Memo

Date:	Monday, December 04, 2023
Project:	WM Twin Creeks Environmental Centre Landfill Optimization Project Environmental Assessment
To:	Wayne Jenken, Landfill Engineering Manager, WM Canada
From:	Larry Fedec, Solid Waste Program Leader, Canada, HDR Kelly Beri, Senior Environmental Planner, HDR
Subject:	Draft Screening of Alternative Methods

Introduction

'Alternative methods' of carrying out the undertaking are different ways of implementing the proposed project. The development of an additional 14,000,000 m^3 of landfill capacity within the 301 ha Twin Creeks Environmental Centre (TCEC) site area can be achieved through a:

- vertical expansion of the currently approved Expansion Landfill footprint;
- horizontal expansion into other available areas of the TCEC site.
- horizontal expansion over the closed Old Landfill to the east of the Expansion Landfill; or

As outlined in the approved Terms of Reference for the project, based on a qualitative consideration of the potential vertical and horizontal expansion methods available within the site area, in addition to potentially locating waste in close proximity to the Village of Watford, horizontal alternative methods would result in significant additional costs and would not optimize the use of the available and constructed infrastructure at the site to the extent possible. Given the financial, technological, and community risks and concerns associated with the horizontal alternative methods, WM Canada (WM) identified a preference for a vertical alternative method.

WM committed to undertaking a screening of vertical and horizontal alternative methods as part of the EA to confirm that a vertical alternative method would be preferred. This technical memo provides a description of representative vertical and horizontal alternative methods that could be constructed at the TCEC followed by a screening-level assessment of the alternative methods and provides confirmation on the preferred alternative method.

Methods

The first step in developing Alternative Methods was to determine the available areas of the site that could provide up to 14,000,000 m³ of landfill capacity. This involved examining the past, existing, and planned land uses within the TCEC site to determine suitable locations for development.

Once suitable locations for development were identified on the TCEC site, representative concepts were developed for vertical and horizontal Alternative Methods within these areas to accommodate the required landfill capacity. The representative concepts were intended to encompass several different landfill configurations that could occur within the defined development areas.

Screening evaluation criteria were developed to allow for a comparison of the identified Alternative Methods based on other landfill and waste facility siting assessments conducted in Canada along with professional judgement, with a focus on aspects where the Alternative Methods were likely to differ. Consideration was given to various cost, constructability, technical, environmental, social, cultural, and land use factors.

A qualitative screening evaluation of the Alternative Methods was conducted based on the identified evaluation criteria. The Alternative Methods were compared against each other for each set of criteria. Colour-coding was used to indicate whether an Alternative Method was considered to be better (green), average (yellow), or worse (orange) for each criterion. The Alternative Method that resulted in the most 'green' coding overall was identified as the preferred Alternative Method to be carried forward for further development.

Description of Alternative Methods

Available Areas for Development

Three areas within the TCEC were identified as potentially available for the development of an additional 14,000,000 m³ of landfill capacity:

- the Expansion Landfill footprint (75.4 ha);
- the vacant southern portion of the TCEC site south of the soil stockpile (43.2 ha); and
- part of the Expansion Landfill footprint (excluding the north, west and south side slopes) plus the closed Old Landfill footprint to the east (79.2 ha).

Alternative Method concepts were developed within each of these areas, as outlined below.

Alternative Method Concepts

Vertical Alternative Method

The potential exists to develop the additional landfill capacity vertically above the existing Expansion Landfill. The representative area for this alternative is shown in **Figure 1**. The ground elevation in the area of the TCEC site is approximately 245 masl. The approved Expansion

Landfill utilizes 4:1 exterior side slopes to an elevation of 265.7 masl, and then transitions to 20:1 side slopes to the landfill peak elevation of 278 masl. A two-metre thick final cover results in a landfill peak at 280 masl. A vertical expansion would involve redesigning the originally planned and approved final contours of the 75.4 ha Expansion Landfill including potential changes to the grade of the side slopes and the peak elevation. A range of variations and combinations of potential changes, or alternative methods, to the side slopes and peak elevation (up to approximately 320 masl or 75 m above surrounding ground surface) exist. By constructing over the engineered Expansion Landfill footprint, this alternative optimizes the use of the available and constructed infrastructure at the site to the greatest extent possible.

During consultation and engagement on the development of the approved ToR, WM received comments regarding the feasibility of increasing the height of the Expansion Landfill; specifically, the comments were focused on the strength of the underlying leachate collection system pipes and if they could withstand the weight of the additional landfilled waste. To address these comments, WM completed a geotechnical feasibility review of the vertical alternative methods focused on the following design aspects:

- Settlement/deformation of the landfill base due to the increased weight of waste and cover material;
- Stability of the exterior side slopes if they are increased from 4:1 to 3:1; and
- Effects of the added weight on the leachate drainage systems, specifically drainage pipe deformation/deflection in the primary drainage layer and geonet compression within the secondary drainage layer.

The feasibility assessment focused on potential vertical alternatives with a proposed increase in the side slopes (i.e., steeper, at 3:1) and peak elevation (i.e., up to approximately 320 masl or 75 m above surrounding ground surface). The feasibility assessment confirmed that vertical alternative methods within this envelope are acceptable as follows:

- Post-settlement landfill base grades meet O.Reg. 232/98 requirements and maintain acceptable leachate collection in the primary leachate drainage layer;
- The combination of 3:1 final side slopes and proposed peak elevation are stable;
- The strength of the primary drainage layer collection pipes is acceptable for the landfill optimization alternatives; and,
- The flow capacity of the geonet within the secondary drainage layer will meet the design requirements for the landfill optimization alternatives.

Horizontal Alternative Method 1

A large portion of undeveloped landfill is available within the southern portion of the TCEC site. The representative area for this alternative is shown in **Figure 2**. Current land uses within this area are the excess soil stockpile, a 28.3 ha area to dispose on-site treated leachate referred to as the Poplar Plantation, and approximately 36 ha currently used for agriculture and recreation. WM is in the process of developing a Renewable Natural Gas (RNG) facility just north of the excess soil stockpile which will be serviced by a new on-site road along the western property boundary from Confederation Road. The southern portion of the site area is in close proximity to the Village of Watford and sensitive land uses within the community.

The additional landfill capacity would be developed within an approximate footprint area of 43.2 ha. To be able to provide 14,000,000 m^3 of landfill capacity, the area will be required to be excavated by about 10 m below ground and the top final cover elevation will be approximately 40 m above ground. Any existing vegetation or agricultural areas will require removal for the landfill development. The proposed top elevation including the final cover would be consistent with the approved Expansion Landfill peak elevation of approximately 280 masl.

The Horizontal Alternative Method 1 area is bound to the south by County Road 39 (Confederation Line), to the east by Brown Creek, to the north by the excess soil stockpile, and to the west by the walking trail and Industrial Park. The landfill footprint area for this alternative method provides a buffer of approximately 170 m to County Road 39 and 110 m to Brown Creek.

For stormwater management, the establishment of drainage ditches and the requirement for a stormwater pond(s) in the south area are anticipated. The potential impact on surface water flows discharging to Brown Creek and surrounding lands will need to be considered. Potential effects to groundwater quantity may be associated with a reduction in precipitation infiltration rates. In addition, the majority of this area is within a significant groundwater recharge area designated by the St. Clair Region Conservation Authority. Groundwater recharge rates are predicted to be typically greater than for the surrounding areas.

