Stormwater Design Brief
West Carleton Environmental Centre

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1. Introduction and Background

This report has been prepared in support of the Waste Management of Canada Corporation (WM) Site Plan Control application for a site expansion at the West Carleton Environmental Centre (WCEC). The Site Plan Control approval is required by the City of Ottawa before the proposed site development, in addition to the Environmental Compliance Approval (ECA) by Ontario Ministry of the Environment and Climate Change (MOECC). WM applied for an ECA approval in September 2014 and their application is under review.

Details of the proposed landfill expansion are outlined in the Development and Operations Report dated July 2014, by WSP Canada Inc.

1.1 Location

The WCEC is located adjacent to Carp Road and Highway 417, locally known as 2301 Carp Road, at the westerly end of Ottawa. The landfill site expansion is an extension of the existing Waste Management Facility, owned and operated by WM.

The WCEC is located on Parts of Lots 2, 3 and 4, Concession 2 and parts of Lots 3, 4 and 5, Concession 3, in the former Township of Huntley, formerly in the Township of West Carleton, now the City of Ottawa, near Carp Road and Highway 417. The existing landfill footprint occupies approximately 34 hectares (ha), bordered by the City of Ottawa Road 5 (Carp Road) on the east, Highway 417 on the south, William Mooney Road to the west and private lands south of Richardson Sideroad. Those lands between Richardson Sideroad and 300 m southerly, between William Mooney Road and Carp Road, are owned by WM, but are not designated as part of the site. The Contaminant Attenuation Zone (CAZ) part of the site consists of two (2) land parcels, one large parcel north of Highway 417 and the second small parcel south of Highway 417. **Figure 1-1** shows these lands and various facilities within the existing and proposed landfill site.

2. Stormwater Management

The stormwater management features of the landfill expansion are shown on **Drawing 4**. Sections through the stormwater ponds and infiltration basins are shown on **Drawings 9 and 10.** **Figure 8-1** shows the drainage areas before development of the landfill expansion. **Figure 8-2** shows how drainage and subdrainage areas are broken down and controlled after the development of the new landfill footprint. **Figure 8-3** provides details related to water storage facilities.

2.1 Existing Topography and Drainage

The natural topography on the area of WCEC property, which has been modified by aggregate extraction and waste disposal activities, ranges from an elevation of approximately 131 metres above sea level (masl) southwest of the landfill site to less than 110 masl on the Huntley Quarry property, east of Carp Road. The present landfill extends to an elevation of approximately 174 masl, and the Huntley Quarry has been mined to a floor elevation of less than 75 masl. Refer to **Figure 1-1** for the area conditions.

From within the boundaries of the existing landfill property, there is no direct off-site discharge of surface water that is in contact with waste that has been landfilled; internal surface water drainage is contained within the landfill property and is directed to on-site ponds, which are engineered, natural, or depressions remaining from aggregate extraction. The exceptions to this are the external slopes of the vegetated site perimeter berms along the east and south boundaries of the landfill property; this amount of surface water is very minor and is not in contact with activities at the landfill. Runoff from the vegetated berms flow into Carp Road and Highway 417 drainage systems. There is a small area of drainage from the extreme western end of the site, in the area of the existing service entrance which flows into the ditch along William Mooney Road and northward into the tributary of Huntley Creek.

The above noted tributary of Huntley Creek originates from the wetland west of William Mooney Road and west of the WCEC property. The wetland feeds a drainage course that collects surface water from the agricultural and residential properties along William Mooney Road, west of the WCEC property. Flowing from west to east under William Mooney Road the drainage course bends to the north and flows towards Richardson Sideroad. Along the south side of Richardson Sideroad, the creek is aligned as a roadside drainage ditch, flowing eastward to a point approximately 450 m east of William Mooney Road. Surface water from the agricultural land east of William Mooney Road and south of the Richardson Sideroad is controlled by drainage ditches and flows northward to the roadside ditch along Richardson Sideroad.

The Huntley Creek tributary then flows northward through a culvert under Richardson Sideroad. Here the creek collects drainage from the area north of Richardson Sideroad, including several residential and commercial/industrial properties. Approximately 250 m west of Carp Road, Huntley Creek flows in a southeasterly direction under Richardson Sideroad and bends towards the northeast, where it passes under Carp Road. From there, the creek flows eastward, parallel to Richardson Sideroad, then northward through a culvert under the road, eventually discharging to the Carp River, some 3.8 km northeast of the landfill property. Ditches along both sides of Carp Road between the landfill property and Richardson Sideroad also drain into this tributary.

Drainage south of the existing landfill is contained within a large wet forested area on the westerly end. The south central and southeasterly lands largely drain through a series of on-site stormwater ditching to a sedimentation pond and infiltration pond designated Stormwater Pond #2, which in turn discharges to the low lying area of Depression #1. The southerly part of the existing landfill at the easterly end drains to Depression #2 and recharges into the water table.

The stormwater flow pattern on the lands for the new landfill footprint can be divided into two (2) zones. On the south central and easterly part, surface flow is controlled by a series of ditches and Stormwater Pond #1, which recharges the water into the water table. Surface flow is generally from southwest to northeast. Because the east end of the property was used for aggregate extraction, the ground surface is lower than the surrounding area, and consequently there is no direct off-site surface water runoff from this area. A previous residential property is located beyond the eastern limit of the former extraction area, west of Carp Road. Surface water flow is northeast, following the slope of the land surface. On the north half of the property for the new landfill footprint, and the complete westerly part, is partially wooded and partially agricultural land. The southeast corner was a manufacturing facility (Laurysen Kitchens Limited). The western and north central part is flat lying, and surface drainage follows land contours and agricultural ditches in a northerly to northeasterly orientation toward Richardson Sideroad and into the tributary of Huntley Creek described previously. The eastern portion of the new lands for the landfill slopes, and has a northeasterly orientation along the edge of a post-glacial beach ridge. Surface drainage follows the land slope into ditches along Carp Road. These ditches drain northerly into the Huntley Creek tributary. West of the previous residential properties, a large depression from aggregate extraction remains, and designated as Depression #5 on **Figure 1-1**. Where the land surface in former extraction areas are depressed, surface water collects in localized ponds. The water level in the depressions reflects low flow groundwater table elevation.

There are no flood hazard zones located within the proposed landfill area. Elevated topography and high recharge potential on beach ridge deposits along Carp Road negate the potential for surface flooding.

2.2 Objectives

The general objectives of the stormwater management plan are as follows:

- control surface water draining on-site;
- control quality and rate of runoff discharging directly from the site to protect water quality and wildlife habitat and to prevent flooding within the South Huntley Creek watershed. Off-site discharge of surface water will be limited to the site perimeter and no offsite discharge from the existing and proposed waste fill areas will occur; and
- control sediment discharge and erosion during site operation and development.

Runoff from the landfill expansion area will drain into landfill perimeter ditching and pass through lined Stormwater Pond #2, where it will be settled before being discharged into Infiltration Basin #2. Runoff from the existing landfill footprint will be contained on-site in one of several depressions including new Infiltration Basin #1. These natural and manmade water storage facilities serve as groundwater recharge areas. Clean runoff from non-operating areas along the site perimeter will continue to drain off-site bypassing the above noted groundwater recharge areas.

The stormwater management plan complies with the MOE Landfill Standards. The design criteria for the site's stormwater facilities are as follows:

Internal Ditches and Stormwater Structures

- 1:25 year storm
- Provide overland flow route to carry peak flow from a 1:100 year storm.

Surface Water Quality Control

- Stormwater ponds sized to store/treat runoff generated from a 4-hour, 25-mm storm event.

Surface Water Quantity Control

- Control post-development peak flows from all storm events up to 1:100 year at or below pre-development levels. This applies only to the areas with direct off-site discharge along the site boundary. There will be no off-site discharge from the central part of the site containing all waste disposal areas.

Infiltration Basins

The proposed infiltration basins are sized for 1:100 year storm event and in accordance with design criteria outlined in the MOE "Stormwater Management Planning and Design Manual" as follows:

- Depth to bedrock and water table – at least 1 m
- Water storage depth – no more than 0.6 m

The 1:100 year storm is the regulatory flood for Eastern Ontario (Zone 2), which includes the WCEC Facility.

2.3 Detailed Stormwater System Assessment

2.3.1 Pre-Development Conditions

Refer to **Figure 8-1** for the outline of the pre-development drainage areas. General hydrologic information concerning each drainage area is presented in **Table 8-1**.

The site is situated within the South Huntley Creek watershed which drains in an easterly direction north of the site. The South Huntley Creek is a tributary of Huntley Creek which in turn empties into the Carp River northeast of the site. South Huntley Creek is a permanent warm water system that has been significantly impacted historically by surrounding agricultural land use and roadways which have bisected its length into smaller reaches, separated generally by culverts. The South Huntley Creek watershed extends to the south of Highway 417 west of the site. The drainage divide runs near the south limit of the WM property just north of Highway 417. The lands draining south to Highway 417 belong to the Feedmill Creek watershed. Feedmill Creek is also a Carp River tributary. The active quarry on the east side of Carp Road locally influences drainage patterns.

The site is relatively flat with the exception of the existing landfill mound which rises approximately 40 – 45 m above the adjacent ground. Generally, the land slopes northeasterly and local drainage patterns are influenced by wetlands and manmade depressions (ponds, pits). These no outlet features serve as groundwater recharge areas and contribute to South Huntley Creek base flow. A portion of the groundwater flow is also drawn by the quarry east of the site.

As shown on **Figure 8-1**, the existing landfill footprint belongs to three (3) separate, no outlet Drainage Areas B, C and D. The existing Waste Transfer & Processing Facility (WTPF) in the southwest part of the site is located within Drainage Area E. The old aggregate extraction pit (Depression #5) forms another no outlet Drainage Area A. In total, on site, no outlet areas occupy 127.5 ha out of 188.3 ha under pre-development conditions. The remaining drainage areas (SH1 and SH2) discharge off-site to the South Huntley Creek and Drainage Area FD to the Highway 417 drainage system and ultimately to Feedmill Creek. A small portion of the site near the existing landfill entrance (Drainage Area F) drains into the quarry on the east side of Carp Road. Generally, drainage areas discharging off-site are located along the site perimeter and do not encroach waste fill or waste processing areas.

The site soil textures according to the Ontario Soil Map are classified as follows:

- Kg – Kars Gravely Sandy Loam — Soil Group B
- Rs – Rubicon Sand — Soil Group AB
- Li – Lyons Loam — Soil Group B

These soils provide good drainage and are relatively permeable.

The Rational Method was used to determine peak flows using Ottawa rainfall intensity duration frequency (IDF) data. The design rainfall intensity was calculated in accordance with the formula:

$$i = A \times T_c^B$$

where i = rainfall intensity (mm/hr)

Tc = time of concentration (hr)

A, B = rainfall equation coefficients dependent on storm return frequency and meteorological station location.

The following runoff coefficients were used to calculate a cumulative runoff coefficient "C" for each drainage area:

- pavement/buildings - 0.9
- gravel areas - 0.55
- existing capped landfill – soil C - 0.45
- woods-soil B - 0.19
- pasture-soil B - 0.24
- pond, wetland - 0.05

- proposed landfill 5% slope – soil C/D - 0.42
- proposed landfill steep slope – soil C/D - 0.50
- lined stormwater pond - 0.5
- infiltration basin - 0.16

The time of concentration required to determine rainfall intensity in the Rational Method was calculated using the Kirpich Method. This method gives conservative, relatively short travel times as shown in **Table 8-1**.

In the Rational Method, peak flows for storms having a return period of more than ten (10) years were increased as follows:

- 1:25 year - 10%;
- 1:50 year - 20%; and
- 1:100 year - 25%.

2.3.1.1 Drainage Areas With No Off-Site Discharge

a) Drainage Area A

Drainage Area A, located in the northeast corner of the site, occupies approximately 10.08 ha. Surface water drains overland into Depression #5 which is an old, presently unused aggregate extraction pit. The west part of the existing Laurysen manufacturing facility and gravel yard west of the building belong to this catchment. Surface water flow is not channelized. The bottom of Depression #5 is at approximately 117.5 masl.

b) Drainage Area B

Drainage Area B is subdivided into two (2) subcatchments, B1 and B2. Catchment B1 collects stormwater from the north slope of the existing landfill. The landfill perimeter ditch directs stormwater to the existing Stormwater Pond #1 which overflows into the elongated natural wetland (Depression #3). Under high flow conditions Depression #3 may overflow into the rehabilitated old Dibbley Pit (Depression #4) which has a bottom elevation at approximately 122.0 masl. Sub-Area B2 drains directly into Depression #4.

Drainage Area B has a very large water storage capacity particularly within Depression #4 where the water level would have to rise more than 3 m before overflowing in a northerly direction. Drainage Area B encompasses 39.47 ha.

c) Drainage Area C

Drainage Area C is also subdivided into two (2) subcatchments, C1 and C2. Area C1 includes a large portion of the south slope of the existing landfill and lands to the south of the existing landfill. Sub-basin C2 collects runoff from the majority of the Closed South Cell including the poplar plantation and lands surrounding the Gas to Energy Facility. Area C1 drains via manmade ditch into existing Stormwater Pond #2. Under high flow conditions, this pond may overflow into adjacent Depression #1 which services sub-basin C2. Depression #1 also has substantial storage capacity and the water level may rise up to 124.5 masl (approximately 2 m) without overflowing. Drainage Area C encompasses 45.19 ha.

d) Drainage Area D

Drainage Area D includes the most easterly part of the existing landfill and the north section of the Closed South Cell. Stormwater drains into Depression #2 which lies south of the lined part of the existing landfill. Ground elevations range from 121.5 (bottom of Depression #2) to 170 masl at the top of the existing landfill mound. The area occupies 21.34 ha.

e) Drainage Area E

This 11.50 ha catchment in the southwest part of the site is very flat and mostly tree covered. Stormwater drains into the wetland inside the wooded area north of Highway 417. The existing waste transfer station is located within the slightly elevated west part of this area.

2.3.1.2 Drainage Areas Discharging Off-Site

a) Drainage Area F

This relatively small drainage area of 5.8 ha, on the west side of Carp Road near the existing landfill entrance, drains northerly along the roadside ditch which crosses Carp Road south of the existing Laurysen building entrance. Further downstream this channel enters Huntley Quarry. The 1:100 year peak flow at the Carp Road crossing is estimated at 0.99 m^3/s. This area has a higher level of imperviousness due to paved road surfaces within the Carp Road allowance and near the existing landfill entrance.

b) Drainage Area SH1

This large catchment of 41.35 ha occupies the northwest part of the site. Generally, it drains northerly towards South Huntley Creek through several channels. A large part of this area drains overland towards

Richardson Sideroad along an undefined flow path. Ditching north of the WTPF directs stormwater westerly across William Mooney Road where it joins the tributary of South Huntley Creek. In summary, stormwater outletting from this basin follows multiple pathways instead of a single concentrated channel.

The area is relatively flat with ground elevations varying from 127 masl in the south beside the existing landfill to 121.5 masl in the north near the property boundary. This basin includes a large woodlot and open field which is used for agricultural purposes.

c) Drainage Area SH2

Runoff from this area of 5.77 ha, located in the northeast corner of the site, drains northerly via roadside ditch along Carp Road into South Huntley Creek. This area includes the commercial/industrial strip on the west side of Carp Road including a large part of the Laurysen manufacturing facility. Generally land in this part of the site slopes easterly towards Carp Road. The Rational Method 1:100 year peak flow at the outlet of this area was calculated as 0.75 m^3/s.

d) Drainage Area FD

This small drainage area of 7.79 ha is situated along the southern property boundary and drains into the Highway 417 ditching system which ultimately discharges into the Carp River through Feedmill Creek east of the site. There is minimal direct off-site discharge from this catchment, generally limited to the external slopes of perimeter berms along the south and east boundaries of the landfill property.

2.3.2 Post-Development Conditions

Refer to **Figure 8-2** for the outline of the post-development drainage areas. Hydrologic parameters characterizing each catchment are shown in **Table 8-2**.

Post-development conditions are characterized by higher runoff coefficients and shorter travel times (time of concentration) due to steep landfill grades and flow channelization. These factors tend to increase peak flows but because the site design is based on no off-site discharge, peak flow attenuation is not an issue for the landfill development area. Runoff from the proposed landfilling area will be contained on-site in Infiltration Basin #2.

The existing Stormwater Pond #1 and small wetland (Depression #3) located within the landfill expansion area will be eliminated and replaced with new clay lined Stormwater Pond #1 and Infiltration Basin #1 within Depression #4. Similarly, Stormwater Pond #2 and Infiltration Basin #2 are proposed in the area designated as Depression #5. Infiltration Basin #2 will service the entire landfill expansion area while Infiltration Basin #1 almost the entire north half of the existing landfill. The landfill expansion will shift drainage boundaries within Drainage Areas A and B, and in catchments located along the site perimeter (SH1, SH2 and F). Drainage patterns within the remaining part of the property will be hardly affected and generally will remain the same as under pre-development conditions. There will be a significant increase in the size of on-site no outlet areas to 151.76 ha from 127.48 ha under pre-development conditions. As a result, more stormwater will be contained on-site and recharged into groundwater and less discharged off-site as surface flow from lands located along the site perimeter.

Drainage Areas A and B were subdivided into small subcatchments for the purpose of hydrologic modelling which was used for sizing of the proposed stormwater storage facilities. Cumulative runoff coefficients and times of concentration were established in a similar fashion as those for the pre-development conditions. Runoff coefficient for the entire study area will increase to 0.35 from 0.29 before the development.

The following soil/land use CN curve numbers were used to establish cumulative CN value for each subcatchment within Drainage Areas A and B, which were subject to hydrologic modelling:

- pavement/buildings - 98
- gravel areas - 90
- existing capped landfill – soil C - 81
- pasture – native or imported soil B - 73
- lined stormwater pond - 85
- proposed landfill 5% slope – soil C/D - 81
- proposed landfill steep slope – soil C/D - 83
- infiltration basin - 70

All above values are for the average antecedent moisture conditions (AMC II).

2.3.2.1 Drainage Areas With No Off-Site Discharge

a) Drainage Area A

This drainage area was subdivided into nine (9) smaller sub-areas to facilitate hydrologic modelling. The overall size of the catchment will expand to 51.66 ha. The cumulative runoff coefficient was calculated as 0.432 in comparison to 0.29 prior to landfill expansion. The Rational Method 1:100 year peak flow at Pond #2 was calculated as 5.31 m^3/s.

Stormwater Pond #2 will control stormwater flows by providing temporary storage and treatment before releasing water into Infiltration Basin #2. All runoff originating from the landfill expansion area will be handled within this catchment. The proposed landfill will be graded such that all runoff from the mound will drain toward the landfill perimeter and be intercepted by the perimeter ditching. The ditching system will direct stormwater into Stormwater Pond #2. A large part of the on-site road network, including the main access road and scale house area, will be also routed through Stormwater Pond #2. Stormwater accumulating over the landfill base during base preparation as well as stormwater pools west of the lined area will be pumped to the perimeter ditching system, on an as required basis.

b) Drainage Area B

This watershed was also subdivided into multiple sub-areas to facilitate hydrologic modelling. Drainage Area B will be smaller, 22.58 ha down from 39.47 ha originally as a result of the proposed development. The northwest part of the catchment will be shifted into Drainage Area A and comprise part of the landfill footprint. The cumulative runoff coefficient increases to 0.398 from 0.32 prior to development. The overall CN number was estimated at 79.1 and the Rational Method 1:100 year flow at Pond #1 was calculated as 2.13 m^3/s.

Stormwater Pond #1 and Infiltration Basin #1 will function in the same fashion as stormwater storage facilities within Drainage Area A. New ditching will be provided on the west and south side of the existing landfill to intercept runoff coming from side slopes and direct it towards new Stormwater Pond #1. The south half of the main access road between two (2) mounds and the entire Mini-Transfer Area (MTA) are included within this drainage basin.

c) Remaining Drainage Areas

The size of Drainage Areas C, D and E will not change as a result of the landfill expansion as there is no major development planned for the south half of the WM property. Construction activities will be limited to the leachate treatment plant, contingency poplar plantation, road improvement (paving), extension of underground utilities and minor building improvements (blower building). These activities will have a negligible effect on the existing drainage patterns, and stormwater flows will remain the same as under pre-development conditions.

2.3.2.2 Drainage Areas Discharging Off-Site

a) Drainage Area F

The catchment boundary will be slightly realigned as a result of the landfill expansion with a minor reduction in size to 5.24 ha from 5.8 ha. The imperviousness level will increase with construction of the new access road off Carp Road and the Carp Road widening near the new entrance. This part of the site will also be subject to landscaping activities such as tree and bush planting, etc. The runoff coefficient for this area will increase by approximately 10% to 0.38. The 1:100 year peak flow will remain at the pre-development level of 0.99 m^3/s. This area will continue to discharge into the quarry east of the site.

b) Drainage Area SH1

The post-development size of this area will decrease to 18.44 ha down from 41.35 ha. For this reason there will be no increase in flows leaving the site. A decrease in size of this basin is a result of the proposed development; a portion of this area would become part of the landfill footprint.

Generally, this area extends near the limit of the development area and as such will not see major construction activities. Clearing and earthwork will be limited to the south and east catchment boundary. Landscaping and reforestation activities will take place within the westerly and northerly buffer area.

c) Drainage Area SH2

This area will not be heavily affected by the proposed development and its boundary will be slightly realigned because of interference with Infiltration Basin #2 and Stormwater Pond #2. Other project related activities will be limited to the Carp Road widening and minor landscaping work along the site boundary. Post-development size of this catchment will shrink to 5.06 ha down from 5.77 ha originally. The runoff coefficient remains unchanged at 0.36 after development. The 1:100 year flow was estimated as 0.66 m^3/s at the catchment outlet and is lower than under pre-development conditions.

d) Drainage Area FD

There will be no change in hydrologic characteristics of this area as there is no new development proposed within this part of the site.

2.3.3 Hydrologic Modelling

The Bentley Pondpack Version 8i computer program utilizing the SCS Unit Hydrograph Method was used for hydrologic modelling. A summary of the modelling procedure is outlined in **Appendix A**. Pondpack printouts for post-development conditions within Drainage Areas A and B are provided in **Appendix B**. The reader is referred to the same appendix for schematic of both catchments. **Tables 8-3 and 8-4** provide a comprehensive summary of the hydrologic modelling results. These results include rainfall data, flows, runoff volumes and coefficients, water levels, storage capacities and draining times.

The synthetic SCS Type II rainfall distribution for the 24-hour storm for the Ottawa meteorological station was used for hydrograph development with the following input parameters:

- size of drainage area;
- time of concentration;
- calibrated CN curve number; and
- constant infiltration rate of 12 mm/hr for both infiltration basins as recommended by the geotechnical investigation and hydrogeologist.

Default equations for time to peak and peak discharge of the hydrograph were used.

Hydrograph routing and addition in accordance with the drainage area schematic was carried out by the computer model. Stormwater ponds and infiltration basins were sized through an iterative process until they complied with the established design criteria. The Modified Puls Method was used for reach routing to account for hydrograph translation through the on-site ditching network.

It is interpreted that modelling results are conservative because simulated low frequency peak flows exceed those calculated manually with the Rational Method. For example, simulated 1:100 year flow at Pond #2 is 7.71 m^3/s, and is 45% higher than the same flow determined with the Rational Method. Similarly, runoff coefficients shown in **Table 8-3**, Column (7) for low frequency events are generally higher than the corresponding coefficients shown in **Table 8-2** even when accounting for the Rational Method peak flow increase factor for infrequent storms. For example, the simulated 1:100 year runoff coefficient for Catchment B is 0.533 and higher than the adjusted corresponding Rational Method coefficient of 0.498 (0.398 x 1.25) shown in **Table 8-2**. This indicates that the ponds are not undersized and that their storage capacities are adequate and conservative.

