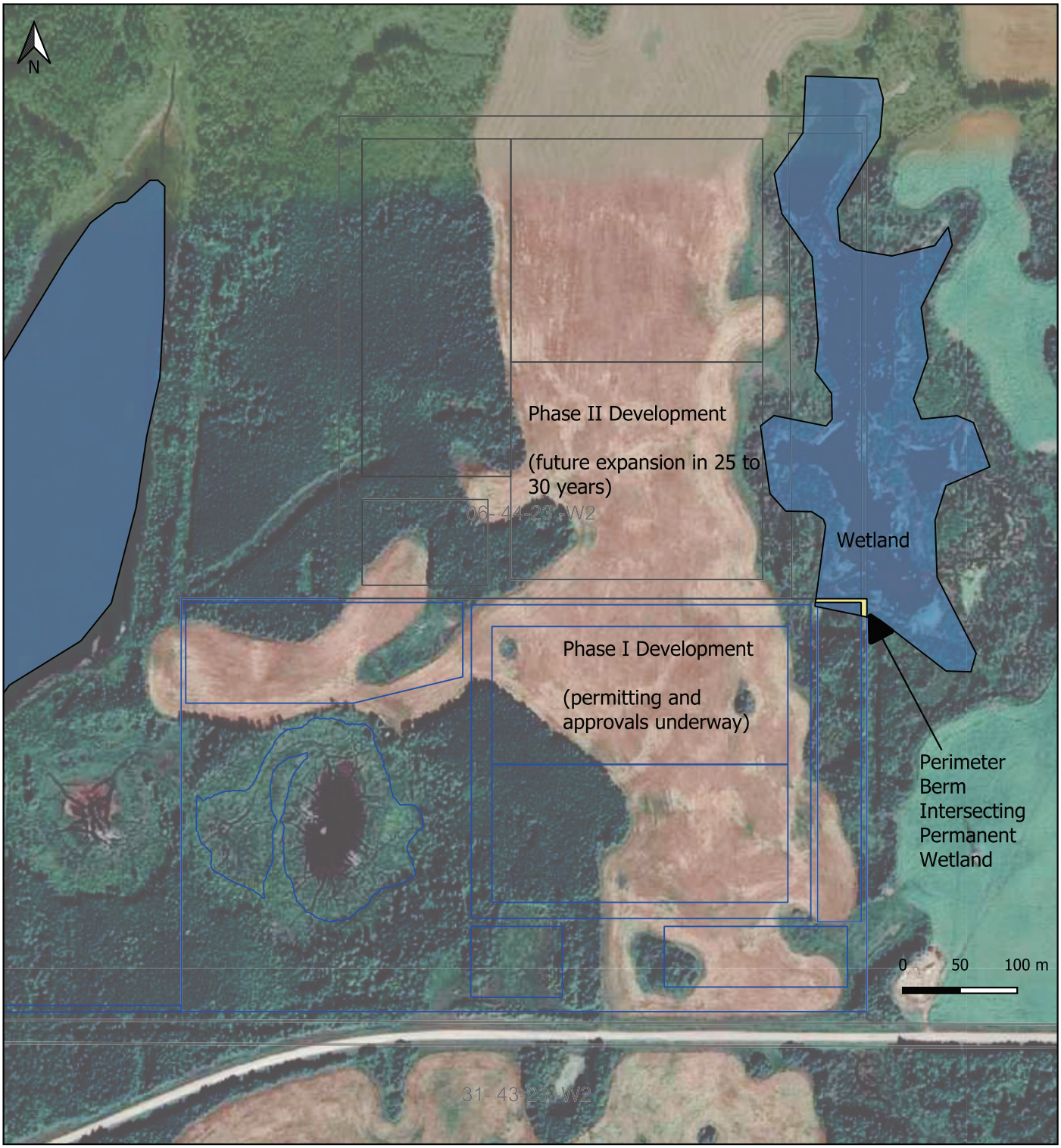
A complete application consists of:

1) a completed, signed application form, and
2) all required supporting information identified in this application form or the information page.

The Water Security Agency may require additional information during the technical review of any application considered incomplete or in the case of more complicated projects upon initial review, which may cause delays in review process.

The Water Security Agency and/or other compliance/enforcement staff may conduct inspections before, during or after proposed construction.

APPENDIX A – SITE PLAN



Map CRS: EPSG:26913

Date: 27 Nov 2024	Drawn by: ALG	Approved by: ALG	Scale: 1:5000	File No: WM566.3 AHPP	Drawing No: WM566.3-1
			Client: Invergordon Landfill Inc.		
			Project: Proposed Industrial Landfill		
			Title: AHPP Revised Scope of Wetland Impact		

Site Photo: looking southeast at subject property in early summer at the ponds on eastern property boundary.

Anna Gagnon

From: agagnon@watermarkconsulting.net
Sent: December 20, 2022 11:27 AM
To: 'Ben Wilson'
Subject: RE: Regional Landfill Development

Hi Ben,

I appreciate your help, it sounds like we do not need any approvals or further engagement from WSA. To confirm: yes, we are working closely with MOE for licensing and EIA screening so there is certainly regulatory oversight encompassing drainage and surface water considerations.

Happy holidays!

Anna Gagnon, **P.Eng.**

WaterMark CONSULTING LTD.
306.565.0091 (w)
306.533.5677 (c)

From: Ben Wilson <Ben.Wilson@wsask.ca>
Sent: December 20, 2022 10:58 AM
To: agagnon@watermarkconsulting.net
Subject: Re: Regional Landfill Development

Thanks for getting back to me so quickly Anna, I have shared your amended drawing and our drainage team and they have suggested that they would not require a permit for phase one. Seeing as phase two will not be considered for approximately 25 years if would be tough to speculate on the regulatory requirements of the day. As i mentioned in my last email the easiest mitigation is avoidance, so if there is opportunity to shift phase 2 west 50-100 metres out of the wetland it's probably a good idea.

So just to confirm on my end you are dealing with MOE on permitting for phase one of the landfill already, correct?

Ben

From: agagnon@watermarkconsulting.net <agagnon@watermarkconsulting.net>
Sent: Monday, December 19, 2022 3:54 PM
To: Ben Wilson <Ben.Wilson@wsask.ca>
Subject: RE: Regional Landfill Development

Hi Ben,

Thanks for your email and for helping me navigate the necessary approvals. My application for AHPP was not directed by the Ministry of Environment, rather I just assumed it would be required. We have advanced the design since I

submitted the AHPP application, namely in staging the construction of the project (Phase I in the near future, Phase II in roughly 25 years). I've attached a drawing I'm hoping you can pass on to the drainage approval team. The Phase I development should not impact the permanent wetland.

I look forward to hearing from the drainage approvals team re: Phase II. I'm interested to know whether the construction of a wetland on site (i.e. runoff holding pond B in attached drawing) and reduction of the catchment area of the wetland is considered in the drainage approvals? In this case the wetland is not so much being infilled as segregated and expanded. Again, this is somewhat hypothetical at the moment because we are only applying for a permit to construct Phase I but it would be great to understand what design objectives and constraints are likely to arise in Phase II.

Regards,

Anna Gagnon, **P.Eng.**

WaterMark CONSULTING LTD.
306.565.0091 (w)
306.533.5677 (c)

From: Ben Wilson <Ben.Wilson@wsask.ca>
Sent: December 19, 2022 1:45 PM
To: agagnon@watermarkconsulting.net
Subject: Re: Regional Landfill Development

Good Afternoon Anna, I just took a quick look through your application and wondered if you were directed to submit an application to the Water Security Agency by the Ministry of Environment to obtain an Aquatic Habitat Protection Permit?

WSA does not typically get involved in the review/approval process for regional landfills. That said, during my cursory review I noted that the wetland was described as an ephemeral drainage. From the imagery I reviewed, this appears to be a permanent wetland. Infilling of a wetland (reducing its capacity) would require a drainage approval pursuant to the Water Secutiry Agency Act. I have sent your application over to our drainage approval folks to get their thoughts on it.

I would suggest a redesign of the perimeter berms to exclude the wetland area would be the easiest/most appropriate solution here.

I will let you know when I hear back from our drainage team

Ben

APPENDIX C CIVIL ENGINEERING DRAWINGS: SITE CONTAINMENT & TRAFFICABILITY

WaterMark CONSULTING LTD.

X-TERRA Environmental Services Ltd.

WM566.3 Site Plan Feb 2024.dwg

WM566.3-C1	LIST OF DRAWINGS - SITE CONTAINMENT & TRAFFICABILITY
WM566.3-C2	TRAFFICABILITY & SITE CONTAINMENT
WM566.3-C3	TYPICAL EMBANKMENT AND ROAD PROFILES
WM566.3-C4	CULVERT DETAILS

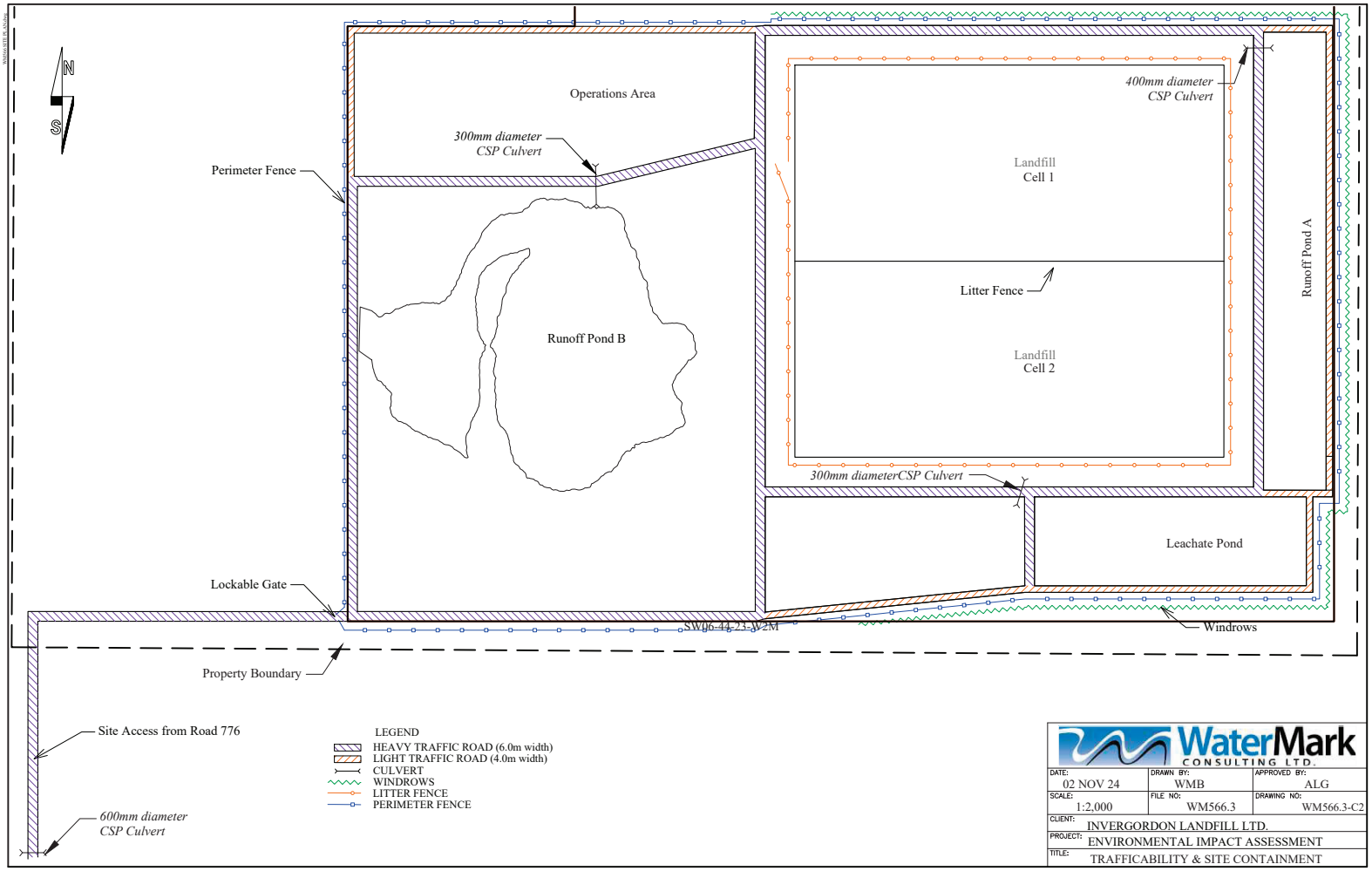
DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
01 NOV 24	WMB	ALG	NTS	WM566.3	WM566.3-C1

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL LTD.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: LIST OF DRAWINGS - SITE CONTAINMENT & TRAFFICABILITY



WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
02 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:2,000	WM566.3	WM566.3-C2

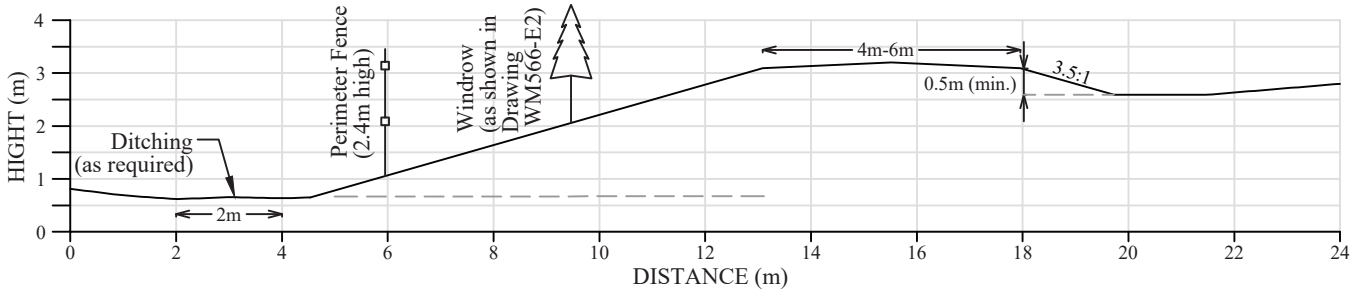
CLIENT: INVERGORDON LANDFILL LTD.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

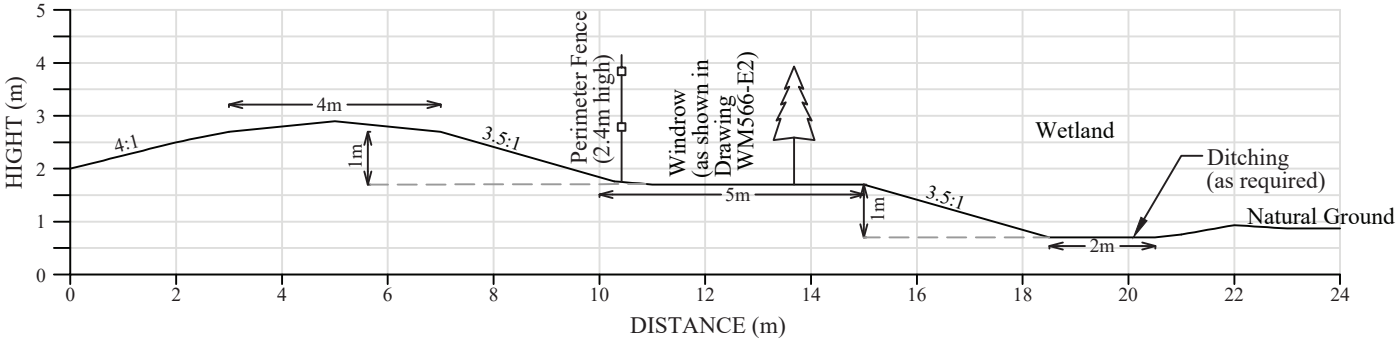
TITLE: TRAFFICABILITY & SITE CONTAINMENT

WM566.3 Site Plan Feb 2024.dwg

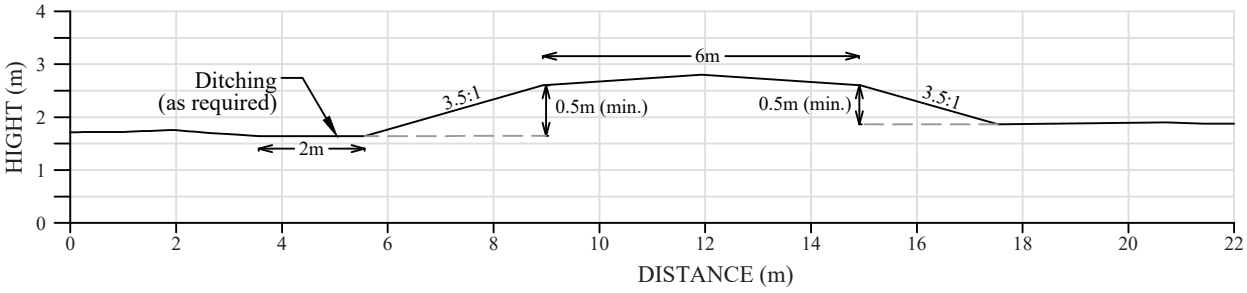
TYPICAL PERIMETER EMBANKMENT PROFILE



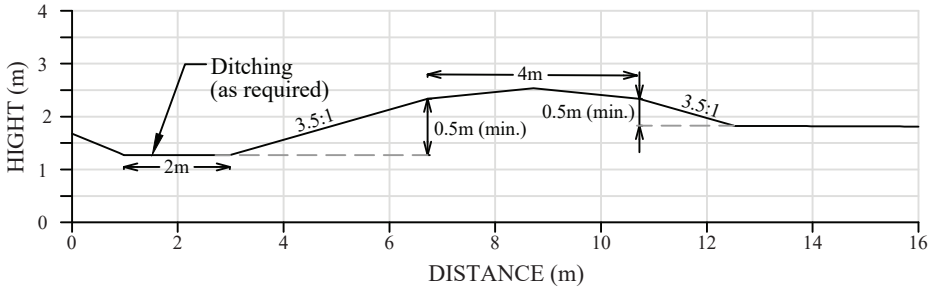
PERIMETER EMBANKMENT PROFILE ADJACENT WETLAND



TYPICAL INTERNAL ROAD PROFILE - HEAVY TRAFFIC



TYPICAL INTERNAL ROAD PROFILE - LIGHT TRAFFIC



DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
02 NOV 24	WMB	ALG	AS NOTED	WM566.3	WM566.3-C3

WaterMark CONSULTING LTD.

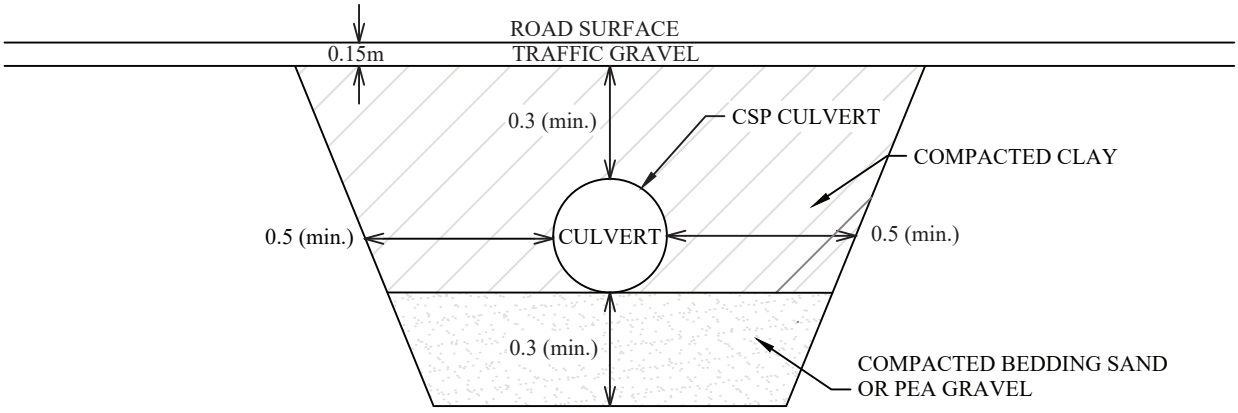
CLIENT: INVERGORDON LANDFILL LTD.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: TYPICAL EMBANKMENT & ROAD PROFILES

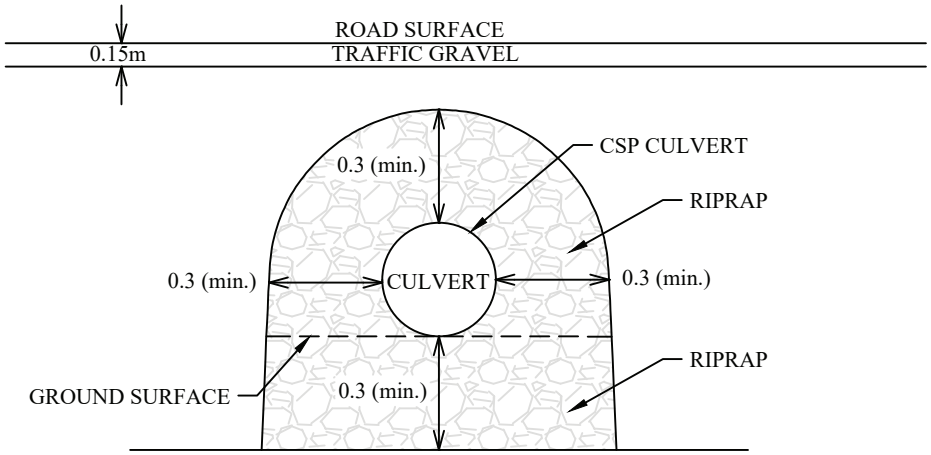
WM566.3 Site Plan Feb 2024.dwg

BACKFILL DETAILS: PROFILE VIEW



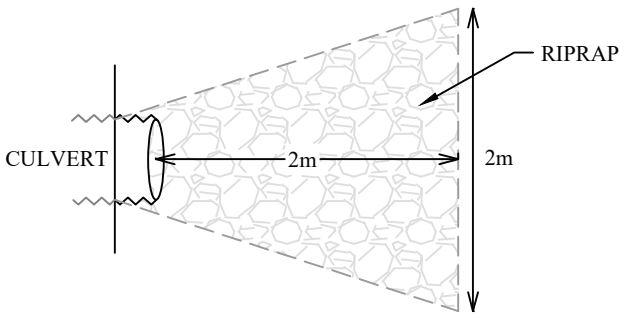
IN SITU SOIL OR MINIMUM 0.3m
COMPACTED CLAY FILL BELOW CULVERT

EROSION CONTROL DETAILS: PROFILE VIEW AT OUTLET



IN SITU SOIL OR MINIMUM 0.3m
COMPACTED CLAY FILL BELOW CULVERT

PLAN VIEW



DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
02 NOV 24	WMB	ALG	NTS	WM566.3	WM566.3-C4

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL LTD.
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT
TITLE: CULVERT DETAILS

APPENDIX D CIVIL ENGINEERING DRAWINGS: LANDFILL CELLS

WaterMark CONSULTING LTD.

X-TERRA Environmental Services Ltd.