The leachate collection system for this alternative requires its own separate pump stations and the potential for a new holding tank or a long forcemain to transfer the collected leachate to the leachate storage tanks. This alternative will result in additional leachate volumes being generated due to the increase in overall landfill surface area. An assessment of alternative leachate disposal alternatives will be required considering the increased leachate volumes and the poplar forest irrigation zones will significantly be reduced as part of the alternative method development.

To be able to connect the landfill gas collection system for this alternative to the existing landfill gas infrastructure located north of the excess soil stockpile, longer header pipes will be required which could cause a potential pressure loss. This will require additional infrastructure upgrades.

As part of the site development and to reduce vehicle travel time to access the landfill, consideration of alternative haul routes may be necessary including relocating the site entrance to County Road 39.

This alternative would also require the development of perimeter screening berms along County Road 39 and the western and eastern property boundaries.

Horizontal Alternative Method 2

A horizontal expansion could also be developed to the east of the Expansion Landfill, integrating the Expansion Landfill with the closed Old Landfill. The representative area for this alternative is shown in **Figure 3**. The closed Old Landfill is situated east of the Expansion Landfill and covers an area of approximately 30.9 ha. A road separates the closed Old Landfill from the 75.4 ha Expansion Landfill. By integrating these two landfill footprints, the total area of this alternative method would be approximately 79.2 ha.

The closed Old Landfill is a partially lined landfill under final cover. Poplar trees planted on 9.3 ha of the final cover, referred to as the Poplar System, are utilized for the on-site management of leachate. Horizontal expansion in this area would require that development occurs over the

existing partially-lined landfill area, or excavation of landfilled waste to line the landfill area, with limited buffer from the eastern site boundary and the neighbouring land use (i.e., greenhouse). This alternative would require significant cost associated with remediation and/or engineering of the area in order to comply with applicable landfill design standards.

To be able to provide 14,000,000 m^3 of landfill capacity, the height of the closed Old Landfill area would increase to a peak elevation of approximately 280 masl, which is an increase in height of about 31 m. The Expansion Landfill peak elevation would need to increase by approximately 18 m, from the current approved height of 280 masl to approximately 298 masl. The north, east, and south side slopes of the closed Old Landfill would be extended at 4H:1V and the connection to the Expansion Landfill would have a finished grade of 5% sloping to the east.

Horizontal Alternative Method 2 is bound to the south by the existing poplar forest, to the east by the neighbouring greenhouse, to the north by Sedimentation Pond 4 and Zion Line, and to the west by the active landfill area. The proposed Horizontal Alternative Method 2 provides a buffer of approximately 180 m to Zion Line and 30 m to the east property line, except for the existing poplar forest area located in the southeast corner which has a setback to the property line of 8 m.

The existing poplar forest located on the south corner of the closed Old Landfill would need to be removed followed by removal of the final cover. The east access road between the Expansion Landfill and the closed Old Landfill would need to be decommissioned and replaced with an access road east of the closed Old Landfill. An engineered base liner would then be constructed after excavation of the old waste or over the closed landfill. Additional investigation of either design approach and approvability would be required.

Stormwater management infrastructure is in place at the site for both the Expansion and closed Old landfills. Some design modifications may be required due to increased surface areas subject to precipitation and run-off.

Depending on the design criteria for the base liner system, the approach to leachate collection and management from the closed Old Landfill area will require upgrade. While the total area of the site subject to precipitation percolating into waste and generating leachate would only be marginally greater than the current situation, it is anticipated that an increased volume of leachate would be collected through the leachate collection system and require management. As noted above, the existing poplar forest which is used for leachate treatment would be removed as part of this alternative method.

The landfill gas collection system for the closed Old Landfill will need to be decommissioned. The Expansion Landfill perimeter landfill gas collection system would then be extended around the perimeter of the closed Old Landfill area. Additional landfill gas collection piping within the waste footprint area would be installed and connected to the active landfill gas infrastructure.

The existing site entrance to the TCEC and on-site road network would continue to be utilized except for Street D.

Screening of Alternative Methods

The three Alternative Methods were evaluated and comparatively screened against each other using criteria consisting of:

- Cost and Constructability considerations
- Technical considerations
- Environmental considerations
- Social and Cultural considerations
- Land Use considerations

The criteria, their indicator and rationale, for each of these considerations are presented in **Table 1**.

TABLE 1. SCREENING EVALUATION CRITERIA, INDICATORS, AND RATIONALE

Criteria	Indicator	Rationale
Cost & Constructability Considerations		
Landfill Capacity	Landfill capacity provided by the Alternative Method.	Provided landfill capacity must be sufficient to justify capital cost. Alternative Methods with larger capacities are preferred as they allow for maximum site life extension.
Site Life Extension	Potential site life extension for the landfill based on the estimated landfill capacity.	Provided site life extension must be sufficient to justify capital cost. Alternative Methods with longer site life extensions are preferred.
Required infrastructure	Infrastructure required but not currently available in the proposed landfill area.	New infrastructure increases capital cost. Alternative Methods with comparatively lower requirements for new infrastructure are preferred.
Upgrades to existing infrastructure	Infrastructure present in the landfill area that requires upgrades.	Infrastructure upgrades increase capital cost. Alternative Methods with comparatively lower requirements for infrastructure upgrades are preferred.
Required site development	Site development required to accommodate the Alternative Method.	Additional site development increases capital cost. Alternative Methods with comparatively lower site development requirements are preferred.
Required permits and approvals	Nature and complexity of required permits and approvals.	Increased complexity of permits, approvals, and agreements can increase capital cost and create schedule delays. Alternative Methods with less-complex permitting and approval requirements are preferred.
Technical Considerations		
Excavation requirements	Excavation required to accommodate the Alternative Method.	Excavation requirements add to the technically complexity of the development. Alternative Methods with comparatively lower excavation requirements are preferred.
Soil stockpiling requirements	Soil stockpiling requirements for the Alternative Method.	Soil stockpiling and soil management add to the technical complexity of the development. Alternative Methods with comparatively lower soil stockpiling and soil management requirements are preferred.

TABLE 1. SCREENING EVALUATION CRITERIA, INDICATORS, AND RATIONALE

Criteria	Indicator	Rationale
Liner requirements	Liner system required for the Alternative Method.	Liner system requirements add to the technical complexity of the development. Alternative Methods with comparatively lower additional liner requirements are preferred.
Landfill gas management	Landfill gas management required for the Alternative Method.	Landfill gas management requirements add to the technical complexity of the development. Alternative Methods with comparatively lower landfill gas management requirements are preferred.
Leachate management	Leachate management required for the Alternative Method.	Leachate management requirements add to the technical complexity of the development. Alternative Methods with comparatively lower leachate management requirements are preferred.
Stormwater management	Stormwater management required for the Alternative Method.	Stormwater management requirements add to the technical complexity of the development. Alternative Methods with comparatively lower stormwater management requirements are preferred.
Haul distance on site	Distance from the weigh scale to the Alternative Method along on-site roadways.	Longer on-site haul distances add to the technical complexity of the design. Shorter on-site haul distances are preferred.
Environmental Considerations		
Air Quality, Odour, and Noise	Changes in potential effects on air quality, odour, and noise.	Air, odour, and noise emissions from the landfill can affect local air quality at nearby receptors and cause disturbance through odour and noise. Alternative Methods with minimal changes to air quality, odour, and noise at nearby receptors are preferred.
Surface Water	Changes in potential effects on surface water.	Alternative Methods that avoid changes in potential effects on surface water are preferred.
Groundwater	Changes in potential effects on groundwater.	Alternative Methods that avoid changes in potential effects on groundwater are preferred.
Vegetation Removal	Extent of vegetation removal required for landfill development.	Alternative Methods that avoid vegetation removal are preferred.
Social and Cultural Considerations		
Residential Areas and Sensitive Receptors	Proximity to residential areas and sensitive receptors.	The proximity to residential areas and sensitive receptors could result in potential noise, odour, air quality, and visual impacts.
Cultural Heritage and Archaeological Resources	Proximity to cultural heritage sites, structures, areas of significance, archaeological resources, historic artifacts, or historic sites.	The importance of preserving and protecting cultural heritage sites and archaeological resources.
Agricultural Land	Proximity to agricultural lands.	Potential impact on agricultural land such as crop production.