2.3.4 Stormwater System Infrastructure

2.3.4.1 Ditching

The overall layout of the proposed ditching system including invert elevations is shown on **Drawing 4**.

Ditching will be trapezoidal in the section with bottom width ranging from zero (triangular section) to 2 m depending on estimated flow. Schedule of ditch bottom widths is provided on **Drawing 4**. The highest flows will be in the landfill perimeter ditch draining into Stormwater Pond #2. The design 1:25 year flow for the south and north branches of the landfill perimeter ditch near Pond #2 inlet was calculated at approximately 1.8 m^3/s. Water depth under such flow in trapezoidal channel having a bottom width of 2 m and a slope of 0.5% would be 0.5 m which is less than the minimum ditch depth of approximately 1.1 m.

The landfill perimeter ditch will have an outer slope of 3H:1V (minimum) and an inner (landfill side) slope of 4H:1V (minimum) which is the same as the landfill side slopes. All other ditches will have side slopes not steeper than 3H:1V. Generally, the proposed ditches are relatively flat at grades around 0.5%. Flow velocity under such conditions for the 1:25 year storm event will be low at less than 1.0 m/s. Such velocities are suitable for grass lining which will assist in sediment filtering and erosion control.

Locally, ditching will be steeper and all ditches sloping at more than 3 to 4% will be rip rap lined with appropriately sized stone over geotextile. This includes ditching along the high access road having a grade of up to 8%. The rip rap lining will also be provided at all culvert ends, ditch inlets and at ditch alignment changes exceeding 45 degrees. Rip rap grouting may be used to further reduce erosion potential and washouts. Rock check dams will be installed along the long, steep ditch sections to reduce flow velocity.

Erosion control mats and sod may be used wherever establishment of vegetation cover is critical.

2.3.4.2 Storm Sewers and Culverts

Two (2) sections of storm sewers are part of the proposed drainage system. The first is 300 mm diameter overflow line for Infiltration Basin #1 discharging into Infiltration Basin #2. This line is provided in compliance with design guidelines which require overflow protection for infiltration basins. The line will not transmit any stormwater under normal conditions.

The second short section of storm sewer will service the mini-transfer drop-off area. This sewer line will be equipped with an isolation valve and Stormceptor unit to provide continuous treatment of total suspended solids as well as oil separation in case of an accidental spill upstream within the drop-off area. The above noted system components will prevent pollution from reaching Stormwater Pond #1 and ultimately Infiltration Basin #1.

Corrugated steel pipe (circular and arch) will be used for culvert installation. Corrugated steel pipe arch (CSPA) is proposed under roads where increased depth of cover is required to withstand loadings from vehicular traffic. Concrete culverts are proposed at critical locations where heavy truck traffic is anticipated and where lighter pipe integrity could be in question.

All culverts were sized for the 1:25 year flow with sufficient spare capacity to allow for the 1:100 year flow to pass without overtopping ditch embankments.

2.3.4.3 Stormwater Ponds

Two (2) new stormwater ponds are proposed for surface water quality control in accordance with the MOE Landfill Design Standards. The ponds will attenuate peak flows but this function is not important since pre-treated stormwater discharges into the infiltration basin where it is recharged into the shallow groundwater system. The ponds outflow rates are controlled by recharge capacity of the shallow groundwater regime in the vicinity of the downstream infiltration facilities.

Stormwater pond dimensions and outlet pipe details are outlined on **Figure 8-3**. Hydrologic modelling results related to stormwater ponds are shown in **Table 8-3**. This table shows pond flows, volumes, water levels and drainage times. The ponds internal side slopes will be 4H:1V (minimum) and external side slopes 3H:1V (minimum). Each pond will consist of the following storage zones:

- permanent water pool, which includes sediment storage – between pond bottom and invert of the outlet pipe; and
- settlement zone – above invert of the outlet pipe.

The outlet pipe will be a relatively small diameter culvert (HDPE pipe) equipped with an isolation valve. A typical section for Pond #1 and Pond #2 are shown on **Drawing 9**. All ponds will be lined with a 600 mm clay liner. The pond base and side slopes up to 0.3 m above the normal water level will be covered with at least 150 mm of drainage gravel which will be placed over geotextile separator. The gravel layer will protect the underlying clay liner and serve as an indicator during sediment removal operations. In addition, drainage gravel will protect pond side slopes against wave action. The remaining portion of the internal side slopes will be topsoiled and vegetated. Fill placed within containment berms will consist of well compacted fine grained soils. In order to increase the infiltration contact area with native soils, fill material underlying the clay liner below the pond base will be composed of well compacted permeable granular material (sand). All surficial, in-place loose fill will be removed down to native soil before any fill placement. A large quantity of such unsuitable material has been identified through the geotechnical investigation within Dibbley Pit (Depression #4). All of the above noted requirements are illustrated on Sections C, D and E, **Drawing 9**. The stability of pond side slopes has been assessed by the geotechnical engineer and found to be satisfactory under various operational scenarios.

The proponent may change the lining of the stormwater ponds and use geomembrane supported geosynthetic clay liner (GCL) instead of a conventional clay liner. This option would be decided based on economics and subject to a geotechnical slope stability assessment.

Each pond will be capable of settling particles larger than 40 microns even during major storm events. It was determined that both ponds will be capable of settling particles as small as 7 microns. A high sediment capture efficiency is caused by relatively low outflow rates. Refer to **Appendix A** for the theoretical size of settled particle calculations.

Both ponds have sufficient capacity to store/treat all runoff generated from the 25 mm storm event. This volume, as determined through hydrologic modelling, is 436 m^3 and 1,296 m^3 for Ponds #1 and #2 respectively and they are substantially lower than the corresponding permanent water pool volumes of 2,600 m^3 and 4,200 m^3 as is shown in **Table 8-3**.

Both ponds were sized with a relatively high length to width ratio exceeding 4:1.

A plunge pool (forebay) will be provided near each pond inlet to capture coarser suspended particles. The forebay will be 0.5 m deeper than pond bottom design elevation, providing additional sediment storage capacity. The forebay area will also be covered with drainage gravel and geotextile. Each pond inlet will be reinforced with rip rap. Accumulated sediment will be removed in accordance with criteria outlined in the Erosion and Sediment Control Plan, West Carleton Environmental Centre, WSP, March 2015. Removed sediment will be used as daily cover within the active disposal area.

A rip rap baffle across the pond width downstream of the inlet(s) is proposed to improve flow distribution, minimize short circuiting and to separate forebay from the more quiescent settling zone. Each pond will be equipped with a rip rap lined overflow spillway sized for the 1:100 year flow rate discharging into the downstream infiltration basin. Pond draining time will not exceed 48 hours.

2.3.4.4 Infiltration Basins

Infiltration facilities are designed to capture and retain runoff and allow it to infiltrate rather than discharge to surface water. This system has several benefits such as reducing surface runoff volume and pollutant discharge as well as augmenting low flow stream conditions and thus supporting wildlife habitat during low flow periods.

Subsurface exploration consisting of several borings was carried out to determine in-situ soil and groundwater conditions within the designated groundwater recharge areas. This work is summarized in the Supplemental Geotechnical Investigation by Alston Associates Inc. Refer to “Geotechnical Studies, West Carleton Environmental Centre” assembled in March 2015 by WSP. The permeability of soil from numerous samples collected within the footprint of infiltration facilities was estimated with the Hazen formula and ranged from 5 x 10^{-2} cm/s to 1.6 x 10^{-5} cm/s.

The constant rate infiltration rate of 12 mm/hr was selected for design in consultation with the hydrogeologist based on the observed local subsurface conditions. This rate was used as an input in hydrologic modelling and was used for sizing of both basins.

Groundwater recharge at infiltration facilities will result in the long term localized mounding of the shallow groundwater table. The maximum long term elevation of the shallow groundwater was determined by the hydrogeologist using “Modflow” groundwater flow computer model as follows:

- Infiltration Basin #1 – 120.81 masl
- Infiltration Basin #2 – 120.86 masl

Infiltration basin base elevations were selected to provide at least 1 m separation from the maximum predicted groundwater level.

Suspended solids loading in stormwater draining into each basin will be largely reduced by sedimentation taking place in both of the new stormwater ponds. This will control/reduce blinding and plugging of the basin base surface.

The following dimensions were established for the base of each infiltration basin:

- Infiltration Basin #1 – 116 x 158 m
- Infiltration Basin #2 – 118 x 217 m

Hydrologic modelling results including basin volumes, water levels and draining times are presented in **Table 8-4**. Maximum water storage under the 1:100 year design storm was calculated as 5,669 m^3 for Basin #1 and 15,530 m^3 for Basin #2. Each basin will have substantial additional capacity above the design water level which was calculated as follows:

- Infiltration Basin #1 – 19,573 m^3
- Infiltration Basin #2 – 28,062 m^3

This additional storage will provide a safety cushion in case of an extreme storm, heavier than the 1:100 year design event.

Sections of the infiltration basin are shown on **Drawings 9 and 10**. Imported, permeable fill will be required for construction of each basin. Permeable fill (sand having permeability ranging from 0.01 – 0.001 cm/s) will be placed loose over the scarified native soil following removal of all unsuitable loose fill material which was identified mainly within Infiltration Basin #1 area. Interior and exterior side slopes of infiltration basins will be 3H:1V. Fill placed within containment berms will consist of fine grained soil with the uppermost 600 mm consisting of the clay liner. Permeable material placed below the containment berms will be compacted to 98% SPMDD. Impermeable containment berms are required to ensure integrity and stability of fills when exposed to hydraulic gradients resulting from a sudden rise of water level. This requirement applies to the east and northeast berm in Infiltration Basin #2. The remaining banks of the basins constructed as fill or cut will not require the same treatment as exterior containment berms and engineered fill may be used at these locations. The reader is also referred to Sections C and D, **Drawing 9**, showing construction requirements along the boundary between infiltration basin and stormwater pond. All interior and exterior side slopes of infiltration basins will be topsoiled and vegetated, with the base remaining bare so it can be raked and scarified when needed. Permeable sand on the bottom of an infiltration basin will intercept silt, sediment and debris that could otherwise clog the base of the basin. The upper 50 – 100 mm of this sand layer can be readily restored following removal operations. Sand replacement material shall be of the same quality as originally installed material (hydraulic conductivity 1 x 10^{-4} to 1 x 10^{-5} m/s).

Rip rap lining for energy dissipation will be provided at all inlets into the basin for erosion control. All basins will also be equipped with an access ramp for maintenance access. Overflow spillways are provided in accordance with design guidelines to protect infiltration facilities against catastrophic failure from excessive rise in water level but due to the significant additional capacity within the basins are never anticipated to be used.

2.3.4.5 Operational Controls

Under normal conditions, isolation valves on the outlet piping from stormwater ponds will be open allowing water to drain by gravity into infiltration basins. These valves will be closed if contamination is suspected including the valve controlling drainage from the mini-transfer drop-off area.

Stormwater will flow into the ponds, deposit the coarse fraction of sediment in the forebay and settle smaller particles in the aft-bay section of the stormwater ponds before water is released into the infiltration basin.

In day-to-day operation, staff will visually monitor all stormwater ponds. Should contamination be suspected, testing of the stormwater pond's contents will be carried out by hand-held, on-site instrumentation to measure conductivity, pH and visual aesthetic conditions. Conditions present on site that might indicate the necessity to monitor the pond's contents could include the following:

- visible leachate seep to surface water flowing to one of the surface water ponds;
- evidence of dark stained water;
- oil or any other substance in amounts sufficient to create a visible film, sheen or foam on the receiving waters; or,
- accumulation of floating or settleable solids.

Refer to **Appendix C** for decision-making criteria related to regular and emergency operation of stormwater ponds. Stormwater quality criteria for field and laboratory sampling are also outlined in the same appendix.

The isolation valve on the outlet piping would be closed and remain closed when the pond's water quality is in question. A sample taken for further analysis would be placed in a "rush" category for reporting by an independent laboratory. If the stormwater does not satisfy the trigger concentrations then the stormwater contingency plan will be initiated. Refer to **Appendix C** for a list of contingency corrective actions.

The isolation valve controlling the mini-transfer area shall be closed immediately after spill detection and remain closed until satisfactory clean-up is completed and the area suitable for normal operations.

Depending on the type and severity of contamination, it may be desirable to remove accumulated sediment from the forebay and/or aft bay of the stormwater pond.

These procedures will allow control of surface water discharging into infiltration basins. Under normal conditions, surface water draining into infiltration facilities shall be deemed suitable for groundwater recharge.

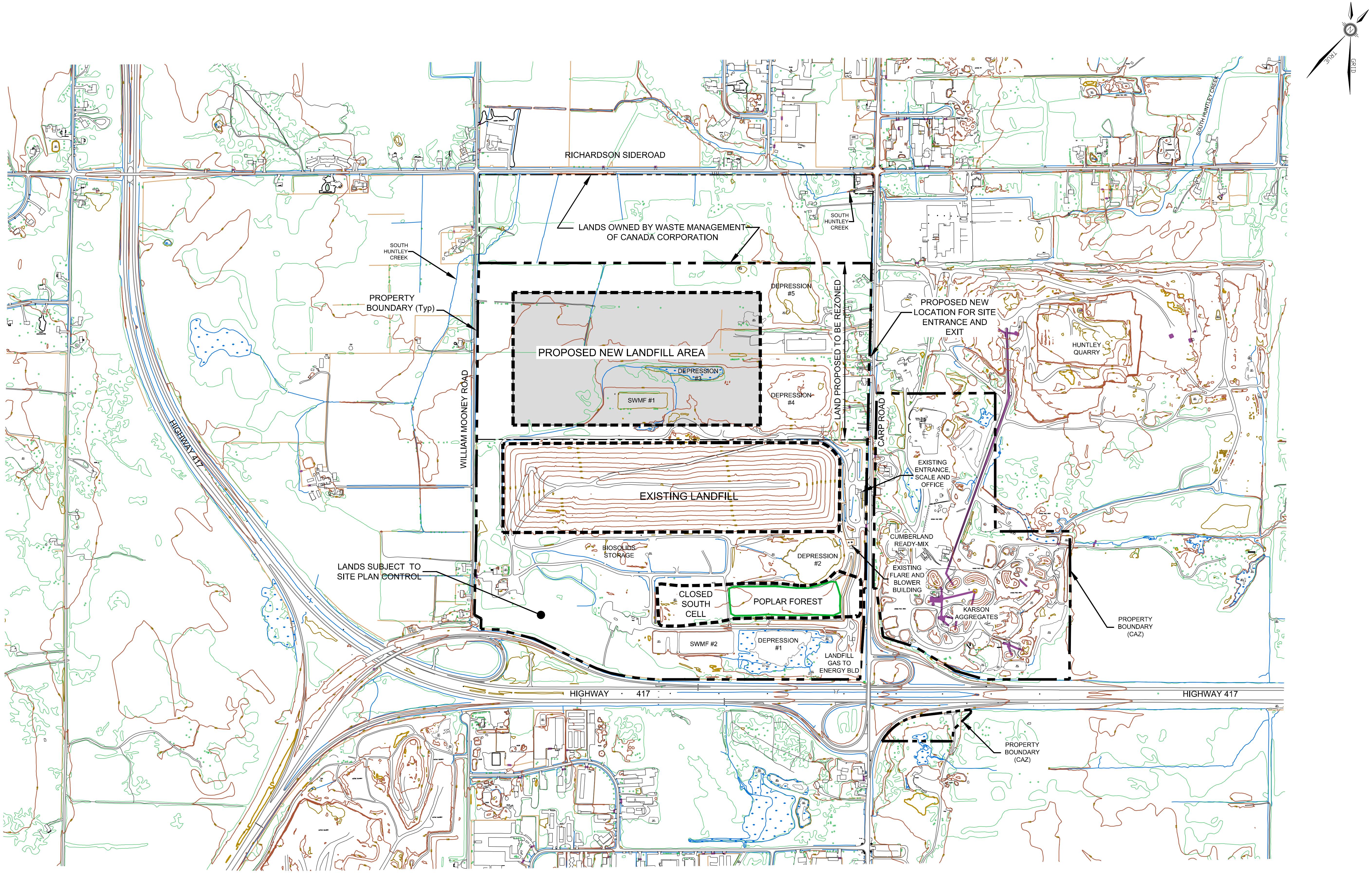
Prepared by:

WSP Canada Inc.

P. Brodzikowski

Peter S. Brodzikowski, P. Eng.
Designated Consulting Engineer
Senior Environmental Engineer
PSB/dlw

Figures



NOTE :

1. TOPOGRAPHIC FEATURES SHOWN ON THIS PLAN ARE BASED ON AERIAL PHOTOGRAPHY BY BASE MAPPING LIMITED FROM JULY 2007

SCALE : 1 : 12500
0 100 200 300 400 500m

P.S.B.	REVISION No. 1	JULY 31, 2015

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WASTE MANAGEMENT

SITE PLAN
SURROUNDING AREA

WEST CARLETON
ENVIRONMENTAL CENTRE

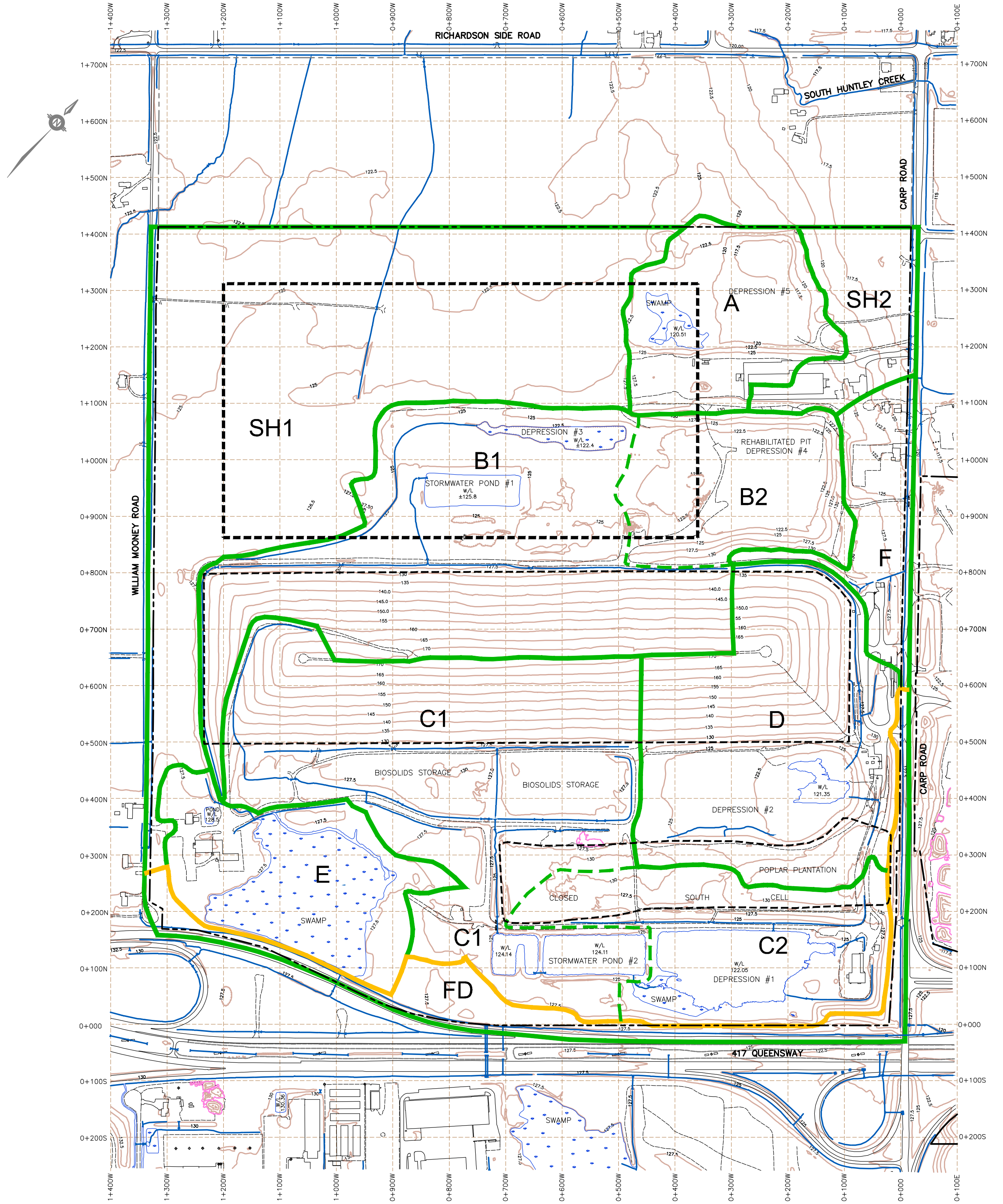
DWN BY: T C G
CHK BY: F C F
DATE: JULY 2014
SCALE: SEE BAR SCALE

WASTE MANAGEMENT OF CANADA CORP.

DRAWING NO. 131-19416-00 – 1-1

FIGURE
1-1

G:\2013\13\13-401 - Environmental\131-19416-00 - Ottawa Landfill Expansion\DRAWINGS FOR SITE PLAN APPROVAL APPLICATION\JULY 2015 RE\131-19416-00 FIG 1-1.dwg Jul 29, 2015 - 2:46pm



LEGEND :

- LIMIT OF DRAINAGE AREA
- LIMIT OF SUBCATCHMENT AREA
- DIVISION BETWEEN FEEDMILL AND SOUTH HUNTLEY CREEK WATERSHEDS
- PROPOSED LANDFILL LIMIT
- WASTE MANAGEMENT OF CANADA PROPERTY LIMIT
- EXISTING LANDFILL LIMIT
- EXISTING GROUND CONTOURS

SCALE :1:10.000:

0 80 160 240 320 400m

FIGURE 8-1

DWN BY: T C G
CHK BY: P S B

DATE: JULY 2014
SCALE: SEE BAR SCALE

WASTE MANAGEMENT OF CANADA CORP.