WM566.3 Site Plan Feb 2024 EIS.dwg

WM566.3-D1	LIST OF DRAWINGS - LANDFILL CELLS
WM566.3-D2	PROPOSED LANDFILL CELLS - FINAL SURFACE
WM566.3-D3	PROPOSED LANDFILL CELLS - CLAY SURFACE
WM566.3-D4	PROPOSED LANDFILL CELLS - ROUGH GRADE
WM566.3-D5	PROPOSED LANDFILL CELLS - PIPING
WM566.3-D6	PROPOSED LANDFILL SITE - CELL 1 CROSS SECTIONS
WM566.3-D7	PROPOSED LANDFILL CELLS - SUMP DETAILS

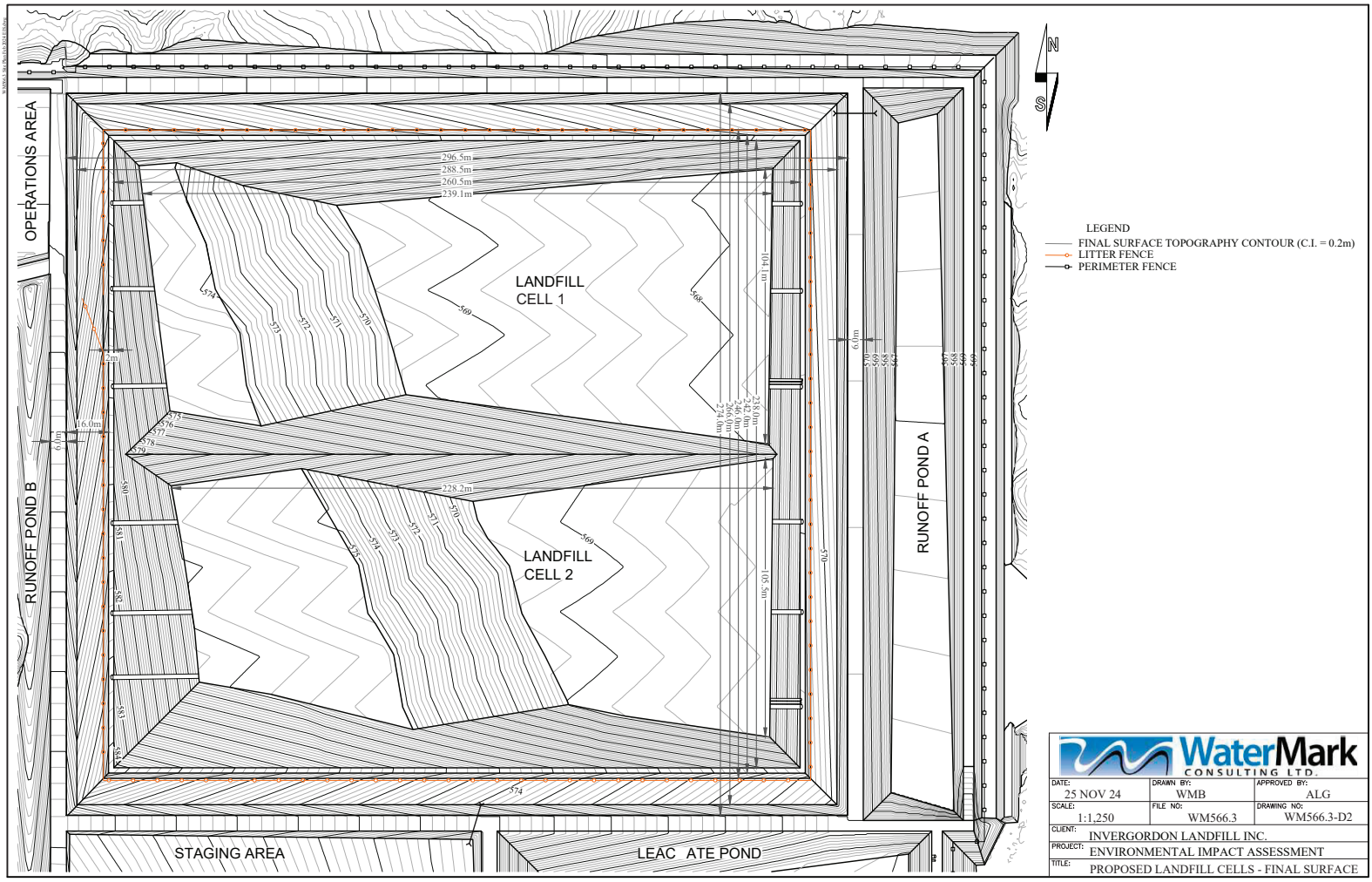
DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	NTS	WM566.3	WM566.3-D1

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: LIST OF DRAWINGS - LANDFILL CELLS



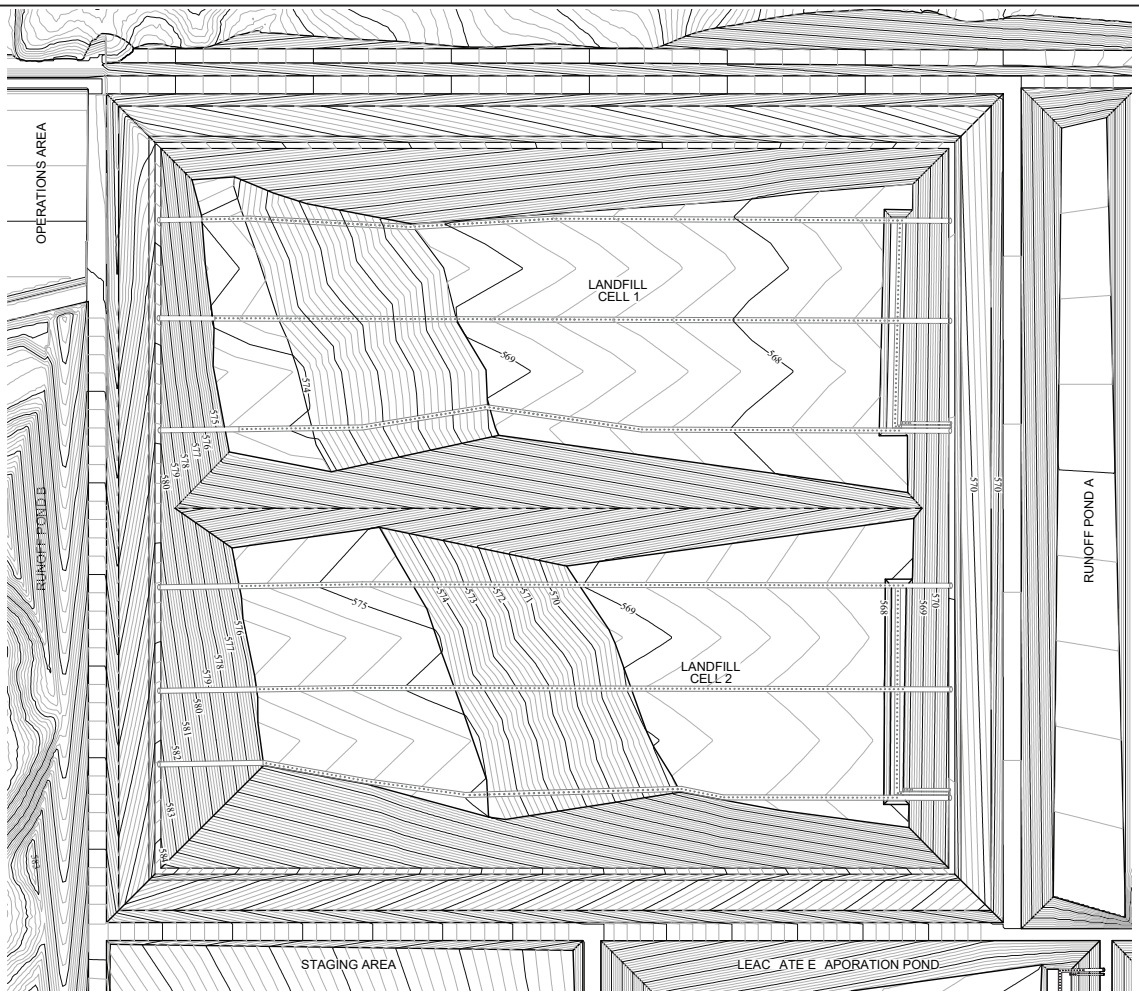
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:1,250	WM566.3	WM566.3-D2

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LANDFILL CELLS - FINAL SURFACE



LEGEND

CLAY SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.2m)

LEACHATE COLLECTION PIPE (See Drawing WM566-D6)

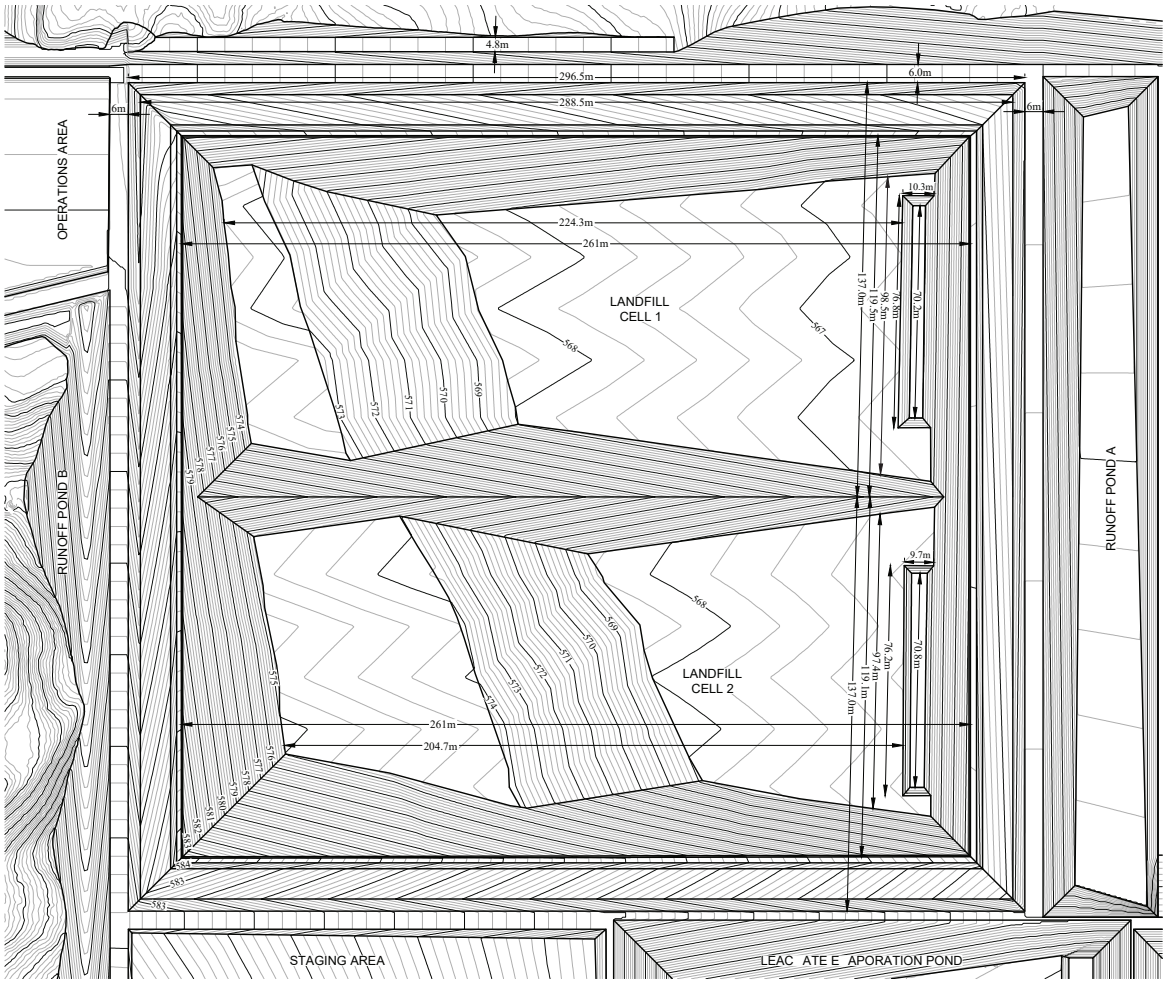
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:1,250	WM566.3	WM566.3-D3

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LANDFILL CELLS - CLAY SURFACE



N

S

LEGEND

ROUGH GRADE SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.2m)

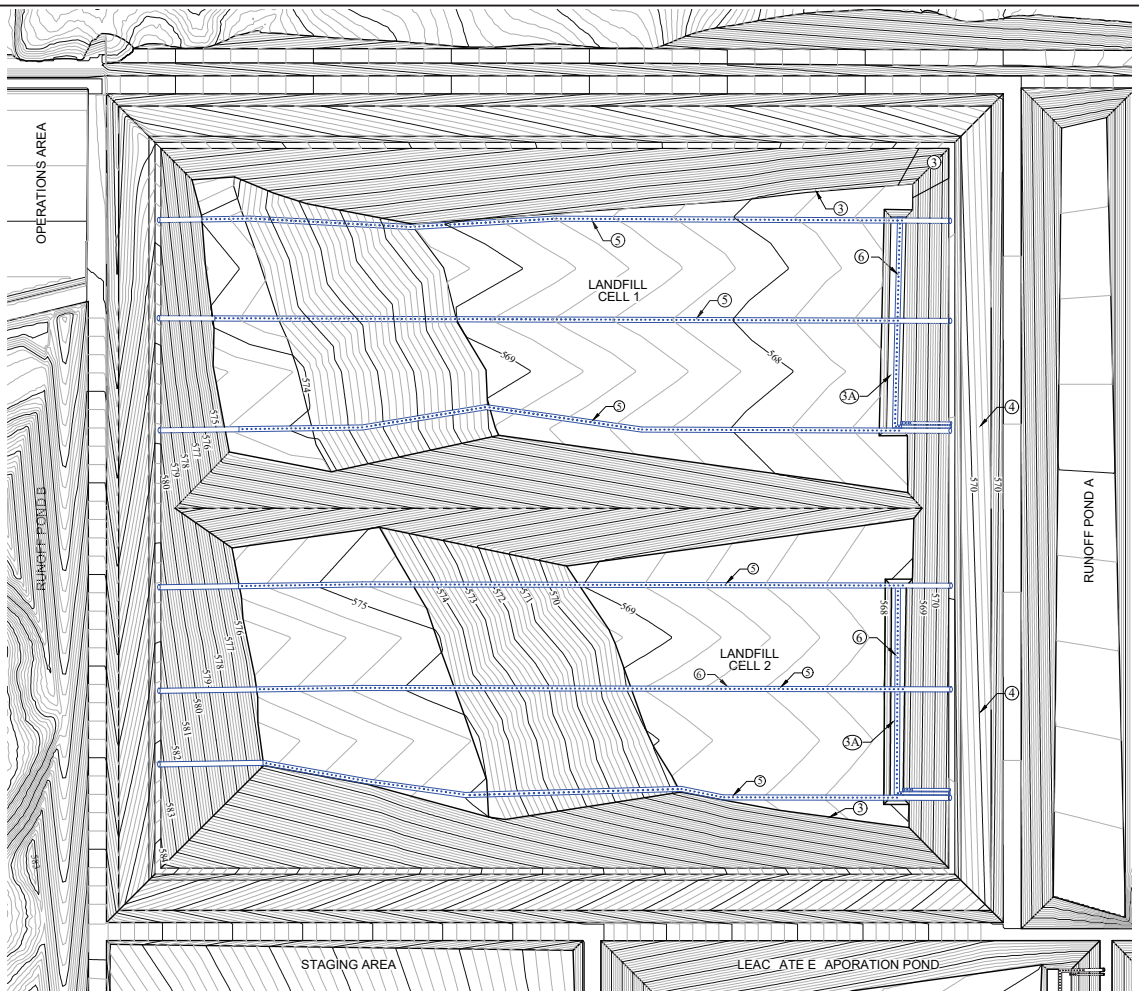
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
05 DEC 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:1,250	WM566.3	WM566.3-D4

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LANDFILL CELLS - ROUGH GRADE



LEGEND

—— CLAY SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.2m)

1. UNDISTURBED CLAY SOILS -UPPER 150mm SCARIFIED & COMPACTED
2. 850mm COMPACTED CLAY LINER
2A. 1050mm COMPACTED CLAY LINER -BENEATH SUMP
3. 300mm FREE DRAINING GRAVEL -ON BASE
3A. 800mm FREE DRAINING GRAVEL -IN SUMP
4. 75mm HDPE LEACHATE MONITORING PIPE -LOWERMOST 1m PERFORATED
5. 150mm HDPE LEACHATE COLLECTION PIPING -PERFORATED ALONG BASE
6. 200mm HDPE LEACHATE WITHDRAWAL PIPING -PERFORATED HEADER ALONG BASE
7. GEOTEXTILE OVERLAY

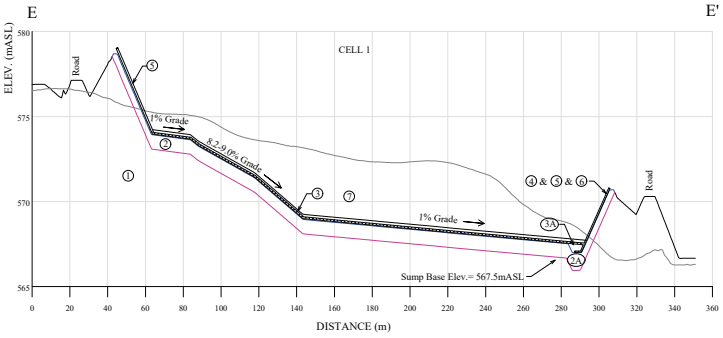
WaterMark CONSULTING LTD.

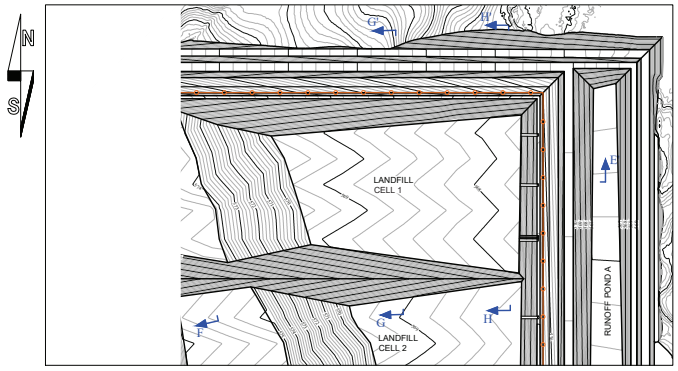
DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:1,250	WM566.3	WM566.3-D5

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LANDFILL CELLS - PIPING





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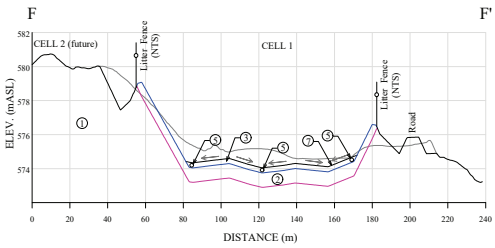
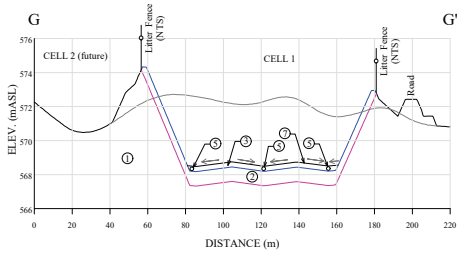
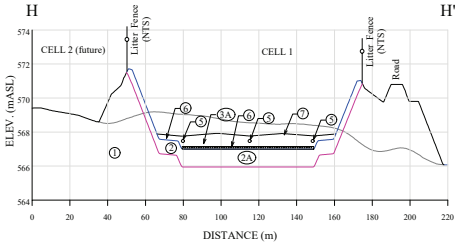




LEGEND
- FINAL SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.2m)
- LITTER FENCE



LEGEND
- FINAL DESIGN SURFACE
- COMPACTED CLAY SURFACE
- ROUGH GRADE SURFACE
- EXISTING GROUND SURFACE

1. UNDISTURBED CLAY SOILS -UPPER 150mm SCARIFIED & COMPACTED
2. 850mm COMPACTED CLAY LINER
2A. 1050mm COMPACTED CLAY LINER -BENEATH SUMP
3. 300mm FREE DRAINING GRAVEL -ON BASE
3A. 800mm FREE DRAINING GRAVEL -IN SUMP
3B. 300mm FREE DRAINING GRAVEL -EXTENDING FULL SLOPE 5m FROM CORNER
4. 75mm HDPE LEACHATE MONITORING PIPE -LOWERMOST 1m PERFORATED
5. 150mm HDPE LEACHATE COLLECTION PIPING -PERFORATED ALONG BASE
6. 200mm HDPE LEACHATE WITHDRAWAL PIPING -PERFORATED HEADER ALONG BASE
7. GEOTEXTILE OVERLAY

WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
AS NOTED	WM566.3	WM566.3-D6

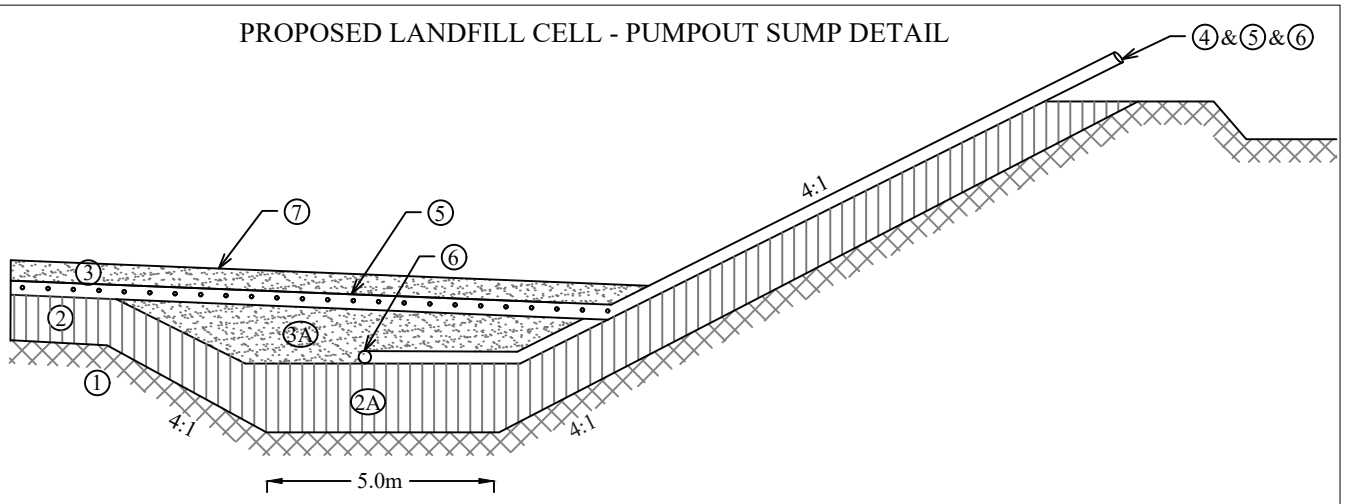
CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LANDFILL SITE - CELL 1 CROSS SECTIONS

WM566.3 Site Plan Feb 2024 EIS.dwg

PROPOSED LANDFILL CELL - PUMPOUT SUMP DETAIL



① UNDISTURBED CLAY SOILS
-UPPER 150mm SCARIFIED & COMPACTED

② 850mm COMPACTED CLAY LINER

2A 1050mm COMPACTED CLAY LINER
-BENEATH SUMP

③ 300mm FREE DRAINING GRAVEL
-ON BASE

3A 800mm FREE DRAINING GRAVEL
-IN SUMP

3B 300mm FREE DRAINING GRAVEL
-EXTENDING FULL SLOPE 5m FROM CORNER

④ 75mm HDPE LEACHATE MONITORING PIPE
-LOWERMOST 1m PERFORATED

⑤ 150mm HDPE LEACHATE COLLECTION PIPING
-PERFORATED ALONG BASE

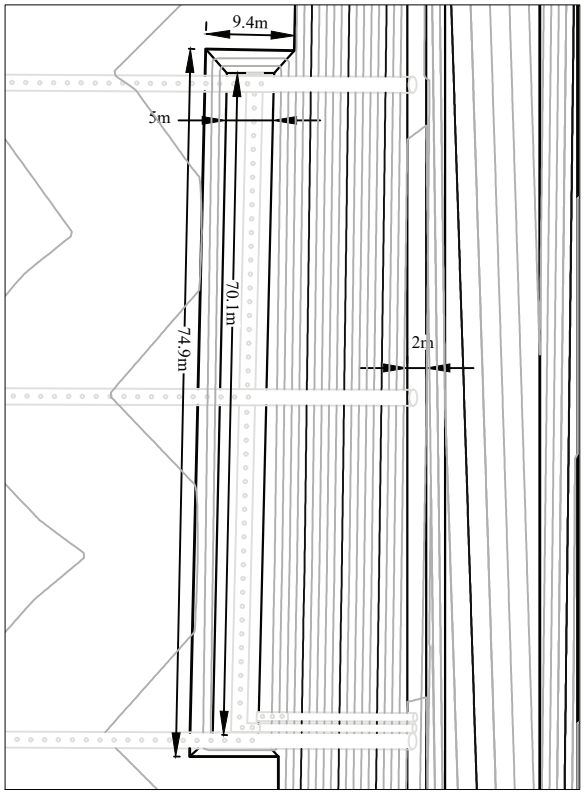
⑥ 200mm HDPE LEACHATE WITHDRAWAL PIPING
-PERFORATED HEADER ALONG BASE

⑦ GEOTEXTILE OVERLAY

SCALE: NTS

NOTE: SEE APPENDIX O FOR CONSTRUCTION SPECIFICATIONS.