TABLE 1. SCREENING EVALUATION CRITERIA, INDICATORS, AND RATIONALE

Criteria	Indicator	Rationale
Land Use Considerations		
Zoning	Compatibility with existing zoning.	Landfill location should be compatible with existing zoning or zoning will need to be amended.
Land Use	Compatibility with current and planned land use.	Landfill locations that are compatible with existing and planned land uses are preferred.

A summary of the screening is presented in **Table 2**, and the detailed screening of the Alternative Methods against these criteria is detailed in **Appendix A**.

TABLE 2. SUMMARY OF SCREENING OF ALTERNATIVE METHODS

Criteria	Indicator	Vertical Alternative Method	Horizontal Alternative Method 1	Horizontal Alternative Method 2
Cost & Constructability Considerations				
Landfill Capacity	Landfill capacity provided by the alternative method.	Approximately 14,000,000 m^3	Approximately 14,000,000 m^3	Approximately 14,000,000 m^3
Site Life Extension	Potential site life extension for the landfill based on the estimated landfill capacity.	About 12 years	About 12 years	About 12 years
Required infrastructure	Infrastructure required but not currently available in the proposed landfill area.	Only upgrades required.	New LFG collection system, leachate collection system, and new on-site access roads.	New LFG collection system and new on-site access road.
Upgrades to existing infrastructure	Infrastructure present in the landfill area that requires upgrades.	Expansion of LFG collection system within the landfill.	Additional leachate pump stations, holding tank and forcemain. LFG upgrades for pressure loss from new LFG system.	Existing leachate collection system within Old Landfill may need substantial upgrades.
Required site development	Site development required to accommodate the alternative method.	Potential addition to visual screening berms.	Excavation, stormwater management (ditches/pond), visual screening berms.	Relocation of poplar forest, final cover removal, potential stormwater management, potential visual screening berms.
Required permits and approvals	Nature and complexity of required permits and approvals.	EA, Environmental Compliance Approvals, Official Plan Amendments.	EA, Environmental Compliance Approvals, Official Plan Amendments, Zoning By-law Amendment.	EA, Environmental Compliance Approvals, Official Plan Amendments.

Criteria	Indicator	Vertical Alternative Method	Horizontal Alternative Method 1	Horizontal Alternative Method 2
Technical Considerations				
Excavation requirements	Excavation required to accommodate the alternative method.	None.	Excavation of 43.2 ha to 10 m below ground.	Excavation of final cover, waste within Old Landfill, and area between Expansion Landfill and Old Landfill.
Soil stockpiling requirements	Soil stockpiling requirements for the alternative method.	None.	Substantial stockpiling of excavated soil will be required.	Stockpiling of removed final cover materials and excavation of area between the Expansion Landfill footprint and the Old Landfill area.
Liner requirements	Liner system required for the alternative method.	None.	A full engineered base liner will be required.	An engineered base liner will be required between the Expansion Landfill footprint and the Old Landfill area. The Old Landfill area was constructed without an engineered base liner.
Landfill gas management	Landfill gas management required for the alternative method.	LFG collection system will require expansion.	Requires new LFG collection system, upgrades to existing LFG collection system.	Requires new LFG collection system.
Leachate management	Leachate management required for the alternative method.	No changes required.	Requires new leachate collection system and upgrades to existing system (pump stations/ forcemain).	Existing leachate collection system in Old Landfill may require substantial upgrades.
Stormwater management	Stormwater management required for the alternative method.	No changes required.	Stormwater management required including new drainage ditches and pond.	Additional stormwater management may be required.
Haul distance on site	Distance from the weigh scale to the alternative method along on-site roadways.	No changes required.	~2 km of additional haul distance	~1.6 km of additional haul distance

Criteria	Indicator	Vertical Alternative Method	Horizontal Alternative Method 1	Horizontal Alternative Method 2
Environmental Considerations				
Air Quality, Odour, and Noise	Changes in potential effects on air quality, odour, and noise.	Potential effects on air quality, odour, and noise would occur within the same general area.	Potential air quality, odour, and noise effects would occur closer to sensitive receptors in Watford and the south end of the TCEC site.	Potential air quality, odour, and noise effects would occur closer to neighbouring residences and businesses to the east of the TCEC site.
Surface Water	Changes in potential effects on surface water.	Unlikely that surface water off-site will be affected.	There may be changes to stormwater drainage patterns and potential effects on surface water flows to Brown Creek and surrounding lands due to required changes in stormwater management.	Unlikely that surface water off-site will be affected.
Groundwater	Changes in potential effects on groundwater.	No changes anticipated.	There may be changes to groundwater quantity from reduced infiltration rates caused by the excavation of 43.2 ha area to 10 m below ground. Situated within a significant groundwater recharge area.	There may be changes to groundwater quality because the Old Landfill was constructed without an engineered base liner.
Vegetation Removal	Extent of vegetation removal required for landfill development.	None.	Removal of vegetation within the footprint and for access roads.	The existing poplar forest located on the south corner of the Old Landfill Area will be required to be compensated. Removal of the final cover will be required.
Social & Cultural Considerations				
Residential Areas and Sensitive Receptors	Proximity to residential areas and sensitive receptors.	No change to proximity to residential areas and sensitive receptors.	Much closer to Watford, residential receptors to the south of the TCEC site, and nearby recreational facilities such as the Watford Dog Park and East Lambton Community Complex.	Closer to residential receptors to the east of the TCEC site and neighbouring farms and businesses.

Criteria	Indicator	Vertical Alternative Method	Horizontal Alternative Method 1	Horizontal Alternative Method 2
Cultural Heritage and Archaeological Resources	Proximity to cultural heritage sites, structures, archaeological resources, historic artifacts, or historic sites.	No change to proximity to cultural heritage and archaeological resources.	Much closer to archaeological resources located in the southeast corner of the TCEC site (within 250 m).	Slightly closer to archaeological resources located in the southeast corner of the TCEC site.
Agricultural Land	Proximity to agricultural lands.	No change to proximity to agricultural lands.	Located partially within existing agricultural lands at the south end of the TCEC site.	Directly adjacent to neighbouring agricultural lands to the east.
Land Use Considerations				
Zoning	Compatibility with existing zoning.	Compatible with existing zoning.	Zoning By-law Amendment required for the use of the agricultural area at the south end of the TCEC site.	Compatible with existing zoning.
Land Use	Compatibility with current and planned land use.	No changes to land use.	Partially compatible with existing land use. Land at the south end of the site is currently used for agriculture.	Partially compatible with existing land use. Land at the east side of the site is used for a closed landfill and a poplar plantation for leachate management.