DRAWING NO. 131-19416-00 – 8-1

PRE-DEVELOPMENT DRAINAGE AREAS

WEST CARLETON ENVIRONMENTAL CENTRE

WASTE MANAGEMENT

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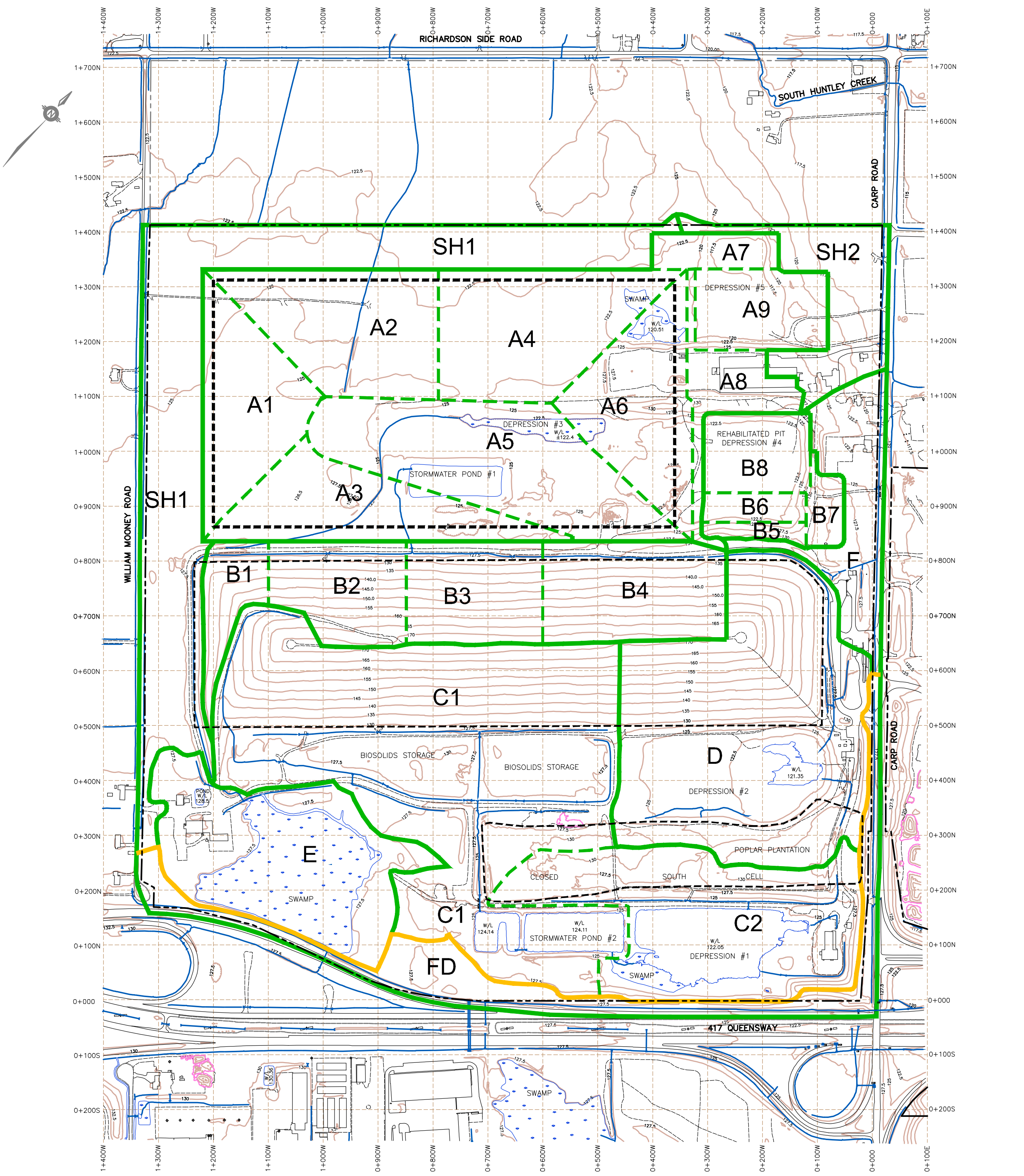

LEGEND :

- LIMIT OF DRAINAGE AREA
- LIMIT OF SUBCATCHMENT AREA
- DIVISION BETWEEN FEEDMILL AND SOUTH HUNTLEY CREEK WATERSHEDS
- PROPOSED LANDFILL LIMIT
- WASTE MANAGEMENT OF CANADA PROPERTY LIMIT
- EXISTING LANDFILL LIMIT
- EXISTING GROUND CONTOURS

SCALE :1:10.000:

0 80 160 240 320 400m

G:\2013\05\13-401 - Environmental\131-19416-00 - Ottawa Landfill Expansion\DRAWINGS FOR D&O\131-19416-00-8-2.dwg Jul 08, 2014 - 10:46am

FIGURE 8-2

DWN BY: T C G
CHK BY: P S B
DATE: JULY 2014
SCALE: SEE BAR SCALE

WASTE MANAGEMENT OF CANADA CORP.

DRAWING NO. 131-19416-00 – 8-2

POST-DEVELOPMENT DRAINAGE AREAS

WEST CARLETON ENVIRONMENTAL CENTRE

WASTE MANAGEMENT

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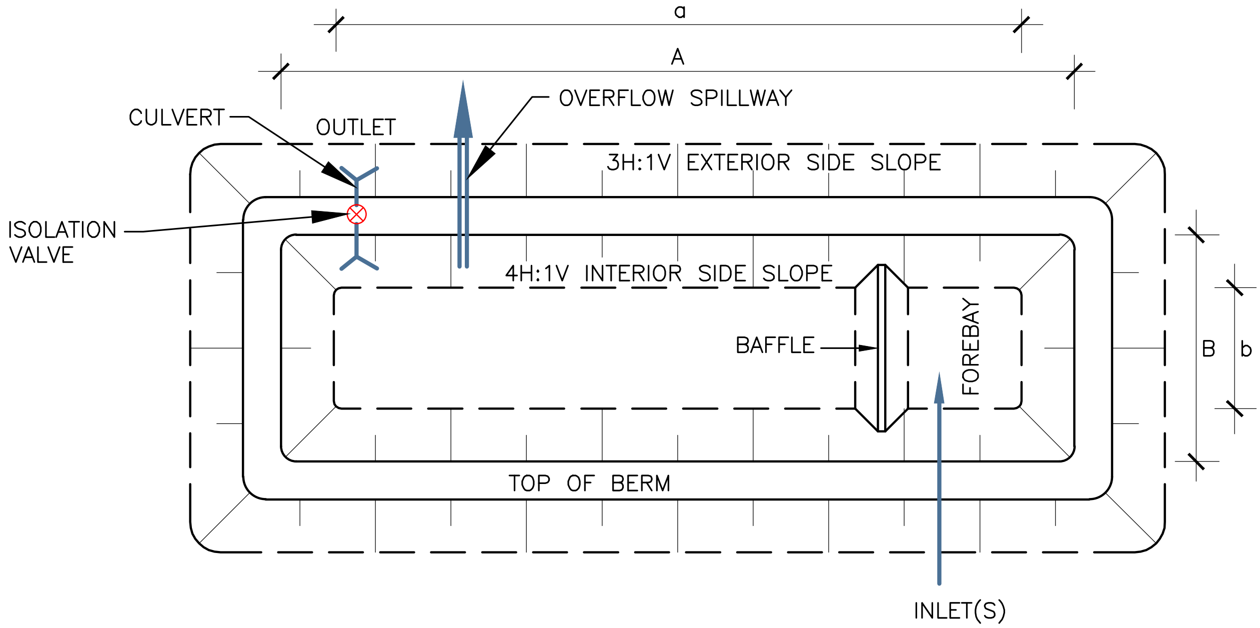

STORMWATER POND SCHEMATIC

SCALE: NTS

POND #	1	2
BOTTOM ELEVATION (m)	124.00	122.80
TOP OF BERM ELEVATION (m)	VARIES 126.75 – 129.00	VARIES 126.30 – 126.80
OUTLET PIPE NOMINAL ø (mm)	300	350
OUTLET INVERT UPSTREAM (m)	124.60	123.40
OUTLET INVERT DOWNSTREAM (m)	124.50	123.30
OVERFLOW SPILLWAY ELEVATION (m)	125.85	125.40
OVERFLOW SPILLWAY BOTTOM WIDTH (m)	3.0	6.0
a (m)	150	200
A (m)	184	228
b (m)	26	32
B (m)	51	62

NOTE :

ACTUAL INLET/OUTLET CONFIGURATION MAY VARY FROM THIS SHOWN HEREIN.

FIGURE 8-3

DWN BY: T C G
CHK BY: P S B
DATE: JULY 2014
SCALE: NTS

WASTE MANAGEMENT OF CANADA CORP.

DRAWING NO. 131–19416–00 – 8–3

STORMWATER POND SCHEMATIC

WEST CARLETON ENVIRONMENTAL CENTRE

WASTE MANAGEMENT

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Tables

TABLE 8-1
DRAINAGE AREA CHARACTERISTICS, PRE-DEVELOPMENT CONDITIONS
WM - WEST CARLETON ENVIRONMENTAL CENTRE

Drainage Area		Size [ha]		Time of Concentration (Tc) [(1)] [min]	Runoff Coefficient C		Rational Method Peak Flow Q_{100} [m^3/s]	Remarks
A		10.08		19	0.29		1.01	No outlet.
B	B1	39.47	29.41	35	0.32	0.34	2.30	No outlet.
	B2		10.06	10		0.25	1.34	No outlet.
C	C1	45.19	31.69	25	0.29	0.32	2.92	No outlet.
	C2		13.50	12		0.22	1.40	No outlet.
D		21.34		16	0.34		2.82	No outlet.
E		11.50		29	0.25		0.83	No outlet.
F		5.80		11	0.34		0.99	No outlet. Drains off-site to Huntley Quarry
SH	SH1	47.12	41.35	-	0.25	0.23	-	Multiple outlets to South Huntley Creek
	SH2		5.77	18		0.36	0.75	
FD		7.79		38	0.31		0.52	Drains to Feedmill Creek
TOTAL		**188.29**		**-**	**0.29**		**-**	

Notes:
(1) Tc established using Kirpich Method

TABLE 8-2
DRAINAGE AREA CHARACTERISTICS, POST-DEVELOPMENT CONDITIONS
WM - WEST CARLETON ENVIRONMENTAL CENTRE

Drainage Area		Size [ha]		Time of Concentration (Tc) [3] [min]		Runoff Coefficient C		Soil/Land Use Curve Number CN (AMC II)		Rational Method Peak Flow Q_{100} $[m^3/s]$		Remarks	
	A1		5.75		15		0.433		80.9		1.01		
	A2		7.59		15		0.435		81.2		1.34		
	A3		6.3		19		0.459		82.1		1.00		
	A4		7.74		19		0.435		81.1		1.17		
A	A5	51.66	10.27	32[1]	17	0.432	0.44	80.9	81.6	5.31[1]	1.69	No outlet	
	A6		6.25		15		0.45		81.4		1.14		
	A7		1.5		-		0.5		85		-		No concentrated flow
	A8		2.8		18		0.561		85.7		0.57		
	A9		3.46		-		0.16		70		-		No concentrated flow
	B1		2.11		11		0.412		79.6		0.44		
	B2		4.28		12		0.418		79.7		0.84		
	B3		4.67		14		0.42		79.9		0.84		
	B4		6.1		15		0.439		80.5		1.09		
B	B5	22.58	0.64	31[2]	6	0.398	0.24	79.1	72	2.13[2]	0.12	No outlet	
	B6		1.03		-		0.5		85		-		No concentrated flow
	B7		0.94		6		0.606		86.2		0.43		
	B8		2.81		-		0.16		70		-		No concentrated flow
C	C1	45.19	31.69	25		0.29	0.32	-		2.91		No outlet. No change.	
	C2		13.5	12			0.22	-		1.40		No outlet. No change.	
D		20.83		16		0.34		-		2.75		No outlet. No change.	
E		11.50		29		0.25		-		0.83		No outlet. No change.	
F		5.24		11		0.38		-		0.99		No outlet. No flow increase.	
SH	SH1	23.50	18.44	-		0.27	0.25	-		-		Multiple outlets. Drainage area reduced by 55%. Flow lower than under pre-development conditions.	
	SH2		5.06	18			0.36	-		0.66		Flow lower than under pre-development conditions.	
FD		7.79		38		0.31		-		0.52		No change.	
TOTAL		**188.29**		**-**		**0.35**		**-**		**-**			

Notes:

(1) Tc and Q_{100} at Pond 2
(2) Tc and Q_{100} at Pond 1
(3) Tc established using Kirpich Method

TABLE 8-3
HYDROLOGIC MODELLING RESULTS - STORMWATER PONDS (24-HR SCS II STORM)
WM - WEST CARLETON ENVIRONMENTAL CENTRE

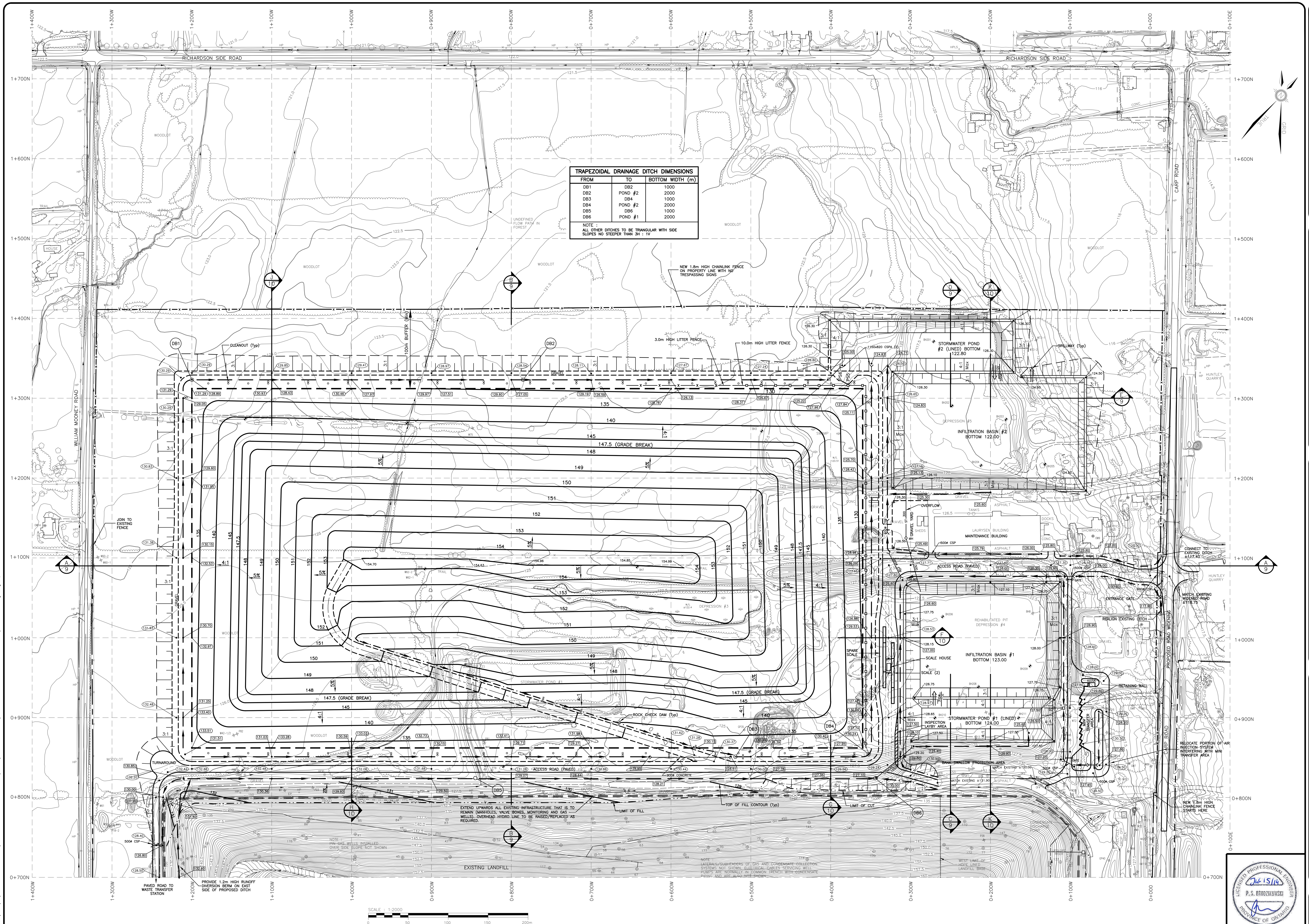
Storm	Rainfall Depth [mm]	Post Development Conditions									
		Rainfall Volume [m^3]	Pond Peak Inflow [m^3/s]	Rational Method Pond Peak Inflow [m^3/s]	Runoff Volume [m^3]	Calculated Runoff Coefficient (6) / (3)	Peak Pond Outflow [m^3/s]	Maximum Water Level [mASL]	Maximum Water Storage excluding PWPV [m^3]	Total Pond Water Storage [m^3]	Draining Time After Storm [hr]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Drainage Area A (Pond #2) - 48.2 ha, Normal Water Level - 123.4 m, Permanent Water Pool Volume (PWPV) - 4,200 m^3											
1:2 yr	48.2	23,232	1.50	2.06	7,024	0.302	0.10	123.87	3,845	8,045	23
1:5 yr	63.8	30,752	2.94	2.65	12,177	0.396	0.15	124.25	7,247	11,447	31
1:10 yr	74.2	35,764	4.01	3.04	15,954	0.446	0.18	124.53	9,917	14,117	35
1:25 yr	87.3	41,206	5.46	3.88	20,988	0.509	0.22	124.88	13,609	17,809	40
1:50 yr	97.0	46,754	6.57	4.66	24,866	0.532	0.24	125.15	16,534	20,734	44
1:100 yr	106.6	51,381	7.71	5.31	28,805	0.561	0.26	125.40	19,543	23,743	48
Drainage Area B - (Pond #1) - 19.77 ha, Normal Water Level - 124.60 m, Permanent Water Pool Volume (PWPV) - 2,598 m^3											
1:2 yr	48.2	9,529	0.51	0.83	2,606	0.273	0.04	124.88	1,369	3,967	11
1:5 yr	63.8	12,613	1.07	1.06	4,617	0.366	0.08	125.08	2,444	5,042	14
1:10 yr	74.2	14,669	1.49	1.22	6,106	0.416	0.10	125.25	3,391	5,989	17
1:25 yr	87.3	17,259	2.08	1.55	8,104	0.469	0.12	125.47	4,720	7,318	20
1:50 yr	97.0	19,177	2.54	1.87	9,651	0.503	0.13	125.64	5,784	8,382	23
1:100 yr	106.6	21,075	3.00	2.13	11,226	0.533	0.15	125.81	6,890	9,488	25

TABLE 8-4
HYDROLOGIC MODELLING RESULTS - INFILTRATION BASINS (24-HR SCS II STORM)
WM - WEST CARLETON ENVIRONMENTAL CENTRE

Storm	Post-Development Conditions				
	Runoff Volume [m^3]	Maximum Water Level [mASL]	Maximum Water Storage [m^3]	Draining Time After Upstream Pond Empties [hr]	Capacity Up to Emergency Overflow Level [m^3]
(1)	(2)	(3)	(4)	(5)	(6)
Drainage Area A - Infiltration Basin 2 - Bottom 122.00, Overflow Spillway Level - 123.60 mASL					
1:2 yr	7,084	122.05	1,348	5	
1:5 yr	12,448	122.16	3,997	7	
1:10 yr	16,399	122.25	6,381	13	43,592
1:25 yr	21,680	122.38	9,827	24	
1:50 yr	25,760	122.48	12,612	32	
1:100 yr	29,909	122.59	15,530	40	
Drainage Area B - Infiltration Basin 1 - Bottom 123.00 - Overflow Storm Sewer Invert - 124.30 mASL					
1:2 yr	2,728	123.03	525	8	
1:5 yr	4,921	123.06	1,165	9	
1:10 yr	6,558	123.11	2,040	10	25,242
1:25 yr	8,767	123.18	3,370	15	
1:50 yr	10,484	123.24	4,484	18	
1:100 yr	12,238	123.31	5,669	23	

Note: Constant infiltration rate 12 mm/hr

Drawings



TRAPEZOIDAL DRAINAGE DITCH DIMENSIONS

FROM	TO	BOTTOM WIDTH (m)
DB1	DB2	1000
DB2	POND #2	2000
DB3	DB4	1000
DB4	POND #2	2000
DB5	DB6	1000
DB6	POND #1	2000

NOTE :
ALL OTHER DITCHES TO BE TRIANGULAR WITH SIDE SLOPES NO STEEPER THAN 3H : 1V

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WASTE MANAGEMENT

PROPOSED FINAL LANDFILL CONTOURS

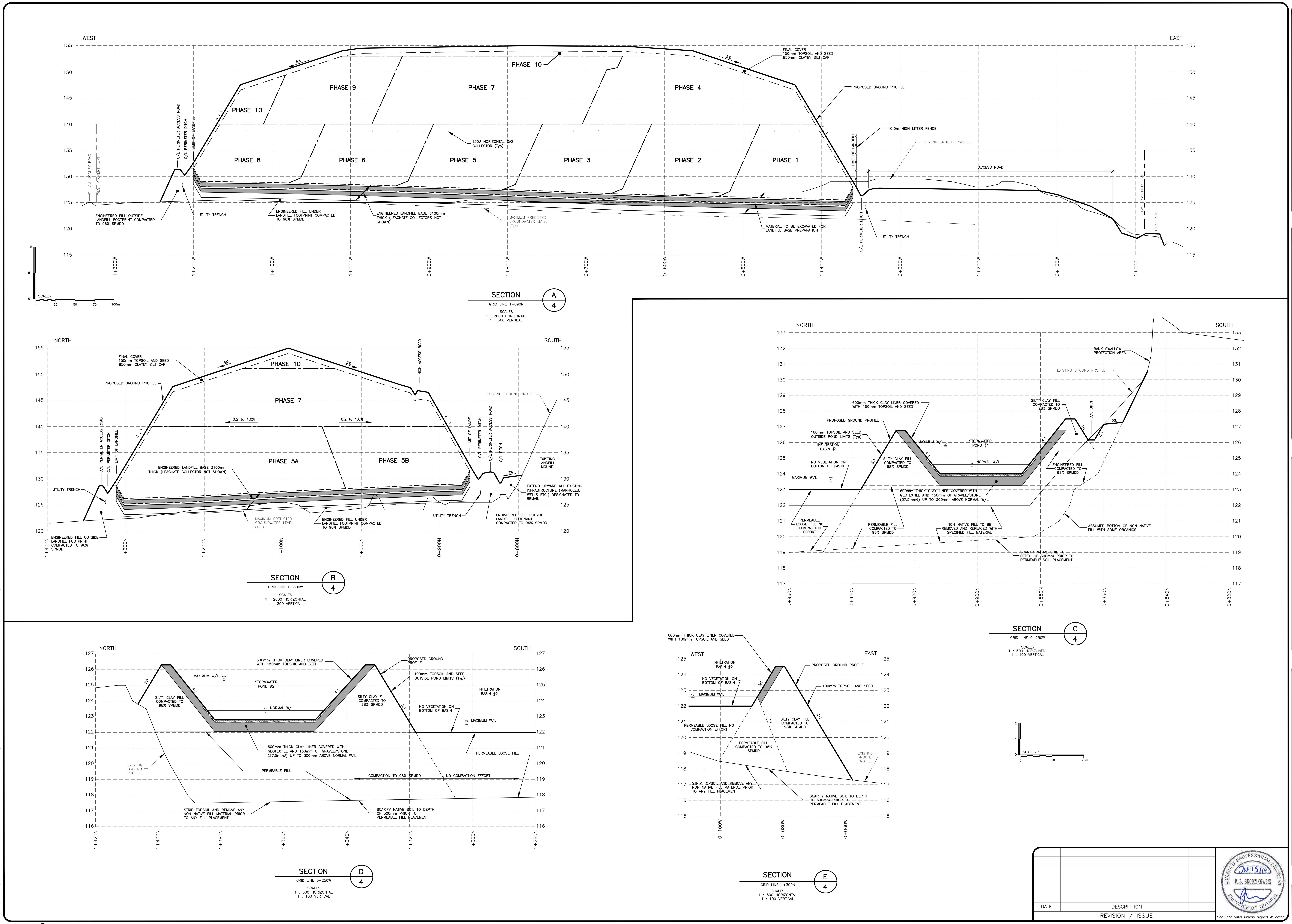
WEST CARLETON ENVIRONMENTAL CENTRE

DWN BY: T C G DATE: JULY 2014
CHK BY: P S B SCALE: SEE BAR SCALE

WASTE MANAGEMENT OF CANADA CORPORATION

DRAWING NO. 131-19416-00 - 4

DRAWING 4



DATE | DESCRIPTION
REVISION / ISSUE

P.S. BRODZIKOWSKI
LICENSED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO
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WASTE MANAGEMENT