SUMP DETAIL



SCALE: 1:800

LEGEND

—— CLAY SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.2m)

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	AS NOTED	WM566.3	WM566.3-D7

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LANDFILL CELLS- SUMP DETAILS

APPENDIX E CIVIL ENGINEERING DRAWINGS: SURFACE WATER MANAGEMENT

WaterMark CONSULTING LTD.

X-TERRA Environmental Services Ltd.

WM566.3-E1	LIST OF DRAWINGS - SURFACE WATER MANAGEMENT
WM566.3-E2	SITE GRADING PLAN
WM566.3-E3	PROPOSED RUNOFF POND A - FINAL SURFACE
WM566.3-E4	PROPOSED RUNOFF POND A - CUT/FILL
WM566.3-E5	PROPOSED RUNOFF POND A - CROSS SECTIONS
WM566.3-E6	PROPOSED RUNOFF POND B - FINAL SURFACE
WM566.3-E7	PROPOSED RUNOFF POND B - CROSS SECTIONS

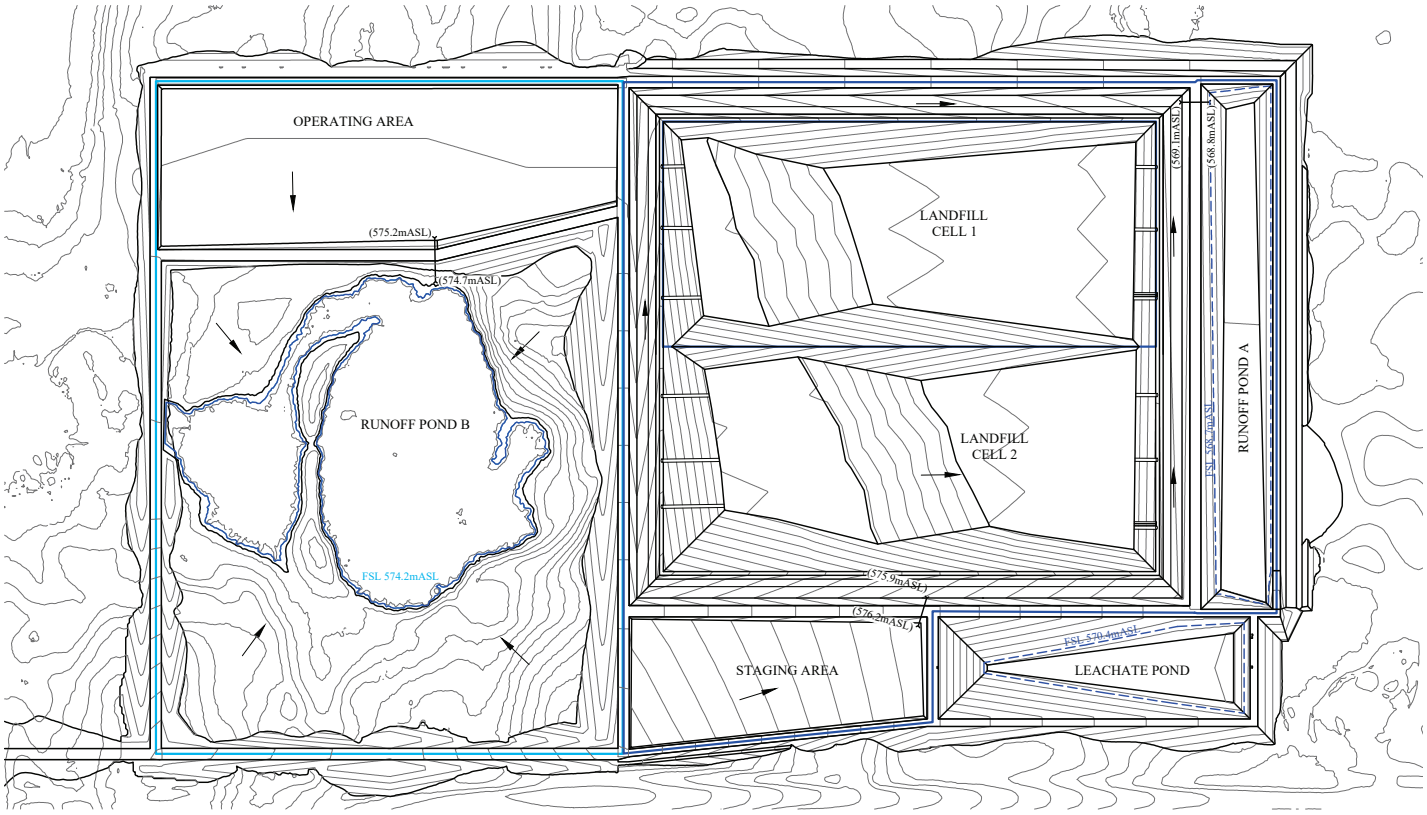
DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	NTS	WM566.3	WM566.3-E1

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: LIST OF DRAWINGS - SURFACE WATER MANAGEMENT



LEGEND

- FINAL SURFACE TOPOGRAPHY CONTOUR (C.I. = 1.0m)
- POND A CATCHMENT AREA- 108,100m²
- POND B CATCHMENT AREA- 88,350m²
- DRAINAGE DIRECTION
- CULVERT (Invert Elev.)

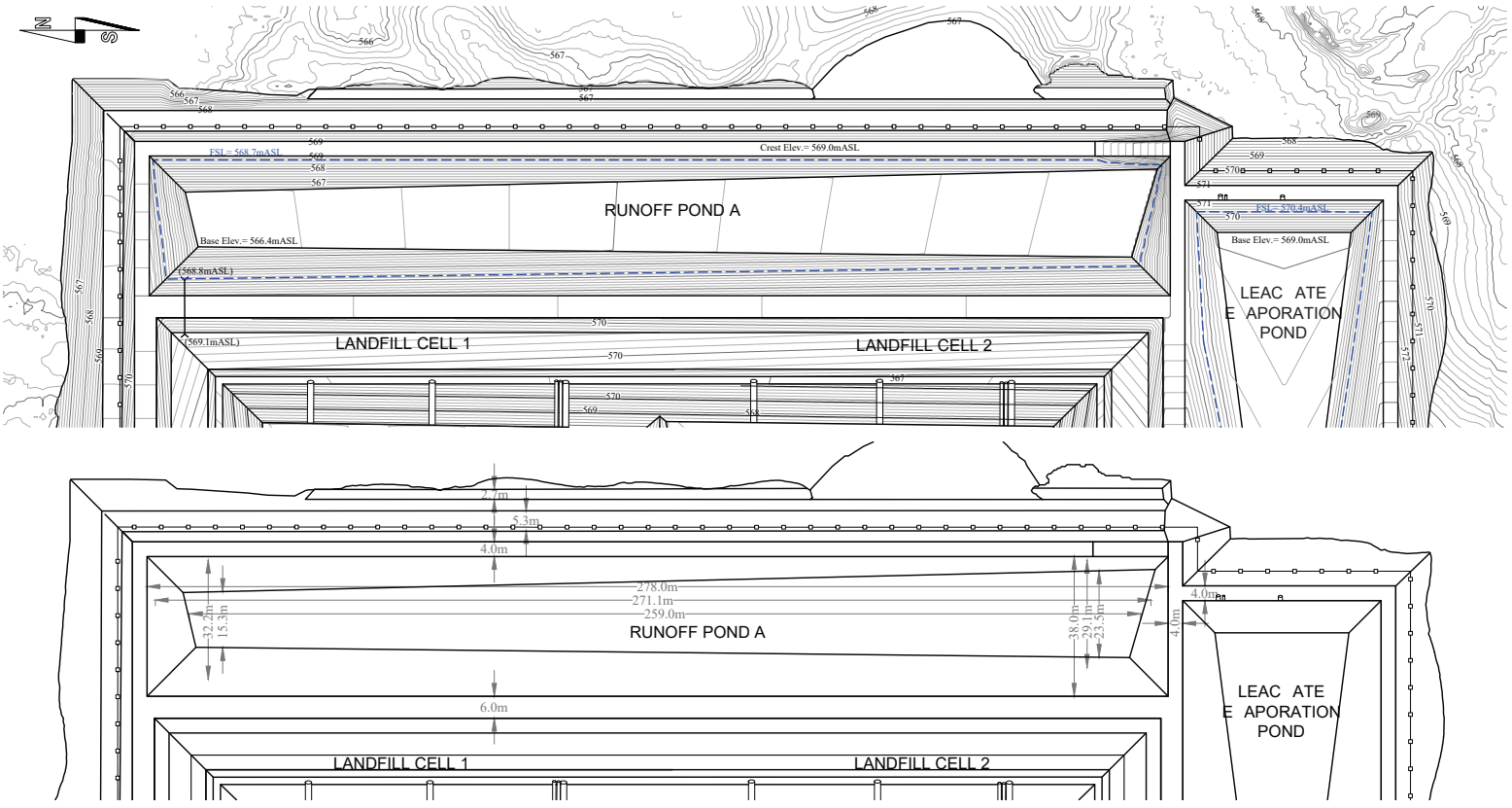
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:2,000	WM566.3	WM566.3-E2

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: SITE GRADING PLAN



LEGEND

- FINAL SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.2m)
- FSL CONTOUR
- PERIMETER FENCE
- CULVERT (Invert Elev.)

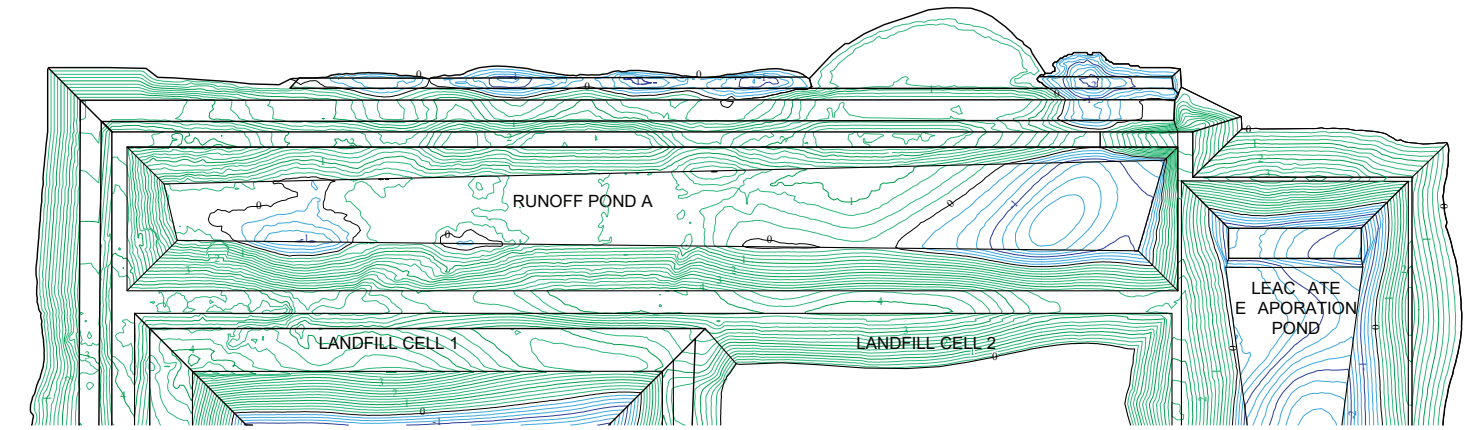
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:1,000	WM566.3	WM566.3-E3

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED RUNOFF POND A - FINAL SURFACE



LEGEND

ISOPACH CONTOUR SHOWING CUT (-ve) THICKNESS (C.I.=0.25m)

ISOPACH CONTOUR SHOWING FILL (+ve) THICKNESS (C.I.=0.25m)

WaterMark CONSULTING LTD.

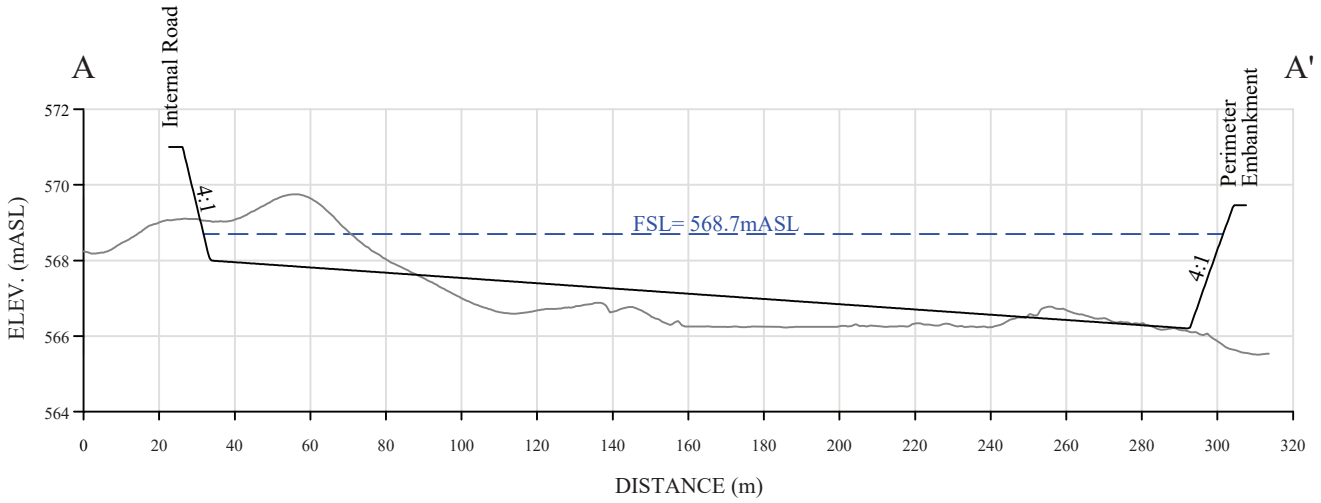
DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:1,000	WM566.3	WM566.3-E4

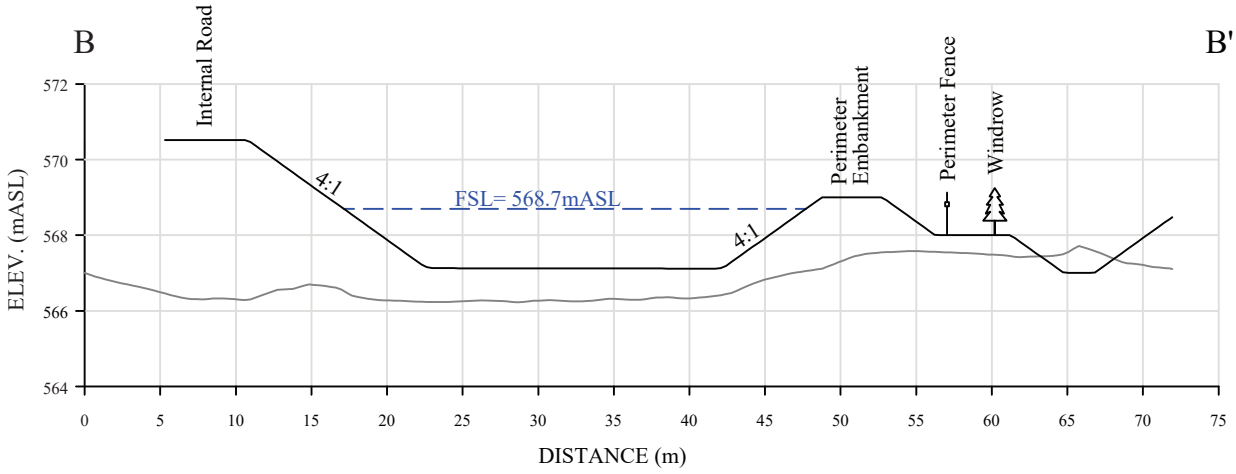
CLIENT: INVERGORDON LANDFILL INC.

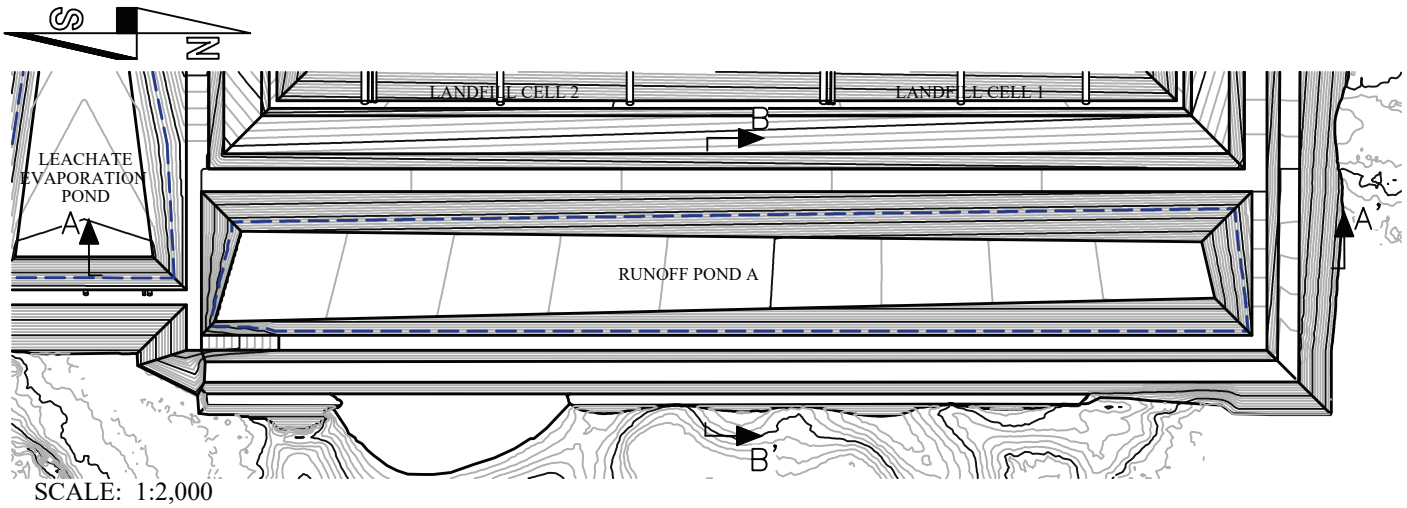
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED RUNOFF POND A - CUT/FILL

WM566 Site Plan Feb 2024 EIS.dwg







SCALE: 1:2,000

LEGEND

- FINAL DESIGN SURFACE
- ORIGINAL TOPOGRAPHY (C.I.=0.2m)
- FSL = 568.7mASL

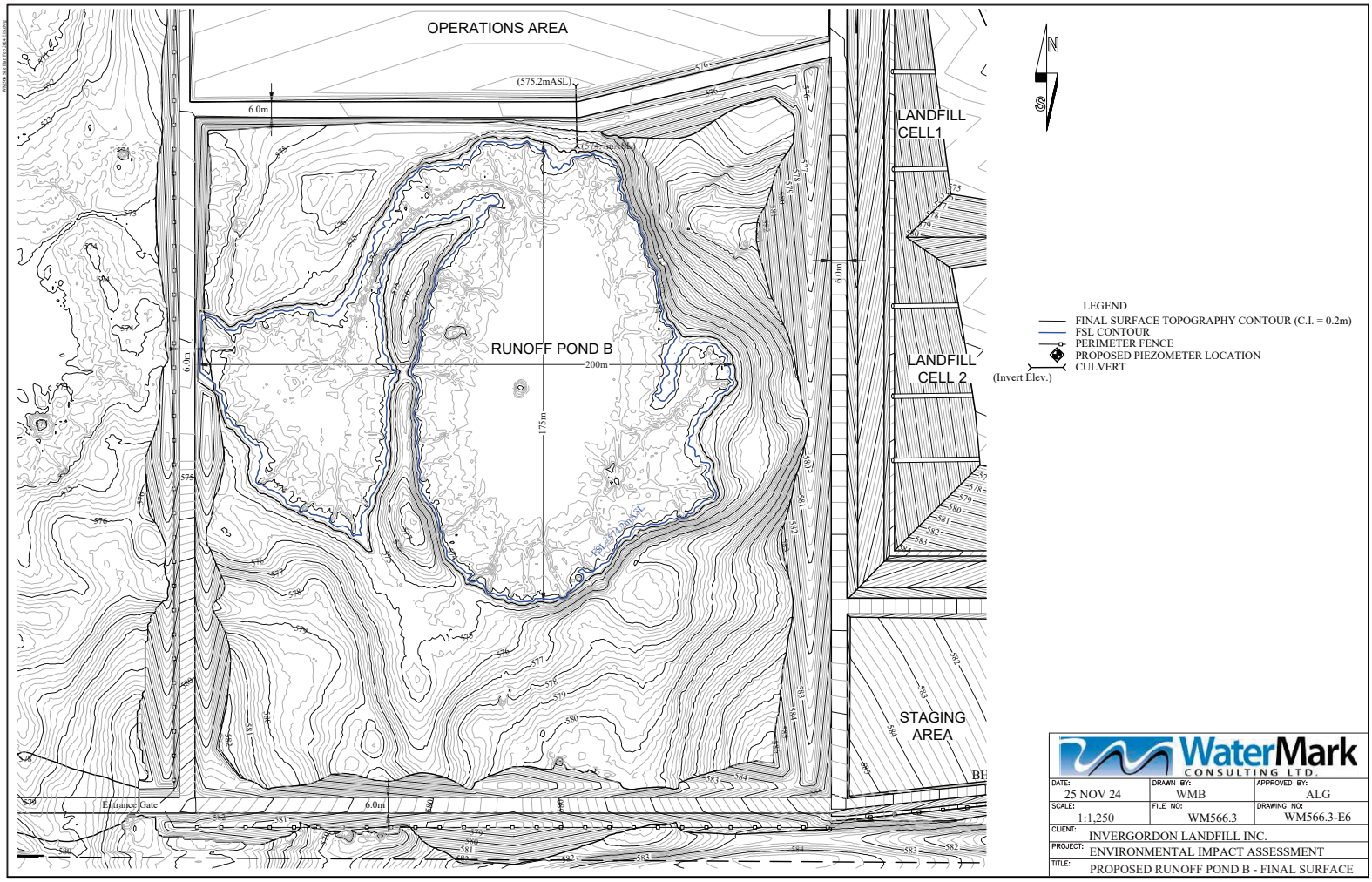
DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	AS NOTED	WM566.3	WM566.3-E5

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED RUNOFF POND A - CROSS SECTIONS



WaterMark CONSULTING LTD.