The screening level comparison shows that the Vertical Alternative Method is preferred over both Horizontal Alternative Methods for all criteria and considerations.

Summary and Conclusions

The results of the screening indicate that the representative Vertical Alternative Method is preferred over the Horizontal Alternative Methods.

WM will now proceed with developing specific vertical Alternative Methods within the same footprint area to achieve the additional landfill capacity. These vertical Alternative Methods will be assessed and comparatively evaluated in the EA in order to identify a preferred alternative.

Figures

LEGEND – EXISTING :

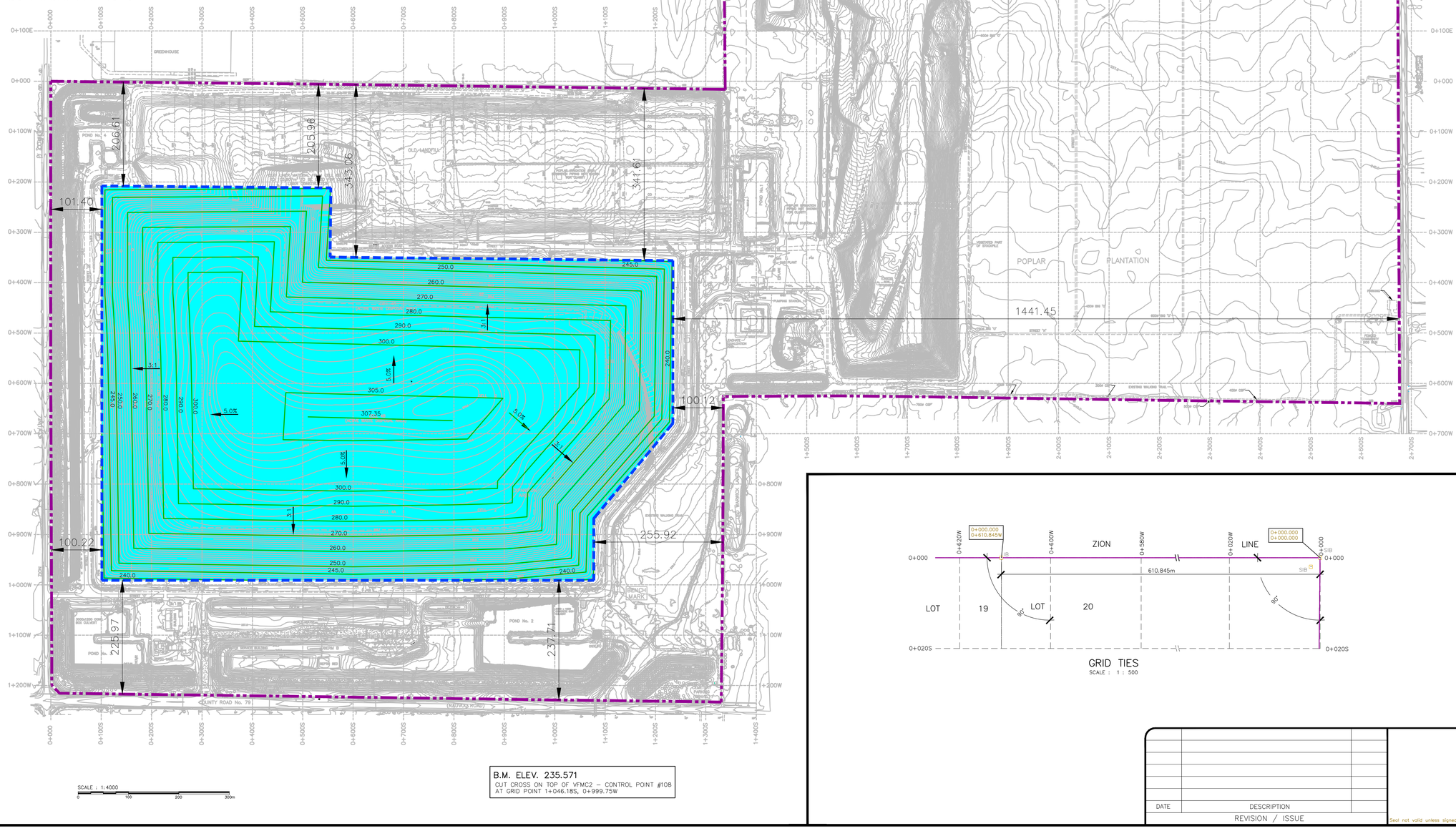
(APPLICABLE TO 1:750 SCALE DRAWINGS)

SIB	STANDARD IRON BAR
IB	IRON BAR
SSIB	SHORT STANDARD IRON BAR
MH18	MANHOLE
DI–5	DITCH INLET
DIMH1	DITCH INLET MANHOLE
CBMH2	CATCH BASIN MANHOLE
COMH4	FORCEMAIN CLEANOUT MANHOLE
PDT#1	PUMP DRAIN TRAP (LANDFILL GAS)
DC5	DRAIN CHAMBER
	VALVE AND VALVE BOX
OS3#1	POND OUTLET STRUCTURE
AS2	AIR SAMPLER
VC3	VALVE CHAMBER
HH4	HANDHOLE
	CONCRETE HEADWALL
OW6–12	OBSERVATION WELL
FH	FIRE HYDRANT
10D	GABION BASKET BASE FOR VERTICAL GAS WELL
GW4/12	GAS WELL
GDT4	GRAVITY DRAIN TRAP (LANDFILL GAS)
CO	CLEANOUT
AP	ANCHOR POLE
IVC01	ISOLATION VALVE CHAMBER (LANDFILL GAS)
BD1	BLOW DOWN (LANDFILL GAS)
HP/P01	HYDRO POLE
CDT3	CONDENSATE TRAP
DC16	LEACHATE DRAIN CHAMBER
UN	UNKNOWN ITEM
RTW	RETAINING WALL
	LITTER FENCE
	RIP RAP
	CONCRETE ROAD
	LANDFILL PROPERTY LIMIT (WITH POST AND WIRE FENCE)
	LANDFILL LIMIT (ACTUAL WASTE LIMIT MAY VARY)
	WASTE MANAGEMENT OF CANADA CORPORATION PROPERTY LIMIT

	EDGE PAVED ROAD
	EDGE GRAVEL ROAD/TRAIL
	DITCH/SWALE
	CULVERT – PIPE
	CULVERT – CONCRETE BOX
CT	COMMON TRENCH
	FENCE LINE
	TREE LINE
ST	STORM SEWER
E	ELECTRICAL POWER LINE (BURIED)
T	TELEPHONE LINE IN CONDUIT
PF	POPLAR FLUSHING FORCEMAIN
PI	POPLAR IRRIGATION FORCEMAIN
IT	POPLAR IRRIGATION TUBING
D	CONDENSATE DRAIN
LD	LEACHATE DRAIN
LG	LANDFILL GAS PIPING
SA	SANITARY SEWER/FORCEMAIN
B	BELL TELEPHONE
W	WATERMAIN
SP	SPARE CONDUIT
PLC	PROGRAMABLE LOGIC CONTROLLER LINE IN CONDUIT
L	LEACHATE COLLECTION PIPE/FORCEMAIN – SOLID
L	LEACHATE COLLECTION PIPE – PERFORATED
LR	LEACHATE RECIRCULATION FORCEMAIN
	EXISTING GROUND CONTOURS 0.5m INTERVALS
237.5	EXISTING GROUND CONTOURS 2.5m INTERVALS

NOTES :

1. TOPOGRAPHIC FEATURES SHOWN ON THIS PLAN ARE BASED ON TOP OF WASTE CONTOURS (LANDFILL EXPANSION AREA), QUARTERLY SURVEYS BY SMC GEOMATICS INC. AND AERIAL SURVEY DATA OBTAINED ON JUNE 21, 2018 BY BASE MAPPING LIMITED.