SECTIONS

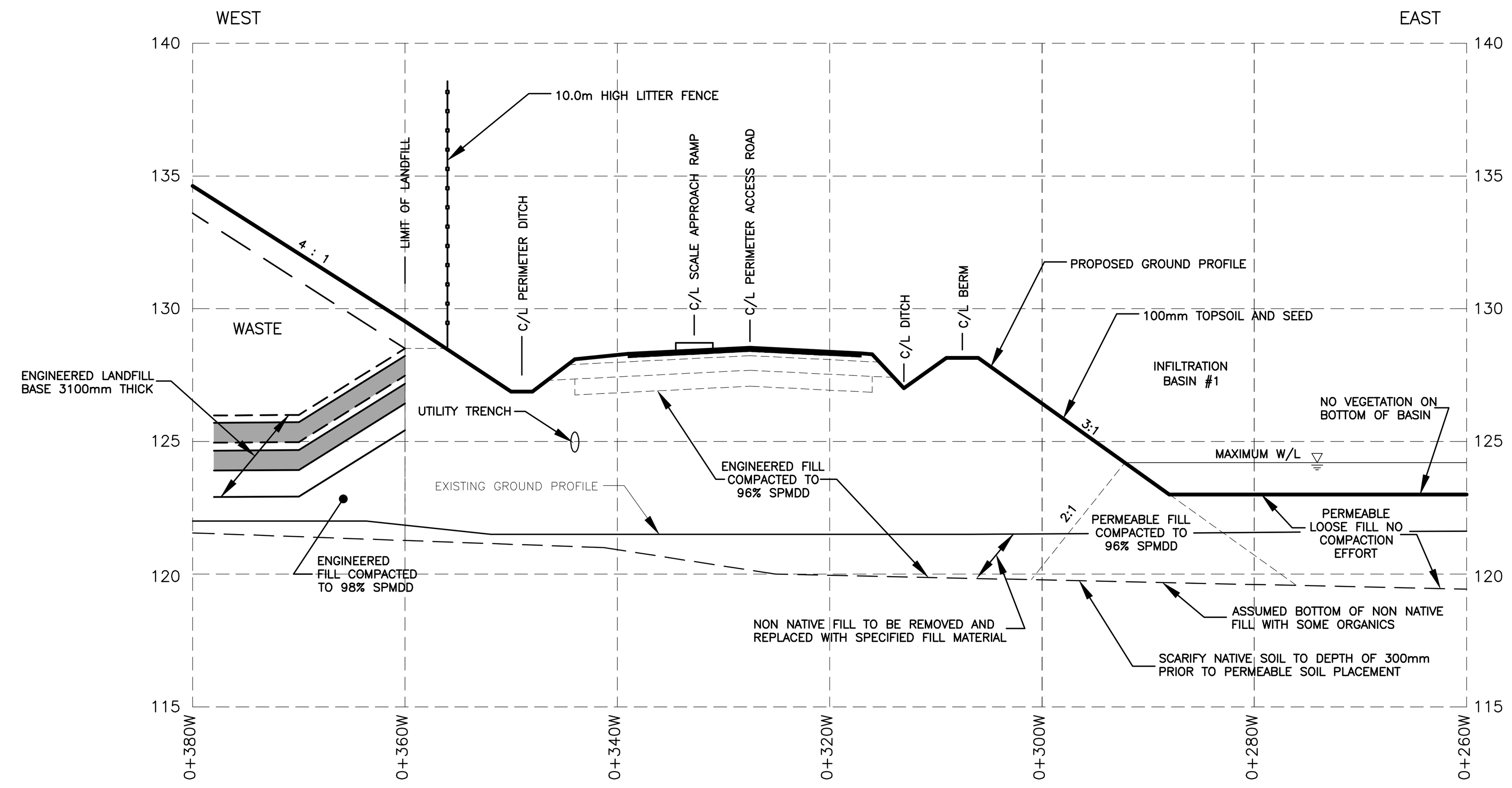
WEST CARLETON ENVIRONMENTAL CENTRE

WASTE MANAGEMENT OF CANADA CORPORATION

DWN BY: T C G DATE: JULY 2014
CHK BY: P S B SCALE: SEE BAR SCALE

DRAWING NO. 131-19416-00 - 9

DRAWING 9



SECTION F / 4
GRID LINE 1+000N
SCALES
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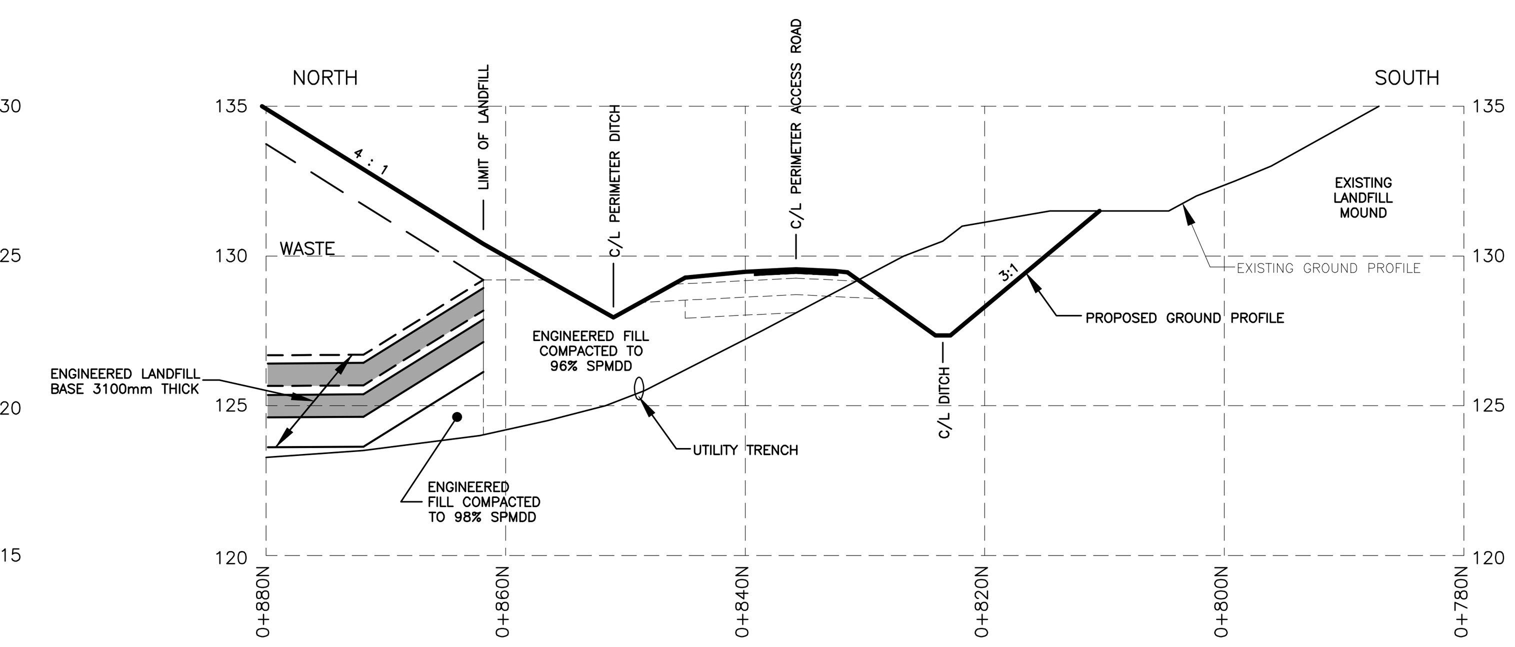
1 : 200 VERTICAL



SECTION G / 4
GRID LINE 0+400W
SCALES
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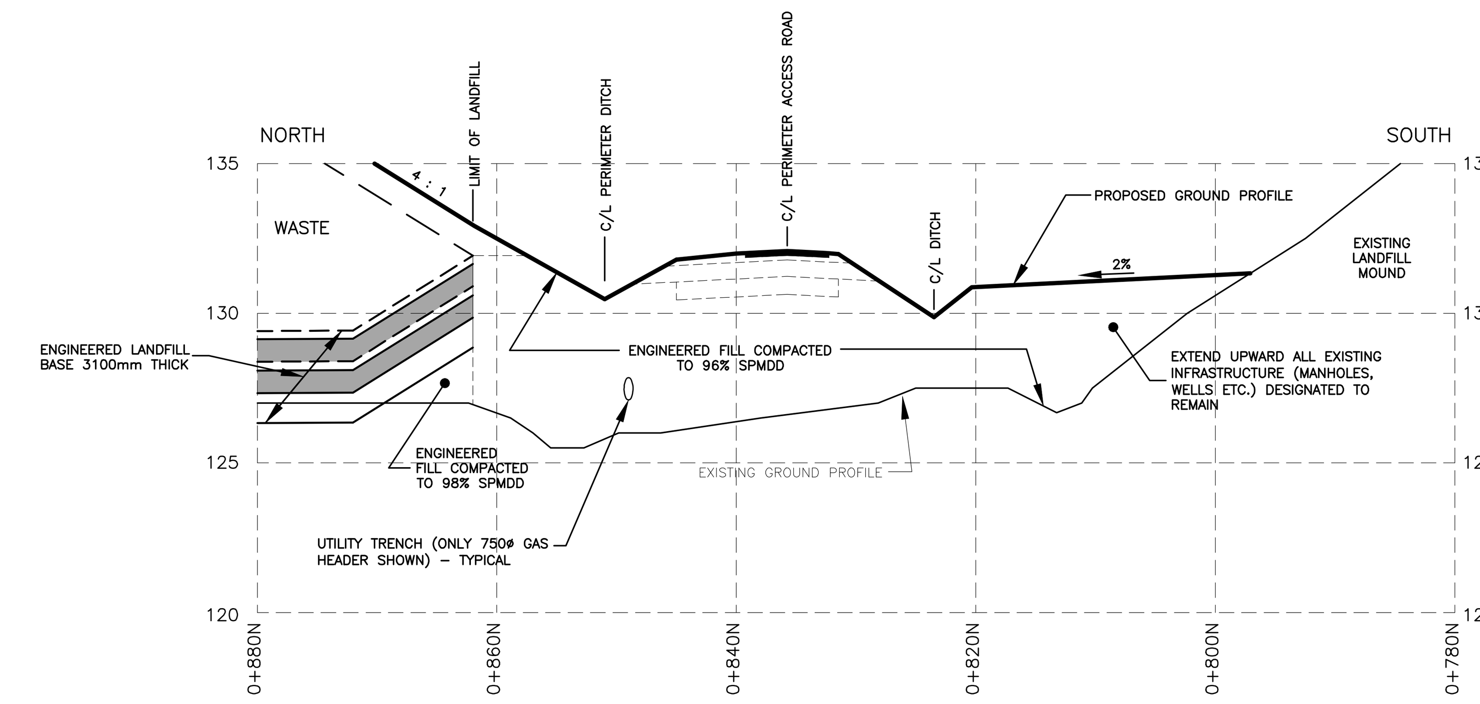
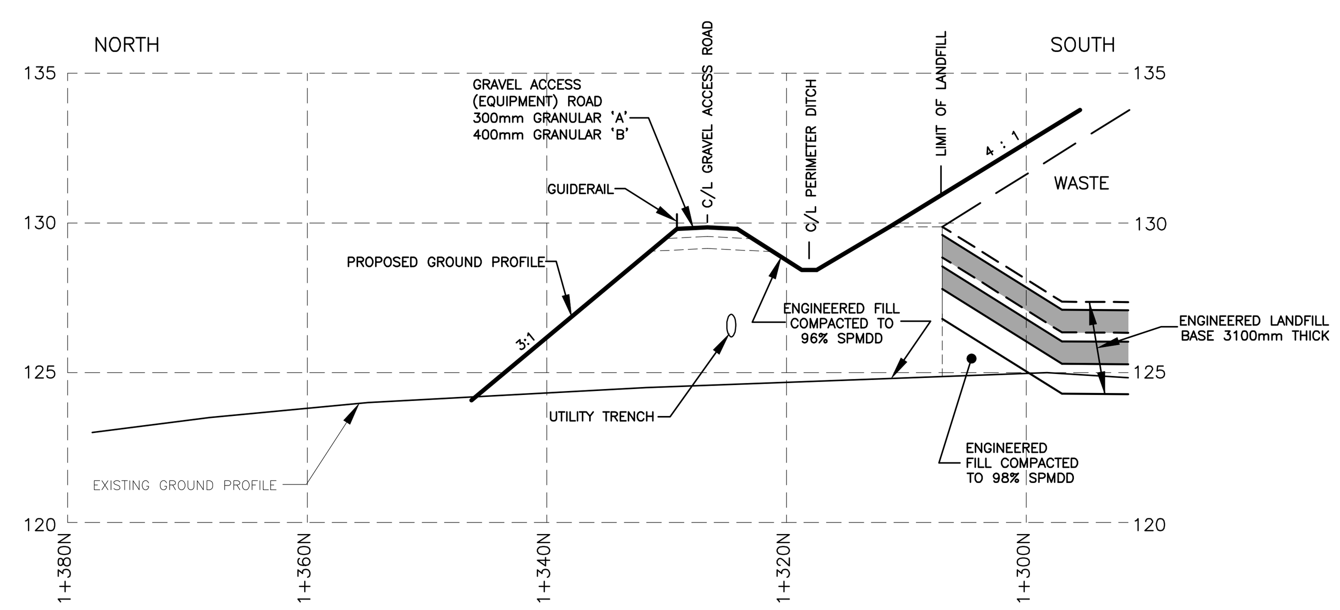
1 : 200 VERTICAL



SECTION H / 4
GRID LINE 1+000W
SCALES
1 : 500 HORIZONTAL
1 : 200 VERTICAL

SCALES : 0 10 20m



SECTION J / 4
GRID LINE 1+100W
SCALES
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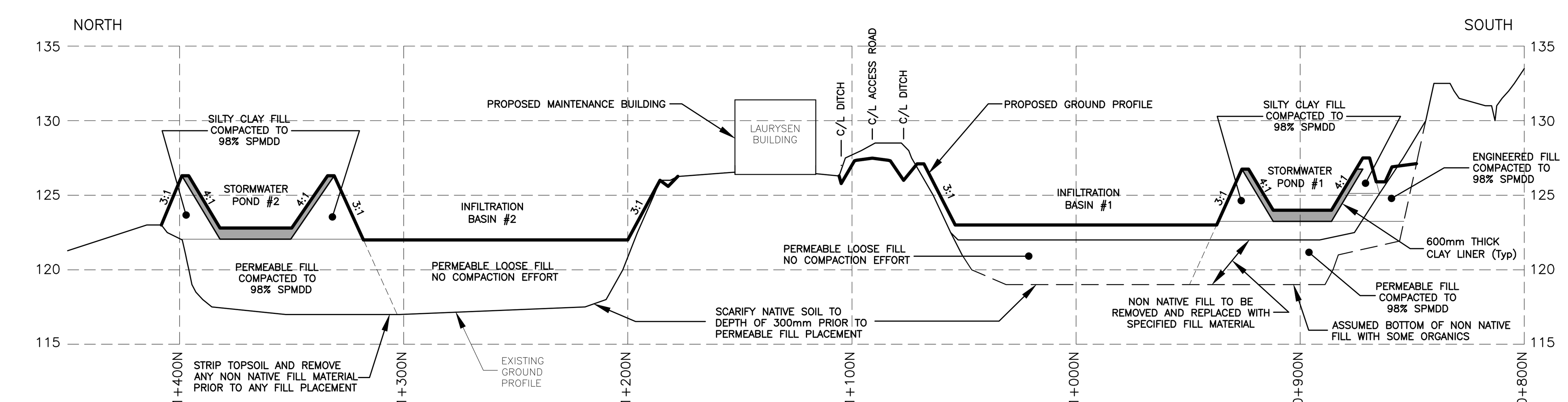
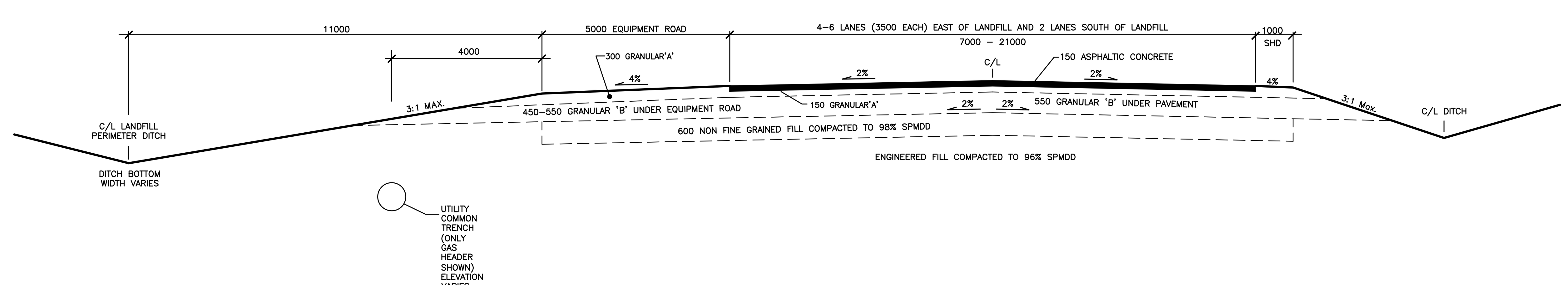
1 : 200 VERTICAL



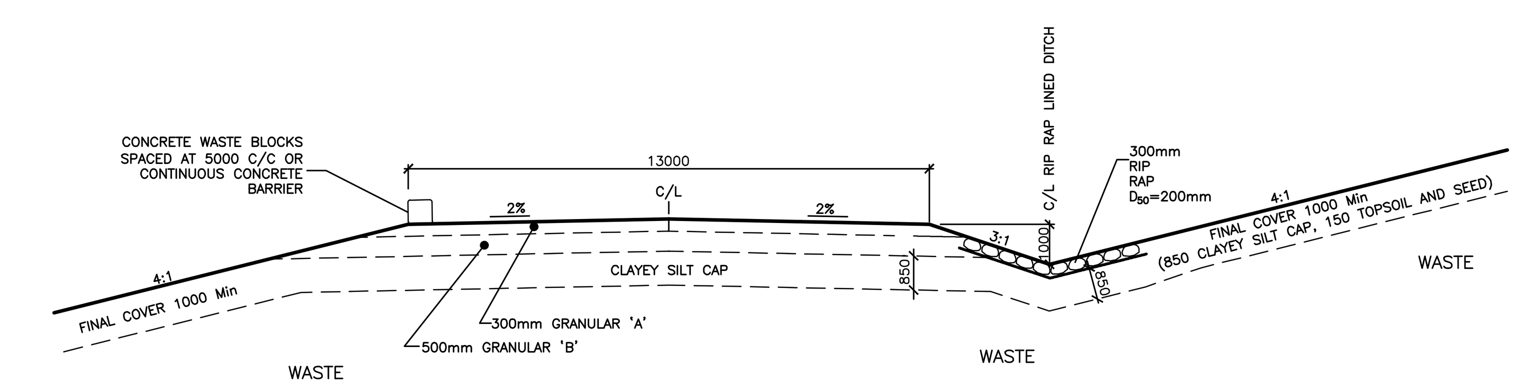
SECTION K / 4
GRID LINE 0+200W
SCALES
1 : 2000 HORIZONTAL
1 : 300 VERTICAL

SCALES : 0 25 50 75 100m



PERIMETER LANDFILL ACCESS ROAD DETAIL

SCALES : 1:100



HIGH ACCESS ROAD

SCALES : 1:150

DATE	DESCRIPTION
	REVISION / ISSUE

LICENSED PROFESSIONAL ENGINEER
P. S. BRODZIKOWSKI
PROVINCE OF ONTARIO
Jul 15/14
Seal not valid unless signed & dated

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SECTIONS

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WASTE MANAGEMENT OF CANADA CORPORATION

DRAWING NO. 131-19416-00 - 10

DRAWING 10

Appendices

Appendix A

Summary of Modelling Procedure

Appendix A

Stormwater Modelling Procedure Summary

Hydrologic modelling of the stormwater management system is limited to the post development conditions because there will be no off-site discharge from lands encompassing waste disposal area. All runoff originating from landfilling areas will be diverted to infiltration basins and recharged into subsurface groundwater regime.

Post Development Conditions

1. Establish drainage network schematic for each infiltration basin watershed.

2. Define input parameters for SCS Unit Hydrograph Method used by Bentley PondPack model. These include the following parameters:

   a) Subwatershed area.
   b) Time of concentration for each subwatershed which is established within PondPack model using Kirpich equation. This method is conservative and provides relatively short times.
   c) CN curve number for each watershed. Cumulative CN value was established for each subwatershed from conservatively selected CN values corresponding to various applicable land cover features.

3. Enter geometric information for drainage channels as required for hydrograph routing by Modified Puls Method.

4. Establish stormwater pond and infiltration basin dimensions. Use constant infiltration rate of 12 mm/hour recommended by a hydrogeologist for sizing of both infiltration basins.

5. Size outlet structures including emergency overflows for all water storage facilities.

6. Run PondPack model for 24 hour SCS storm (2 to 100 year return period). Verify peak flows and check water levels at each water storage location to ensure compliance with design criteria.

7. Optimize size of water storage facilities and fit them into the overall site design.

In addition to PondPack Modelling, the Rational Method was used to calculate peak flows for all subwatersheds using the following input parameters:

a) subwatershed area;

b) runoff coefficient C;

c) time of concentration (Kirpich Method)

d) rainfall intensity i calculated from Ottawa Intensity Duration Frequency (IDF) data.

The peak flow increase factor was applied to all storms having a return period of more than 10 years. Rational Method peak flows were used for sizing of all proposed culverts.