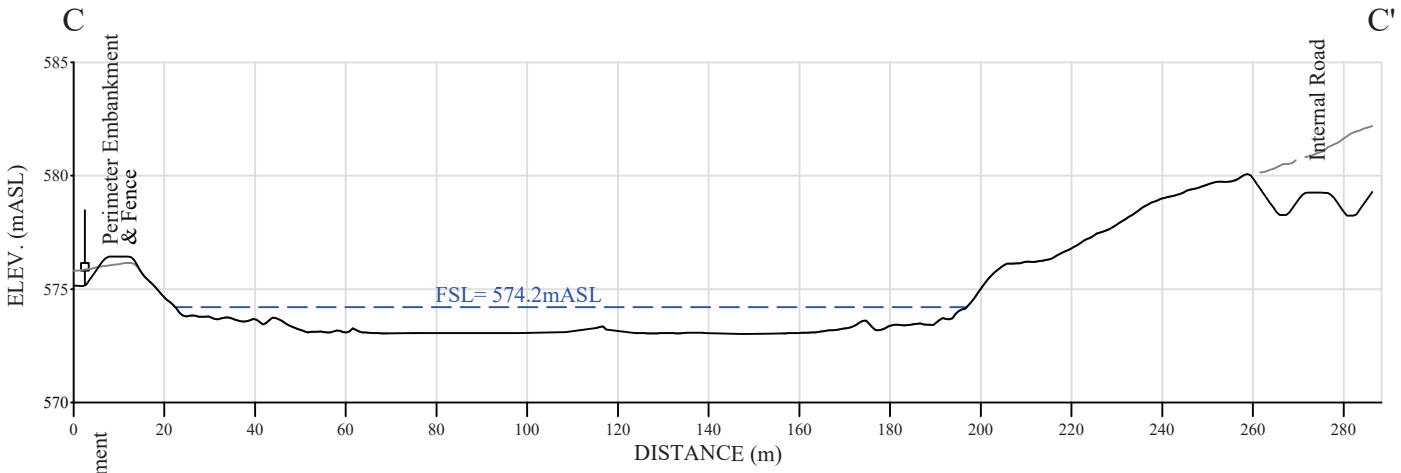
DATE:	DRAWN BY:	APPROVED BY:
25 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:1,250	WM566.3	WM566.3-E6

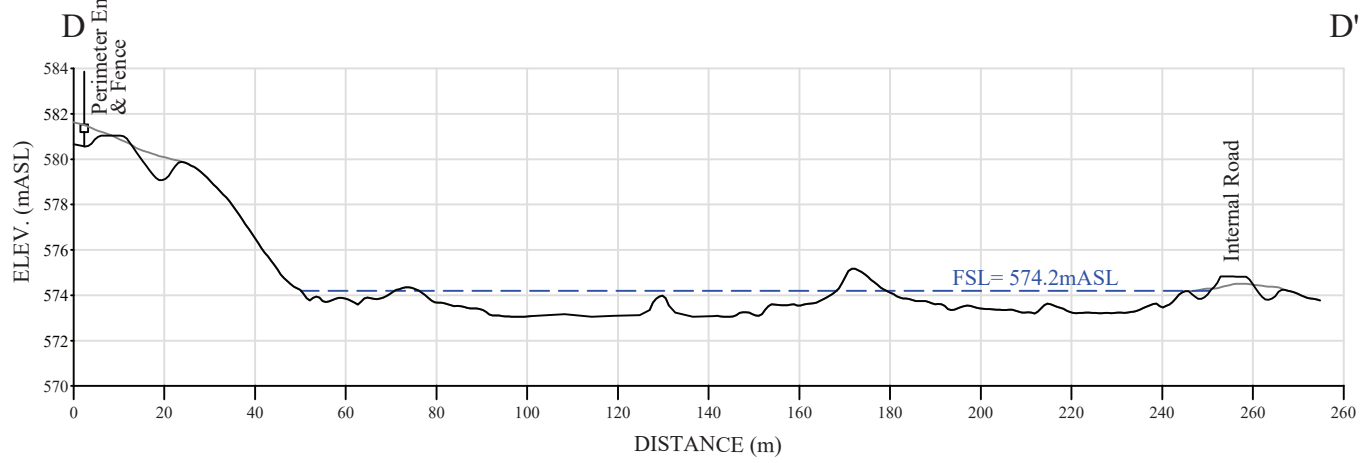
CLIENT: INVERGORDON LANDFILL INC.

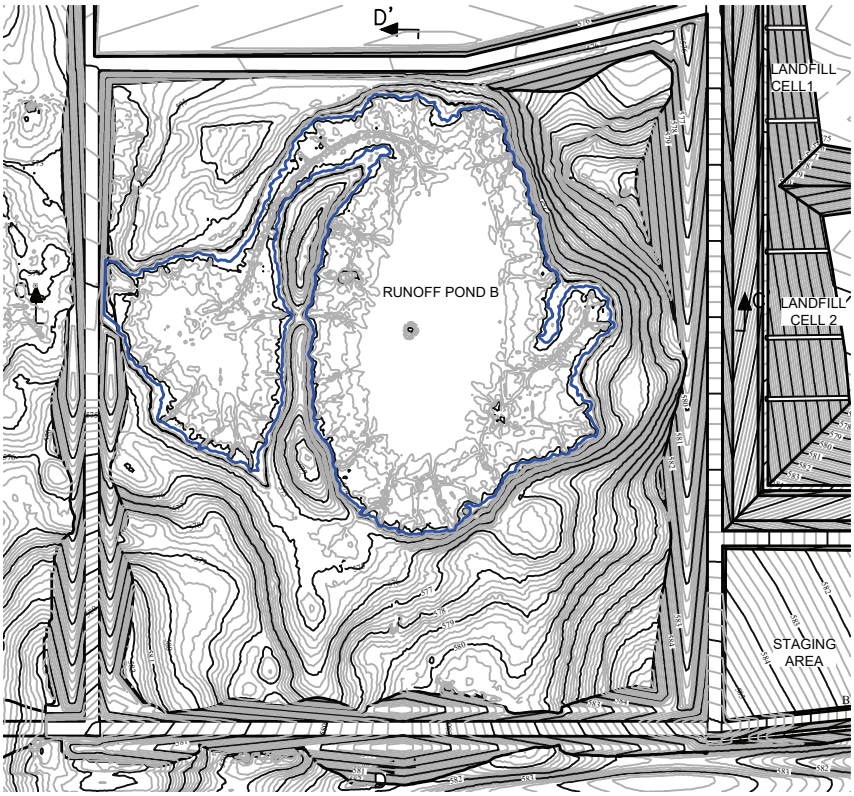
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED RUNOFF POND B - FINAL SURFACE

WM566 Site Plan Feb 2024 EIS.dwg







LEGEND

FINAL DESIGN SURFACE

ORIGINAL TOPOGRAPHY (C.I.=0.2m)

SCALE: 1:3,000

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
25 NOV 24	WMB	ALG	AS NOTED	WM566.3	WM566.3-E7

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED RUNOFF POND B - CROSS SECTIONS

APPENDIX F CIVIL ENGINEERING DRAWINGS: LEACHATE POND

WaterMark CONSULTING LTD.

X-TERRA Environmental Services Ltd.

WM566.3-F1	LIST OF DRAWINGS - LEACHATE EVAPORATION POND
WM566.3-F2	PROPOSED LEACHATE EVAPORATION POND - FINAL SURFACE
WM566.3-F3	PROPOSED LEACHATE EVAPORATION POND - CLAY SURFACE
WM566.3-F4	PROPOSED LEACHATE EVAPORATION POND - ROUGH GRADE
WM566.3-F5	PROPOSED LEACHATE EVAPORATION POND - PIPING
WM566.3-F6	PROPOSED LEACHATE EVAPORATION POND - CROSS SECTIONS
WM566.3-F7	PROPOSED LEACHATE EVAPORATION POND - SUMP DETAILS

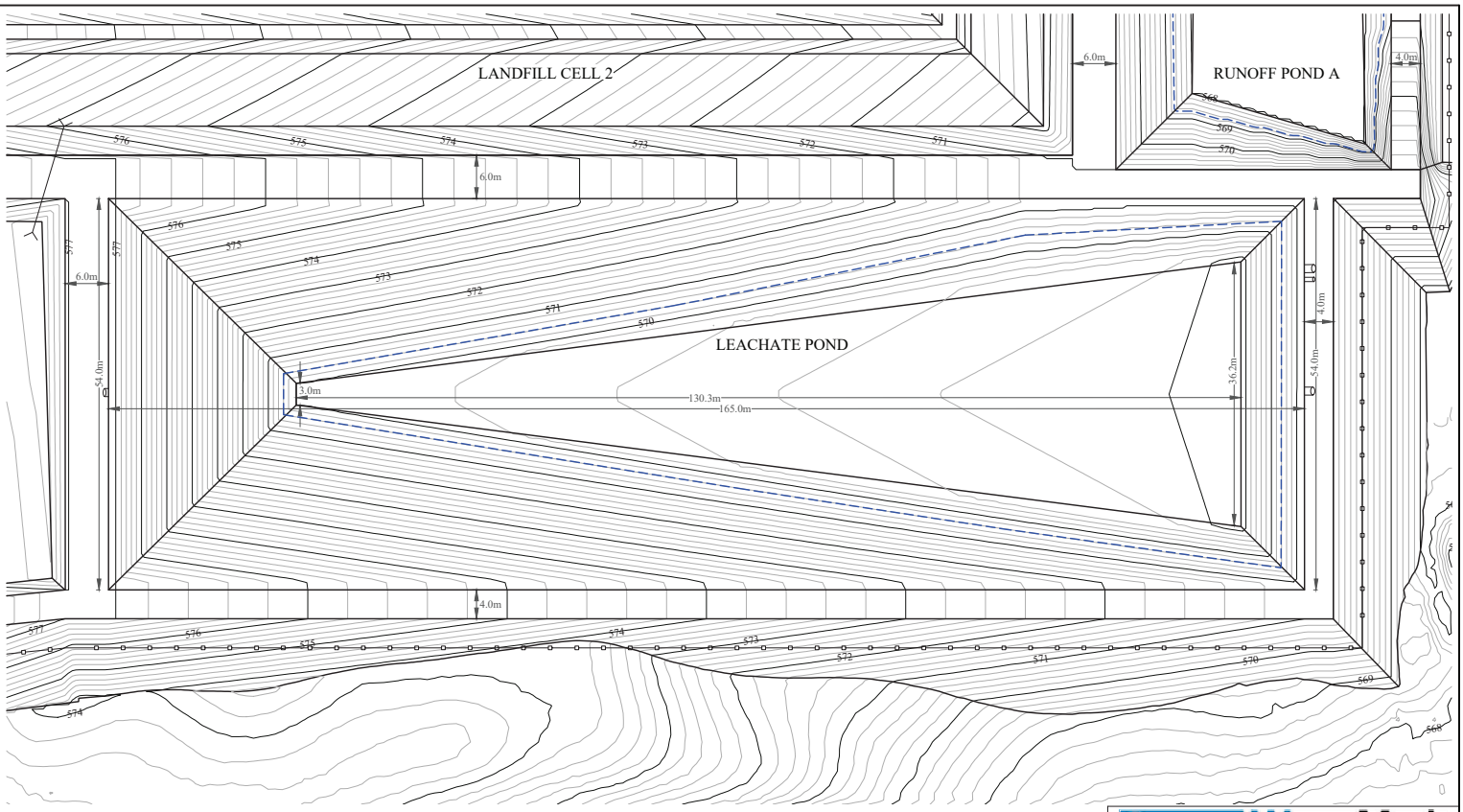
DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
15 NOV 24	WMB	ALG	NTS	WM566.3	WM566.3-F1

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL LTD.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: LIST OF DRAWINGS - LEACHATE EVAPORATION POND



LEGEND

- FINAL SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.2m)
- FSL CONTOUR (mASL)
- PERIMETER FENCE

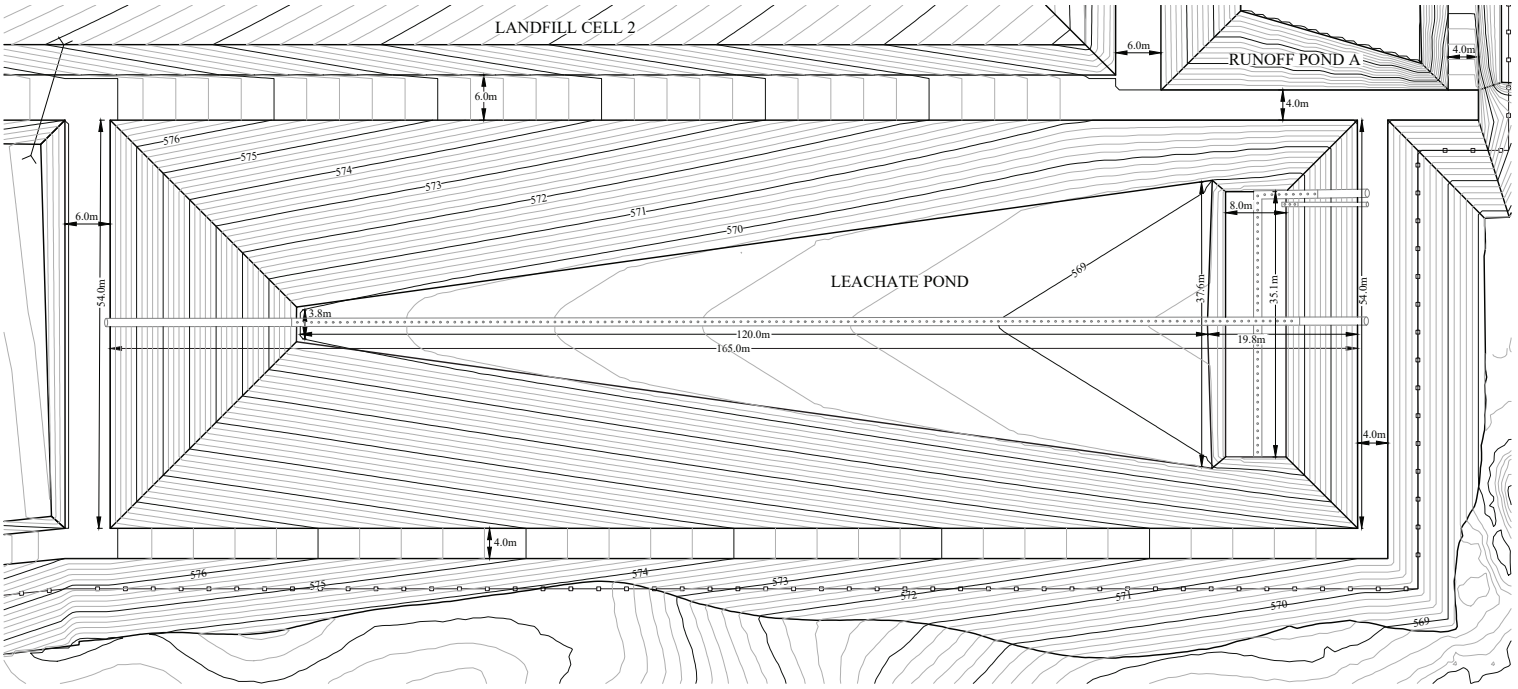
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
07 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:500	WM566.3	WM566.3-F2

CLIENT: INVERGORDON LANDFILL LTD.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LEACHATE POND - FINAL SURFACE



LEGEND

—— CLAY SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.2m)

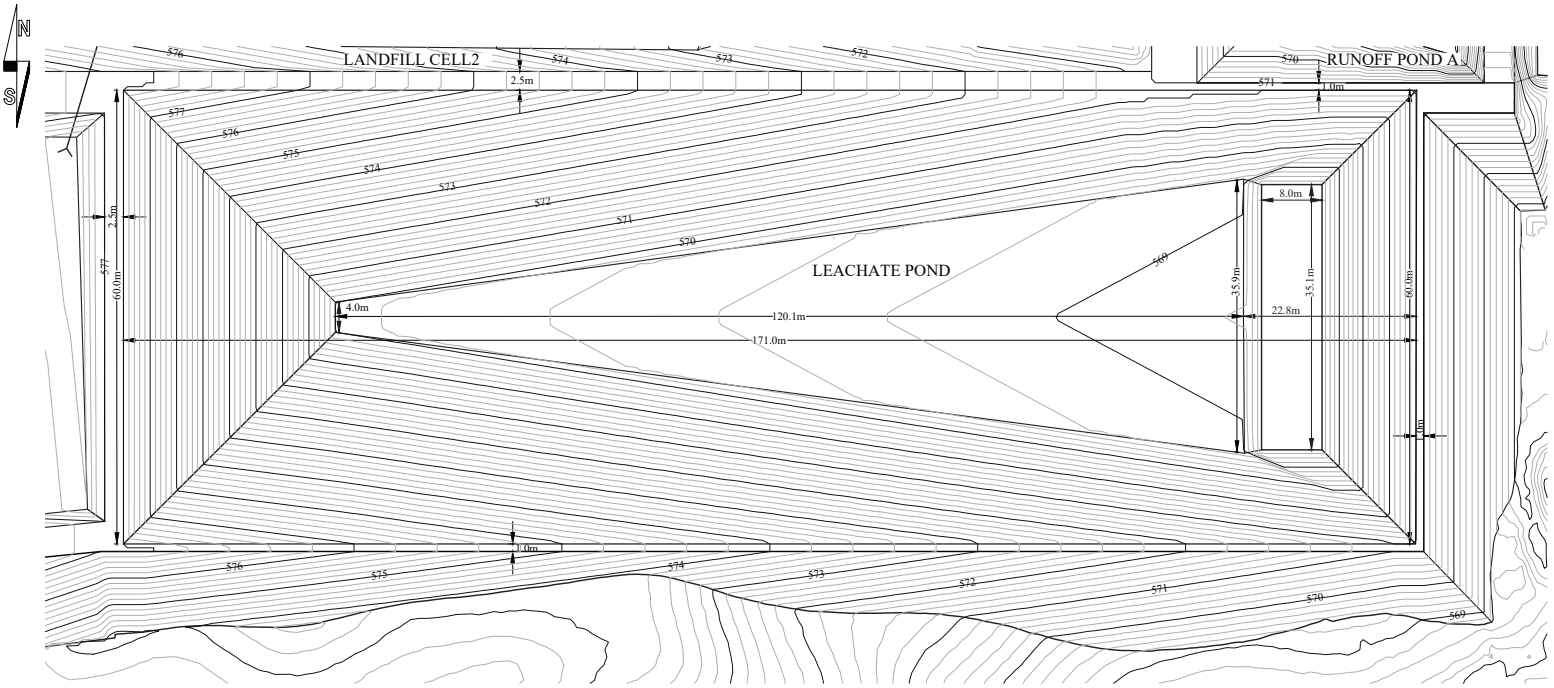
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
07 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:500	WM566.3	WM566.3-F3

CLIENT: INVERGORDON LANDFILL LTD.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LEACHATE POND - CLAY SURFACE



LEGEND

—— ROUGH GRADE SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.2m)

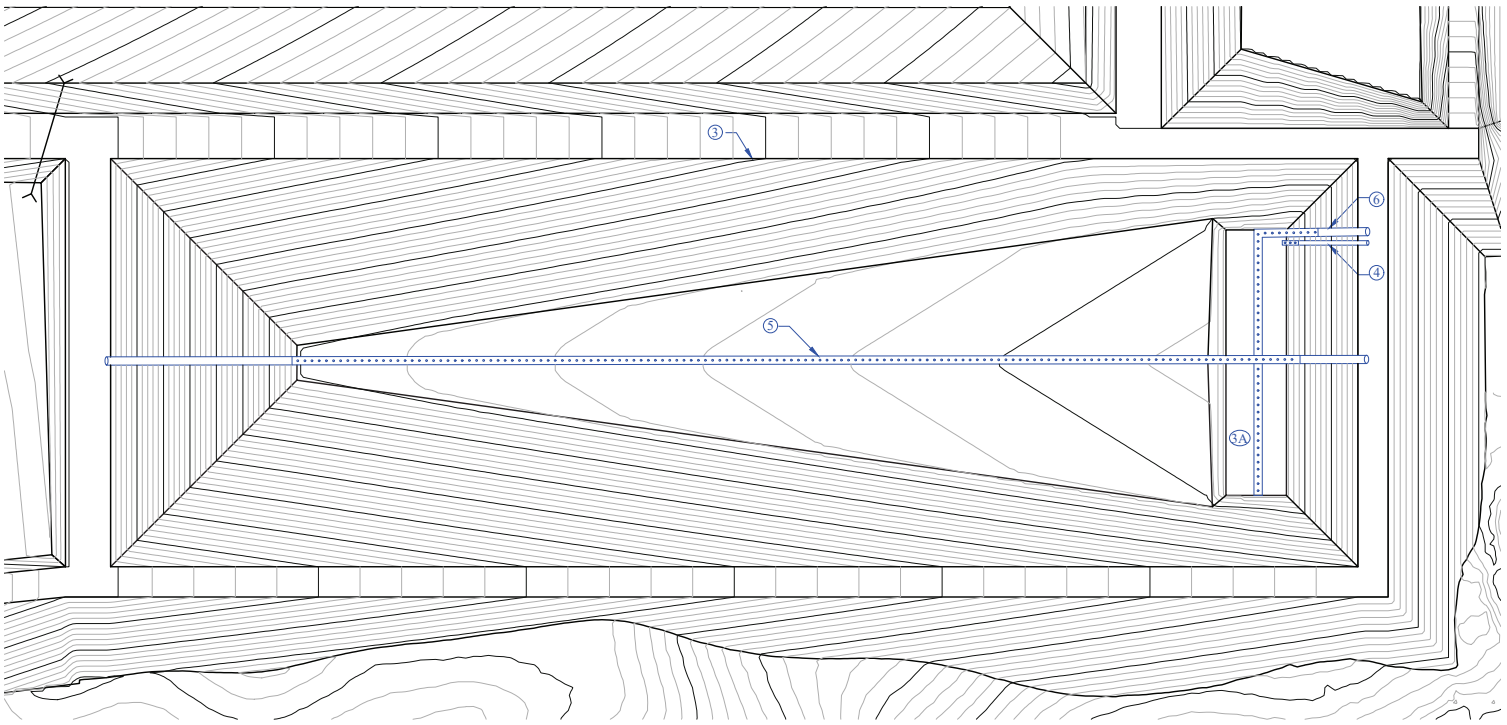
WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
12 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:500	WM566.3	WM566.3-F4

CLIENT: INVERGORDON LANDFILL LTD.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LEACHATE POND - ROUGH GRADE



1. UNDISTURBED CLAY SOILS
   -UPPER 150mm SCARIFIED & COMPACTED
2. 850mm COMPACTED CLAY LINER
2A. 1050mm COMPACTED CLAY LINER
   -BENEATH SUMP
3. 300mm FREE DRAINING GRAVEL
   -ON BASE AND EXTENDING UP ALL SIDE SLOPES
3A. 800mm FREE DRAINING GRAVEL
   -IN SUMP
4. 75mm HDPE LEACHATE MONITORING PIPE
   -LOWERMOST 1m PERFORATED
5. 150mm HDPE LEACHATE COLLECTION PIPING
   -PERFORATED ALONG BASE
6. 200mm HDPE LEACHATE WITHDRAWAL PIPING
   -PERFORATED HEADER ALONG BASE
7. GEOTEXTILE OVERLAY
8. 60mil HDPE GEOMEMBRANE

LEGEND

—— CLAY SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.2m)

NOTE: SEE APPENDIX O FOR CONSTRUCTION SPECIFICATIONS.