B.M. ELEV. 235.571
CUT CROSS ON TOP OF VFMC2 – CONTROL POINT #108
AT GRID POINT 1+046.185, 0+999.75W

GRID TIES
SCALE : 1 : 500

DATE	DESCRIPTION
	REVISION / ISSUE

Seal not valid unless signed & dated

wsp
55 KING STREET, SUITE 700
ST.CATHARINES (ONTARIO) CANADA L2R 3H5
TEL.: 905-687-1771 | WWW.WSP.COM

PROPOSED
WEST EXPANSION

TWIN CREEKS ENVIRONMENTAL CENTRE
WARWICK TOWNSHIP

DWN BY: T C G
CHK BY: C O R

DATE: DECEMBER 1, 2023
SCALE: SEE BAR SCALE

WASTE MANAGEMENT OF CANADA CORP.

DRAWING NO. 211-01678-02 - SE1

DRAWING
SE1

G:\2021\211-01678-02 TWIN CREEKS EXPANSION\DRAWINGS\EXPANSION NOV 28 2023\211-10678-02-SE1.dwg Dec 01, 2023 - 11:28am

LEGEND – EXISTING :

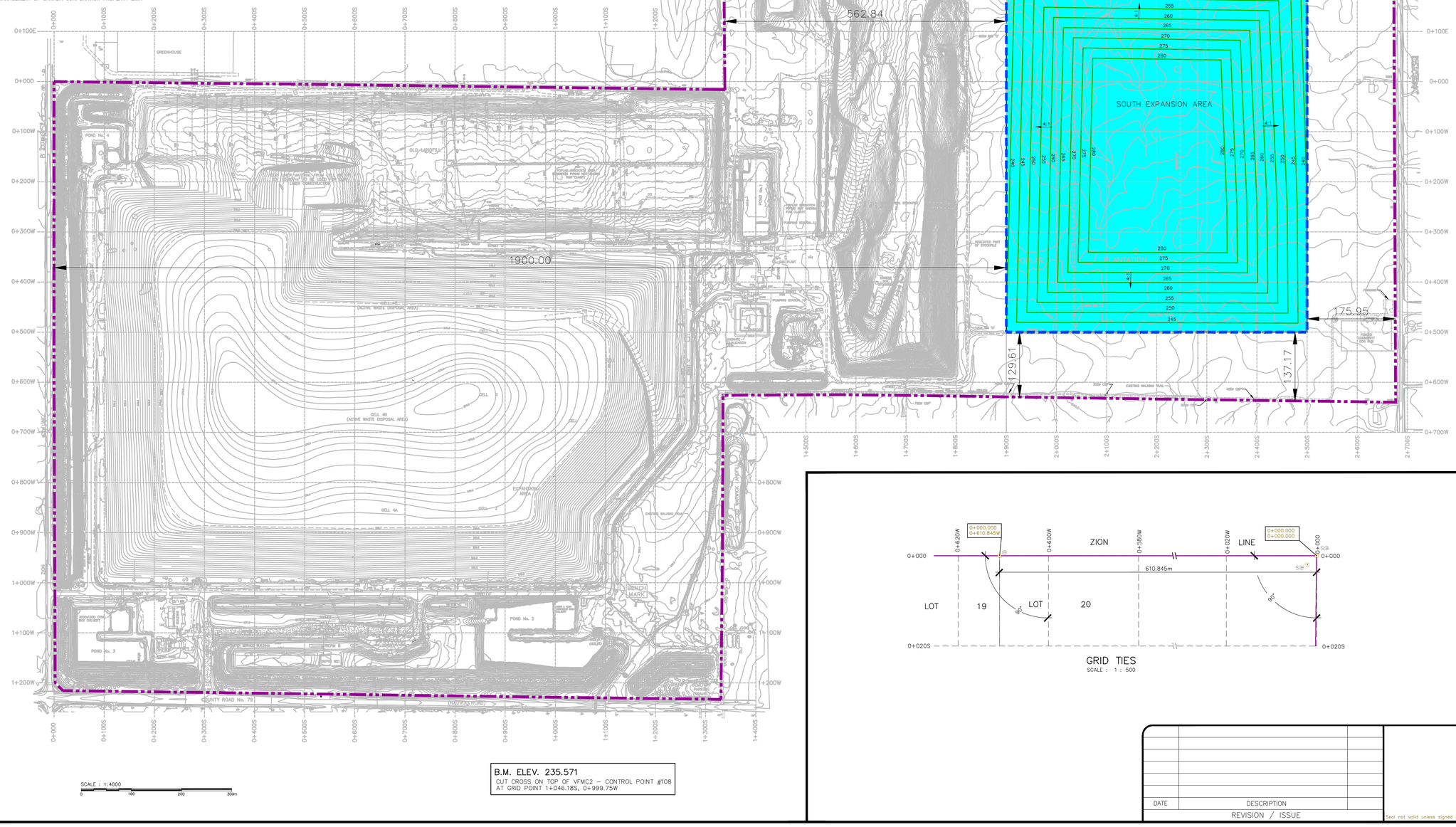
(APPLICABLE TO 1:750 SCALE DRAWINGS)

SIB	STANDARD IRON BAR
IB	IRON BAR
SSIB	SHORT STANDARD IRON BAR
MH18	MANHOLE
DI–5	DITCH INLET
DIMH1	DITCH INLET MANHOLE
CBMH2	CATCH BASIN MANHOLE
COMH4	FORCEMAIN CLEANOUT MANHOLE
PDT#1	PUMP DRAIN TRAP (LANDFILL GAS)
DC5	DRAIN CHAMBER
	VALVE AND VALVE BOX
OS3#1	POND OUTLET STRUCTURE
AS2	AIR SAMPLER
VC3	VALVE CHAMBER
HH4	HANDHOLE
	CONCRETE HEADWALL
OW6–12	OBSERVATION WELL
FH	FIRE HYDRANT
100	GABION BASKET BASE FOR VERTICAL GAS WELL
GW4/12	GAS WELL
GDT4	GRAVITY DRAIN TRAP (LANDFILL GAS)
CO	CLEANOUT
AP	ANCHOR POLE
IVC01	ISOLATION VALVE CHAMBER (LANDFILL GAS)
BD1	BLOW DOWN (LANDFILL GAS)
HP/P01	HYDRO POLE
CDT3	CONDENSATE TRAP
DC16	LEACHATE DRAIN CHAMBER
UN	UNKNOWN ITEM
RTW	RETAINING WALL
	LITTER FENCE
	RIP RAP
	CONCRETE ROAD
	LANDFILL PROPERTY LIMIT (WITH POST AND WIRE FENCE)
	LANDFILL LIMIT (ACTUAL WASTE LIMIT MAY VARY)
	WASTE MANAGEMENT OF CANADA CORPORATION PROPERTY LIMIT