Settling Velocities for Lined Ponds

Formula to calculate settling velocity is:

$$V_s = \frac{1.2\ Q}{A}$$

Q - is 1:100 year peak pond outflow

A - is water surface area in pond at top of settlement zone i.e. invert of culvert outlet

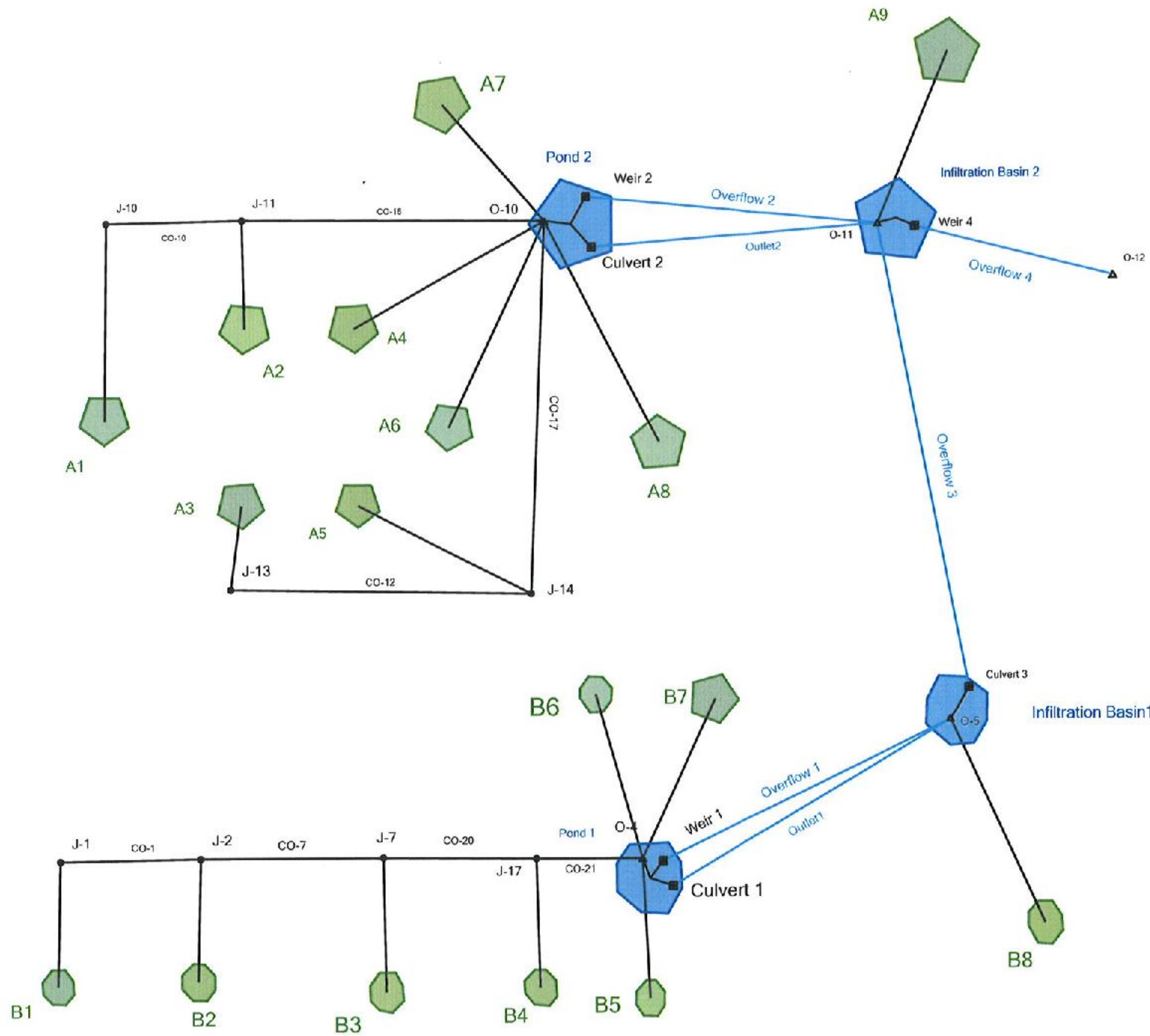
The table below shows calculation results including size of settled particles corresponding to settling velocity V_s

Pond #	Settled Particle Size [Microns]	Q [m^3/s]	A [m^2]	Top of Settlement Zone Elevation [masL]	Calculated V_S [m/s]
1	7	0.15	4,768	124.6	3.78 x ·10^{-5}
2	7	0.26	7,537	123.4	4.14 x ·10^{-5}

Appendix B

Pondpack Printouts – Drainage Areas A & B Post Development

Scenario: Post-Development 1



Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m^3)	Time to Peak (hours)	Peak Flow (m^3/s)
B1	Post-Development 1	1	39.304	4.000	0.01
B1	Post-Development 2	2	260.430	12.050	0.09
B1	Post-Development 5	5	469.578	12.000	0.17
B1	Post-Development 10	10	625.463	12.000	0.23
B1	Post-Development 25	25	835.319	12.000	0.30
B1	Post-Development 50	50	998.254	12.000	0.36
B1	Post-Development 100	100	1,164.530	12.000	0.42
B2	Post-Development 1	1	81.099	4.000	0.02
B2	Post-Development 2	2	532.187	12.050	0.18
B2	Post-Development 5	5	957.761	12.050	0.33
B2	Post-Development 10	10	1,274.768	12.000	0.44
B2	Post-Development 25	25	1,701.333	12.000	0.60
B2	Post-Development 50	50	2,032.357	12.000	0.72
B2	Post-Development 100	100	2,370.120	12.000	0.84
B3	Post-Development 1	1	91.633	4.000	0.02
B3	Post-Development 2	2	589.981	12.050	0.19
B3	Post-Development 5	5	1,057.917	12.050	0.35
B3	Post-Development 10	10	1,405.903	12.050	0.48
B3	Post-Development 25	25	1,873.697	12.050	0.64
B3	Post-Development 50	50	2,236.521	12.050	0.76
B3	Post-Development 100	100	2,606.481	12.050	0.89
B4	Post-Development 1	1	132.466	4.000	0.03
B4	Post-Development 2	2	806.832	12.050	0.25
B4	Post-Development 5	5	1,431.332	12.050	0.47
B4	Post-Development 10	10	1,893.604	12.050	0.63
B4	Post-Development 25	25	2,513.233	12.050	0.84
B4	Post-Development 50	50	2,992.779	12.050	1.00
B4	Post-Development 100	100	3,481.132	12.050	1.16
B6	Post-Development 1	1	43.523	4.000	0.01
B6	Post-Development 2	2	188.590	11.950	0.08
B6	Post-Development 5	5	310.749	11.950	0.13
B6	Post-Development 10	10	398.220	11.950	0.16
B6	Post-Development 25	25	513.158	11.950	0.21
B6	Post-Development 50	50	600.799	11.950	0.25
B6	Post-Development 100	100	689.175	11.950	0.28
B5	Post-Development 1	1	1.699	4.000	0.00
B5	Post-Development 2	2	40.691	12.000	0.01
B5	Post-Development 5	5	86.904	12.000	0.03
B5	Post-Development 10	10	123.801	11.950	0.05
B5	Post-Development 25	25	175.536	11.950	0.07
B5	Post-Development 50	50	216.907	11.950	0.09
B5	Post-Development 100	100	260.005	11.950	0.11
B8	Post-Development 1	1	2.605	4.000	0.00
B8	Post-Development 2	2	145.039	12.000	0.04
B8	Post-Development 5	5	328.872	12.000	0.12

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m^3)	Time to Peak (hours)	Peak Flow (m^3/s)
B8	Post-Development 10	10	478.810	12.000	0.18
B8	Post-Development 25	25	691.781	11.950	0.27
B8	Post-Development 50	50	863.720	11.950	0.35
B8	Post-Development 100	100	1,043.816	11.950	0.42
A3	Post-Development 1	1	176.301	4.000	0.04
A3	Post-Development 2	2	939.128	12.100	0.26
A3	Post-Development 5	5	1,620.856	12.100	0.47
A3	Post-Development 10	10	2,119.459	12.100	0.63
A3	Post-Development 25	25	2,782.781	12.100	0.82
A3	Post-Development 50	50	3,293.334	12.100	0.98
A3	Post-Development 100	100	3,811.363	12.100	1.13
A5	Post-Development 1	1	266.065	4.000	0.06
A5	Post-Development 2	2	1,474.826	12.100	0.43
A5	Post-Development 5	5	2,566.979	12.050	0.78
A5	Post-Development 10	10	3,368.714	12.050	1.04
A5	Post-Development 25	25	4,437.816	12.050	1.39
A5	Post-Development 50	50	5,262.091	12.050	1.65
A5	Post-Development 100	100	6,099.392	12.050	1.91
A6	Post-Development 1	1	156.932	4.000	0.03
A6	Post-Development 2	2	884.477	12.050	0.28
A6	Post-Development 5	5	1,544.741	12.050	0.50
A6	Post-Development 10	10	2,030.176	12.050	0.67
A6	Post-Development 25	25	2,678.094	12.050	0.89
A6	Post-Development 50	50	3,177.971	12.050	1.05
A6	Post-Development 100	100	3,686.004	12.050	1.22
A1	Post-Development 1	1	133.316	4.000	0.03
A1	Post-Development 2	2	783.839	12.050	0.25
A1	Post-Development 5	5	1,380.814	12.050	0.45
A1	Post-Development 10	10	1,821.396	12.050	0.61
A1	Post-Development 25	25	2,410.811	12.050	0.81
A1	Post-Development 50	50	2,866.316	12.050	0.96
A1	Post-Development 100	100	3,329.778	12.050	1.11
A2	Post-Development 1	1	184.626	4.000	0.04
A2	Post-Development 2	2	1,058.116	12.050	0.33
A2	Post-Development 5	5	1,854.329	12.050	0.61
A2	Post-Development 10	10	2,440.572	12.050	0.81
A2	Post-Development 25	25	3,223.760	12.050	1.07
A2	Post-Development 50	50	3,828.438	12.050	1.27
A2	Post-Development 100	100	4,443.225	12.050	1.48
A4	Post-Development 1	1	185.334	4.000	0.04
A4	Post-Development 2	2	1,070.547	12.100	0.30
A4	Post-Development 5	5	1,879.389	12.100	0.55
A4	Post-Development 10	10	2,475.374	12.100	0.73
A4	Post-Development 25	25	3,271.983	12.100	0.97
A4	Post-Development 50	50	3,887.223	12.100	1.15

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m^3)	Time to Peak (hours)	Peak Flow (m^3/s)
A4	Post-Development 100	100	4,512.912	12.100	1.33
A7	Post-Development 1	1	63.373	4.000	0.01
A7	Post-Development 2	2	274.673	11.950	0.11
A7	Post-Development 5	5	452.532	11.950	0.19
A7	Post-Development 10	10	579.957	11.950	0.24
A7	Post-Development 25	25	747.310	11.950	0.31
A7	Post-Development 50	50	874.962	11.950	0.36
A7	Post-Development 100	100	1,003.662	11.950	0.41
A9	Post-Development 1	1	3.228	4.000	0.00
A9	Post-Development 2	2	178.594	12.000	0.05
A9	Post-Development 5	5	404.959	12.000	0.15
A9	Post-Development 10	10	589.557	12.000	0.22
A9	Post-Development 25	25	851.827	11.950	0.33
A9	Post-Development 50	50	1,063.524	11.950	0.43
A9	Post-Development 100	100	1,285.273	11.950	0.52
B7	Post-Development 1	1	46.468	4.000	0.01
B7	Post-Development 2	2	186.891	11.950	0.08
B7	Post-Development 5	5	302.339	11.950	0.13
B7	Post-Development 10	10	384.373	11.950	0.16
B7	Post-Development 25	25	491.580	11.950	0.20
B7	Post-Development 50	50	573.048	11.950	0.23
B7	Post-Development 100	100	655.025	11.950	0.27
A8	Post-Development 1	1	129.776	4.000	0.02
A8	Post-Development 2	2	538.133	12.100	0.16
A8	Post-Development 5	5	877.114	12.050	0.27
A8	Post-Development 10	10	1,118.799	12.050	0.34
A8	Post-Development 25	25	1,435.324	12.050	0.44
A8	Post-Development 50	50	1,676.159	12.050	0.51
A8	Post-Development 100	100	1,918.721	12.050	0.58

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m^3)	Time to Peak (hours)	Peak Flow (m^3/s)
J-1	Post-Development 1	1	39.304	4.000	0.01
J-1	Post-Development 2	2	260.430	12.050	0.09
J-1	Post-Development 5	5	469.578	12.000	0.17
J-1	Post-Development 10	10	625.463	12.000	0.23
J-1	Post-Development 25	25	835.319	12.000	0.30
J-1	Post-Development 50	50	998.254	12.000	0.36
J-1	Post-Development 100	100	1,164.530	12.000	0.42
J-2	Post-Development 1	1	120.403	4.000	0.03
J-2	Post-Development 2	2	792.617	12.050	0.23
J-2	Post-Development 5	5	1,427.339	12.050	0.46

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m^3)	Time to Peak (hours)	Peak Flow (m^3/s)
J-2	Post-Development 10	10	1,900.230	12.050	0.62
J-2	Post-Development 25	25	2,536.651	12.050	0.84
J-2	Post-Development 50	50	3,030.610	12.050	1.01
J-2	Post-Development 100	100	3,534.650	12.050	1.18
J-7	Post-Development 1	1	212.037	4.050	0.05
J-7	Post-Development 2	2	1,382.598	12.100	0.36
J-7	Post-Development 5	5	2,485.256	12.100	0.72
J-7	Post-Development 10	10	3,306.162	12.050	0.99
J-7	Post-Development 25	25	4,410.349	12.050	1.36
J-7	Post-Development 50	50	5,267.132	12.050	1.65
J-7	Post-Development 100	100	6,141.131	12.050	1.95
J-10	Post-Development 1	1	133.316	4.000	0.03
J-10	Post-Development 2	2	783.839	12.050	0.25
J-10	Post-Development 5	5	1,380.814	12.050	0.45
J-10	Post-Development 10	10	1,821.396	12.050	0.61
J-10	Post-Development 25	25	2,410.811	12.050	0.81
J-10	Post-Development 50	50	2,866.316	12.050	0.96
J-10	Post-Development 100	100	3,329.778	12.050	1.11
J-11	Post-Development 1	1	317.942	4.000	0.07
J-11	Post-Development 2	2	1,841.954	12.100	0.53
J-11	Post-Development 5	5	3,235.143	12.050	0.98
J-11	Post-Development 10	10	4,261.969	12.050	1.33
J-11	Post-Development 25	25	5,634.571	12.050	1.78
J-11	Post-Development 50	50	6,694.754	12.050	2.13
J-11	Post-Development 100	100	7,773.003	12.050	2.49
J-13	Post-Development 1	1	176.301	4.000	0.04
J-13	Post-Development 2	2	939.128	12.100	0.26
J-13	Post-Development 5	5	1,620.856	12.100	0.47
J-13	Post-Development 10	10	2,119.459	12.100	0.63
J-13	Post-Development 25	25	2,782.781	12.100	0.82
J-13	Post-Development 50	50	3,293.334	12.100	0.98
J-13	Post-Development 100	100	3,811.363	12.100	1.13
J-14	Post-Development 1	1	442.337	4.000	0.09
J-14	Post-Development 2	2	2,413.955	12.100	0.64
J-14	Post-Development 5	5	4,187.835	12.100	1.18
J-14	Post-Development 10	10	5,488.173	12.100	1.58
J-14	Post-Development 25	25	7,220.569	12.100	2.11
J-14	Post-Development 50	50	8,555.425	12.100	2.50
J-14	Post-Development 100	100	9,910.783	12.100	2.91
O-12	Post-Development 1	1	0.000	0.000	0.00
O-12	Post-Development 2	2	0.000	0.000	0.00
O-12	Post-Development 5	5	0.000	0.000	0.00
O-12	Post-Development 10	10	0.000	0.000	0.00
O-12	Post-Development 25	25	0.000	0.000	0.00
O-12	Post-Development 50	50	0.000	0.000	0.00

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m³)	Time to Peak (hours)	Peak Flow (m³/s)
O-12	Post-Development 100	100	0.000	0.000	0.00
J-17	Post-Development 1	1	344.474	4.050	0.08
J-17	Post-Development 2	2	2,189.430	12.100	0.49
J-17	Post-Development 5	5	3,916.588	12.100	1.04
J-17	Post-Development 10	10	5,199.766	12.100	1.45
J-17	Post-Development 25	25	6,923.582	12.100	2.00
J-17	Post-Development 50	50	8,259.911	12.100	2.42
J-17	Post-Development 100	100	9,622.263	12.100	2.85

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m³)	Time to Peak (hours)	Peak Flow (m³/s)	Maximum Water Surface Elevation (m)	Maximum Pond Storage (m³)
Pond 1 (IN)	Post-Development 1	1	436.164	4.000	0.09	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 1	1	426.876	5.350	0.00	124.68	2,992.977
Pond 1 (IN)	Post-Development 2	2	2,605.631	12.150	0.51	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 2	2	2,582.949	15.400	0.04	124.88	3,967.417
Pond 1 (IN)	Post-Development 5	5	4,616.580	12.150	1.07	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 5	5	4,591.860	14.450	0.08	125.08	5,042.154
Pond 1 (IN)	Post-Development 10	10	6,106.160	12.100	1.49	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 10	10	6,079.712	14.600	0.10	125.25	5,989.070
Pond 1 (IN)	Post-Development 25	25	8,103.885	12.100	2.08	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 25	25	8,074.945	14.800	0.12	125.47	7,317.894
Pond 1 (IN)	Post-Development 50	50	9,650.664	12.100	2.54	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 50	50	9,619.856	15.000	0.13	125.64	8,382.155

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m^3)	Time to Peak (hours)	Peak Flow (m^3/s)	Maximum Water Surface Elevation (m)	Maximum Pond Storage (m^3)
Pond 1 (IN)	Post-Development 100	100	11,226.469	12.100	3.00	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 100	100	11,193.734	15.150	0.15	125.81	9,488.267
Infiltration Basin1 (IN)	Post-Development 1	1	429.482	5.350	0.00	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 1	1	0.000	0.000	0.00	123.00	50.829
Infiltration Basin1 (IN)	Post-Development 2	2	2,727.988	15.100	0.05	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 2	2	0.000	0.000	0.00	123.03	524.711
Infiltration Basin1 (IN)	Post-Development 5	5	4,920.732	12.000	0.13	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 5	5	0.000	0.000	0.00	123.06	1,164.700
Infiltration Basin1 (IN)	Post-Development 10	10	6,558.493	12.000	0.20	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 10	10	0.000	0.000	0.00	123.11	2,040.455
Infiltration Basin1 (IN)	Post-Development 25	25	8,766.726	12.000	0.30	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 25	25	0.000	0.000	0.00	123.18	3,370.441
Infiltration Basin1 (IN)	Post-Development 50	50	10,483.576	12.000	0.39	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 50	50	0.000	0.000	0.00	123.24	4,483.774
Infiltration Basin1 (IN)	Post-Development 100	100	12,237.550	11.950	0.48	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 100	100	0.000	0.000	0.00	123.31	5,669.231
Pond 2 (IN)	Post-Development 1	1	1,295.666	4.000	0.25	(N/A)	(N/A)

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m^3)	Time to Peak (hours)	Peak Flow (m^3/s)	Maximum Water Surface Elevation (m)	Maximum Pond Storage (m^3)
Pond 2 (OUT)	Post-Development 1	1	1,228.215	5.200	0.02	123.55	5,377.426
Pond 2 (IN)	Post-Development 2	2	7,023.711	12.150	1.50	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 2	2	6,905.374	15.700	0.10	123.87	8,045.212
Pond 2 (IN)	Post-Development 5	5	12,176.754	12.150	2.94	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 5	5	12,042.702	15.950	0.15	124.25	11,447.227
Pond 2 (IN)	Post-Development 10	10	15,954.419	12.100	4.01	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 10	10	15,809.295	16.100	0.18	124.53	14,117.647
Pond 2 (IN)	Post-Development 25	25	20,987.852	12.100	5.46	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 25	25	20,828.485	16.400	0.22	124.88	17,809.569
Pond 2 (IN)	Post-Development 50	50	24,866.495	12.100	6.58	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 50	50	24,696.226	16.700	0.24	125.15	20,734.756
Pond 2 (IN)	Post-Development 100	100	28,805.057	12.100	7.71	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 100	100	28,623.886	16.800	0.26	125.40	23,742.911
Infiltration Basin 2 (IN)	Post-Development 1	1	1,231.415	5.200	0.02	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 1	1	0.000	0.000	0.00	122.01	156.337
Infiltration Basin 2 (IN)	Post-Development 2	2	7,083.969	15.300	0.11	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 2	2	0.000	0.000	0.00	122.05	1,347.599

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m^3)	Time to Peak (hours)	Peak Flow (m^3/s)	Maximum Water Surface Elevation (m)	Maximum Pond Storage (m^3)
Infiltration Basin 2 (IN)	Post-Development 5	5	12,447.661	12.000	0.16	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 5	5	0.000	0.000	0.00	122.16	3,996.583
Infiltration Basin 2 (IN)	Post-Development 10	10	16,398.852	12.000	0.26	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 10	10	0.000	0.000	0.00	122.25	6,381.230
Infiltration Basin 2 (IN)	Post-Development 25	25	21,680.284	12.000	0.41	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 25	25	0.000	0.000	0.00	122.38	9,827.333
Infiltration Basin 2 (IN)	Post-Development 50	50	25,759.750	12.000	0.52	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 50	50	0.000	0.000	0.00	122.48	12,611.927
Infiltration Basin 2 (IN)	Post-Development 100	100	29,909.159	11.950	0.63	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 100	100	0.000	0.000	0.00	122.59	15,530.431

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.248 hours
Area (User Defined)	5.750 ha

Computational Time Increment	0.033 hours
Time to Peak (Computed)	12.032 hours
Flow (Peak, Computed)	1.12 m³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	1.11 m³/s

Drainage Area	
SCS CN (Composite)	80.900
Area (User Defined)	5.750 ha
Maximum Retention (Pervious)	60.0 mm
Maximum Retention (Pervious, 20 percent)	12.0 mm

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	57.9 mm
Runoff Volume (Pervious)	3,329.496 m³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	3,329.778 m³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.248 hours
Computational Time Increment	0.033 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.84 m³/s
Unit peak time, Tp	0.165 hours
Unit receding limb, Tr	0.661 hours
Total unit time, Tb	0.826 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	110.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.40 m/s
Segment Time of Concentration	0.077 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	70.00 m
Slope	0.250 m/m
Tc Multiplier	2.000
Average Velocity	0.67 m/s
Segment Time of Concentration	0.029 hours

Segment #3: Kirpich (TN)	
Hydraulic Length	290.00 m
Slope	0.006 m/m
Tc Multiplier	0.750
Average Velocity	0.57 m/s
Segment Time of Concentration	0.142 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.248 hours

Modified Puls Results Summary	
Length (Channel)	430.00 m
Travel Time (Channel)	0.091 hours
Number of Sections	1
Length (Section)	430.00 m
Flow (Weighted)	0.39 m³/s
Overflow Channel	No Overflow Data
Elevation (Overflow)	130.11 m

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Starting Water Surface)	128.91 m
Volume (Starting, per section)	0.000 m³
Flow (Out Starting)	0.00 m³/s
Infiltration (Starting, per section)	0.00 m³/s
Flow (Total Out Starting)	0.00 m³/s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	1.11 m³/s	Time to Peak (In)	12.050 hours
Flow (Peak Out)	1.05 m³/s	Time to Peak (Out)	12.100 hours

Mass Balance (m³)	
Volume (Initial)	0.000 m³
Volume (Total Inflow)	3,329.776 m³
Volume (Total Infiltration)	0.000 m³
Volume (Total Outlet Outflow)	3,329.776 m³
Volume (Retained)	0.000 m³
Volume (Unrouted)	0.000 m³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.250 hours
Area (User Defined)	7.590 ha

Computational Time Increment	0.033 hours
Time to Peak (Computed)	12.058 hours
Flow (Peak, Computed)	1.48 m^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	1.48 m^3/s

Drainage Area

SCS CN (Composite)	81.200
Area (User Defined)	7.590 ha
Maximum Retention (Pervious)	58.8 mm
Maximum Retention (Pervious, 20 percent)	11.8 mm

Cumulative Runoff

Cumulative Runoff Depth (Pervious)	58.5 mm
Runoff Volume (Pervious)	4,443.191 m^3

Hydrograph Volume (Area under Hydrograph curve)

Volume	4,443.225 m^3

SCS Unit Hydrograph Parameters

Time of Concentration (Composite)	0.250 hours
Computational Time Increment	0.033 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	2.41 m^3/s
Unit peak time, Tp	0.167 hours
Unit receding limb, Tr	0.666 hours
Total unit time, Tb	0.833 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	140.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.42 m/s
Segment Time of Concentration	0.092 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	80.00 m
Slope	0.250 m/m
Tc Multiplier	2.000
Average Velocity	0.69 m/s
Segment Time of Concentration	0.032 hours

Segment #3: Kirpich (TN)	
Hydraulic Length	220.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.49 m/s
Segment Time of Concentration	0.125 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.250 hours

Modified Puls Results Summary	
Length (Channel)	400.00 m
Travel Time (Channel)	0.142 hours
Number of Sections	1
Length (Section)	400.00 m
Flow (Weighted)	0.87 m^3/s
Overflow Channel	No Overflow Data
Elevation (Overflow)	128.16 m