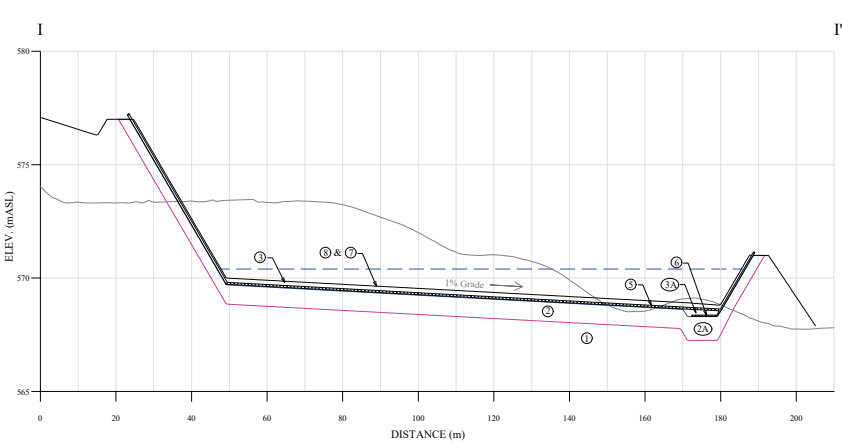
WaterMark CONSULTING LTD.

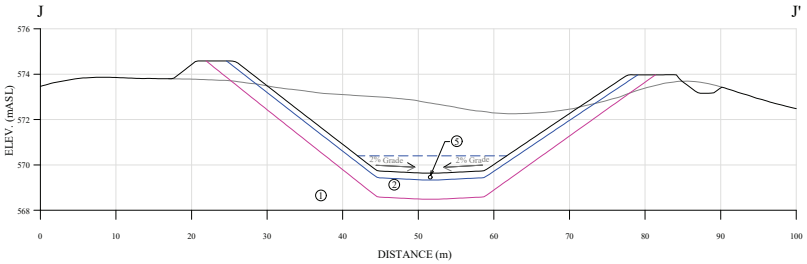
DATE:	DRAWN BY:	APPROVED BY:
15 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
1:500	WM566.3	WM566.3-F5

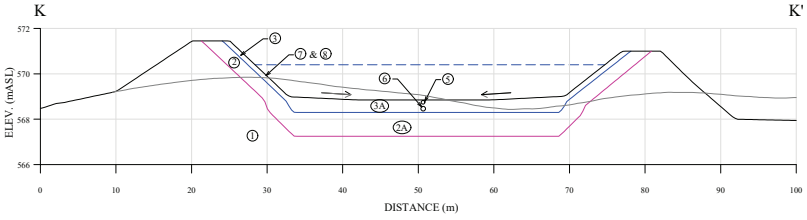
CLIENT: INVERGORDON LANDFILL LTD.

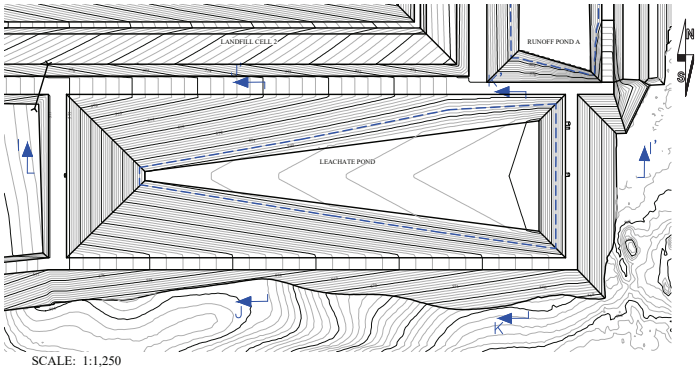
PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LEACHATE POND - PIPING









SCALE: 1:1,250

LEGEND

FINAL SURFACE TOPOGRAPHY CONTOUR (C.I. = 0.2m)

FSL = 570.4m

1. UNDISTURBED CLAY SOILS
   -UPPER 150mm SCARIFIED & COMPACTED
2. 850mm COMPACTED CLAY LINER
2A. 1050mm COMPACTED CLAY LINER
   -BENEATH SUMP
3. 300mm FREE DRAINING GRAVEL
   -ON BASE AND EXTENDING UP ALL SIDE SLOPES
3A. 800mm FREE DRAINING GRAVEL
   -IN SUMP
4. 75mm HDPE LEACHATE MONITORING PIPE
   -LOWERMOST 1m PERFORATED
5. 150mm HDPE LEACHATE COLLECTION PIPING
   -PERFORATED ALONG BASE
6. 200mm HDPE LEACHATE WITHDRAWAL PIPING
   -PERFORATED HEADER ALONG BASE
7. GEOTEXTILE OVERLAY
8. 60mil HDPE GEOMEMBRANE

NOTE: SEE APPENDIX O FOR CONSTRUCTION SPECIFICATIONS.

LEGEND

FINAL DESIGN SURFACE

COMPACTED CLAY SURFACE

ROUGH GRADE SURFACE

FSL = 570.4m

WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
05 MAR 25	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
AS NOTED	WM566.3	WM566.3-F6

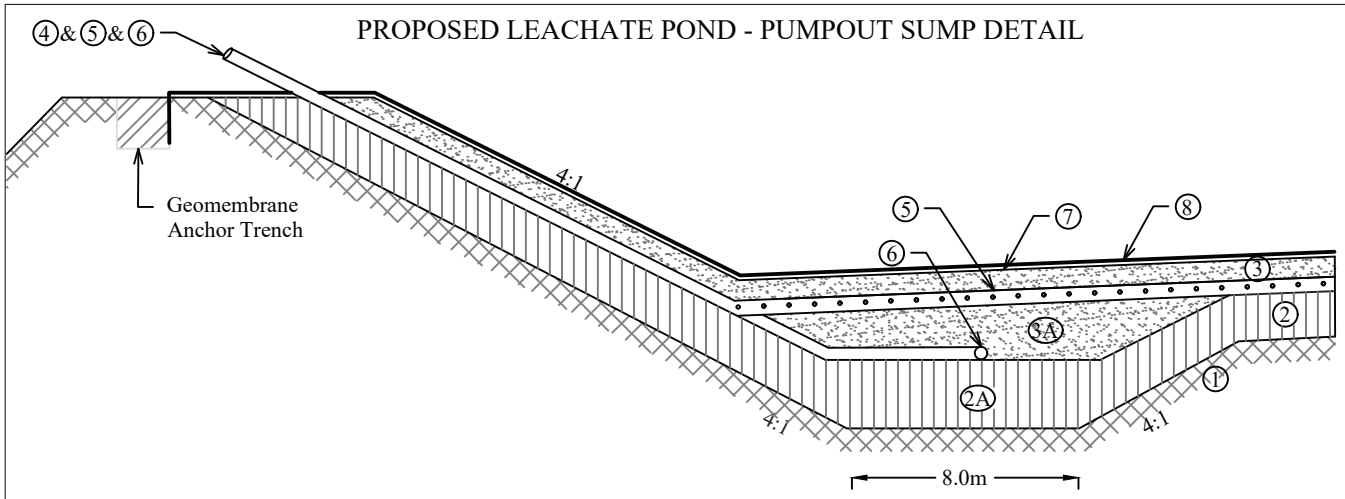
CLIENT: INVERGORDON LANDFILL INC.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LEACHATE EVAPORATION POND - CROSS SECTIONS

WM566.3 Site Plan Feb 2024 EIS.dwg

PROPOSED LEACHATE POND - PUMPOUT SUMP DETAIL



① UNDISTURBED CLAY SOILS
-UPPER 150mm SCARIFIED & COMPACTED

② 850mm COMPACTED CLAY LINER

2A 1050mm COMPACTED CLAY LINER
-BENEATH SUMP

③ 300mm FREE DRAINING GRAVEL
-ON BASE AND EXTENDING UP ALL SIDES SLOPES

3A 800mm FREE DRAINING GRAVEL
-IN SUMP

④ 75mm HDPE LEACHATE MONITORING PIPE
-LOWERMOST 1m PERFORATED

⑤ 150mm HDPE LEACHATE COLLECTION PIPING
-PERFORATED ALONG BASE

⑥ 200mm HDPE LEACHATE WITHDRAWAL PIPING
-PERFORATED HEADER ALONG BASE

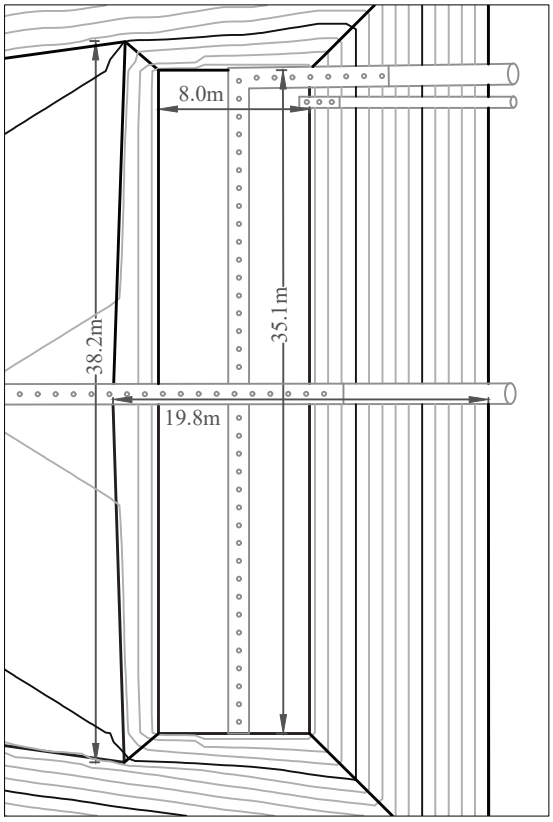
⑦ GEOTEXTILE OVERLAY

⑧ 60mil HDPE GEOMEMBRANE

SCALE: NTS

NOTE: SEE APPENDIX O FOR CONSTRUCTION SPECIFICATIONS.

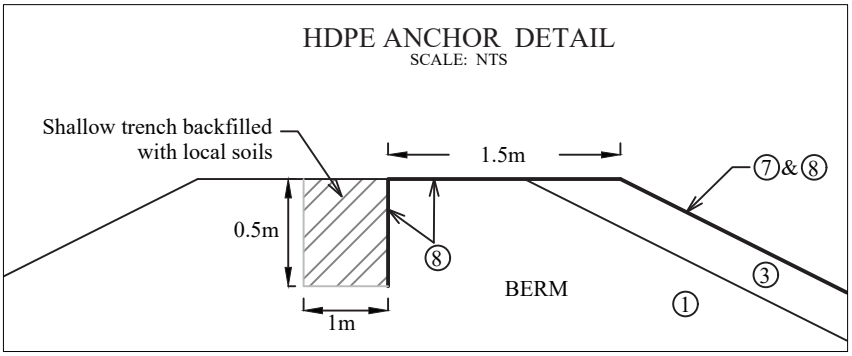
SUMP DETAIL



SCALE: 1:400

HDPE ANCHOR DETAIL

SCALE: NTS



LEGEND

—— CLAY SURFACE TOPOGRAPHY CONTOUR
(C.I. = 0.2m)

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
15 NOV 24	WMB	ALG	NTS	WM566.3	WM566.3-F7

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL LTD.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: PROPOSED LEACHATE POND - SUMP DETAILS

APPENDIX G CONSTRUCTION SPECIFICATIONS

DATE:	DRAWN BY:	APPROVED BY:	SCALE:	FILE NO:	DRAWING NO:
01 NOV 24	WMB	ALG	NTS	WM566.3	WM566.3-G1

WaterMark CONSULTING LTD.

CLIENT: INVERGORDON LANDFILL LTD.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: LIST OF DRAWINGS -CONSTRUCTION SPECS.

1.0 GENERAL

1.1 WORK INCLUDED
- .1 TOPSOIL STRIPPING & STOCKPILING OF WORKING AREA.
- .2 CONSTRUCTION OF PERIMETER EMBANKMENT AROUND THE DEVELOPMENT AREA INCLUDING DITCHING AS REQUIRED.
- .3 CONSTRUCTION OF INTERNAL ROADWAYS AND SITE ACCESS ROAD INCLUDING CULVERTS AND DITCHING.
- .4 GRADING OF OPERATIONS AREA.
- .5 GRADING OF LANDFILLING AREA INCLUDING PERIMETER PAD AND PERIMETER BERM.
- .6 GRADING OF HOLDING POND A AND HOLDING POND B.
- .7 CONSTRUCTION OF LANDFILL CELL 1 & LANDFILL CELL 2, INCLUDING CONSTRUCTION OF COMPACTED CLAY LINERS, INSTALLATION OF LEACHATE COLLECTION AND WITHRAWAL PIPING AND PLACEMENT OF DRAINAGE AGGREGATE.
- .8 CONSTRUCTION OF LEACHATE EVAPORATION POND, INCLUDING CONSTRUCTION OF COMPACTED CLAY LINER, INSTALLATION OF LEACHATE COLLECTION AND WITHDRAWAL PIPING, PLACEMENT OF DRAINAGE AGGREGATE, AND INSTALLATION OF GEOSYNTHETIC LINER.
- .9 CONSTRUCTION OF PERIMETER FENCING.
- .10 CONSTRUCTION OF LITTER FENCING.
- .11 PLANTING WINDROW ALONG EASTERN SITE BOUNDARY AND ON THE EASTERN HALF OF THE NORTH AND WEST SITE.

1.2 DEFINITIONS
- .1 TOPSOIL: ORGANIC SOIL CAPABLE OF SUPPORTING GOOD VEGETATION GROWTH AND SUITABLE FOR USE IN TOP DRESSING, LANDSCAPING AND SEEDING.
- .2 COMMON EXCAVATION: EXCAVATION OF SOILS OF WHATEVER NATURE, INCLUDING DENSE TILL, HARDPAN, FROZEN MATERIALS, AND PARTIALLY CEMENTED SOILS WHICH CAN BE RIPPED AND EXCAVATED WITH HEAVY CONSTRUCTION EQUIPMENT.
- .3 WASTE MATERIAL: MATERIAL UNSUITABLE FOR USE IN WORK OR SURPLUS TO ACHIEVE REQUIREMENTS.
- .4 BORROW MATERIAL: MATERIAL OBTAINED FROM AREAS OUTSIDE RIGHT-OF-WAY AND REQUIRED FOR CONSTRUCTION OF EMBANKMENTS OR FOR OTHER PORTIONS OF WORK.
- .5 EMBANKMENT: MATERIAL DERIVED FROM USEABLE EXCAVATION AND PLACED ABOVE ORIGINAL GROUND OR STRIPPED SURFACE UP TO SUBGRADE ELEVATION.
- .6 SUBGRADE ELEVATION: ELEVATION IMMEDIATELY BELOW ENGINEERED SOIL STRUCTURE.

1.3 QUALITY CONTROL/QUALITY ASSURANCE TESTING
- .1 DEFINITIONS
  - .1 QUALITY CONTROL IS DEFINED AS ACTIONS TAKEN BY THE CONTRACTOR OR SUPPLIER TO PROVIDE CONTROL OVER WHAT IS BEING DONE AND WHAT IS BEING PROVIDED SO THAT APPLICABLE STANDARDS OF GOOD PRACTICE FOR THE WORK ARE FOLLOWED.
  - .2 QUALITY ASSURANCE IS DEFINED AS ACTIONS TAKEN BY THE OWNER OR HIS REPRESENTATIVE TO PROVIDE ASSURANCE THAT WHAT IS BEING DONE AND WHAT IS BEING PROVIDED ARE IN ACCORDANCE WITH THE APPLICABLE STANDARDS OF GOOD PRACTICE FOR THE WORK.
- .2 QUALITY CONTROL TESTING FREQUENCY MINIMUM TESTING REQUIREMENTS
  - .1 BERMS & SITE FILL.
    - .1 MINIMUM ONE COMPACTION TEST (ASTM D-6938) FOR EVERY 1000m² FOR EACH 150mm LIFT.
    - .2 STANDARD PROCTOR (ASTM D-698) TESTS AS REQUIRED.
  - .2 COMPACTED CLAY LINER:
    - .1 MINIMUM ONE COMPACTION TEST (ASTM D-6938) FOR EVERY 800m² FOR EACH 150mm LIFT.
    - .2 STANDARD PROCTOR (ASTM D-698) TESTS AS REQUIRED.
  - .3 TRENCH BACKFILL:
    - .1 MINIMUM ONE COMPACTION TEST (ASTM D-6938) FOR EVERY TWO HOURS OF TRENCH BACKFILL ACTIVITIES.
  - .3 IN ALL LOCATIONS WHERE INITIAL TEST RESULTS FAIL TO MEET THE SPECIFIED REQUIREMENTS:
    - .1 THE SAMPLE SHALL BE RETESTED IMMEDIATELY.
    - .2 ENGINEER SHALL BE NOTIFIED IMMEDIATELY OF WORKMANSHIP WHICH DOES NOT COMPLY TO THE SPECIFICATIONS AND/OR STANDARDS OF QUALITY SPECIFIED.
    - .3 THE AREA THAT FAILS BOTH INITIAL AND SUPPLEMENTARY TESTING SHALL BE SCARIFIED, MOISTURE CONDITIONED (IF NECESSARY), MIXED, RECOMPACTED, AND RETESTED UNTIL THE COMPACTION TESTING PASSES THE RECOMMENDED SPECIFICATIONS.

1.4 COMMUNICATION:
- .1 THE ENGINEER SHALL BE NOTIFIED:
  - .1 TWO WEEKS PRIOR TO MOBILIZING TO SITE.
  - .2 WHEN SITE ACTIVITIES CHANGE, INCLUDING, BUT NOT LIMITED TO:
    - .1 ONCE AN AREA HAS BEEN STRIPPED OF TOPSOIL AND PRIOR TO EXCAVATION OR PLACEMENT OF FILL FOR INSPECTION PURPOSES.
    - .2 ONCE AN AREA HAS BEEN EXCAVATED TO ROUGH GRADE ELEVATIONS AND PRIOR TO PLACEMENT OF ANY SUBSEQUENT FILL FOR INSPECTION PURPOSES.
    - .3 WHEN FINAL GRADE ELEVATIONS ARE ACHIEVED FOR INSPECTION PURPOSES.
  - .3 WHEN SOIL OR SITE CONDITIONS VARY FROM THOSE ANTICIPATED.
  - .4 WHEN COMPACTION TESTING FAILS TO ACHIEVE SPECIFICATION REQUIREMENTS.
  - .5 WHEN CLARIFICATION ON THE DESIGN OR CONTRACT DETAILS ARE REQUIRED.

2.0 SITE DEMOLITION AND REMOVAL

2.1 SITE PREPARATION & DEMOLITION
- .1 INSPECT SITE AND VERIFY EXTENT AND LOCATIONS OF ITEMS DESIGNATED FOR REMOVAL, DISPOSAL, ALTERNATIVE DISPOSAL, RECYCLING, SALVAGE, AND ITEMS TO REMAIN.
- .2 LOCATE AND PROTECT UTILITIES, PRESERVE ACTIVE UTILITIES TRAVERSING SITE IN OPERATING CONDITION.
- .3 PROTECT EXISTING ITEMS & INFRASTRUCTURE DESIGNATED TO REMAIN AND ITEMS DESIGNATED FOR SALVAGE. IN EVENT OF DAMAGE TO ITEMS, IMMEDIATELY REPLACE OR MAKE REPAIRS TO THE APPROVAL OF ENGINEER AT NO COST TO OWNER.
- .4 REMOVE AND STORE MATERIALS TO BE SALVAGED, IN MANNER TO PREVENT DAMAGE.
- .5 ENSURE THAT SELECTIVE DEMOLITION WORK DOES NOT ADVERSELY AFFECT ADJACENT WATERCOURSES, GROUNDWATER AND WILDLIFE, OR CONTRIBUTE TO EXCESS AIR AND NOISE POLLUTION.

2.2 WASTE MANAGEMENT AND DISPOSAL
- .1 SEPARATE WASTE MATERIALS FOR REUSE AND RECYCLING.
- .2 HANDLE AND DISPOSE OF HAZARDOUS MATERIALS IN ACCORDANCE WITH CEPA, TDGA, REGIONAL AND MUNICIPAL REGULATIONS.
- .3 DO NOT DISPOSE OF WASTE OF VOLATILE MATERIALS INCLUDING BUT NOT LIMITED TO MINERAL SPIRITS, OIL, PETROLEUM BASED LUBRICANTS, OR TOXIC CLEANING SOLUTIONS INTO WATERCOURSES, STORM, OR SANITARY SEWERS.
- .4 DO NOT PUMP WATER CONTAINING SUSPENDED MATERIALS INTO WATERCOURSES, STORM, OR SANITARY SEWERS, OR ONTO ADJACENT PROPERTIES.
- .5 CONTROL DISPOSAL OR RUNOFF OF WATER CONTAINING SUSPENDED MATERIALS OR OTHER HARMFUL SUBSTANCES IN ACCORDANCE WITH LOCAL AUTHORITIES.

3.0 TOPSOIL STRIPPING & STOCKPILING

3.1 GENERAL
- .1 NOTIFY ENGINEER WHEN CONDITIONS VARY FROM THOSE ANTICIPATED.

3.2 EXCAVATION
- .1 STRIP ALL TOPSOIL AND ORGANIC SOILS OVER FOOTPRINT OF PROPOSED DEVELOPMENT.
- .2 TOPSOIL OR ORGANIC SOILS SHALL NOT BE USED AS COMMON FILL AND SHOULD BE HANDLED AND STORED SEPARATELY.
- .3 STOCKPILE TOPSOIL AS DIRECTED BY ENGINEER.

4.0 COMMON EXCAVATION

4.1 GENERAL
- .1 NOTIFY ENGINEER WHENEVER UNSUITABLE MATERIALS ARE ENCOUNTERED AND REMOVE UNSUITABE MATERIALS TO DEPTH AND EXTENT AS DIRECTED.
- .2 DISPOSE OF WASTE MATERIAL AS DIRECTED BY ENGINEER.