	EDGE PAVED ROAD
	EDGE GRAVEL ROAD/TRAIL
	DITCH/SWALE
	CULVERT – PIPE
	CULVERT – CONCRETE BOX
CT	COMMON TRENCH
	FENCE LINE
	TREE LINE
ST	STORM SEWER
E	ELECTRICAL POWER LINE (BURIED)
T	TELEPHONE LINE IN CONDUIT
PF	POPLAR FLUSHING FORCEMAIN
PI	POPLAR IRRIGATION FORCEMAIN
IT	POPLAR IRRIGATION TUBING
D	CONDENSATE DRAIN
LD	LEACHATE DRAIN
LG	LANDFILL GAS PIPING
SA	SANITARY SEWER/FORCEMAIN
B	BELL TELEPHONE
W	WATERMAIN
SP	SPARE CONDUIT
PLC	PROGRAMABLE LOGIC CONTROLLER LINE IN CONDUIT
L	LEACHATE COLLECTION PIPE/FORCEMAIN – SOLID
L	LEACHATE COLLECTION PIPE – PERFORATED
LR	LEACHATE RECIRCULATION FORCEMAIN
	EXISTING GROUND CONTOURS 0.5m INTERVALS
237.5	EXISTING GROUND CONTOURS 2.5m INTERVALS

NOTES :

1. TOPOGRAPHIC FEATURES SHOWN ON THIS PLAN ARE BASED ON TOP OF WASTE CONTOURS (LANDFILL EXPANSION AREA), QUARTERLY SURVEYS BY SMC GEOMATICS INC. AND AERIAL SURVEY DATA OBTAINED ON JUNE 21, 2018 BY BASE MAPPING LIMITED.



SCALE : 1: 4000

0 100 200 300m

B.M. ELEV. 235.571
CUT CROSS ON TOP OF VFMC2 – CONTROL POINT #108
AT GRID POINT 1+046.185, 0+999.75W

GRID TIES
SCALE : 1 : 500

DATE	DESCRIPTION
	REVISION / ISSUE

Seal not valid unless signed & dated

wsp
55 KING STREET, SUITE 700
ST.CATHARINES (ONTARIO) CANADA L2R 3H5
TEL.: 905-687-1771 | WWW.WSP.COM

PROPOSED
SOUTH EXPANSION

TWIN CREEKS ENVIRONMENTAL CENTRE
WARWICK TOWNSHIP

DWN BY: T C G
CHK BY: C O R
DATE: DECEMBER 1, 2023
SCALE: SEE BAR SCALE

WASTE MANAGEMENT OF CANADA CORP.

DRAWING NO. 211-01678-02 - ES2

DRAWING
SE2

G:\2021\211-01678-02 TWIN CREEKS EXPANSION\DRAWINGS\EXPANSION NOV 28 2023\211-01678-02-SE2.dwg Dec 01, 2023 - 11:35am

LEGEND – EXISTING :

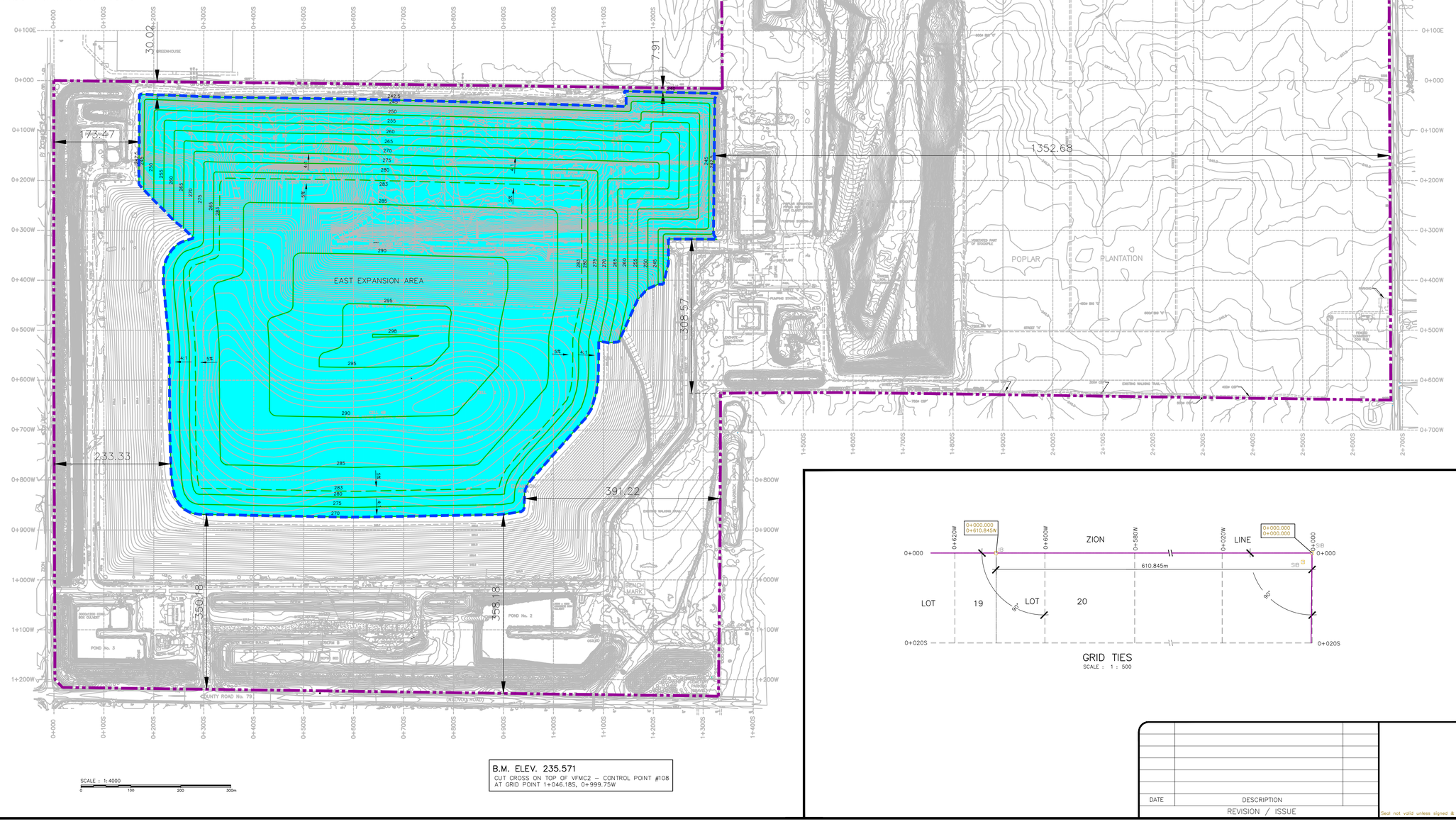
(APPLICABLE TO 1:750 SCALE DRAWINGS)