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Starting Water Surface)	126.96 m
Volume (Starting, per section)	0.000 m^3
Flow (Out Starting)	0.00 m^3/s
Infiltration (Starting, per section)	0.00 m^3/s
Flow (Total Out Starting)	0.00 m^3/s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	2.49 m^3/s	Time to Peak (In)	12.050 hours
Flow (Peak Out)	2.19 m^3/s	Time to Peak (Out)	12.150 hours

Mass Balance (m^3)	
Volume (Initial)	0.000 m^3
Volume (Total Inflow)	7,773.002 m^3
Volume (Total Infiltration)	0.000 m^3
Volume (Total Outlet Outflow)	7,773.002 m^3
Volume (Retained)	0.000 m^3
Volume (Unrouted)	0.000 m^3
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.324 hours
Area (User Defined)	6.300 ha

Computational Time Increment	0.043 hours
Time to Peak (Computed)	12.094 hours
Flow (Peak, Computed)	1.14 m³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	1.13 m³/s

Drainage Area	
SCS CN (Composite)	82.100
Area (User Defined)	6.300 ha
Maximum Retention (Pervious)	55.4 mm
Maximum Retention (Pervious, 20 percent)	11.1 mm

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	60.5 mm
Runoff Volume (Pervious)	3,809.572 m³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	3,811.363 m³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.324 hours
Computational Time Increment	0.043 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.54 m³/s
Unit peak time, Tp	0.216 hours
Unit receding limb, Tr	0.864 hours
Total unit time, Tb	1.080 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	105.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.39 m/s
Segment Time of Concentration	0.074 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	70.00 m
Slope	0.250 m/m
Tc Multiplier	2.000
Average Velocity	0.67 m/s
Segment Time of Concentration	0.029 hours

Segment #3: Kirpich (TN)	
Hydraulic Length	460.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.58 m/s
Segment Time of Concentration	0.221 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.324 hours

Modified Puls Results Summary	
Length (Channel)	215.00 m
Travel Time (Channel)	0.099 hours
Number of Sections	1
Length (Section)	215.00 m
Flow (Weighted)	0.41 m^3/s
Overflow Channel	No Overflow Data
Elevation (Overflow)	129.88 m

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Starting Water Surface)	128.68 m
Volume (Starting, per section)	0.000 m^3
Flow (Out Starting)	0.00 m^3/s
Infiltration (Starting, per section)	0.00 m^3/s
Flow (Total Out Starting)	0.00 m^3/s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	1.13 m^3/s	Time to Peak (In)	12.100 hours
Flow (Peak Out)	1.07 m^3/s	Time to Peak (Out)	12.150 hours

Mass Balance (m^3)	
Volume (Initial)	0.000 m^3
Volume (Total Inflow)	3,811.376 m^3
Volume (Total Infiltration)	0.000 m^3
Volume (Total Outlet Outflow)	3,811.376 m^3
Volume (Retained)	0.000 m^3
Volume (Unrouted)	0.000 m^3
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.320 hours
Area (User Defined)	7.740 ha

Computational Time Increment	0.043 hours
Time to Peak (Computed)	12.073 hours
Flow (Peak, Computed)	1.35 m^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	1.33 m^3/s

Drainage Area

SCS CN (Composite)	81.100
Area (User Defined)	7.740 ha
Maximum Retention (Pervious)	59.2 mm
Maximum Retention (Pervious, 20 percent)	11.8 mm

Cumulative Runoff

Cumulative Runoff Depth (Pervious)	58.3 mm
Runoff Volume (Pervious)	4,514.567 m^3

Hydrograph Volume (Area under Hydrograph curve)

Volume	4,512.912 m^3

SCS Unit Hydrograph Parameters

Time of Concentration (Composite)	0.320 hours
Computational Time Increment	0.043 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.92 m^3/s
Unit peak time, Tp	0.213 hours
Unit receding limb, Tr	0.853 hours
Total unit time, Tb	1.066 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	150.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.43 m/s
Segment Time of Concentration	0.097 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	80.00 m
Slope	0.250 m/m
Tc Multiplier	2.000
Average Velocity	0.69 m/s
Segment Time of Concentration	0.032 hours

Segment #3: Kirpich (TN)	
Hydraulic Length	400.00 m
Slope	0.005 m/m
Tc Multiplier	0.750
Average Velocity	0.58 m/s
Segment Time of Concentration	0.190 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.320 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.286 hours
Area (User Defined)	10.270 ha

Computational Time Increment	0.038 hours
Time to Peak (Computed)	12.071 hours
Flow (Peak, Computed)	1.93 m^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	1.91 m^3/s

Drainage Area	
SCS CN (Composite)	81.600
Area (User Defined)	10.270 ha
Maximum Retention (Pervious)	57.3 mm
Maximum Retention (Pervious, 20 percent)	11.5 mm

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	59.4 mm
Runoff Volume (Pervious)	6,099.708 m^3

Hydrograph Volume (Area under Hydrograph curve)	
Volume	6,099.392 m^3

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.286 hours
Computational Time Increment	0.038 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	2.85 m^3/s
Unit peak time, Tp	0.190 hours
Unit receding limb, Tr	0.762 hours
Total unit time, Tb	0.952 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	100.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.39 m/s
Segment Time of Concentration	0.071 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	160.00 m
Slope	0.015 m/m
Tc Multiplier	0.750
Average Velocity	0.73 m/s
Segment Time of Concentration	0.061 hours

Segment #3: Kirpich (TN)	
Hydraulic Length	290.00 m
Slope	0.080 m/m
Tc Multiplier	0.750
Average Velocity	1.59 m/s
Segment Time of Concentration	0.051 hours

Segment #4: Kirpich (TN)	
Hydraulic Length	170.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.46 m/s
Segment Time of Concentration	0.103 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.286 hours

Modified Puls Results Summary	
Length (Channel)	490.00 m
Travel Time (Channel)	0.154 hours
Number of Sections	1
Length (Section)	490.00 m
Flow (Weighted)	1.04 m³/s
Overflow Channel	No Overflow Data
Elevation (Overflow)	128.94 m

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Starting Water Surface)	127.74 m
Volume (Starting, per section)	0.000 m³
Flow (Out Starting)	0.00 m³/s
Infiltration (Starting, per section)	0.00 m³/s
Flow (Total Out Starting)	0.00 m³/s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	2.91 m³/s	Time to Peak (In)	12.100 hours
Flow (Peak Out)	2.57 m³/s	Time to Peak (Out)	12.150 hours

Mass Balance (m³)	
Volume (Initial)	0.000 m³
Volume (Total Inflow)	9,910.780 m³
Volume (Total Infiltration)	0.000 m³
Volume (Total Outlet Outflow)	9,910.780 m³
Volume (Retained)	0.000 m³
Volume (Unrouted)	0.000 m³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.255 hours
Area (User Defined)	6.250 ha

Computational Time Increment	0.034 hours
Time to Peak (Computed)	12.051 hours
Flow (Peak, Computed)	1.22 m³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	1.22 m³/s

Drainage Area	
SCS CN (Composite)	81.400
Area (User Defined)	6.250 ha
Maximum Retention (Pervious)	58.0 mm
Maximum Retention (Pervious, 20 percent)	11.6 mm

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	59.0 mm
Runoff Volume (Pervious)	3,685.372 m³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	3,686.004 m³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.255 hours
Computational Time Increment	0.034 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.95 m³/s
Unit peak time, Tp	0.170 hours
Unit receding limb, Tr	0.679 hours
Total unit time, Tb	0.849 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	150.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.43 m/s
Segment Time of Concentration	0.097 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	85.00 m
Slope	0.250 m/m
Tc Multiplier	2.000
Average Velocity	0.70 m/s
Segment Time of Concentration	0.034 hours

Segment #3: Kirpich (TN)	
Hydraulic Length	250.00 m
Slope	0.006 m/m
Tc Multiplier	0.750
Average Velocity	0.56 m/s
Segment Time of Concentration	0.123 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.255 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.100 hours
Area (User Defined)	1.500 ha

Computational Time Increment	0.013 hours
Time to Peak (Computed)	11.933 hours
Flow (Peak, Computed)	0.42 m³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.41 m³/s

Drainage Area

SCS CN (Composite)	85.000
Area (User Defined)	1.500 ha
Maximum Retention (Pervious)	44.8 mm
Maximum Retention (Pervious, 20 percent)	9.0 mm

Cumulative Runoff

Cumulative Runoff Depth (Pervious)	66.9 mm
Runoff Volume (Pervious)	1,003.741 m³

Hydrograph Volume (Area under Hydrograph curve)

Volume	1,003.662 m³

SCS Unit Hydrograph Parameters

Time of Concentration (Composite)	0.100 hours
Computational Time Increment	0.013 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.19 m³/s
Unit peak time, Tp	0.067 hours
Unit receding limb, Tr	0.267 hours
Total unit time, Tb	0.333 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.302 hours
Area (User Defined)	2.800 ha

Computational Time Increment	0.040 hours
Time to Peak (Computed)	12.084 hours
Flow (Peak, Computed)	0.59 m³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	0.58 m³/s

Drainage Area	
SCS CN (Composite)	85.700
Area (User Defined)	2.800 ha
Maximum Retention (Pervious)	42.4 mm
Maximum Retention (Pervious, 20 percent)	8.5 mm

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	68.5 mm
Runoff Volume (Pervious)	1,918.732 m³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	1,918.721 m³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.302 hours
Computational Time Increment	0.040 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	0.73 m³/s
Unit peak time, Tp	0.201 hours
Unit receding limb, Tr	0.806 hours
Total unit time, Tb	1.007 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	240.00 m
Slope	0.003 m/m
Tc Multiplier	0.750
Average Velocity	0.43 m/s
Segment Time of Concentration	0.155 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	250.00 m
Slope	0.005 m/m
Tc Multiplier	0.750
Average Velocity	0.53 m/s
Segment Time of Concentration	0.131 hours

Segment #3: Kirpich (TN)	
Hydraulic Length	50.00 m
Slope	0.050 m/m
Tc Multiplier	0.750
Average Velocity	0.89 m/s
Segment Time of Concentration	0.016 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.302 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.100 hours
Area (User Defined)	3.460 ha

Computational Time Increment	0.013 hours
Time to Peak (Computed)	11.947 hours
Flow (Peak, Computed)	0.52 m³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.52 m³/s

Drainage Area

SCS CN (Composite)	70.000
Area (User Defined)	3.460 ha
Maximum Retention (Pervious)	108.9 mm
Maximum Retention (Pervious, 20 percent)	21.8 mm

Cumulative Runoff

Cumulative Runoff Depth (Pervious)	37.2 mm
Runoff Volume (Pervious)	1,285.498 m³

Hydrograph Volume (Area under Hydrograph curve)

Volume	1,285.273 m³

SCS Unit Hydrograph Parameters

Time of Concentration (Composite)	0.100 hours
Computational Time Increment	0.013 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	2.74 m³/s
Unit peak time, Tp	0.067 hours
Unit receding limb, Tr	0.267 hours
Total unit time, Tb	0.333 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.188 hours
Area (User Defined)	2.110 ha

Computational Time Increment	0.025 hours
Time to Peak (Computed)	12.009 hours
Flow (Peak, Computed)	0.43 m^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	0.42 m^3/s

Drainage Area

SCS CN (Composite)	79.600
Area (User Defined)	2.110 ha
Maximum Retention (Pervious)	65.1 mm
Maximum Retention (Pervious, 20 percent)	13.0 mm

Cumulative Runoff

Cumulative Runoff Depth (Pervious)	55.2 mm
Runoff Volume (Pervious)	1,164.532 m^3

Hydrograph Volume (Area under Hydrograph curve)

Volume	1,164.530 m^3

SCS Unit Hydrograph Parameters

Time of Concentration (Composite)	0.188 hours
Computational Time Increment	0.025 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	0.89 m^3/s
Unit peak time, Tp	0.125 hours
Unit receding limb, Tr	0.500 hours
Total unit time, Tb	0.625 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	340.00 m
Slope	0.012 m/m
Tc Multiplier	0.750
Average Velocity	0.79 m/s
Segment Time of Concentration	0.119 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	100.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.40 m/s
Segment Time of Concentration	0.069 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.188 hours

Modified Puls Results Summary	
Length (Channel)	250.00 m
Travel Time (Channel)	0.134 hours
Number of Sections	1
Length (Section)	250.00 m
Flow (Weighted)	0.14 m³/s
Overflow Channel	No Overflow Data
Elevation (Overflow)	131.36 m

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Starting Water Surface)	130.36 m
Volume (Starting, per section)	0.000 m³
Flow (Out Starting)	0.00 m³/s
Infiltration (Starting, per section)	0.00 m³/s
Flow (Total Out Starting)	0.00 m³/s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	0.42 m³/s	Time to Peak (In)	12.000 hours
Flow (Peak Out)	0.36 m³/s	Time to Peak (Out)	12.100 hours

Mass Balance (m³)	
Volume (Initial)	0.000 m³
Volume (Total Inflow)	1,164.534 m³
Volume (Total Infiltration)	0.000 m³
Volume (Total Outlet Outflow)	1,164.534 m³
Volume (Retained)	0.000 m³
Volume (Unrouted)	0.000 m³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.203 hours
Area (User Defined)	4.280 ha

Computational Time Increment	0.027 hours
Time to Peak (Computed)	12.012 hours
Flow (Peak, Computed)	0.85 m³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	0.84 m³/s

Drainage Area	
SCS CN (Composite)	79.700
Area (User Defined)	4.280 ha
Maximum Retention (Pervious)	64.7 mm
Maximum Retention (Pervious, 20 percent)	12.9 mm

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	55.4 mm
Runoff Volume (Pervious)	2,371.010 m³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	2,370.120 m³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.203 hours
Computational Time Increment	0.027 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.67 m³/s
Unit peak time, Tp	0.136 hours
Unit receding limb, Tr	0.542 hours
Total unit time, Tb	0.678 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	75.00 m
Slope	0.286 m/m
Tc Multiplier	2.000
Average Velocity	0.71 m/s
Segment Time of Concentration	0.029 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	25.00 m
Slope	0.020 m/m
Tc Multiplier	2.000
Average Velocity	0.20 m/s
Segment Time of Concentration	0.035 hours

Segment #3: Kirpich (TN)	
Hydraulic Length	250.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.50 m/s
Segment Time of Concentration	0.139 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.203 hours

Modified Puls Results Summary	
Length (Channel)	250.00 m
Travel Time (Channel)	0.103 hours
Number of Sections	1
Length (Section)	250.00 m
Flow (Weighted)	0.41 m^3/s
Overflow Channel	No Overflow Data
Elevation (Overflow)	130.28 m

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Starting Water Surface)	129.28 m
Volume (Starting, per section)	0.000 m^3
Flow (Out Starting)	0.00 m^3/s
Infiltration (Starting, per section)	0.00 m^3/s
Flow (Total Out Starting)	0.00 m^3/s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	1.18 m^3/s	Time to Peak (In)	12.050 hours
Flow (Peak Out)	1.09 m^3/s	Time to Peak (Out)	12.100 hours

Mass Balance (m^3)	
Volume (Initial)	0.000 m^3
Volume (Total Inflow)	3,534.656 m^3
Volume (Total Infiltration)	0.000 m^3
Volume (Total Outlet Outflow)	3,534.656 m^3
Volume (Retained)	0.000 m^3
Volume (Unrouted)	0.000 m^3
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.234 hours
Area (User Defined)	4.670 ha

Computational Time Increment	0.031 hours
Time to Peak (Computed)	12.020 hours
Flow (Peak, Computed)	0.89 m^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	0.89 m^3/s

Drainage Area

SCS CN (Composite)	79.900
Area (User Defined)	4.670 ha
Maximum Retention (Pervious)	63.9 mm
Maximum Retention (Pervious, 20 percent)	12.8 mm

Cumulative Runoff

Cumulative Runoff Depth (Pervious)	55.8 mm
Runoff Volume (Pervious)	2,606.385 m^3

Hydrograph Volume (Area under Hydrograph curve)

Volume	2,606.481 m^3

SCS Unit Hydrograph Parameters

Time of Concentration (Composite)	0.234 hours
Computational Time Increment	0.031 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.59 m^3/s
Unit peak time, Tp	0.156 hours
Unit receding limb, Tr	0.623 hours
Total unit time, Tb	0.779 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	10.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.23 m/s
Segment Time of Concentration	0.012 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	140.00 m
Slope	0.285 m/m
Tc Multiplier	2.000
Average Velocity	0.82 m/s
Segment Time of Concentration	0.047 hours

Segment #3: Kirpich (TN)	
Hydraulic Length	25.00 m
Slope	0.020 m/m
Tc Multiplier	2.000
Average Velocity	0.20 m/s
Segment Time of Concentration	0.035 hours

Segment #4: Kirpich (TN)	
Hydraulic Length	250.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.50 m/s
Segment Time of Concentration	0.139 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.234 hours

Modified Puls Results Summary	
Length (Channel)	310.00 m
Travel Time (Channel)	0.103 hours
Number of Sections	1
Length (Section)	310.00 m
Flow (Weighted)	0.68 m^3/s
Overflow Channel	No Overflow Data
Elevation (Overflow)	129.21 m

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Starting Water Surface)	128.21 m
Volume (Starting, per section)	0.000 m^3
Flow (Out Starting)	0.00 m^3/s
Infiltration (Starting, per section)	0.00 m^3/s
Flow (Total Out Starting)	0.00 m^3/s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	1.95 m^3/s	Time to Peak (In)	12.050 hours
Flow (Peak Out)	1.79 m^3/s	Time to Peak (Out)	12.100 hours

Mass Balance (m^3)	
Volume (Initial)	0.000 m^3
Volume (Total Inflow)	6,141.144 m^3
Volume (Total Infiltration)	0.000 m^3
Volume (Total Outlet Outflow)	6,141.144 m^3
Volume (Retained)	0.000 m^3
Volume (Unrouted)	0.000 m^3
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.246 hours
Area (User Defined)	6.100 ha

Computational Time Increment	0.033 hours
Time to Peak (Computed)	12.036 hours
Flow (Peak, Computed)	1.17 m^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	1.16 m^3/s

Drainage Area	
SCS CN (Composite)	80.500
Area (User Defined)	6.100 ha
Maximum Retention (Pervious)	61.5 mm
Maximum Retention (Pervious, 20 percent)	12.3 mm

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	57.1 mm
Runoff Volume (Pervious)	3,480.797 m^3

Hydrograph Volume (Area under Hydrograph curve)	
Volume	3,481.132 m^3

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.246 hours
Computational Time Increment	0.033 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.97 m^3/s
Unit peak time, Tp	0.164 hours
Unit receding limb, Tr	0.656 hours
Total unit time, Tb	0.820 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	13.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.24 m/s
Segment Time of Concentration	0.015 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	140.00 m
Slope	0.285 m/m
Tc Multiplier	2.000
Average Velocity	0.82 m/s
Segment Time of Concentration	0.047 hours

Segment #3: Kirpich (TN)	
Hydraulic Length	25.00 m
Slope	0.020 m/m
Tc Multiplier	2.000
Average Velocity	0.20 m/s
Segment Time of Concentration	0.035 hours

Segment #4: Kirpich (TN)	
Hydraulic Length	255.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.50 m/s
Segment Time of Concentration	0.141 hours

Segment #5: Kirpich (TN)	
Hydraulic Length	55.00 m
Slope	0.013 m/m
Tc Multiplier	0.200
Average Velocity	2.02 m/s
Segment Time of Concentration	0.008 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.246 hours

Modified Puls Results Summary	
Length (Channel)	165.00 m
Travel Time (Channel)	0.056 hours
Number of Sections	1
Length (Section)	165.00 m
Flow (Weighted)	1.01 m³/s
Overflow Channel	No Overflow Data
Elevation (Overflow)	127.40 m

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Starting Water Surface)	126.40 m
Volume (Starting, per section)	0.000 m³
Flow (Out Starting)	0.00 m³/s
Infiltration (Starting, per section)	0.00 m³/s
Flow (Total Out Starting)	0.00 m³/s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	2.85 m³/s	Time to Peak (In)	12.100 hours
Flow (Peak Out)	2.78 m³/s	Time to Peak (Out)	12.100 hours

Mass Balance (m³)	
Volume (Initial)	0.000 m³
Volume (Total Inflow)	9,622.263 m³
Volume (Total Infiltration)	0.000 m³
Volume (Total Outlet Outflow)	9,622.263 m³
Volume (Retained)	0.000 m³
Volume (Unrouted)	0.000 m³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.106 hours
Area (User Defined)	0.640 ha

Computational Time Increment	0.014 hours
Time to Peak (Computed)	11.942 hours
Flow (Peak, Computed)	0.11 m³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.11 m³/s

Drainage Area

SCS CN (Composite)	72.000
Area (User Defined)	0.640 ha
Maximum Retention (Pervious)	98.8 mm
Maximum Retention (Pervious, 20 percent)	19.8 mm

Cumulative Runoff

Cumulative Runoff Depth (Pervious)	40.6 mm
Runoff Volume (Pervious)	260.041 m³

Hydrograph Volume (Area under Hydrograph curve)

Volume	260.005 m³

SCS Unit Hydrograph Parameters

Time of Concentration (Composite)	0.106 hours
Computational Time Increment	0.014 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	0.48 m³/s
Unit peak time, Tp	0.071 hours
Unit receding limb, Tr	0.283 hours
Total unit time, Tb	0.353 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	20.00 m
Slope	0.285 m/m
Tc Multiplier	2.000
Average Velocity	0.53 m/s
Segment Time of Concentration	0.011 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	165.00 m
Slope	0.005 m/m
Tc Multiplier	0.750
Average Velocity	0.48 m/s
Segment Time of Concentration	0.095 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.106 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.100 hours
Area (User Defined)	1.030 ha

Computational Time Increment	0.013 hours
Time to Peak (Computed)	11.933 hours
Flow (Peak, Computed)	0.29 m³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.28 m³/s

Drainage Area	
SCS CN (Composite)	85.000
Area (User Defined)	1.030 ha
Maximum Retention (Pervious)	44.8 mm
Maximum Retention (Pervious, 20 percent)	9.0 mm

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	66.9 mm
Runoff Volume (Pervious)	689.236 m³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	689.175 m³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.100 hours
Computational Time Increment	0.013 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	0.82 m³/s
Unit peak time, Tp	0.067 hours
Unit receding limb, Tr	0.267 hours
Total unit time, Tb	0.333 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.091 hours
Area (User Defined)	0.940 ha

Computational Time Increment	0.012 hours
Time to Peak (Computed)	11.929 hours
Flow (Peak, Computed)	0.28 m³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.27 m³/s

Drainage Area	
SCS CN (Composite)	86.200
Area (User Defined)	0.940 ha
Maximum Retention (Pervious)	40.7 mm
Maximum Retention (Pervious, 20 percent)	8.1 mm

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	69.7 mm
Runoff Volume (Pervious)	655.080 m³

Hydrograph Volume (Area under Hydrograph curve)	
Volume	655.025 m³

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.091 hours
Computational Time Increment	0.012 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	0.82 m³/s
Unit peak time, Tp	0.060 hours
Unit receding limb, Tr	0.242 hours
Total unit time, Tb	0.302 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	25.00 m
Slope	0.010 m/m
Tc Multiplier	0.400
Average Velocity	0.76 m/s
Segment Time of Concentration	0.009 hours

Segment #2: Kirpich (TN)	
Hydraulic Length	170.00 m
Slope	0.010 m/m
Tc Multiplier	0.750
Average Velocity	0.63 m/s
Segment Time of Concentration	0.075 hours

Segment #3: Kirpich (TN)	
Hydraulic Length	30.00 m
Slope	0.005 m/m
Tc Multiplier	0.200
Average Velocity	1.22 m/s
Segment Time of Concentration	0.007 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.091 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.100 hours
Area (User Defined)	2.810 ha