4.2 EXECUTION
- .1 WHERE INDICATED OR DIRECTED BY ENGINEER, EXCAVATE THE SOIL TO THE DEPTHS &/OR ELEVATIONS SPECIFIED.
- .2 EXISTING BURIED UTILITIES AND STRUCTURES:
  - .1 SIZE, DEPTH AND LOCATION OF EXISTING UTILITIES AND STRUCTURES AS INDICATED ARE FOR GUIDANCE ONLY. COMPLETENESS AND ACCURACY ARE NOT GUARANTEED.
  - .2 PRIOR TO COMMENCING EXCAVATION WORK, NOTIFY APPLICABLE OWNER OR AUTHORITIES HAVING JURISDICTION TO CONFIRM LOCATION AND STATE OF USE OF BURIED UTILITIES.
  - .3 MAINTAIN AND PROTECT FROM DAMAGE, WATER, SEWER, GAS ELECTRIC, TELEPHONE AND OTHER UTILITIES AND STRUCTURES ENCOUNTERED AS INDICATED.
  - .4 WHERE UTILITY LINES OR STRUCTURES EXIST IN AREA OF EXCAVATION, OBTAIN DIRECTION OF ENGINEER BEFORE REMOVING OR RE-ROUTING.
  - .5 RECORD LOCATION OF MAINTAINED, REROUTED, AND ABANDONED UNDERGROUND LINES.
- .3 EXCAVATE TO LINES, GRADES, ELEVATIONS AND DIMENSIONS AS INDICATED AS DIRECTED BY ENGINEER.

5.0 COMMON / EMBANKMENT FILL

5.1 MATERIALS
- .1 COMMON FILL / EMBANKMENT FILL MAYBE ANY COMPETENT LOCALLY DERIVED CLAY RICH OR GRANULAR SOIL THAT WILL PACK FORMING A COMPETENT SURFACE.
- .2 ENSURE MATERIAL UTILIZED IS THAWED (NOT FROZEN) AND FREE FROM ROCKS LARGER THAN 100 mm CINDER, ASH, SOD, REFUSE, OR OTHER DELETERIOUS MATERIALS.
- .3 NOTIFY ENGINEER WHENEVER UNSUITABLE MATERIALS ARE ENCOUNTERED.
  - .1 REMOVE AND DISPOSE OF UNSUITABLE MATERIALS TO DEPTH AND EXTENT AS DIRECTED BY ENGINEER.

5.2 EXECUTION
- .1 PRIOR TO PLACING AND COMPACTING ANY FILL, PROOF ROLL THE SUBGRADE SURFACE TO ENSURE SOFT OR MOIST SOILS DO NOT OCCUR ON SURFACE.
  - .1 IF DETECTED, OVER-EXCAVATE THESE SOILS AND REPLACE WITH SUITABLE FILL, COMPACTED IN PLACE.
- .2 SCARIFY AND RECOMPACT TOP 150mm OF SUBGRADE PRIOR TO PLACEMENT OF ANY LOOSE FILL.
- .3 CONSTRUCT AN EMBANKMENT USING SUCCESSIVE LIFTS OF SOIL PLACED, MIXED, MOISTURE CONDITIONED AND COMPACTED IN PLACE.
- .4 EACH SUCCESSIVE LIFT OF SOIL SHALL CONSIST OF A LOOSE PLACEMENT OF SUITABLE SOIL IN THICKNESSES NO MORE THAN 200 mm THICK, MEASURED IN LOOSE STATE.
- .5 IF REQUIRED, LOOSE SOIL SHALL BE MOISTURE CONDITIONED TO ACHIEVE THE MOISTURE CONTENT SPECIFICATIONS.
- .6 THE LOOSE SOIL SHALL BE SCARIFIED TO BREAK UP SOIL CLODS AND TO FULLY MIX THE SOIL TO CREATE A HOMOGENOUS SOIL WITH A UNIFORM MOISTURE CONTENT.
- .7 ROCKS GREATER THAN 100 mm IN DIAMETER SHALL BE REMOVED PRIOR TO COMPACTING THE SOILS.
- .8 COMPACTION SHALL OCCUR USING A SHEEPSFOOT TYPE COMPACTING ROLLER OR OTHER COMPACTOR APPROVED BY THE ENGINEER.
- .9 COMPACTION OF EACH SOIL LIFT SHALL BE KNEADED WITH PREVIOUS LIFTS FORMING A BOND BETWEEN LIFTS AND EXHIBIT UNIFORM PROFILE WITH LITTLE EVIDENCE OF HORIZONTAL STRATIFICATION.
- .10 DO NOT PLACE MATERIAL WHICH IS FROZEN OR PLACE MATERIALS ON FROZEN SURFACES.
- .11 MAINTAIN A CROWNED SURFACE DURING CONSTRUCTION TO ENSURE READY RUN-OFF OF SURFACE WATER.
- .12 COMPACTION SPECIFICATIONS FOR COMMON FILL:
  - .1 MOISTURE CONTENT: -2% TO +3% OF OPTIMUM MOISTURE CONTENT
  - .2 MINIMUM DRY DENSITY: 95% MAXIMUM DRY DENSITY (ASTM D698-78 / AASHTO T99-74)

6. ENGINEERED COMPACTED CLAY LINER

6.1 MATERIALS
- .1 SELECTED CLAY RICH SOIL FROM EXCAVATION OR OTHER SOURCES, APPROVED BY ENGINEER FOR USE INTENDED.
- .2 ENSURE MATERIAL UTILIZED IS THAWED (NOT FROZEN) AND FREE FROM ROCKS LARGER THAN 75 mm, CINDER, ASH, SOD, REFUSE, OR OTHER DELETERIOUS MATERIALS.

6.2 EXECUTION
- .1 REMOVE OBSTRUCTIONS, ICE AND SNOW, FROM SURFACES TO BE CONSTRUCTED WITHIN LIMITS INDICATED.
- .2 PROTECT FILL MATERIALS FROM CONTAMINATION.
- .3 PROTECT OPEN EXCAVATIONS AGAINST FLOODING AND DAMAGE DUE TO SURFACE RUN-OFF.
- .4 PRIOR TO PLACING AND COMPACTING ANY FILL, PROOF ROLL THE SUBGRADE SURFACE TO ENSURE SOFT OR MOIST SOILS DO NOT OCCUR ON SURFACE.
  - .1 IF DETECTED, OVER-EXCAVATE THESE SOILS AND REPLACE WITH SUITABLE FILL COMPACTED IN PLACE.
- .2 SCARIFY AND RECOMPACT TOP 150mm OF SUBGRADE PRIOR TO PLACEMENT OF ANY LOOSE FILL.
- .3 CONSTRUCT AN EMBANKMENT USING SUCCESSIVE LIFTS OF SOIL PLACED, MIXED, MOISTURE CONDITIONED AND COMPACTED IN PLACE.
- .4 EACH SUCCESSIVE LIFT OF SOIL SHALL CONSIST OF A LOOSE PLACEMENT OF SUITABLE SOIL IN THICKNESSES NO MORE THAN 200 mm THICK, MEASURED IN LOOSE STATE.
- .5 IF REQUIRED, LOOSE SOIL SHALL BE MOISTURE CONDITIONED TO ACHIEVE THE MOISTURE CONTENT SPECIFICATIONS.
- .6 THE LOOSE SOIL SHALL BE SCARIFIED TO BREAK UP SOIL CLODS AND TO FULLY MIX THE SOIL TO CREATE A HOMOGENOUS SOIL WITH A UNIFORM MOISTURE CONTENT.
- .7 ROCKS GREATER THAN 75 mm IN DIAMETER SHALL BE REMOVED PRIOR TO COMPACTING THE SOILS.
- .8 COMPACTION SHALL OCCUR USING A SHEEPSFOOT TYPE COMPACTING ROLLER OR OTHER COMPACTOR APPROVED BY THE ENGINEER. THE COMPACTOR SHALL HAVE GROUND PRESSURE NOT LESS THAN 2,400kPa.
- .9 COMPACTION OF EACH SOIL LIFT SHALL BE KNEADED WITH PREVIOUS LIFTS FORMING A BOND BETWEEN LIFTS AND EXHIBIT UNIFORM PROFILE WITH LITTLE EVIDENCE OF HORIZONTAL STRATIFICATION.
- .10 DO NOT PLACE MATERIAL WHICH IS FROZEN OR PLACE MATERIALS ON FROZEN SURFACES.
- .11 MAINTAIN A CROWNED SURFACE DURING CONSTRUCTION TO ENSURE READY RUN-OFF OF SURFACE WATER.

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.12 COMPACTION SPECIFICATIONS FOR COMPACTED CLAY LINER:
.1 MOISTURE CONTENT: -2% TO +3% OF OPTIMUM MOISTURE CONTENT
.2 MINIMUM DRY DENSITY: 98% MAXIMUM DRY DENSITY (ASTM D698-78 / AASHTO T99-74)

7.0 TRENCH EXCAVATIONS / BACKFILL

7.1 GENERAL
.1 NOTIFY ENGINEER WHENEVER UNSUITABLE MATERIALS ARE ENCOUNTERED AND REMOVE UNSUITABLE MATERIALS TO DEPTH AND EXTENT AS DIRECTED.
.2 DISPOSE OF WASTE OR EXCESS MATERIAL AS DIRECTED BY ENGINEER.

7.2 EXECUTION
.1 EXCAVATION MUST NOT INTERFERE WITH BEARING CAPACITY OF ADJACENT FOUNDATIONS.
.2 AVOID EXCAVATION BELOW GROUNDWATER TABLE IF QUICK CONDITION OR HEAVE IS LIKELY TO OCCUR. PREVENT PIPING OR BOTTOM HEAVE OF EXCAVATIONS BY GROUNDWATER LOWERING, SHEET PILE CUT-OFFS, OR OTHER MEANS.
.3 PROTECT OPEN EXCAVATIONS AGAINST FLOODING AND DAMAGE DUE TO SURFACE RUN-OFF.
.4 FOR TRENCH EXCAVATION, UNLESS OTHERWISE AUTHORIZED BY ENGINEER IN WRITING, DO NOT EXCAVATE MORE THAN 30m OF TRENCH IN ADVANCE OF INSTALLATION OPERATIONS AND DO NOT LEAVE OPEN MORE THAN 15m AT END OF DAY OPERATION.
.5 KEEP EXCAVATED AND STOCKPILED MATERIALS A SAFE DISTANCE AWAY FROM EDGE OF TRENCH.
.6 RESTRICT VEHICLE OPERATIONS DIRECTLY ADJACENT OPEN EXCAVATIONS.
.7 DO NOT OBSTRUCT FLOW OF SURFACE DRAINAGE OR NATURAL WATERCOURSES.
.8 BOTTOMS OF EXCAVATIONS TO BE UNDISTURBED SOIL, FREE FROM LOOSE, SOFT OR ORGANIC MATTER.
.9 CORRECT UNAUTHORIZED OVER-EXCAVATION AT NO COST TO OWNER.
.10 ENSURE THE SOIL USED FOR BACKFILLING IS FREE FROM DEBRIS, SNOW, ICE, WATER AND FROZEN GROUND.
.11 PLACE BACKFILL MATERIAL IN UNIFORM LAYERS NOT EXCEEDING 150 MM COMPACTED THICKNESS UP TO GRADES INDICATED.
.13 BACKFILLING AROUND INSTALLATIONS.
.1 PLACE AND COMPACT GRANULAR MATERIAL FOR BEDDING AND SURROUND OF UNDERGROUND SERVICES.
.2 DO NOT BACKFILL AROUND OR OVER CAST-IN-PLACE CONCRETE WITHIN 24 HOURS AFTER PLACING OF CONCRETE.
.3 PLACE LAYERS SIMULTANEOUSLY ON BOTH SIDES OF INSTALLED WORKS TO EQUALIZE LOADING.
.14 PROVIDE IN-SITU DENSITY TESTS AS DIRECTED BY ENGINEER TO CONFIRM COMPACTION OF BEDDING SAND AND TRENCH BACKFILL. THE FREQUENCY SHOULD GENERALLY BE ON A PER DAY DEPENDING ON QUANTITY OF BACKFILL.

8.0 TOPSOIL TREATMENT & SEEDING

8.1 GENERAL
.1 NOTIFY ENGINEER WHEN CONDITIONS VARY FROM THOSE ANTICIPATED.
.2 UTILIZE A NATURAL SEED MIXTURE THAT HAS BEEN APPROVED BY THE ENGINEER FOR USE.

8.2 EXECUTION
.1 ENSURE SOIL SURFACE TO BE TOPSOILED IS AT PROPER GRADES AND HAS BEEN SMOOTHED AND PREPARED.
.2 PLACE TOPSOIL IN THE SPECIFIED THICKNESS.
.3 SCARIFY AND LEVEL THE PLACED TOPSOIL WITH MINIMAL COMPACTION.
.4 DISTRIBUTE AND INCORPORATE SEEDS THROUGH THE TOPSOIL PROFILE.
.5 MOISTURE CONDITION THE SOIL AS DIRECTED BY ENGINEER.
.6 2 WEEKS FOLLOWING SEEDING OF THE SITE, RESEED AREAS THAT HAVE NOT GERMINATED, AT NO SUBSEQUENT CHARGE TO THE OWNER.

9.0 AGGREGATES

9.1 DRAINAGE GRAVEL
.1 GRADATION OF DRAINAGE GRAVEL SHALL BE WITHIN THE LIMITS SET FORTH IN THE FOLLOWING TABLE:

SIEVE SIZE	PERCENT PASSING
50 mm	100%
25 mm	60-90%
12 mm	0-5%

.2 ROUNDED WASHED ROCK FREE OF ORGANIC OR OTHER DELETERIOUS MATERIALS.
.3 AGGREGATE SHOULD BE FREE OF ANGULAR ROCK FACES AS APPROVED BY THE ENGINEER.

9.2 TIRE DERIVED AGGREGATE (TDA)
.1 GRADATION OF TDA SHALL BE COARSE SHRED.

9.3 RIPRAP
.1 TYPE I RIPRAP GRADATION SHALL BE:
1 NOMINAL SIZE – 250mm DIAMETER
2 100% PASSING 300mm
3 0% PASSING 50mm
.2 TYPE II RIPRAP GRADATION SHALL BE:
1 NOMINAL SIZE – 150mm DIAMETER
2 100% PASSING 200mm
3 0-5% PASSING 50mm
.3 CLAY BEARING ROCKS (SHALE) ARE UNACCEPTABLE.
.4 UNDERLAY RIPRAP WITH 8 oz NONWOVEN GEOTEXTILE FABRIC.

9.4 TRAFFIC GRAVEL
.1 TRAFFIC GRAVEL SHALL BE PLACED IN THICKNESS OF ABOUT 45mm (+/- 5 mm) OVER THE WIDTH OF THE ROADWAY MINUS 1.0m (0.5m ON EITHER SHOULDER).
.2 THE TRAFFIC GRAVEL SHALL BE INCORPORATED EVENLY INTO THE UPPER 75 mm OF THE FINISHED ROADWAY SURFACE AND PACKED IN PLACE USING A SMOOTH DRUM ROLLER, PNEUMATIC TIRED ROLLER, OR METHOD APPROVED BY ENGINEER.
.3 GRADATION SHALL CONFORM WITH SASKATCHEWAN HIGHWAYS & TRANSPORTATION TYPE 31 BASE COURSE:

SIEVE SIZE	PERCENT PASSING
31.5 mm	100%
16 mm	75-90%
5 mm	40-69%
0.5 mm	17-32%
80 µm	6-11%
Plasticity Index	0 – 7%
Fracture Face	50% min
Los Angeles Fraction	35% max

9.5 BEDDING SAND
.1 GRADATION OF BEDDING SAND SHALL BE WITHIN THE LIMITS SET FORTH IN THE FOLLOWING TABLE:

SIEVE SIZE	PERCENT PASSING
10.0 mm	100
5.0 mm	95-100
0.63 mm	25-60
80 µm	0-3

.2 BEDDING SAND SHALL BE COMPACTED TO 95% STANDARD PROCTOR DENSITY.

9.6 PEA GRAVEL
.1 GRADATION OF PEA GRAVEL SHALL BE WITHIN THE LIMITS SET FORTH IN THE FOLLOWING TABLE:

SIEVE SIZE	PERCENT PASSING
10.0 mm	100
5.0 mm	90-100
0.5 mm	5-15
80 µm	0-3

10.0 GEOTEXTILE

10.1 PRODUCTS
.1 NON-WOVEN GEOTEXTILE SYNTHETIC FIBRE FABRIC SHALL BE A GEOTEX 801 MANUFACTURED BY PROPEX GEOSYNTHETIC OR APPROVED EQUAL. ANY SUBSTITUTE GEOTEXTILE MATERIAL MUST BE APPROVED BY THE ENGINEER PRIOR TO PLACEMENT.
.2 WOVEN GEOTEXTILE SYNTHETIC FIBRE FABRIC CAN BE SUBSTITUTED FOR NONWOVEN GEOTEXTILE ONLY IF THE UNDERLYING AGGREGATE IS TDA AND NOT DRAINAGE GRAVEL. WOVEN GEOTEXTILE SHALL BE A GEOTEX 801 MANUFACTURED BY PROPEX GEOSYNTHETIC OR APPROVED EQUAL. ANY SUBSTITUTE GEOTEXTILE MATERIAL MUST BE APPROVED BY THE ENGINEER PRIOR TO PLACEMENT.
.3 PHYSICAL PROPERTIES:
.1 GRAB TENSILE STRENGTH AND ELONGATION: TO ASTM D-4632.
.2 BREAKING FORCE: 0.9 KN
.3 ELONGATION AT FUTURE: 50%.
.4 TRAPEZOIDAL SHEAR: TO ASTM D-4533, 0.35 KN.
.5 HYDRAULIC PROPERTIES: APPARENT OPENING SIZE (AOS): TO ASTM D-4751, 0.180 MM WATER FLOW RATE TO ASTM D-4491, 1.5 PER SECOND.
.6 ROLL SIZE:
.1 WIDTH: 4.6 m MINIMUM
.2 LENGTH: 91.5 m MINIMUM

10.2 INSTALLATION
.1 PLACE GEOTEXTILE MATERIAL BY UNROLLING ONTO GRADED SURFACE IN ORIENTATION, MANNER AND LOCATIONS INDICATED.
.2 PLACE GEOTEXTILE MATERIAL SMOOTH AND FREE OF TENSION STRESS, FOLDS, WRINKLES AND CREASES.
.3 PLACE GEOTEXTILE MATERIAL ON SLOPING SURFACES IN ONE CONTINUOUS LENGTH FROM TOE OF SLOPE TO UPPER EXTENT OF GEOTEXTILE.
.4 OVERLAP EACH SUCCESSIVE STRIP OF GEOTEXTILE AT LEAST 300mm OVER PREVIOUSLY LAID STRIP.
.5 OVERLAP BUTT END OF SUBSEQUENT GEOTIXTILE ROLLS AT LEAST 600 mm.
.6 SECURE THE OVERLAPPED SEAMS USING THERMAL HEAT FUSION METHODS.
.7 PROTECT INSTALLED GEOTEXTILE MATERIAL FROM DISPLACEMENT, DAMAGE OR DETERIORATION BEFORE, DURING AND AFTER PLACEMENT OF MATERIAL LAYERS.
.8 REPLACE DAMAGED OR DETERIORATED GEOTEXTILE TO APPROVAL OF ENGINEER.

11.0 HDPE TEXTURED GEOMEMBRANE

11.1 PRODUCTS
.1 GEOMEMBRANE SHALL BE A HDPE 60 MIL MANUFACTURED BY MANUFACTURER APPROVED BY ENGINEER.
.2 ANY SUBSTITUTE HDPE GEOMEMBRANE MATERIAL MUST BE APPROVED BY THE ENGINEER PRIOR TO PLACEMENT.
.3 EXPOSED SURFACE SHALL BE TEXTURED, LOWER SURFACE MAY BE SMOOTH.

11.2 PHYSICAL PROPERTIES:
.1 THICKNESS (MIN. AVG.): 150 mm TO ASTM D-994
.2 SHEET DENSITY: 0.940 g/cc TO ASTM D-1505
.3 CARBON BLACK: 2-3% TO ASTM D-4218
.4 TENSILE STRENGTH AT BREAK: 16 kN/m TO ASTM D-6693
.5 ELONGATION AT BREAK: 100kg TO ASTM D-6693
.6 TEAR RESISTANCE: 187 N TO ASTM D-1004
.7 PUNCTURE RESISTANCE: 480 N TO ASTM D-4833

11.3 INSTALLATION
.1 SEAMING METHODS – EQUIPMENT APPROVAL PROCESSES FOR SEAMING ARE DOUBLED WEDGE FUSION WELDING FOR GENERAL SEAMING AND EXTRUSION WELDING FOR PATCHING. PROPOSED ALTERNATIVES MUST BE SUBMITTED FOR APPROVAL TO THE ENGINEER.
.2 FUSION WELDING:
.1 THE SEAM SHALL BE PRODUCED BY SELF PROPELLED WEDGE WELDING APPARATUS.
.2 THE APPARATUS SHALL BE EQUIPPED WITH GAUGES TO MONITOR WELD TEMPERATURE.
.3 WELD TEMPERATURE AND MACHINE SPEED SHALL BE VARIED ACCORDING TO AMBIENT CONDITIONS IN ORDER TO MAINTAIN AND DEMONSTRATE A CONSISTENT ACCEPTABLE WELD.
.4 ALL WELDING SURFACES SHALL BE KEPT CLEAN AND DRY.
.5 THE MEMBRANE SHALL HAVE AN OVERLAP OF APPROXIMATELY 150MM.
.6 THE AREA SHALL BE PREPARED BY WIPING THE AREA WITH A CLEAN DRY CLOTH TO REMOVE ANY FOREIGN MATTE.
.7 THE WELDER SHALL BE INSERTED AT ONE END OF THE SEAM, THEN THE PRESSURE ROLLERS ARE TO BE CLAMPED DOWN AND THE WEDGE ENGAGED AND DRIVE MOTOR TURNED ON.
.8 IF THE WELDER IS INTERRUPTED DURING THE SEAMING PROCESS, THE AREA AFFECTED SHALL BE MARKED AND REPAIRED.
.3 EXTRUSION WELDING:
.1 THE SEAM SHALL BE PRODUCED BY EXTRUDING MOLTEN RESIN AT THE EDGE OF TWO OVERLAPPED SHEETS OF GEOMEMBRANE TO AFFECT A HOMOGENEOUS BOND.
.2 THE EXTRUSION APPARATUS SHALL BE EQUIPPED WITH GAUGES TO MONITOR EXTRUDATE TEMPERATURE.
.3 TEMPERATURE AND FLOW RATE SHALL BE VARIED ACCORDING TO AMBIENT CONDITIONS TO MAINTAIN AND DEMONSTRATE A CONSISTENT ACCEPTABLE WELD.
.4 THE EXTRUDER SHALL BE PURGED OF ALL HEAT DEGRADED OR COOLED EXTRUDATE PRIOR TO THE COMMENCEMENT OF EACH SEAMING SEQUENCE.
.5 THE INSTALLER SHALL MAINTAIN AT LEAST ONE SPARE OPERABLE SEAMING UNIT OF EACH TYPE ONSITE AT ALL TIMES.
.6 THE WELD AREA SHALL BE PREPARED BY SANDING OR GRINDING TO A DEPTH OF LESS THAN .02mm IN THE SHEET SURFACE TO BE IN CONTACT WITH THE EXTRUDATE.
.7 GRINDING REQUIRED ALONG A SEAM SHALL BE DONE CONCURRENT WITH OR WITHIN TWENTY MINUTES OF THE SEAMING OPERATION AND SHALL NOT DAMAGE THE GEOMEMBRANE.
.8 MEMBRANE SHALL BE OVERLAPPED IN A MINIMUM OF 75mm PRIOR TO SEAMING.
.9 THE WELD AREA SHALL BE KEPT CLEAN AND DRY DURING THIS PROCESS.
.10 INSTALLER SHALL DETERMINE WHEN PREHEATING OF THE AREA TO BE SEAMED IS REQUIRED.
.11 ARTIFICIALLY INDUCED COOLING OF EXTRUSION WELDS, BY WATER OR ANY OTHER MEANS, SHALL NOT BE ALLOWED.
.12 CARE SHALL BE TAKEN DURING VACUUM TESTING THAT EXTRUSION WELDS BEING VACUUM TESTED ARE AT AMBIENT TEMPERATURES.
.4 PANEL DEPLOYMENT COMPENSATION FOR THERMAL CONTRACTION OF THE GEOMEMBRANE SHALL BE PROVIDED AS NECESSARY DURING THE LINER INSTALLATION AS DETERMINED BY THE ONSITE SUPERVISOR.
.5 SEAMING PROCEDURES: WHERE CONDITIONS WARRANT, THE INSTALLER SHALL BE ALLOWED TO USE A TEMPORARY SUPPORT SURFACE BETWEEN THE GEOMEMBRANE AND THE SUBGRADE TO ACHIEVE PROPER SUPPORT DURING THE SEAMING OPERATION. SEAMING SHALL BE A CONTINUOUS PROCESS WITH A MINIMUM OF INTERRUPTIONS ALONG ANY GIVEN SEAM. PRIOR TO SEAMING, THE GEOMEMBRANE SHALL BE OVERLAPPED A MINIMUM OF 75 MILLIMETERS FOR EXTRUSION WELDING AND 10 TO 150 MILLIMETERS FOR FUSION WELDING. ANY GEOMEMBRANE AREA SHOWING INJURY DUE TO EXCESSIVE SCUFFLING, PUNCTURE, OR DISTRESS FROM ANY CAUSE SHALL, AT THE DISCRETION OF THE INSTALLER'S ONSITE SUPERVISOR, BE REPAIRED OR REPLACED WITH AN ADDITIONAL PIECE OF GEOMEMBRANE.