SIB	STANDARD IRON BAR
IB	IRON BAR
SSIB	SHORT STANDARD IRON BAR
MH18	MANHOLE
DI-5	DITCH INLET
DIMH1	DITCH INLET MANHOLE
CBMH2	CATCH BASIN MANHOLE
COMH4	FORCEMAIN CLEANOUT MANHOLE
PDT#1	PUMP DRAIN TRAP (LANDFILL GAS)
DC5	DRAIN CHAMBER
	VALVE AND VALVE BOX
OS3#1	POND OUTLET STRUCTURE
AS2	AIR SAMPLER
VC3	VALVE CHAMBER
HH4	HANDHOLE
	CONCRETE HEADWALL
OW6–12	OBSERVATION WELL
FH	FIRE HYDRANT
100	GABION BASKET BASE FOR VERTICAL GAS WELL
GW4/12	GAS WELL
GDT4	GRAVITY DRAIN TRAP (LANDFILL GAS)
CO	CLEANOUT
AP	ANCHOR POLE
IVC01	ISOLATION VALVE CHAMBER (LANDFILL GAS)
BD1	BLOW DOWN (LANDFILL GAS)
HP/P01	HYDRO POLE
CDT3	CONDENSATE TRAP
DC16	LEACHATE DRAIN CHAMBER
UN	UNKNOWN ITEM
RTW	RETAINING WALL
	LITTER FENCE
	RIP RAP
	CONCRETE ROAD
	LANDFILL PROPERTY LIMIT (WITH POST AND WIRE FENCE)
	LANDFILL LIMIT (ACTUAL WASTE LIMIT MAY VARY)
	WASTE MANAGEMENT OF CANADA CORPORATION PROPERTY LIMIT

	EDGE PAVED ROAD
	EDGE GRAVEL ROAD/TRAIL
	DITCH/SWALE
	CULVERT – PIPE
	CULVERT – CONCRETE BOX
CT	COMMON TRENCH
x x	FENCE LINE
	TREE LINE
ST	STORM SEWER
E	ELECTRICAL POWER LINE (BURIED)
T	TELEPHONE LINE IN CONDUIT
PF	POPLAR FLUSHING FORCEMAIN
PI	POPLAR IRRIGATION FORCEMAIN
IT	POPLAR IRRIGATION TUBING
D	CONDENSATE DRAIN
LD	LEACHATE DRAIN
LG	LANDFILL GAS PIPING
SA	SANITARY SEWER/FORCEMAIN
B	BELL TELEPHONE
W	WATERMAIN
SP	SPARE CONDUIT
PLC	PROGRAMABLE LOGIC CONTROLLER LINE IN CONDUIT
L	LEACHATE COLLECTION PIPE/FORCEMAIN – SOLID
L	LEACHATE COLLECTION PIPE – PERFORATED
LR	LEACHATE RECIRCULATION FORCEMAIN
	EXISTING GROUND CONTOURS 0.5m INTERVALS
237.5	EXISTING GROUND CONTOURS 2.5m INTERVALS

NOTES :

1. TOPOGRAPHIC FEATURES SHOWN ON THIS PLAN ARE BASED ON TOP OF WASTE CONTOURS (LANDFILL EXPANSION AREA), QUARTERLY SURVEYS BY SMC GEOMATICS INC. AND AERIAL SURVEY DATA OBTAINED ON JUNE 21, 2018 BY BASE MAPPING LIMITED.



B.M. ELEV. 235.571
CUT CROSS ON TOP OF VFMC2 – CONTROL POINT #108
AT GRID POINT 1+046.185, 0+999.75W

GRID TIES
SCALE : 1 : 500

DATE	DESCRIPTION
	REVISION / ISSUE

Seal not valid unless signed & dated

wsp
55 KING STREET, SUITE 700
ST.CATHARINES (ONTARIO) CANADA L2R 3H5
TEL.: 905-687-1771 | WWW.WSP.COM

PROPOSED
EAST EXPANSION

TWIN CREEKS ENVIRONMENTAL CENTRE
WARWICK TOWNSHIP

DWN BY: T C G
CHK BY: C O R
DATE: DECEMBER 1, 2023
SCALE: SEE BAR SCALE

WASTE MANAGEMENT OF CANADA CORP.

DRAWING NO. 211-01678-02 - SE3

DRAWING
SE3

G:\2021\211-01678-02 TWIN CREEKS EXPANSION\DRAWINGS\EXPANSION NOV 28 2023\211-10678-02-SE3.dwg Dec 01, 2023 - 11:29am

Appendix A
Detailed Screening of Alternative Methods

Criteria	Indicator	Rationale	Vertical Alternative Method	Horizontal Alternative Method 1	Horizontal Alternative Method 2
Cost & Constructability Considerations					
Landfill Capacity	Landfill capacity provided by the alternative method.	Provided landfill capacity must be sufficient to justify capital cost. Alternative methods with larger capacities are preferred as they allow for maximum site life extension.	Approximately 14,000,000 m^3	Approximately 14,000,000 m^3	Approximately 14,000,000 m^3
Site Life Extension	Potential site life extension for the landfill based on the estimated landfill capacity.	Provided site life extension must be sufficient to justify capital cost. Alternative methods with longer site life extensions are preferred.	About 12 years	About 12 years	About 12 years
Required infrastructure	Infrastructure required but not currently available in the proposed landfill area.	New infrastructure increases capital cost. Alternative methods with comparatively lower requirements for new infrastructure are preferred.	None. Infrastructure is in place and upgrades will be required.	As no infrastructure currently exists in the proposed area, required infrastructure includes a landfill gas collection system, a leachate collection system, and on-site access roads to allow trucks to reach the landfill.	Infrastructure currently exists within the Expansion Landfill footprint and the Old Landfill area; however, a new landfill gas collection system and a new access road east of the Old Landfill area will be required.
Upgrades to existing infrastructure	Infrastructure present in the landfill area that requires upgrades.	Infrastructure upgrades increase capital cost. Alternative methods with comparatively lower requirements for infrastructure upgrades are preferred.	The existing landfill gas collection system will require expansion as the landfill is constructed.	The leachate collection system will require additional pump stations and potentially a new holding tank and a long forcemain to dispose the collected leachate at the existing storage tank. The landfill gas collection system may require upgrading due to pressure loss from longer header pipes required to connect the new landfill gas collection system to the existing landfill gas infrastructure.	The existing leachate collection system within the Old Landfill area may require substantial upgrades to handle additional leachate generation.

Criteria	Indicator	Rationale	Vertical Alternative Method	Horizontal Alternative Method 1	Horizontal Alternative Method 2
Required site development	Site development required to accommodate the alternative method.	Additional site development increases capital cost. Alternative methods with comparatively lower site development requirements are preferred.	Site development that may be required includes the potential addition to existing visual screening berms.	Site development that may be required includes excavation of the landfill area, the establishment of stormwater management including drainage ditches and potentially a new stormwater management pond, and the construction of visual screening berms.	Site development that may be required includes the relocation of the existing poplar forest within the Old Landfill area, the removal of final cover, potential additional stormwater management, and potentially the construction of visual screening berms.
Required permits and approvals	Nature and complexity of required permits and approvals.	Increased complexity of permits, approvals, and agreements can increase capital cost and create schedule delays. Alternative methods with less-complex permitting and approval requirements are preferred.	Key permits and approvals that will be required include an environmental assessment (EA), amendments to environmental compliance approvals (ECAs), and Official Plan Amendments (OPAs) to the County of Lambton Official Plan and the Township of Warwick Official Plan.	Key permits and approvals that will be required include an environmental assessment (EA), amendments to environmental compliance approvals (ECAs), Official Plan Amendments (OPAs) to the County of Lambton Official Plan and the Township of Warwick Official Plan, and an amendment to the Township of Warwick Zoning By-law.	Key permits and approvals that will be required include an environmental assessment (EA), amendments to environmental compliance approvals (ECAs), and Official Plan Amendments (OPAs) to the County of Lambton Official Plan and the Township of Warwick Official Plan.
Technical Considerations					
Excavation requirements	Excavation required to accommodate the alternative method.	Excavation requirements add to the technically complexity of the development. Alternative methods with comparatively lower excavation requirements are preferred.	None.	Excavation of 43.2 ha area to 10 m below ground.	Excavation of final cover and partial excavation of waste within the Old Landfill area, and excavation of area between the Expansion Landfill footprint and the Old Landfill area.
Soil stockpiling requirements	Soil stockpiling requirements for the alternative method.	Soil stockpiling and soil management add to the technical complexity of the development. Alternative methods with comparatively lower soil stockpiling and soil	None.	Substantial stockpiling of excavated soil will be required.	Stockpiling of removed final cover materials and excavation of area between the Expansion Landfill footprint and the Old Landfill area.