Computational Time Increment	0.013 hours
Time to Peak (Computed)	11.947 hours
Flow (Peak, Computed)	0.43 m^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.42 m^3/s

Drainage Area	
SCS CN (Composite)	70.000
Area (User Defined)	2.810 ha
Maximum Retention (Pervious)	108.9 mm
Maximum Retention (Pervious, 20 percent)	21.8 mm

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	37.2 mm
Runoff Volume (Pervious)	1,044.003 m^3

Hydrograph Volume (Area under Hydrograph curve)	
Volume	1,043.816 m^3

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.100 hours
Computational Time Increment	0.013 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	2.23 m^3/s
Unit peak time, Tp	0.067 hours
Unit receding limb, Tr	0.267 hours
Total unit time, Tb	0.333 hours

```
            Length
      .--Top---- B ----------.
W     |                      |
i     |   .------b2------.   |
d     A   b1             |   C
t     |   `----Bottom----'   |
h     |                      |
      `----------D-----------'
     Diagram Not to Scale
```

Pond Volume Calculation for Trapezoidal Basin	
Trapezoid Top Elevation	126.75 m
Trapezoid Top Length (A to C)	172.00 m
Trapezoid Top Width (B to D)	48.00 m
Trapezoid Bottom Elevation	124.00 m
Trapezoid Bottom Length	150.00 m
Trapezoid Bottom Width	26.00 m

Pond Volume Calculation for Trapezoidal Basin	
Trapezoid Width Offset (B to b2)	11.00 m
Trapezoid Length Offset (A to b1)	11.00 m
Trapezoid Vertical Increment	0.10 m

Elevation (m)	Planimeter (m^2)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m^3)	Volume (Total) (m^3)
124.00	0.0	0.390	0.000	0.000	0.000
124.10	0.0	0.404	1.191	397.059	397.059
124.20	0.0	0.418	1.234	411.246	808.304
124.30	0.0	0.433	1.277	425.602	1,233.907
124.40	0.0	0.447	1.320	440.072	1,673.979
124.50	0.0	0.462	1.364	454.655	2,128.606
124.60	0.0	0.477	1.408	469.380	2,597.986
124.70	0.0	0.492	1.453	484.218	3,082.204
124.80	0.0	0.507	1.498	499.198	3,581.401
124.90	0.0	0.522	1.543	514.291	4,095.720
125.00	0.0	0.537	1.589	529.525	4,625.245
125.10	0.0	0.553	1.635	544.901	5,170.146
125.20	0.0	0.568	1.681	560.390	5,730.509

Elevation (m)	Planimeter (m^2)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m^3)	Volume (Total) (m^3)
125.30	0.0	0.584	1.728	575.993	6,306.530
125.40	0.0	0.600	1.775	591.737	6,898.267
125.50	0.0	0.616	1.823	607.623	7,505.862
125.60	0.0	0.632	1.871	623.622	8,129.483
125.70	0.0	0.648	1.919	639.734	8,769.246
125.80	0.0	0.664	1.968	655.988	9,425.234
125.90	0.0	0.681	2.017	672.384	10,097.618
126.00	0.0	0.697	2.067	688.892	10,786.510
126.10	0.0	0.714	2.117	705.543	11,492.052
126.20	0.0	0.731	2.167	722.306	12,214.358
126.30	0.0	0.748	2.218	739.211	12,953.541
126.40	0.0	0.765	2.269	756.230	13,709.771
126.50	0.0	0.782	2.320	773.390	14,483.161
126.60	0.0	0.799	2.372	790.663	15,273.795
126.75	0.0	0.826	2.437	1,218.644	16,492.468

Structure ID: Culvert 1
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	291.0 mm
Length	20.00 m
Length (Computed Barrel)	20.00 m
Slope (Computed)	0.005 m/m

Outlet Control Data

Manning's n	0.013
Ke	0.900
Kb	0.033
Kr	0.900
Convergence Tolerance	0.00 m

Inlet Control Data

Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1.158
T2 ratio (HW/D)	1.304
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	124.94 m	T1 Flow	0.07 m³/s
T2 Elevation	124.98 m	T2 Flow	0.08 m³/s

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	124.60 m
Volume (Initial)	2,597.986 m^3
Flow (Initial Outlet)	0.00 m^3/s
Flow (Initial Infiltration)	0.00 m^3/s
Flow (Initial, Total)	0.00 m^3/s
Time Increment	0.050 hours

Elevation (m)	Outflow (m^3/s)	Storage (m^3)	Area (ha)	Infiltration (m^3/s)	Flow (Total) (m^3/s)	2S/t + O (m^3/s)
124.00	0.00	0.000	0.390	0.00	0.00	0.00
124.05	0.00	196.757	0.397	0.00	0.00	2.19
124.10	0.00	397.051	0.404	0.00	0.00	4.41
124.15	0.00	600.897	0.411	0.00	0.00	6.68
124.20	0.00	808.310	0.418	0.00	0.00	8.98
124.25	0.00	1,019.308	0.426	0.00	0.00	11.33
124.30	0.00	1,233.906	0.433	0.00	0.00	13.71
124.35	0.00	1,452.120	0.440	0.00	0.00	16.13
124.40	0.00	1,673.966	0.447	0.00	0.00	18.60
124.45	0.00	1,899.460	0.455	0.00	0.00	21.11
124.50	0.00	2,128.618	0.462	0.00	0.00	23.65
124.55	0.00	2,361.457	0.469	0.00	0.00	26.24
124.60	0.00	2,597.991	0.477	0.00	0.00	28.87
124.65	0.00	2,838.237	0.484	0.00	0.00	31.54
124.70	0.01	3,082.212	0.492	0.00	0.01	34.25
124.75	0.01	3,329.930	0.499	0.00	0.01	37.01
124.80	0.02	3,581.409	0.507	0.00	0.02	39.82
124.85	0.04	3,836.663	0.514	0.00	0.04	42.67
124.90	0.05	4,095.710	0.522	0.00	0.05	45.56
124.95	0.06	4,358.565	0.530	0.00	0.06	48.49
125.00	0.07	4,625.244	0.537	0.00	0.07	51.47
125.05	0.08	4,895.763	0.545	0.00	0.08	54.48
125.10	0.09	5,170.138	0.553	0.00	0.09	57.53
125.15	0.09	5,448.384	0.560	0.00	0.09	60.63
125.20	0.10	5,730.520	0.568	0.00	0.10	63.77
125.25	0.10	6,016.559	0.576	0.00	0.10	66.95
125.30	0.11	6,306.518	0.584	0.00	0.11	70.18
125.35	0.11	6,600.413	0.592	0.00	0.11	73.45
125.40	0.12	6,898.260	0.600	0.00	0.12	76.76
125.45	0.12	7,200.075	0.608	0.00	0.12	80.12
125.50	0.12	7,505.875	0.616	0.00	0.12	83.52
125.55	0.13	7,815.674	0.624	0.00	0.13	86.97
125.60	0.13	8,129.490	0.632	0.00	0.13	90.46
125.65	0.14	8,447.337	0.640	0.00	0.14	93.99
125.70	0.14	8,769.233	0.648	0.00	0.14	97.58
125.75	0.14	9,095.192	0.656	0.00	0.14	101.20

Elevation (m)	Outflow (m^3/s)	Storage (m^3)	Area (ha)	Infiltration (m^3/s)	Flow (Total) (m^3/s)	2S/t + O (m^3/s)
125.80	0.15	9,425.232	0.664	0.00	0.15	104.87
125.85	0.15	9,759.367	0.672	0.00	0.15	108.59
125.90	0.21	10,097.615	0.681	0.00	0.21	112.41
125.95	0.33	10,439.990	0.689	0.00	0.33	116.33
126.00	0.49	10,786.510	0.697	0.00	0.49	120.34
126.05	0.69	11,137.190	0.706	0.00	0.69	124.44
126.10	0.93	11,492.046	0.714	0.00	0.93	128.62
126.15	1.22	11,851.093	0.722	0.00	1.22	132.90
126.20	1.54	12,214.349	0.731	0.00	1.54	137.26
126.25	1.91	12,581.829	0.739	0.00	1.91	141.71
126.30	2.32	12,953.549	0.748	0.00	2.32	146.24
126.35	2.77	13,329.525	0.756	0.00	2.77	150.87
126.40	3.26	13,709.773	0.765	0.00	3.26	155.59
126.45	3.80	14,094.308	0.773	0.00	3.80	160.41
126.50	4.39	14,483.149	0.782	0.00	4.39	165.31
126.55	5.02	14,876.309	0.791	0.00	5.02	170.32
126.60	5.71	15,273.805	0.799	0.00	5.71	175.41
126.65	6.44	15,675.651	0.808	0.00	6.44	180.61
126.70	7.22	16,081.861	0.817	0.00	7.22	185.90
126.75	8.05	16,492.460	0.826	0.00	8.05	191.30

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            Length
    .--Top---- B ----------.
W   |                      |
i   |    .------b2------.  |
d   A    b1             |  C
t   |    `----Bottom----'  |
h   |                      |
    `----------D----------'
      Diagram Not to Scale
```

Pond Volume Calculation for Trapezoidal Basin	
Trapezoid Top Elevation	126.30 m
Trapezoid Top Length (A to C)	228.00 m
Trapezoid Top Width (B to D)	62.00 m
Trapezoid Bottom Elevation	122.80 m
Trapezoid Bottom Length	200.00 m
Trapezoid Bottom Width	32.00 m

Pond Volume Calculation for Trapezoidal Basin	
Trapezoid Width Offset (B to b2)	15.00 m
Trapezoid Length Offset (A to b1)	14.00 m
Trapezoid Vertical Increment	0.10 m

Elevation (m)	Planimeter (m^2)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m^3)	Volume (Total) (m^3)
122.80	0.0	0.640	0.000	0.000	0.000
122.90	0.0	0.660	1.950	649.872	649.872
123.00	0.0	0.680	2.009	669.693	1,319.565
123.10	0.0	0.700	2.069	689.685	2,009.250
123.20	0.0	0.720	2.129	709.790	2,719.040
123.30	0.0	0.740	2.190	730.037	3,449.077
123.40	0.0	0.761	2.251	750.425	4,199.502
123.50	0.0	0.781	2.313	770.954	4,970.484
123.60	0.0	0.802	2.375	791.626	5,762.082
123.70	0.0	0.823	2.437	812.410	6,574.520
123.80	0.0	0.844	2.500	833.365	7,407.885
123.90	0.0	0.865	2.563	854.433	8,262.318
124.00	0.0	0.886	2.627	875.642	9,137.960

Elevation (m)	Planimeter (m^2)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m^3)	Volume (Total) (m^3)
124.10	0.0	0.908	2.691	896.993	10,034.952
124.20	0.0	0.929	2.755	918.485	10,953.438
124.30	0.0	0.951	2.820	940.091	11,893.557
124.40	0.0	0.973	2.886	961.867	12,855.423
124.50	0.0	0.995	2.951	983.756	13,839.179
124.60	0.0	1.017	3.017	1,005.786	14,844.965
124.70	0.0	1.039	3.084	1,027.958	15,872.923
124.80	0.0	1.061	3.151	1,050.272	16,923.223
124.90	0.0	1.084	3.218	1,072.727	17,995.951
125.00	0.0	1.107	3.286	1,095.296	19,091.246
125.10	0.0	1.129	3.354	1,118.034	20,209.280
125.20	0.0	1.152	3.423	1,140.886	21,350.166
125.30	0.0	1.175	3.492	1,163.879	22,514.045
125.40	0.0	1.199	3.561	1,187.014	23,701.031
125.50	0.0	1.222	3.631	1,210.290	24,911.321
125.60	0.0	1.245	3.701	1,233.680	26,145.001
125.70	0.0	1.269	3.772	1,257.240	27,402.241
125.80	0.0	1.293	3.843	1,280.913	28,683.125
125.90	0.0	1.317	3.914	1,304.727	29,987.852
126.00	0.0	1.341	3.986	1,328.683	31,316.535
126.10	0.0	1.365	4.058	1,352.781	32,669.316
126.20	0.0	1.389	4.131	1,376.992	34,046.307
126.30	0.0	1.414	4.204	1,401.372	35,447.680

Structure ID: Culvert 2 Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	327.0 mm
Length	20.00 m
Length (Computed Barrel)	20.00 m
Slope (Computed)	0.005 m/m

Outlet Control Data	
Manning's n	0.013
Ke	0.900
Kb	0.028
Kr	0.900
Convergence Tolerance	0.00 m

Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1.158
T2 ratio (HW/D)	1.304
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	123.78 m	T1 Flow	0.09 m^3/s
T2 Elevation	123.83 m	T2 Flow	0.11 m^3/s

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	123.40 m
Volume (Initial)	4,199.502 m³
Flow (Initial Outlet)	0.00 m³/s
Flow (Initial Infiltration)	0.00 m³/s
Flow (Initial, Total)	0.00 m³/s
Time Increment	0.050 hours

Elevation (m)	Outflow (m³/s)	Storage (m³)	Area (ha)	Infiltration (m³/s)	Flow (Total) (m³/s)	2S/t + O (m³/s)
122.80	0.00	0.000	0.640	0.00	0.00	0.00
122.85	0.00	322.459	0.650	0.00	0.00	3.58
122.90	0.00	649.861	0.660	0.00	0.00	7.22
122.95	0.00	982.223	0.670	0.00	0.00	10.91
123.00	0.00	1,319.562	0.680	0.00	0.00	14.66
123.05	0.00	1,661.895	0.690	0.00	0.00	18.47
123.10	0.00	2,009.240	0.700	0.00	0.00	22.32
123.15	0.00	2,361.614	0.710	0.00	0.00	26.24
123.20	0.00	2,719.033	0.720	0.00	0.00	30.21
123.25	0.00	3,081.516	0.730	0.00	0.00	34.24
123.30	0.00	3,449.078	0.740	0.00	0.00	38.32
123.35	0.00	3,821.738	0.750	0.00	0.00	42.46
123.40	0.00	4,199.512	0.761	0.00	0.00	46.66
123.45	0.00	4,582.418	0.771	0.00	0.00	50.92
123.50	0.01	4,970.472	0.781	0.00	0.01	55.23
123.55	0.02	5,363.693	0.792	0.00	0.02	59.61
123.60	0.03	5,762.095	0.802	0.00	0.03	64.05
123.65	0.04	6,165.699	0.812	0.00	0.04	68.55
123.70	0.05	6,574.519	0.823	0.00	0.05	73.10
123.75	0.07	6,988.573	0.833	0.00	0.07	77.72
123.80	0.09	7,407.880	0.844	0.00	0.09	82.40
123.85	0.10	7,832.454	0.854	0.00	0.10	87.13
123.90	0.11	8,262.315	0.865	0.00	0.11	91.91
123.95	0.12	8,697.478	0.876	0.00	0.12	96.75
124.00	0.12	9,137.962	0.886	0.00	0.12	101.65
124.05	0.13	9,583.783	0.897	0.00	0.13	106.62
124.10	0.13	10,034.958	0.908	0.00	0.13	111.63
124.15	0.14	10,491.504	0.918	0.00	0.14	116.71
124.20	0.15	10,953.440	0.929	0.00	0.15	121.85
124.25	0.15	11,420.780	0.940	0.00	0.15	127.05
124.30	0.16	11,893.544	0.951	0.00	0.16	132.31
124.35	0.16	12,371.748	0.962	0.00	0.16	137.63
124.40	0.17	12,855.409	0.973	0.00	0.17	143.01
124.45	0.17	13,344.545	0.984	0.00	0.17	148.45
124.50	0.18	13,839.172	0.995	0.00	0.18	153.95
124.55	0.18	14,339.307	1.006	0.00	0.18	159.51

Elevation (m)	Outflow (m^3/s)	Storage (m^3)	Area (ha)	Infiltration (m^3/s)	Flow (Total) (m^3/s)	2S/t + O (m^3/s)
124.60	0.19	14,844.969	1.017	0.00	0.19	165.13
124.65	0.19	15,356.173	1.028	0.00	0.19	170.82
124.70	0.20	15,872.937	1.039	0.00	0.20	176.56
124.75	0.20	16,395.278	1.050	0.00	0.20	182.37
124.80	0.21	16,923.215	1.061	0.00	0.21	188.24
124.85	0.21	17,456.761	1.073	0.00	0.21	194.18
124.90	0.22	17,995.938	1.084	0.00	0.22	200.17
124.95	0.22	18,540.759	1.095	0.00	0.22	206.23
125.00	0.22	19,091.244	1.107	0.00	0.22	212.35
125.05	0.23	19,647.408	1.118	0.00	0.23	218.53
125.10	0.23	20,209.270	1.129	0.00	0.23	224.78
125.15	0.24	20,776.846	1.141	0.00	0.24	231.09
125.20	0.24	21,350.154	1.152	0.00	0.24	237.46
125.25	0.24	21,929.210	1.164	0.00	0.24	243.90
125.30	0.25	22,514.032	1.175	0.00	0.25	250.40
125.35	0.25	23,104.636	1.187	0.00	0.25	256.97
125.40	0.26	23,701.042	1.199	0.00	0.26	263.60
125.45	0.37	24,303.263	1.210	0.00	0.37	270.41
125.50	0.59	24,911.320	1.222	0.00	0.59	277.38
125.55	0.88	25,525.227	1.234	0.00	0.88	284.50
125.60	1.24	26,145.004	1.245	0.00	1.24	291.74
125.65	1.66	26,770.666	1.257	0.00	1.66	299.11
125.70	2.14	27,402.231	1.269	0.00	2.14	306.61
125.75	2.68	28,039.716	1.281	0.00	2.68	314.23
125.80	3.27	28,683.139	1.293	0.00	3.27	321.97
125.85	3.92	29,332.515	1.305	0.00	3.92	329.84
125.90	4.63	29,987.863	1.317	0.00	4.63	337.83
125.95	5.40	30,649.199	1.329	0.00	5.40	345.94
126.00	6.22	31,316.543	1.341	0.00	6.22	354.18
126.05	7.10	31,989.907	1.353	0.00	7.10	362.55
126.10	8.04	32,669.313	1.365	0.00	8.04	371.03
126.15	9.04	33,354.775	1.377	0.00	9.04	379.65
126.20	10.10	34,046.312	1.389	0.00	10.10	388.39
126.25	11.22	34,743.940	1.401	0.00	11.22	397.26
126.30	12.40	35,447.677	1.414	0.00	12.40	406.26

```
             Length
     .--Top---- B ----------.
W    |                      |
i    |    .------b2------.  |
d    A    b1             |  C
t    |    `----Bottom----'  |
h    |                      |
     `----------D-----------'
       Diagram Not to Scale
```

Pond Volume Calculation for Trapezoidal Basin	
Trapezoid Top Elevation	126.75 m
Trapezoid Top Length (A to C)	180.50 m
Trapezoid Top Width (B to D)	138.50 m
Trapezoid Bottom Elevation	123.00 m
Trapezoid Bottom Length	158.00 m
Trapezoid Bottom Width	116.00 m

Pond Volume Calculation for Trapezoidal Basin	
Trapezoid Width Offset (B to b2)	11.25 m
Trapezoid Length Offset (A to b1)	11.25 m
Trapezoid Vertical Increment	0.10 m

Elevation (m)	Planimeter (m^2)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m^3)	Volume (Total) (m^3)
123.00	0.0	1.833	0.000	0.000	0.000
123.10	0.0	1.849	5.523	1,841.020	1,841.020
123.20	0.0	1.866	5.573	1,857.557	3,698.577
123.30	0.0	1.882	5.622	1,874.122	5,572.699
123.40	0.0	1.899	5.672	1,890.772	7,463.500
123.50	0.0	1.916	5.723	1,907.508	9,371.007
123.60	0.0	1.933	5.773	1,924.300	11,295.307
123.70	0.0	1.950	5.824	1,941.176	13,236.483
123.80	0.0	1.967	5.874	1,958.138	15,194.622
123.90	0.0	1.984	5.925	1,975.157	17,169.778
124.00	0.0	2.001	5.977	1,992.232	19,162.010
124.10	0.0	2.018	6.028	2,009.392	21,171.402
124.20	0.0	2.035	6.080	2,026.637	23,198.010

Elevation (m)	Planimeter (m^2)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m^3)	Volume (Total) (m^3)
124.30	0.0	2.053	6.132	2,043.938	25,241.948
124.40	0.0	2.070	6.184	2,061.297	27,303.245
124.50	0.0	2.088	6.236	2,078.740	29,381.985
124.60	0.0	2.105	6.289	2,096.268	31,478.281
124.70	0.0	2.123	6.342	2,113.853	33,592.133
124.80	0.0	2.140	6.395	2,131.522	35,723.656
124.90	0.0	2.158	6.448	2,149.277	37,872.933
125.00	0.0	2.176	6.501	2,167.060	40,039.992
125.10	0.0	2.194	6.555	2,184.956	42,224.949
125.20	0.0	2.212	6.609	2,202.909	44,427.858
125.30	0.0	2.230	6.663	2,220.919	46,648.776
125.40	0.0	2.248	6.717	2,239.013	48,887.818
125.50	0.0	2.266	6.772	2,257.192	51,145.010
125.60	0.0	2.285	6.826	2,275.429	53,420.439
125.70	0.0	2.303	6.881	2,293.750	55,714.160
125.80	0.0	2.321	6.936	2,312.127	58,026.287
125.90	0.0	2.340	6.992	2,330.590	60,356.877
126.00	0.0	2.358	7.047	2,349.109	62,705.986
126.10	0.0	2.377	7.103	2,367.713	65,073.699
126.20	0.0	2.396	7.159	2,386.374	67,460.101
126.30	0.0	2.415	7.215	2,405.120	69,865.221
126.40	0.0	2.433	7.272	2,423.950	72,289.171
126.50	0.0	2.452	7.328	2,442.838	74,732.009
126.60	0.0	2.471	7.385	2,461.782	77,193.790
126.75	0.0	2.500	7.457	3,728.394	80,922.185

Infiltration	
Infiltration Method (Computed)	Average Infiltration Rate
Infiltration Rate (Average)	12.0000 mm/h

Initial Conditions	
Elevation (Water Surface, Initial)	123.00 m
Volume (Initial)	0.000 m³
Flow (Initial Outlet)	0.00 m³/s
Flow (Initial Infiltration)	0.00 m³/s
Flow (Initial, Total)	0.00 m³/s
Time Increment	0.050 hours

Elevation (m)	Outflow (m³/s)	Storage (m³)	Area (ha)	Infiltration (m³/s)	Flow (Total) (m³/s)	2S/t + O (m³/s)
123.00	0.00	0.000	1.833	0.00	0.00	0.00
123.05	0.00	918.456	1.841	0.06	0.06	10.27
123.10	0.00	1,841.032	1.849	0.06	0.06	20.52
123.15	0.00	2,767.735	1.858	0.06	0.06	30.81
123.20	0.00	3,698.576	1.866	0.06	0.06	41.16
123.25	0.00	4,633.562	1.874	0.06	0.06	51.55
123.30	0.00	5,572.704	1.882	0.06	0.06	61.98
123.35	0.00	6,516.009	1.891	0.06	0.06	72.46
123.40	0.00	7,463.487	1.899	0.06	0.06	82.99
123.45	0.00	8,415.148	1.908	0.06	0.06	93.57
123.50	0.00	9,370.999	1.916	0.06	0.06	104.19
123.55	0.00	10,331.051	1.924	0.06	0.06	114.85
123.60	0.00	11,295.311	1.933	0.06	0.06	125.57
123.65	0.00	12,263.790	1.941	0.06	0.06	136.33
123.70	0.00	13,236.495	1.950	0.06	0.06	147.14
123.75	0.00	14,213.436	1.958	0.07	0.07	157.99
123.80	0.00	15,194.623	1.967	0.07	0.07	168.89
123.85	0.00	16,180.063	1.975	0.07	0.07	179.84
123.90	0.00	17,169.767	1.984	0.07	0.07	190.84
123.95	0.00	18,163.742	1.992	0.07	0.07	201.89
124.00	0.00	19,161.998	2.001	0.07	0.07	212.98
124.05	0.00	20,164.545	2.009	0.07	0.07	224.12
124.10	0.00	21,171.390	2.018	0.07	0.07	235.30
124.15	0.00	22,182.544	2.027	0.07	0.07	246.54
124.20	0.00	23,198.014	2.035	0.07	0.07	257.82
124.25	0.00	24,217.811	2.044	0.07	0.07	269.15
124.30	0.00	25,241.942	2.053	0.07	0.07	280.53
124.35	0.00	26,270.417	2.061	0.07	0.07	291.96
124.40	0.01	27,303.246	2.070	0.07	0.08	303.45
124.45	0.02	28,340.436	2.079	0.07	0.09	314.98
124.50	0.03	29,381.998	2.088	0.07	0.10	326.56
124.55	0.04	30,427.939	2.096	0.07	0.11	338.20
124.60	0.06	31,478.270	2.105	0.07	0.13	349.89
124.65	0.07	32,532.998	2.114	0.07	0.14	361.62
124.70	0.09	33,592.133	2.123	0.07	0.16	373.41

Elevation (m)	Outflow (m^3/s)	Storage (m^3)	Area (ha)	Infiltration (m^3/s)	Flow (Total) (m^3/s)	2S/t + O (m^3/s)
124.75	0.11	34,655.685	2.132	0.07	0.18	385.25
124.80	0.13	35,723.661	2.140	0.07	0.20	397.13
124.85	0.15	36,796.072	2.149	0.07	0.22	409.07
124.90	0.17	37,872.925	2.158	0.07	0.24	421.05
124.95	0.17	38,954.231	2.167	0.07	0.24	433.07
125.00	0.17	40,039.997	2.176	0.07	0.24	445.13
125.05	0.17	41,130.233	2.185	0.07	0.24	457.25
125.10	0.17	42,224.949	2.194	0.07	0.25	469.41
125.15	0.18	43,324.152	2.203	0.07	0.25	481.63
125.20	0.18	44,427.853	2.212	0.07	0.25	493.89
125.25	0.18	45,536.059	2.221	0.07	0.25	506.21
125.30	0.18	46,648.781	2.230	0.07	0.26	518.58
125.35	0.18	47,766.026	2.239	0.07	0.26	530.99
125.40	0.19	48,887.804	2.248	0.07	0.26	543.46
125.45	0.19	50,014.125	2.257	0.08	0.26	555.98
125.50	0.19	51,144.996	2.266	0.08	0.27	568.54
125.55	0.19	52,280.428	2.275	0.08	0.27	581.16
125.60	0.19	53,420.428	2.285	0.08	0.27	593.83
125.65	0.20	54,565.007	2.294	0.08	0.27	606.55
125.70	0.20	55,714.172	2.303	0.08	0.28	619.32
125.75	0.20	56,867.934	2.312	0.08	0.28	632.14
125.80	0.20	58,026.300	2.321	0.08	0.28	645.02
125.85	0.21	59,189.280	2.331	0.08	0.28	657.94
125.90	0.21	60,356.884	2.340	0.08	0.29	670.92
125.95	0.21	61,529.119	2.349	0.08	0.29	683.94
126.00	0.21	62,705.996	2.358	0.08	0.29	697.02
126.05	0.21	63,887.522	2.368	0.08	0.29	710.15
126.10	0.22	65,073.708	2.377	0.08	0.30	723.34
126.15	0.22	66,264.561	2.386	0.08	0.30	736.57
126.20	0.22	67,460.091	2.396	0.08	0.30	749.86
126.25	0.22	68,660.308	2.405	0.08	0.30	763.19
126.30	0.22	69,865.219	2.415	0.08	0.30	776.58
126.35	0.23	71,074.835	2.424	0.08	0.31	790.03
126.40	0.23	72,289.163	2.433	0.08	0.31	803.52
126.45	0.23	73,508.214	2.443	0.08	0.31	817.07
126.50	0.23	74,731.995	2.452	0.08	0.31	830.67
126.55	0.23	75,960.517	2.462	0.08	0.32	844.32
126.60	0.24	77,193.787	2.471	0.08	0.32	858.03
126.65	0.24	78,431.815	2.481	0.08	0.32	871.78
126.70	0.24	79,674.611	2.490	0.08	0.32	885.60
126.75	0.24	80,922.182	2.500	0.08	0.32	899.46