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.6 CROSS-SEAMS: THE TOP AND BOTTOM EXCESS OVERLAP SHALL BE REMOVED AND THE TOP AND BOTTOM EDGE OF THE CROSS SEAM SHALL BE GROUND TO A SMOOTH TRANSITION PRIOR TO SEAMING. IF THE CROSS SEAM IS WELDED BY MEANS OF FUSION APPARATUS, THE CROSS SEAMS SHALL STILL BE CUT BACK TO THE EDGE OF THE FUSION WELD AND HAVE A BEAD OF EXTRUSION APPLIED 100 MILLIMETERS IN ALL DIRECTIONS FROM THE CONFLUENCE OF THE TWO SEAMS TO FORM A "T". SEAMS SHALL RUN PARALLEL TO THE SLOPE

12. LEACHATE COLLECTION & WITHDRAWAL PIPING

12.1 LEACHATE COLLECTION PIPE

.1 PIPE SHALL CONSIST OF 150mm DIAMETER SDR13.5 HDPE PIPE

.2 CONFIGURATION SHALL CONSIST OF A PERFORATED SEGMENT OF PIPE ALONG THE ENTIRE LENGTH OF THE POND/CELL BASE, CONNECTED AT BOTH ENDS TO A SOLID SEGMENT OF PIPE EXTENDING UP THE FULL LENGTH OF THE SIDE SLOPE. THE CONNECTION POINTS SHALL CONSIST OF 14 DEGREE ELBOWS TO BE PLACED AT THE CONTACT BETWEEN THE BASE AND THE SIDESLOPE.

.3 PIPE SHALL BE FITTED WITH A CAM LOCK FITTING ON BOTH ENDS TO PROTECT THE PIPE INTERIOR.

.4 THE SEGMENT OF PIPE ALONG THE BASE SHALL BE PERFORATED WITH 19mm DIAMETER HOLES DRILLED AT 135 DEGREES AND 225 DEGREES FROM VERTICAL, ALTERNATING SIDES ON 1m INTERVALS.

.5 PIPE SHALL BE INSTALLED ALONG THE FULL LENGTH OF THE CELL, ALIGNED IN THE INVERT OF A SWALE ON THE BASE OF THE CELL/POND AND EXTENDING UP THE SIDESLOPES TO DAYLIGHT ON THE CREST OF THE CELL/POND.

12.2 LEACHATE WITHDRAWAL PIPE

.1 PIPE SHALL CONSIST OF 150mm DIAMETER SDR13.5 HDPE PIPE

.2 CONFIGURATION SHALL CONSIST OF A PERFORATED HEADER PIPE PLACED HORIZONTALLY ALONG THE BASE OF THE SUMP CONNECTED TO A SOLID EXTRACTOR PIPE WITH A SHORT HORIZONTAL SEGMENT AND A LONGER SEGMENT EXTENDING ALONG THE SIDESLOPE TO SURFACE.

.3 THE HEADER PIPE SHALL BE FITTED ON ONE END WITH A 90 DEGREE ELBOW TO CONNECT TO A 2m HORIZONTAL SEGMENT OF SOLID EXTRACTOR PIPE. THE OTHER END OF THE HEADER PIPE SHALL BE FITTED WITH A CAP.

.4 THE 2m LONG HORIZONTAL SEGMENT OF EXTRACTOR PIPE SHALL BE FITTED WITH A 14 DEGREE ELBOW AT THE CONTACT BETWEEN THE BASE OF THE CELL AND THE SLIDE SLOPE AND CONNECTED TO A SEGMENT OF SOLID EXTRACTOR PIPE THAT EXTENDS TO SURFACE. THE END OF THE EXTRACTOR PIPE AT SURFACE SHALL BE FITTED WITH A CAM LOCK OR END CAP FITTING TO PROTECT THE PIPE AND PROVIDE INTERNAL ACCESS IF REQUIRED.

.4 THE HEADER PIPE ALONG THE BASE SHALL BE PERFORATED WITH 19mm DIAMETER HOLES DRILLED AT 180 DEGREES TO EACH OTHER AT RANDOM LOCATIONS ON 0.1m INTERVALS.

.5 SOLID EXTRACTOR PIPE SHALL EXTEND UP THE SIDESLOPE ADJACENT TO ONE OF THE LEACHATE COLLECTION PIPES AND LABELLED AS "LEACHATE WITHDRAWAL PIPE" AT ITS ACCESS POINT ON SURFACE.

12.2 LEACHATE MONITORING PIPE

.1 PIPE SHALL CONSIST OF 75mm DIAMETER SDR13.5 HDPE PIPE

.2 CONFIGURATION SHALL CONSIST OF A SINGLE SEGMENT OF PIPE EXTENDING FROM THE GROUND SURFACE TO THE BASE OF THE SUMP.

.3 THE LOWER END OF THE PIPE SHALL BE FITTED WITH A CAP.

.4 THE LOWERMOST 1m OF THE PIPE WILL BE PERFORATED WITH A SERIES OF 10mm DIAMETER HOLES DRILLED RANDOMLY WITH SPACING NOT EXCEEDING 0.15m.

.5 THE UPPERMOST END OF THE PIPE SHALL BE FITTED WITH A CAM LOCK FITTING TO PROTECT THE PIPE AND PROVIDE ACCESS AS REQUIRED.

13 CULVERTS

13.1 PRODUCTS

.1 CULVERTS SHALL CONSIST OF CORRUGATED STEEL PIPE (CSP) THAT COMPLIES WITH CSA STANDARD G401 WITH DIAMETERS AS SPECIFIED IN THE PLANS.

.2 CULVERTS SHALL HAVE A HOT-DIP GALVINIZED COATING AND A MINIMUM 2.0mm WALL THICKNESS.

.3 ALL CSP PIPES SHALL BE IN MINIMUM 6.0m LENGTHS.

.4 CULVERT LENGTHS SHALL BE JOINED WITH CORRUGATEDCSP COUPLERS HAVING APPROPRIATE MINIMUM WIDTHS AND CORRUGATIONS THE SAME AS ADJACENT CULVERT SECTIONS.

13.2 INSTALLATION

.1 CULVERTS SHALL BE INSTALLED AT LOCATIONS, LENGTHS AND ELVATIONS THAT CONFORM WITH THE LINES AND GRADES SHOWN ON THE PLAN OR AS DESIGNATED BY THE ENGINEER.

.2 WHEN GRANULAR MATERIAL IS USED TO CONSTRUCT THE CULVERT BED OR TO BACKFILL THE CULVERT, AN IMPERVIOUS AND COMPACTED CLAY SEEPAGE CUTOFF SHALL BE CONSTRUCTED TO THE LINES, GRADES AND DIMENSIONS SHOWN ON THE PLAN.

.3 THE DENSITY FOR EARTH EMBANKMENT, CRUSED AGGRIGATE AND GRANULAR BACKFILL MATERIAL WILL BE DETERMINED IN ACCORDANCE WITH ASTM 02922-04 FOR DENSITY-IN-PLACE BY NUCLEAR GAUGE.

.4 THE DIAMETER OR THE SPAN AND RISE OF CSP CULVERTS SHALL NOT VARY BY MORE THAN 5% DURING COVER AND BACKFILL PLACING OPERATION. IF THE DISTORTION IS GREATER THAN 5% THE CULVERT INSTALLATION MAY BE REJECTED.

.5 SPECIALIZED COMPACTION EQUIPMENT SUCH AS HAND HELD VIBRATORY COMPACTORS OR OTHER SUITABLE EQUIPMINT SHALL BE USED FOR COMPACTION OF THE CLAY BACKFILL AND GRANULAR BACKFILL AROUND THE CULVERT.

14. SITE CLEANUP

14.1 GENERAL

.1 REGRADE ANY REMAINING SOIL STOCKPILES TO ENSURE STABLE SLOPES.

.2 REGRADE AND STABILIZE ANY REMAINING TOPSOIL STOCKPILES FROM WIND OR WATER EROSION. SEED WITH SUITABLE VEGETATIVE STAND.

.3 REPAIR AND REPLACE ANY DAMAGED INFRASTRUCTURE WHICH OCCURRED DURING CONSTRUCTION, AT NO COST TO OWNER.

.4 CLEAN UP AND REPAIR ANY RUTTING THAT MAY HAVE OCCURRED ACROSS THE SITE DUE TO MOVEMENT OF HEAVY MACHINERY ACROSS THE SITE, AT NO COST TO OWNER.

.5 RETURN THE LAY-DOWN AREA TO THE ORIGINAL CLEARED STATE AS DIRECTED BY ENGINEER, AT NO COST TO OWNER

.6 REMOVE AND/OR DISPOSE OF ANY UNUSED PRODUCT, MATERIALS, EQUIPMENT BROUGHT TO SITE AS PART OF THE CONSTRUCTION, AT NO COST TO OWNER.

WaterMark CONSULTING LTD.

DATE:	DRAWN BY:	APPROVED BY:
01 NOV 24	WMB	ALG
SCALE:	FILE NO:	DRAWING NO:
NTS	WM566.3	WM566.3-G4

CLIENT: INVERGORDON LANDFILL LTD.

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT

TITLE: CONSTRUCTION SPECS.- PAGE 3

APPENDIX H STAKEHOLDER ENGAGEMENT DOCUMENTATION

Stakeholder Engagement Documentation:

Attachment 1

Proposed Industrail Landfill SW 06-44-23-W2M

NO. 430 RURAL MUNICIPALITY OF
Invergordon

7 Struthers Lake Drive - Box 40 - Crystal Springs, SK - S0K 1A0

NOTICE TO THE PUBLIC

August 17, 2020

The purpose of this notice is to advise R.M. No. 430 ratepayers that Council is currently considering an expansion to the R.M. landfill site located at NE 36-43-24-W2.

Currently, the R.M. landfill is permitted to remain open until June 2021 with the potential for an additional one (1) year extension to June 2022, or until the site capacity is met whichever comes first. Currently, the landfill has restrictions on the type of waste that can be accepted in order to extend its operating lifespan and to minimize environmental impacts.

As a result, the Council has been discussing various waste management plans, including a proposal that would extend the lifespan of the landfill well into the future. This expansion is primarily being considered to ensure R.M. ratepayers continue to have a local outlet to dispose of their waste. Any further landfill development is anticipated to occur in the general vicinity of the current site and will be designed to meet current environmental regulations.

Council will keep ratepayers informed of any developments.

However, should you have any questions, comments, or concerns about this possible development, please contact the office or a member of Council.

Reeve, Bruce Hunter	huntersbydixon@icloud.com
Councillor, Kelly Dutka (Division 1)	kelvdut@hotmail.com
Councillor, Keith Thibault (Division 2)	ktbo123@hotmail.com
Councillor, Calvin Parsons (Division 3)	beekeeper59@icloud.com
Councillor, Kevin Hawreschuk (Division 4)	hawres@yourlink.ca
Councillor, Wayne Bacon (Division 5)	carway@sasktel.net
Councillor, Edwin Rundbraaten (Division 6)	e.rundbraaten@sasktel.net

Regards,

Courtney Beaulieu
Administrator
R.M. of Invergordon, No. 430

Stakeholder Engagement Documentation:

Attachment 2

Proposed Industrail Landfill SW 06-44-23-W2M

NO. 430 RURAL MUNICIPALITY OF
Invergordon

7 Struthers Lake Drive - Box 40 - Crystal Springs, SK - S0K

PUBLIC NOTICE

Update: Proposed Expansion of RM Landfill Site

December 11, 2020

The purpose of this Public Notice is to invite adjacent landowners and residents in the vicinity of the RM's current landfill site to a public meeting where the Council and the developer proposing the expansion project are able to provide an update and field any questions or concerns prior to conducting an RM-wide Public Notice and open house.

As you may recall, the RM's first Public Notice was published by mail on August 17, 2020 to advise ratepayers that the Council had begun considering an expansion proposal to its existing landfill site.

A desired location has now been identified, among other alternative locations in the nearby area, and you have been identified as an adjacent landowner and/or you reside in a 2-mile radius of the proposed site.

The proposal is to develop a non-hazardous engineered landfill which will meet today's stringent environmental regulations laid out by the Ministry of Environment. The developer and subsequent owner/operator of the proposed landfill site will be a newly formed privately held entity led by Curtis West, President of Greenland Waste based in Prince Albert and Melfort.

MEETING INFORMATION

Date: Monday December 21, 2020
Time: 1:00pm
Place: Yellow Creek Hall - 201 2nd Avenue N

Please R.S.V.P. to the RM Office by:
Friday December 18, 2020 – 4:00pm

The meeting will abide by provincial public health orders which require all attendees to wear a mask inside the venue, maintain 2m social distance, and the maximum number of attendees will be thirty (30), including RM representatives in attendance. Additional meetings will be added if necessary.

Meeting agenda and some site information is on the reverse.

Regards,

Courtney Beaulieu
Administrator
R.M. of Invergordon, No. 430

Ph: (306) 749-2852 | Email: rm430@sasktel.net

MEETING AGENDA

1. **Process followed to this point**
2. **Preliminary site findings**
3. **Features and specifications of a modern engineered landfill**
4. **Benefits of the proposed development**
5. **Next steps**
6. **Question and answer period**

Site Information

✓ Site will be designed, built, and operated according to Alberta Standards (Best Practices accepted by the Saskatchewan Ministry of Environment).

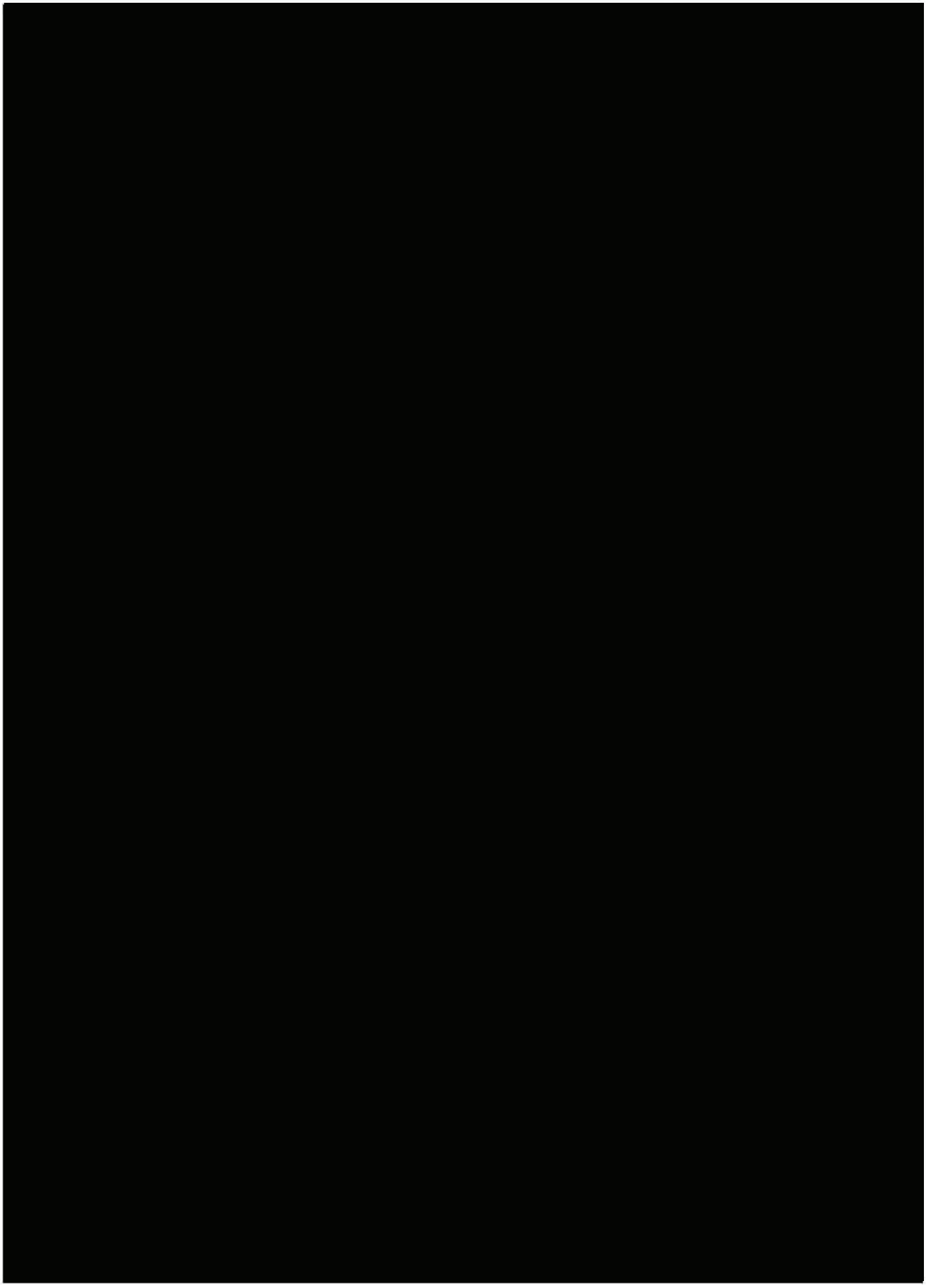
✓ Site will be self-contained, including the following features:
- Landfill cells will be constructed with compacted clay and/or geosynthetic liners to limit infiltration.
- External diversion ditch to direct 'fresh' surface water around the site.
- Internal diversion ditch and runoff holding pond to collect and manage surface water runoff within the site.
- Leachate evaporation pond.
- Landfill gas management system.
- Garbage will be covered daily to enhance the success of litter control, rodent and odour reduction management programs.
- A four-tiered litter control system that includes screens near the tipping area, 20-foot-high meshing around active cells plus fencing and trees around the perimeter
- Site will accept and divert recyclable material, steel, and compost material.

✓ Benefits of the new site that could be realized by the RM and its ratepayers:
- Public access for ratepayers.
- Discounted tonnage rate for RM ratepayers.
- New local employment opportunities.
- Private sector support of local business, not-for-profit groups, and local municipalities.
- Potential reduction in liability related to the original landfill.
- Royalty program for the RM. based on gross revenues.

Stakeholder Engagement Documentation:

Attachment 3

Proposed Landfill SW 06-44-23-W2M



Stakeholder Engagement Documentation:

Attachment 4

Proposed Industrail Landfill SW 06-44-23-W2M

DECEMBER 21, 2020

LANDFILL MEETING

ADJACENT LANDOWNERS

Yellow Creek Hall

Landowners in Attendance:

RM of Invergordon in Attendance:

1. Courtney Beaulieu
2. Bruce Hunter

Developer in Attendance:

1. Curtis West

Stakeholder Engagement Documentation:

Attachment 5

Proposed Industrail Landfill SW 06-44-23-W2M

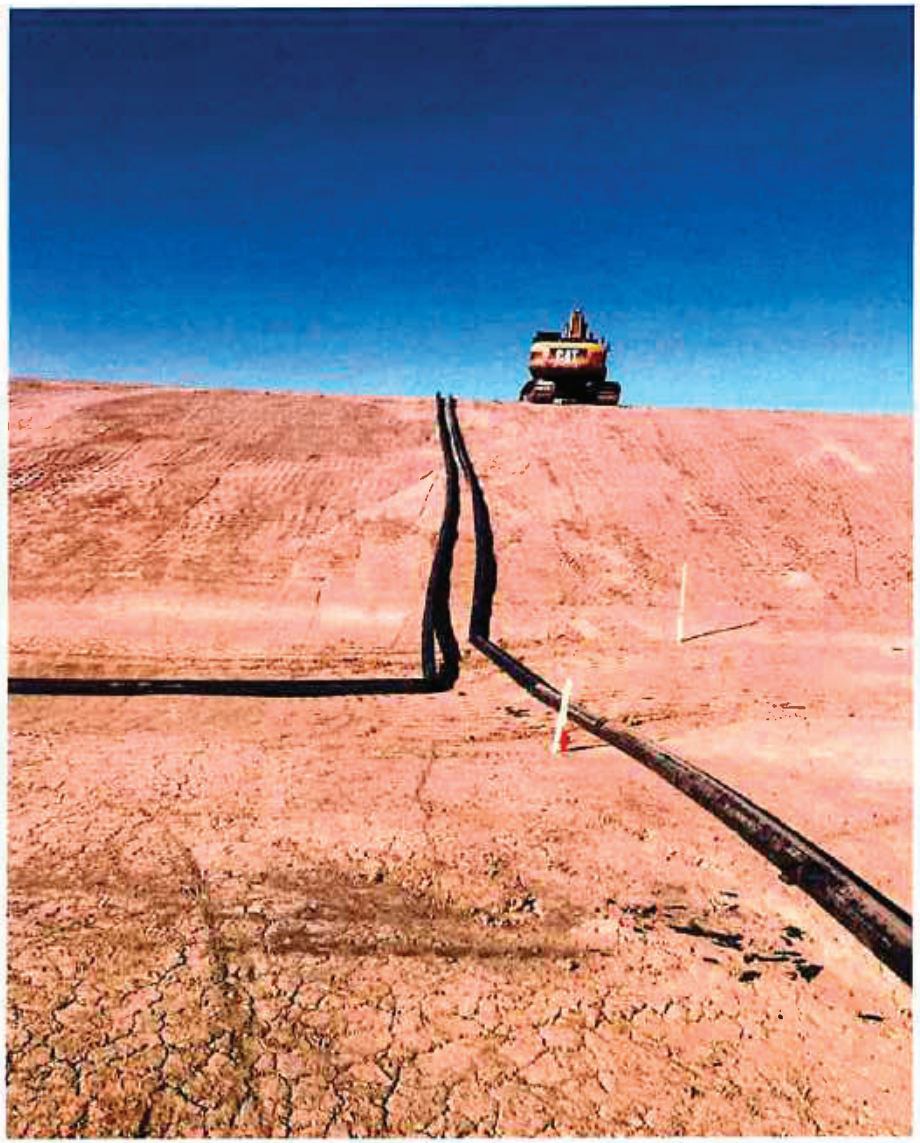
Industrial Site

Runoff Holding Pond

Cell Development

Compacted Cell Floor

Leachate Collection



Leachate Collection

Tipping Area Screens

Debris Netting

Perimeter Fence

Stakeholder Engagement Documentation:

Attachment 6

Proposed Industrail Landfill SW 06-44-23-W2M

DELBERT DYNNA LAW OFFICE

100A- 10th Street East
Prince Albert, SK
S6V 0Y7

Telephone: (306) 764-6856
Fax: (306) 763-9540

Delbert Dynna, BComm., LLB.
ddynnalaw@sasktel.net

Hiltila Krogh, BProc.
hilla.krogh@sasktel.net

Our File: 18334

December 17, 2020

RM of Invergordon
Box 40
Invergordon, SK
S0K 1A0

By email: rm430@sasktel.net

Att.: Courtney Beaulieu

Dear Madam:

RE: Proposed Expansion of RM Landfill Site

We refer to the above matter and confirm acting herein on behalf of [redacted]

Our client received a Public Notice from you by email dated December 14, 2020. Our client will unfortunately not be able to attend the meeting on Monday, December 21, 2020 either in person or by Zoom call as he is out of the country.