Criteria	Indicator	Rationale	Vertical Alternative Method	Horizontal Alternative Method 1	Horizontal Alternative Method 2
		management requirements are preferred.			
Liner requirements	Liner system required for the alternative method.	Liner system requirements add to the technical complexity of the development. Alternative methods with comparatively lower additional liner requirements are preferred.	None.	A full engineered base liner will be required.	An engineered base liner will be required between the Expansion Landfill footprint and the Old Landfill area. The Old Landfill area was constructed without an engineered base liner.
Landfill gas management	Landfill gas management required for the alternative method.	Landfill gas management requirements add to the technical complexity of the development. Alternative methods with comparatively lower landfill gas management requirements are preferred.	The existing landfill gas collection system will require expansion as the landfill is constructed.	A new landfill gas collection system will be required. The existing on-site landfill gas collection system may require upgrading due to pressure loss from longer header pipes required to connect the new landfill gas collection system to the existing landfill gas infrastructure.	A new landfill gas collection system will be required.
Leachate management	Leachate management required for the alternative method.	Leachate management requirements add to the technical complexity of the development. Alternative methods with comparatively lower leachate management requirements are preferred.	No changes required.	A new leachate collection system will be required. The leachate collection system will require additional pump stations and potentially a new holding tank or a long forcemain to dispose of the collected leachate at the existing storage tank.	The existing leachate collection system within the Old Landfill area may require substantial upgrades to handle additional leachate generation.

Criteria	Indicator	Rationale	Vertical Alternative Method	Horizontal Alternative Method 1	Horizontal Alternative Method 2
Stormwater management	Stormwater management required for the alternative method.	Stormwater management requirements add to the technical complexity of the development. Alternative methods with comparatively lower stormwater management requirements are preferred.	No changes required.	Stormwater management will be required including drainage ditches and potentially a new stormwater management pond.	Additional stormwater management may be required.
Haul distance on site	Distance from the weigh scale to the alternative method along on-site roadways.	Longer on-site haul distances add to the technical complexity of the design. Shorter on-site haul distances are preferred.	No changes required.	Approximately 2 km of additional haul distance.	Approximately 1.6 km of additional haul distance.
Environmental Considerations					
Air Quality, Odour, and Noise	Changes in potential effects on air quality, odour, and noise.	Air, odour, and noise emissions from the landfill can affect local air quality at nearby receptors and cause disturbance through odour and noise. Alternative methods with minimal changes to air quality, odour, and noise at nearby receptors are preferred.	There may be changes to potential effects on air quality, odour, and noise due to the change in landfill shape and height; however, they will likely occur within the same general area.	There will be changes to potential effects on air quality, odour, and noise due to the change in location of the landfill. Air quality, odour, and noise effects will occur closer to sensitive receptors in Watford and the south end of the TCEC site.	There will be changes to potential effects on air quality, odour, and noise due to the change in location of the landfill. Air quality, odour, and noise effects will occur closer to neighbouring residences and businesses to the east of the TCEC site.
Surface Water	Changes in potential effects on surface water.	Alternative methods that avoid changes in potential effects on surface water are preferred.	There may be changes to potential effects of stormwater on-site change in landfill shape and height; however, it is unlikely that surface water off-site will be affected.	There may be changes to stormwater drainage patterns and potential effects on surface water flows to Brown Creek and surrounding lands due to required changes in stormwater management.	There may be changes to stormwater drainage patterns and potential effects of stormwater on-site due to change in landfill shape and location; however, it is unlikely that surface water off-site will be affected.

Criteria	Indicator	Rationale	Vertical Alternative Method	Horizontal Alternative Method 1	Horizontal Alternative Method 2
Groundwater	Changes in potential effects on groundwater.	Alternative methods that avoid changes in potential effects on groundwater are preferred.	No changes anticipated.	There may be changes to groundwater quantity from reduced infiltration rates caused by the excavation of 43.2 ha area to 10 m below ground. Situated within a significant groundwater recharge area.	There may be changes to groundwater quality because the Old Landfill was constructed without an engineered base liner.
Vegetation Removal	Extent of vegetation removal required for landfill development.	Alternative methods that avoid vegetation removal are preferred.	None.	Removal of vegetation within the footprint and for access roads.	The existing poplar forest located on the south corner of the Old Landfill Area will be required to be compensated. Removal of the final cover will be required.
Social and Cultural Considerations					
Residential Areas and Sensitive Receptors	Proximity to residential areas and sensitive receptors.	The proximity to residential areas and sensitive receptors could result in potential noise, odour, air quality, and visual impacts.	No change to proximity to residential areas and sensitive receptors.	Much closer to Watford, residential receptors to the south of the TCEC site, and nearby recreational facilities such as the Watford Dog Park and East Lambton Community Complex.	Closer to residential receptors to the east of the TCEC site and neighbouring farms and businesses.
Cultural Heritage and Archaeological Resources	Proximity to cultural heritage sites, structures, areas of significance, archaeological resources, historic artifacts, or historic sites.	The importance of preserving and protecting cultural heritage sites and archaeological resources.	No change to proximity to cultural heritage and archaeological resources.	Much closer to archaeological resources located in the southeast corner of the TCEC site (within 250 m).	Slightly closer to archaeological resources located in the southeast corner of the TCEC site.
Agricultural Land	Proximity to agricultural lands.	Potential impact on agricultural land such as crop production.	No change to proximity to agricultural lands.	Located partially within existing agricultural lands at the south end of the TCEC site.	Directly adjacent to neighbouring agricultural lands to the east.

Criteria	Indicator	Rationale	Vertical Alternative Method	Horizontal Alternative Method 1	Horizontal Alternative Method 2
Land Use Considerations					
Zoning	Compatibility with existing zoning.	Landfill location should be compatible with existing zoning or zoning will need to be amended.	Compatible with existing zoning.	Zoning By-law Amendment required for the use of the agricultural area at the south end of the TCEC site.	Compatible with existing zoning.
Land Use	Compatibility with current and planned land use.	Landfill locations that are compatible with existing and planned land uses are preferred.	No changes to land use.	Land at the south end of the site is currently used for agriculture; therefore, this landfill location is partially compatible with existing land use.	Land at the east side of the site is used for a closed landfill and a poplar plantation for leachate management. This landfill location is partially compatible with existing land use.