```
             Length
    .--Top---- B ----------.
W   |                      |
i   |    .------b2------.  |
d   A    b1             |  C
t   |    `----Bottom----'  |
h   |                      |
    `----------D-----------'
      Diagram Not to Scale
```

Pond Volume Calculation for Trapezoidal Basin	
Trapezoid Top Elevation	124.50 m
Trapezoid Top Length (A to C)	232.00 m
Trapezoid Top Width (B to D)	133.00 m
Trapezoid Bottom Elevation	122.00 m
Trapezoid Bottom Length	217.00 m
Trapezoid Bottom Width	118.00 m

Pond Volume Calculation for Trapezoidal Basin	
Trapezoid Width Offset (B to b2)	7.50 m
Trapezoid Length Offset (A to b1)	7.50 m
Trapezoid Vertical Increment	0.10 m

Elevation (m)	Planimeter (m^2)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m^3)	Volume (Total) (m^3)
122.00	0.0	2.561	0.000	0.000	0.000
122.10	0.0	2.581	7.712	2,570.660	2,570.660
122.20	0.0	2.601	7.773	2,590.822	5,161.481
122.30	0.0	2.621	7.833	2,611.068	7,772.578
122.40	0.0	2.642	7.894	2,631.400	10,403.977
122.50	0.0	2.662	7.955	2,651.788	13,055.737
122.60	0.0	2.682	8.017	2,672.232	15,727.998
122.70	0.0	2.703	8.078	2,692.762	18,420.760
122.80	0.0	2.724	8.140	2,713.377	21,134.137
122.90	0.0	2.744	8.202	2,734.048	23,868.185
123.00	0.0	2.765	8.264	2,754.804	26,622.989
123.10	0.0	2.786	8.327	2,775.617	29,398.607
123.20	0.0	2.807	8.390	2,796.515	32,195.122

Elevation (m)	Planimeter (m^2)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m^3)	Volume (Total) (m^3)
123.30	0.0	2.828	8.452	2,817.470	35,012.620
123.40	0.0	2.849	8.516	2,838.509	37,851.129
123.50	0.0	2.870	8.579	2,859.633	40,710.734
123.60	0.0	2.891	8.642	2,880.814	43,591.548
123.70	0.0	2.913	8.706	2,902.052	46,493.600
123.80	0.0	2.934	8.770	2,923.375	49,416.975
123.90	0.0	2.955	8.834	2,944.782	52,361.757
124.00	0.0	2.977	8.899	2,966.246	55,328.003
124.10	0.0	2.999	8.963	2,987.795	58,315.770
124.20	0.0	3.020	9.028	3,009.401	61,325.171
124.30	0.0	3.042	9.093	3,031.064	64,356.235
124.40	0.0	3.064	9.159	3,052.839	67,409.074
124.50	0.0	3.086	9.224	3,074.671	70,483.745

Infiltration	
Infiltration Method (Computed)	Average Infiltration Rate
Infiltration Rate (Average)	12.0000 mm/h

Initial Conditions	
Elevation (Water Surface, Initial)	122.00 m
Volume (Initial)	0.000 m³
Flow (Initial Outlet)	0.00 m³/s
Flow (Initial Infiltration)	0.00 m³/s
Flow (Initial, Total)	0.00 m³/s
Time Increment	0.050 hours

Elevation (m)	Outflow (m³/s)	Storage (m³)	Area (ha)	Infiltration (m³/s)	Flow (Total) (m³/s)	2S/t + O (m³/s)
122.00	0.00	0.000	2.561	0.00	0.00	0.00
122.05	0.00	1,282.814	2.571	0.09	0.09	14.34
122.10	0.00	2,570.661	2.581	0.09	0.09	28.65
122.15	0.00	3,863.552	2.591	0.09	0.09	43.01
122.20	0.00	5,161.495	2.601	0.09	0.09	57.44
122.25	0.00	6,464.499	2.611	0.09	0.09	71.91
122.30	0.00	7,772.572	2.621	0.09	0.09	86.45
122.35	0.00	9,085.725	2.631	0.09	0.09	101.04
122.40	0.00	10,403.966	2.642	0.09	0.09	115.69
122.45	0.00	11,727.303	2.652	0.09	0.09	130.39
122.50	0.00	13,055.747	2.662	0.09	0.09	145.15
122.55	0.00	14,389.306	2.672	0.09	0.09	159.97
122.60	0.00	15,727.989	2.682	0.09	0.09	174.84
122.65	0.00	17,071.804	2.693	0.09	0.09	189.78
122.70	0.00	18,420.762	2.703	0.09	0.09	204.77
122.75	0.00	19,774.871	2.713	0.09	0.09	219.81
122.80	0.00	21,134.139	2.724	0.09	0.09	234.91
122.85	0.00	22,498.577	2.734	0.09	0.09	250.08
122.90	0.00	23,868.193	2.744	0.09	0.09	265.29
122.95	0.00	25,242.996	2.755	0.09	0.09	280.57
123.00	0.00	26,622.994	2.765	0.09	0.09	295.90
123.05	0.00	28,008.198	2.776	0.09	0.09	311.29
123.10	0.00	29,398.616	2.786	0.09	0.09	326.74
123.15	0.00	30,794.256	2.797	0.09	0.09	342.25
123.20	0.00	32,195.129	2.807	0.09	0.09	357.82
123.25	0.00	33,601.243	2.817	0.09	0.09	373.44
123.30	0.00	35,012.607	2.828	0.09	0.09	389.12
123.35	0.00	36,429.229	2.839	0.09	0.09	404.86
123.40	0.00	37,851.120	2.849	0.09	0.09	420.66
123.45	0.00	39,278.288	2.860	0.10	0.10	436.52
123.50	0.00	40,710.742	2.870	0.10	0.10	452.44
123.55	0.00	42,148.490	2.881	0.10	0.10	468.41
123.60	0.00	43,591.543	2.891	0.10	0.10	484.45
123.65	0.08	45,039.909	2.902	0.10	0.17	500.62
123.70	0.22	46,493.596	2.913	0.10	0.32	516.92

Elevation (m)	Outflow (m^3/s)	Storage (m^3)	Area (ha)	Infiltration (m^3/s)	Flow (Total) (m^3/s)	2S/t + O (m^3/s)
123.75	0.43	47,952.615	2.923	0.10	0.52	533.33
123.80	0.68	49,416.974	2.934	0.10	0.77	549.85
123.85	0.97	50,886.682	2.945	0.10	1.07	566.48
123.90	1.32	52,361.747	2.955	0.10	1.42	583.22
123.95	1.71	53,842.180	2.966	0.10	1.81	600.06
124.00	2.15	55,327.989	2.977	0.10	2.25	617.00
124.05	2.64	56,819.183	2.988	0.10	2.74	634.06
124.10	3.17	58,315.770	2.999	0.10	3.27	651.22
124.15	3.75	59,817.761	3.009	0.10	3.85	668.50
124.20	4.39	61,325.164	3.020	0.10	4.49	685.88
124.25	5.07	62,837.988	3.031	0.10	5.17	703.37
124.30	5.80	64,356.241	3.042	0.10	5.90	720.97
124.35	6.59	65,879.934	3.053	0.10	6.69	738.69
124.40	7.42	67,409.075	3.064	0.10	7.52	756.51
124.45	8.31	68,943.673	3.075	0.10	8.41	774.46
124.50	9.26	70,483.736	3.086	0.10	9.36	792.51

Appendix C

Stormwater Management Performance Assessment

Appendix C

Stormwater Management Performance Assessment

This appendix outlines decision making criteria related to operation of the stormwater management (SWM) system. It includes performance assessment of the SWM ponds, disposal of secondary drainage layer (SDL) water and construction water into the SWM conveyance/holding system. Decision making criteria are presented in the following flow charts. The following field and laboratory sampling information shall be read in conjunction with the flow charts.

1. Sampling Locations

- Stormwater Pond Inlet
- Stormwater Pond Content
- Stormwater Pond Outlet (only if outlet valve open).
- SDL sampling port near Pumping Station PS6.
- Construction water-variable locations.

2. Water Quality Based on Field Sampling

Level 1

- conductivity < 1,000 µS/cm

Level 2

- 1,000 µS/cm < conductivity < 2,000 µS/cm

Level 3

- conductivity > 2,000 µS/cm
- 6.5 < pH < 9.0
- dissolved oxygen (DO) < 3 mg/L May through October
  <5 mg/L November to April

3. Water Quality Based on Laboratory Sample

Elevated:

- conductivity between 1,000 and 2,000 µS/cm
- TDS between 600 and 1,200 mg/L
- chloride between 150 and 250 mg/L
- sodium between 110 and 200 mg/L

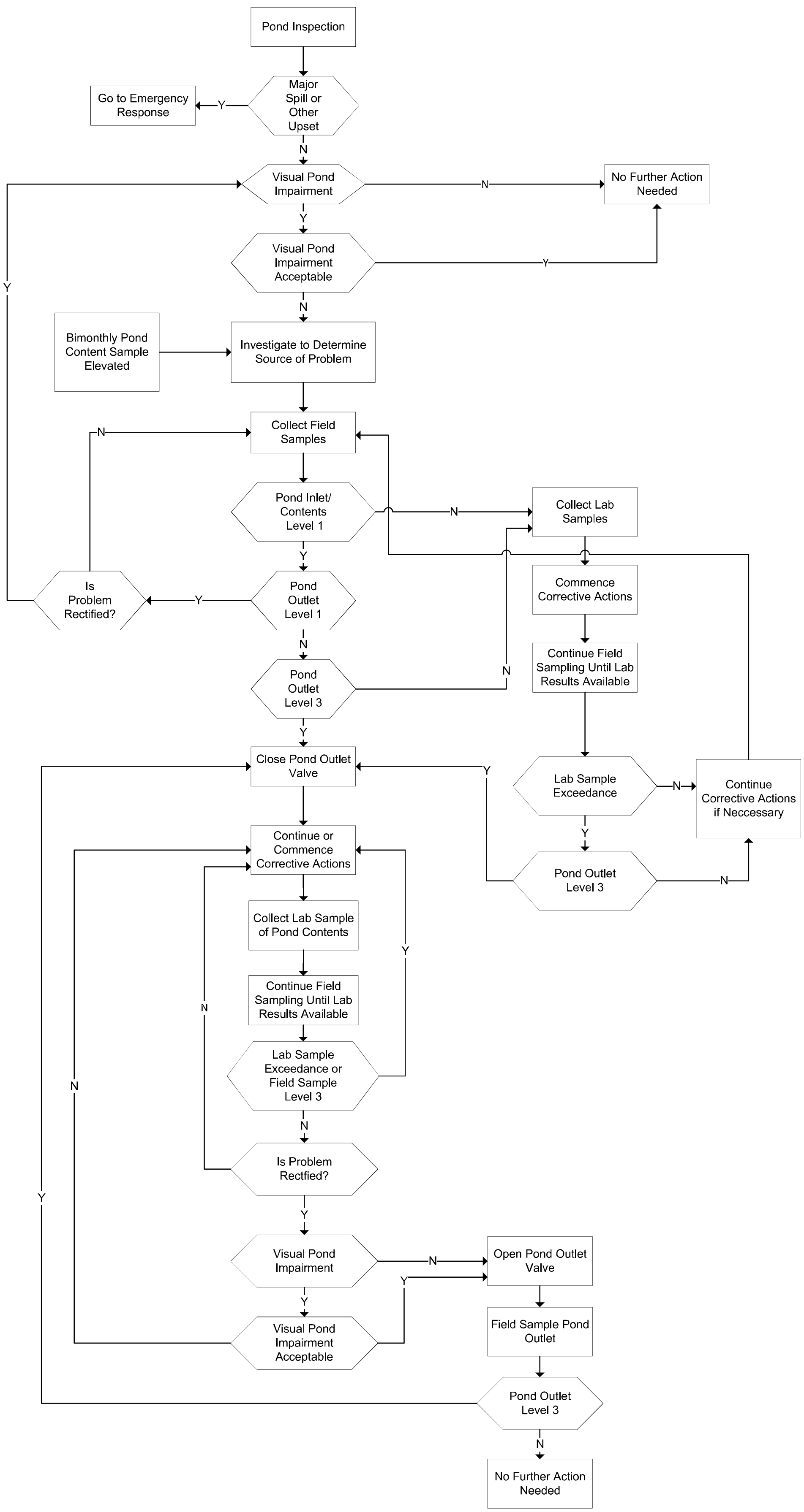
Exceedance:

- conductivity > 2,000 µS/cm
- TDS > 1,200 mg/L
- chloride > 250 mg/L
- sodium > 200 mg/L

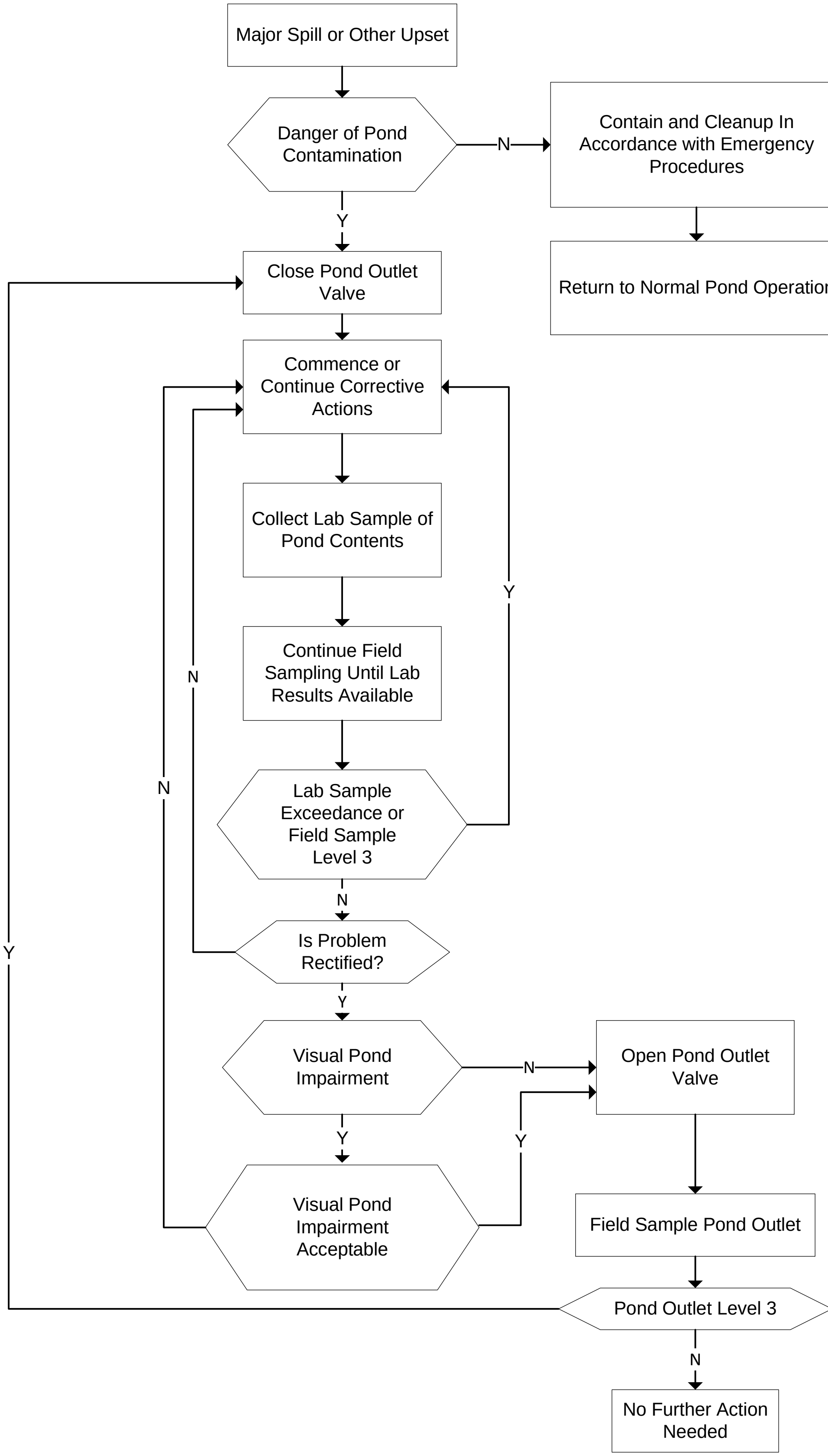
Increased turbidity shall not be considered as visual impairment of surface water. In case of a spill, indicator parameters should be revised/added based on the nature of spilled liquid.

Corrective actions will always depend on the nature of the problem. Usually it will require fixing the source of the problem such as leachate seep, exposed waste, spill, etc. If the pond contents are contaminated, corrective measures may include in-situ treatment, dilution (mixing to agitate contents, floating aerator and/or other measures to prevent stagnation), containment with booms, removal of floating material and removal of pond contents for treatment on-site or off-site.

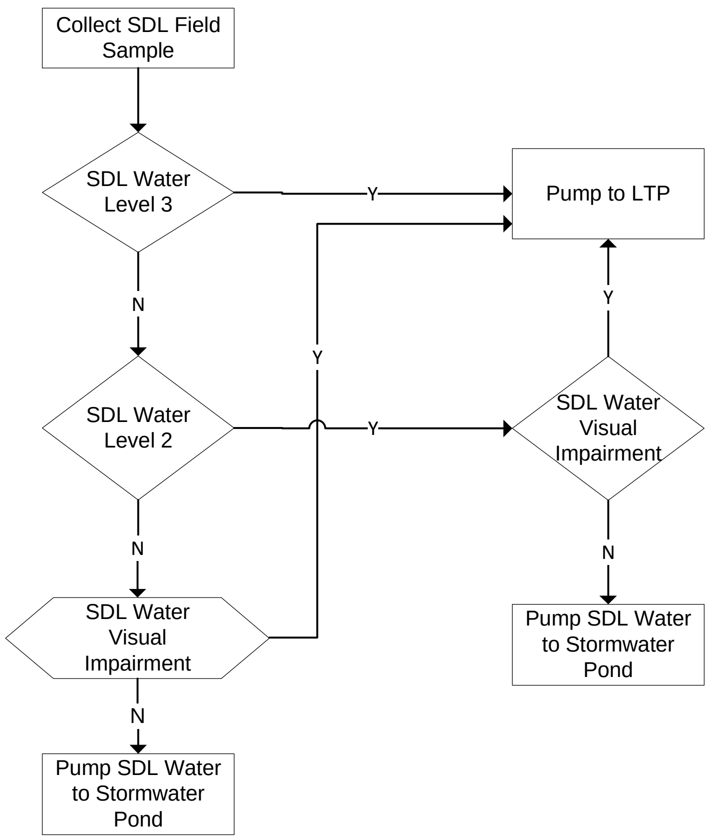
A - Regular Pond Operation



B - Stormwater Pond Emergency Response



C - Handling of Secondary Drainage Layer (SDL) Water



D - Construction DewaterIng
(Handling of Construction Water (CW))