He would however, like to have his firm objection to the proposed expansion noted at the meeting and will continue to firmly oppose the expansion and would like an opportunity to address this issue at an RM meeting sometime in the future.

I trust that this is in order and thank you for your assistance herein.

Yours truly,

DELBERT DYNNA LAW OFFICE

Per:

Hiltila Krogh

HK

From: [redacted]
To: R M Invergordon
Subject: Re: changes to landfill
Date: December 17, 2020 1:47:04 PM

Dec 17, 2020

R.M. of Invergordon #430
Crystal Springs, Sk

Re: concerns related to
proposed changes to the
current landfill.

Firstly, we the undersigned would like to thank the administration of the R.M. for being proactive by making us aware of changes to the landfill site & welcoming our concerns & input.

We had some questions related to this and after a telephone conversation with
Courtney Beaulieu on Dec 17, 2020 we would like to inform the R.M. of our concerns.

We are the current titled owners of the NW 05-44-23 W2 and
NW 08-44-23 W2.

Our concerns are:
- how will a newly engineered landfill contain the spread of debris like plastic bags?
- what measures will be implemented to contain surface water that will be exposed to garbage from entering underground water aquifers?
this concern relates specifically to a water well (potable water source) located in the
southwest corner of the
N.W. 08-44-23 W2.
- lastly, exactly how large an area will the new landfill site be servicing?

Unfortunately we are not able to attend the meeting scheduled for Monday Dec. 21, 2020, however we look forward being kept abreast of this matter as it evolves.

Once again, thank you for the opportunity to express our concerns.

Sincerely,

[redacted]

Sent from my iPhone

Stakeholder Engagement Documentation:

Attachment 7

Proposed Industrail Landfill SW 06-44-23-W2M

NO. 430 RURAL MUNICIPALITY OF
Invergordon

7 Struthers Lake Drive - Box 40 - Crystal Springs, SK - S0K 1A0

NOTICE OF RM. 430 RATEPAYER MEETING

Update: Proposed Expansion of RM Landfill Site

March 26, 2021

The purpose of this notice is to invite R.M. No. 430 ratepayers to a meeting where the Council and the developer proposing the expansion project will be able to provide an update and field any questions or concerns that ratepayers may have.

As you may recall, the RM's first Public Notice was published by mail August 17, 2020 to advise ratepayers that the Council had begun considering an commercial expansion proposal to its existing landfill site.

A specific location has now been identified for the proposed development. That location is SW 6-44-23-W2 Ext 34 (the quarter directly to the north east of the current landfill site).

The proposed landfill development will be a non-hazardous landfill that meets today's stringent environmental regulations laid out by the Ministry of Environment. The developer and subsequent owner/operator of the proposed landfill site will be a newly formed privately held entity led by Curtis West, President of Greenland Waste based in Prince Albert and Melfort.

MEETING INFORMATION

Date: Monday April 12, 2021
Time: 1:00pm
Place: RM Shop, Crystal Springs SK

Please R.S.V.P. to the RM Office by:
Friday, April 9 2021 - 4:00pm

The meeting will abide by provincial public health orders which require all attendees to wear a mask inside the venue, maintain 2m social distance, and the maximum number of attendees will be thirty (30), including RM representatives in attendance. Additional meetings will be added if necessary.

Meeting agenda and some site information is on the reverse.

Regards,

Courtney Beaulieu
Administrator

Ph: (306) 749-2852 | Email: info@rm430.ca | www.rmofinvergordon.com

MEETING AGENDA

1. **Process followed to this point**
2. **Preliminary site findings**
3. **Features and specifications of a modern engineered landfill4**
4. **Benefits of the proposed development**
5. **Next steps**
6. **Question and answer period**

Site Information

- Site will be designed, built, and operated according to Alberta Standards (Best Practices accepted by the Saskatchewan Ministry of Environment).

- Site will be self-contained, including the following features:
    - Landfill cells will be constructed with compacted clay and/or geosynthetic liners to limit infiltration.
    - External diversion ditch to direct 'fresh' surface water around the site.
    - Internal diversion ditch and runoff holding pond to collect and manage surface water runoff within the site.
    - Leachate evaporation pond.
    - Landfill gas management system.
    - Garbage will be covered daily to enhance the success of litter control, rodent, and odour reduction management programs.
    - A four-tiered litter control system that includes screens near the tipping area, 20-foot-high meshing around active cells, as well as fencing and trees around the perimeter.
    - Site will accept and divert recyclable material, steel, and compost material.

- Benefits that could be realized by the R.M. and its ratepayers with this development, some of which are as follows:
    - Public access for ratepayers (local access to a state-of-the-art landfill that meets today's environmental regulations).
    - Discounted tonnage rate for R.M. ratepayers.
    - New local employment opportunities.
    - Private sector support of local business, not-for-profit groups, and local municipalities.
    - Potential reduction in liability related to the original landfill.
    - Royalty program for the R.M. based on gross revenues.

Stakeholder Engagement Documentation:

Attachment 8

Proposed Industrail Landfill SW 06-44-23-W2M

RSVP's
Landfill Ratepayer Meeting
Monday, April 12 2021 1:00pm - RM SHOP

MUST BE RM RATEPAYER TO ATTEND

SHOP FLOOR		
1	*Curtis West (Developer)*	
2	*Courtney Beaulieu (Administrator)*	
3	*Wayne Bacon (Division 5)*	
[redacted]		Division 6 Ratepayer
		Division 1 Ratepayer
		Division 4 (Crystal Springs) Ratepayer
		Division 6 Ratepayer
		Division 5 Ratepayer
		Division 5 Ratepayer
		Division 2 (Tway) Ratepayer
		Division 2 (Tway) Ratepayer
		Division 5 Ratepayer
		Division 1 Ratepayer
		Division 3 Ratepayer
		Divison 4 Ratepayer
		Division 5 Ratepayer
		Division 4 Ratepayer
		Division 2 Ratepayer
		Division 4 Ratepayer
		Division 3&4 Ratepayer
		Division 3&4 Ratepayer
		Division 3&4 Ratepayer
		Division 5 Ratepayer (Crystal Springs Board)
		Division 4 Ratepayer
		Division 5 Ratepayer
		Division 2 Ratepayer

UPPER MEZZANINE - RM STAFF/COUNCIL	
1	*Kelly Dutka (Division 1)*
4	*Keith Thibault (Division 2)*
5	*Calvin Parsons (Division 3)*
6	*Edwin Rundbraaten (Division 6)*
7	*Myron Toner (Foreman)*
8	*Trevor Plessl (Utility Manager)*
9	*Bruce Hunter (Reeve)*

Stakeholder Engagement Documentation:

Attachment 9

Proposed Industrail Landfill SW 06-44-23-W2M

INVERGORDON PROPOSED LANDFILL MEETING

- Due to the pandemic, please adhere to the following guidelines:
- Only registered attendees can enter the building.
- Check-in upon entry.
- Masks are mandatory.
- Sanitize or wash your hands.
- Please avoid gathering and take your seat immediately.
- Individuals that live together may push their chairs together.
- Others should not move chairs to ensure distancing guidelines are followed.
- Once the meeting has concluded, please avoid gathering and exit the hall as soon as possible.

Thank you for your cooperation and attendance.

Invergordon Regional Non-Hazardous Landfill Public Meeting

April 12, 2021

Agenda

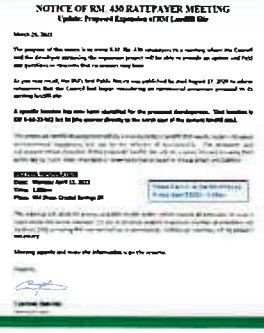
- Process
- Features of a Modern Landfill
  - Landfill Design – Best Practices
  - Landfill Operation – Best Practices
- Concerns
- Benefits
- Next Steps
- Q&A

Process

- Concept
- Communication
- Preliminary findings
- Phase II Environmental study
- Site design, operating and decommissioning plans
- Submission of an application with the Ministry of Environment

Communication

- RM of Invergordon
  - Jul 8, 2020
- RM Info Notice
  - Aug 17, 2020
- Neighbour Notice
  - Dec 11, 2020
- RM Meeting Notice
  - Mar 26, 2021



NOTICE OF RM 430 RATEPAYER MEETING

Process

- Search for potential site for development of new non-hazardous regional landfill
- Location:
  SW 6-44-23 W2
- Conditional offer in place

Preliminary Findings

- No mapped aquifers in upper 100 meters.
- Sandy surficial soils may exist, not expected to be deep.
- Topography may create challenges but can be managed through design.

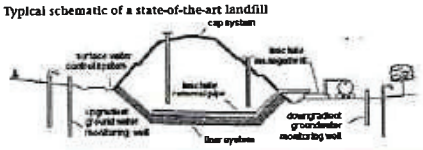
Process

- Preliminary findings
- Phase II Environmental study
- Development of:
  - Technical investigation report
  - Design plan and specification report
  - Operations plan
  - Proof of financial security
  - Landfill monitoring plan
  - Closure plan
  - Post closure plan
- Ministry of Environment application

Landfill Design - Best Practices

- Seepage barrier
- Surface water management
- Groundwater monitoring
- Passive gas management system
- Leachate collection and management
- Final cover
- Reclamation, decommission and closure

Typical schematic of a state-of-the-art landfill



(credit: Paul C. Rizzo Associates)

Landfill Operation – Best Practices

- Landfilling face management
  - Minimize face size, daily cover placement, mixing of wastes & compaction
  - debris, scavenging, & odour minimization, compaction optimization
- Site perimeter management
  - Tall wind fencing around landfilling cells promotes containment of debris & general site cleanliness
  - Paige wire fencing & perimeter treeline assists in site cleanliness and restricting wildlife access

Concerns

- Truck traffic
- Windblown litter / illegal dumping
- Wildlife / pests
- Contamination of water, wells, soil and air
- Company ceases to exist

Defense 1

Defense 2

Defense 3

Concerns

- Truck traffic
- Windblown litter
- Wildlife / pests
- Contamination of water, wells, soil and air
- Company ceases to exist

Cell Development

Leachate Collection

Water Management

Concerns

- Truck traffic
- Windblown litter
- Wildlife / pests
- Contamination of water, wells, soil and air
- Company ceases to exist

Comparable - North

Comparable - East

Comparable - South

Comparable - West

Comparable – Waste Cell

Comparable - Waste Cell

Comparable - Waste Cell

Benefits

- Access to modern landfill for region
- Reduced waste service/tonnage rates for ratepayers
- Employment
- Economic spinoff
- Support of community groups
- Assistance with closure and monitoring of current RM landfill site
- Royalty agreement

Support of Community

- Prince Albert Parkland Health Region
- Kelsey Trail Health Region
- The Ministry of the Environment's Clean-Up Day
- Hazardous Waste Clean Up Day
- The City of Prince Albert's Ward 2 Clean Up Day
- The City of Prince Albert's Waste Reduction Week
- The Food Bank
- Habitat for Humanity
- ReStore
- Prince Albert Community Housing
- The Prince Albert SPCA
- The Prince Albert Exhibition
- Wadena Health Action
- Project Triple Play
- City of Melfort Kerry Vickar Centre
- Crime Stoppers in Saskatchewan
- Minto Bowl
- NEOSS Women's Shelter
- Mont St Joseph
- Big Brothers Big Sisters

Benefits

- Access to modern landfill for region
- Reduced waste service/tonnage rates for ratepayers
- Employment
- Economic spinoff
- Support of community groups
- Assistance with closure and monitoring of current RM landfill site
- Royalty agreement

Next Steps

- Road maintenance agreement
- Waste services agreement
- Royalty agreement
- Further study of site
- Site design, operating and decommissioning plans
- Submission of an application with MOE

Conclusion

Questions?

Stakeholder Engagement Documentation:

Attachment 10

Proposed Industrail Landfill SW 06-44-23-W2M

[redacted]

April 18, 2021

RM of Invergordon (No. 430)
Box 40
Crystal Springs, Saskatchewan, Canada
S0K 1A0

Dear RM of Invergordon (No. 430):

This is a letter to address some of our significant concerns that result from the April 12th Invergordon Non-Hazardous Landfill Public Meeting. To say the least, we are very uncomfortable with the level of transparency of this project to date, and we believe that the Municipal Government has a requirement to provide open and transparent information to the ratepayers of the RM of Invergordon.

List of concerns and questions requiring clarification:

- Greenland Waste Company unanswered questions:
    - Why is Curtis West affiliated with multiple waste management companies (Loraas)?
        - Liability strategy?
    - What is the amount of liability that Greenland Waste would carry (Curtis' stated $5 Million)?
        - Is this enough?
    - Who is liable in situations where Greenland Waste declares bankruptcy?
    - Is Greenland Waste bonded?
    - What are the future plans and how can Greenland change the scope of the landfill site?
        - Hazardous waste
        - Medical waste
        - Rendering collection / Animal carcass disposal
        - Composting waste
    - What is the responsibility of Greenland Waste to the current RM landfill?
        - Lack of clarity of decommissioning and liability

- RM of Invergordon considerations
    - Propose to delay the process to allow for proper notification to all ratepayers of the size and scope of this project.
        - Covid restrictions have resulted in seriously limited ratepayers' ability to understand the project, voice concerns, and attend meetings.
    - Similar to Birch Hills make landfill report public knowledge.
    - Make information of proposal from Greenland public.
    - Has there been any investigation into multiple alternative sites which avoid environmental and ratepayer concerns?
    - RM of Invergordon Landfill
        - Are there other grants provincial / federal to help the RM of Invergordon independently decommission the existing landfill?
        - What are the true costs for decommissioning and post landfill monitoring?
        - Is it possible to obtain the RM's strategic waste disposal plan as mentioned in the April 2019 minutes?
        - What are other options or possibilities for RM ratepayers waste disposal, and have they been explored?
            - Municipal collection site
            - Transfer stations
    - Is there a valid and approved Zoning By-Law already in place or is it the first by-law that is in the development stage as indicated on the RM website? If an existing and valid zoning by-law is in place, please provide a copy of said document.
        - RM Website indicates "Stay tuned as we await the final edits from our planning consultants. 1st Reading of this Bylaw is scheduled for an upcoming Council Meeting"
            - Is there a set Council Meeting date for the 1st Reading of the bylaw? If so, please provide that meeting date
        - Is the Interim Development Control By-Law #14-01 still legally valid or has the by-law expired? Last known date of validity is 2016.
            - Please provide the most recent Interim Development Control By-Law #14-01, and/or any valid Interim Development Control By-Law if in existence.
        - As per section 45 of the Planning and Development Act 2007, council may authorize preparation/adoption of zoning by-law only in conjunction with adoption of an official community plan. Please provide a copy of Official Community Plan
        - If, in the absence of a legally valid/enforceable by-law for development and/or zoning, will the RM move forward with Issuing Development Permits for a large operations such as a Landfill? If so:

- Lack of validated/enforceable zoning by-laws will restrict the RM to only being able to use existing Acts and Regulations(ie The Municipalities Act 2005, The Subdivision Regulations 2014, Planning and Development Act 2007, Etc) which are general and not RM specific for what lands can be used for what purposes.
- If utilizing existing Municipal/Provincial Acts and Regulations, in the absence of valid/approved zoning by-laws, what are those Acts and what specific regulations can be used in this situation to protect ratepayers, council and Administration of the RM, to ensure adequate recourse availability.
- How will the RM ensure that they have legal/enforceable recourse over any/all land use of the owner (Ie. Change to hazardous waste, change to utilization of land, etc)

- Scope and size of landfill
    - Overall tonnage was unclear, one statement (Curtis West 8-10 truck / day) could exceed 50,000 tons per year. This is the equivalent of 1.8 million bushels of wheat.
        - Is there a maximum, is there any oversite or control from the RM?
    - Routes and truck traffic and road infrastructure
        - What exactly is in the road maintenance agreement?
        - Will there be a road tax? ie: like gravel hauling
    - Potential size of service radius, and future expansions
    - Has council viewed comparable landfills that meet Alberta standards which have been in operation longer than 3 months? ie: What does the future hold?
- Biosecurity
    - Pathogen management and sanitization plans and protocols
        - Major concerns of spreading clubroot and other soil transmitted pathogens
- Environmental concerns
    - Drainage and seepage into the Carrot River system. (High runoff years and large rainfall events)
    - Proximity to underground aquifers and contamination of local and potable wells
    - Proximity to the Saskatchewan Wildlife Reserve
        - NE 1 44 24 W2 – Adjacent
        - SE 1 44 24 W2 - Adjacent
        - SW 7 44 23 W2 – Half Mile
    - Noise pollution
    - Dust from truck traffic
    - Increase of scavengers and disease-carrying pests (coyotes, ravens, bears, and rats)
        - Increase risk with surrounding livestock

        - Increase damage to surrounding temporary grain bag storage
    - Use of odor and smell suppression
    - Risk and plan to handle emergency landfill fire
        - Capacity of local and surrounding fire departments to handle
    - Who is responsible for the cost of environmental assessments? Assuming Greenland Waste but not clear.
- Location of landfill in proximity to the established Madraga yard site (NW 32 43 23 W2)
    - Planned construction of residence
    - Effect on resale and land values immediately around landfill
        - Will Greenland subsidize if there is a reduction in value?
    - Lack of Communication / Transparency to neighboring properties
        - Neighbor notice listed in power point was not sent to all affected parties
        - 2020 Notice indicates council will keep ratepayers informed of any developments; there was no communication until the public meeting

In conclusion, we believe the construction of the proposed landfill site (SW 6 44 23 W2) does not accurately represent your slogan for the RM of Invergordon "Welcome to the RM of Invergordon bountiful fields beautiful lakes. A great place to stay or play". With the limited amount of information, it is difficult to understand or see the value that would be brought to our local RM with this project. The RM of Invergordon is currently known for its excellent hunting, fishing, and outdoor recreational activities with unlimited potential; it would be a shame to jeopardize this reputation without taking the time to weigh all considerations of a large regional landfill. We appreciate the time that the council and the RM will take to look into these questions and concerns, and we look forward to a response by the 14th of May 2021.

In summary in addition to the questions asked within the letter, here are the documents we are requesting:

- Interim Development Control By-Law #14-01
- Any other Community Development/Interim Development by-laws/controls
- Official Community Plan
- Proposed Zoning By Law
- Greenland Proposal for Public Landfill in RM 430
- Strategic Waste Disposal Plan
- Environmental Assessments on Proposed Landfill Site

Sincerely,

[redacted]

Stakeholder Engagement Documentation:

Attachment 11

Proposed Industrail Landfill SW 06-44-23-W2M

NO. 430 RURAL MUNICIPALITY OF

Invergordon

7 Struthers Lake Drive (Box 40) Crystal Springs, SK S0K 1A0
306.749.2852 info@rm430.ca www.rmofinvergordon.com

2021 Tax Notice Newsletter

Good day,

Enclosed you will find your Tax Notices and this handy newsletter with all sorts of updates and information! We hope you are enjoying the summer sunshine and your wonderful property here. Please feel free to call, email or drop in with any questions, concerns, ideas, or just to say hello!

Warm regards,

Courtney Beaulieu
Administrator

Taxes

Payments must be received in the office by Friday December 31, 2021 to avoid interest charges. We encourage electronic payment and post-dated cheques to ensure it arrives on time.

2021 Uniform Mill Rate: 9.5 (Yellow Creek 14.5)

Effective Mill Rates with Factors applied:

Property Type:	Invergordon	Average*
Residential	9.5	9.19
Agricultural	7.6	6.74
Commercial	9.5	15.71

*Surrounding RM's

Residential Minimum Tax increased to $150.00 (Land) and $250.00 (Improvements/Buildings)
School Tax Mill Rates increased from 2020
C&D Levies & Hail Rates remained the same

Council Members

Reeve	Bruce Hunter	reeve@rm430.ca
Division 1	Kelvin Dutka	div1@rm430.ca
Division 2	Keith Thibault	div2@rm430.ca
Division 3	Calvin Parsons	div3@rm430.ca
Division 4	Kevin Hawreschuk	div4@rm430.ca
Division 5	Wayne Bacon	div5@rm430.ca
Division 6	Edwin Rundbraaten	div6@rm430.ca

E-Newsletter

Sign up to receive our newsletter to your email address, visit our website for full information! We post notices about meetings, fire bans, events, affiliate promotions, garbage pickup and special projects.

PUBLIC MEETING

When: Monday, August 16 2021
Time: 1:00pm – 3:00pm
Where: R.M. Shop in Crystal Springs, SK

Council will be hosting a public meeting for ratepayers to attend an informational presentation and Q&A session with the R.M., the Ministry of Environment and the developer of the commercial non-hazardous landfill on SW 6-43-24-W2 which was conditionally approved to proceed by the Council in April 2021.

(RSVP is not required)

Virtual attendance is available, please contact the office for the Zoom meeting information.

2021 Audited Financial Statements

Statements are posted to the website, hardcopies are available upon request with the office.

Public Works

Foreman Myron Toner foreman@rm430.ca
Operators 6 + 1 Summer Student

***NEW* Snow Policy:** yards and driveways must plan to wait 3 days after a snow fall before R.M. plows arrive. Council's policy is to ensure all roads are cleared prior to custom work. Please plan accordingly! A waiver remains required for snow removal requests. Visit our website to read the full Custom Work Policy.

Named Speed Curves: watch for signage going up with names to the main speed curves in the R.M.

Special Projects: we recently completed a public beach at Hunter Subdivision and a low-level crossing south of Hwy 320. A bridge-to-culvert replacement is planned in Division 3, as well as upgrades to the fire hall and water sewer plants. Other upcoming projects (2022) include waterfront projects at Rhona Lake, Dixon Lake & Struthers Lake (pending grant funding) and a water level study on Dixon Lake. The boat launch planned for Jumping Lake has been rescinded due to overall complexity and cost.