SECTION 2.4

Stormwater Management Plan

2.4 Stormwater Management Plan

Introduction

The Stormwater Management Plan (Plan) for the Veolia E.S. Zion Landfill Site 2 East Expansion has been designed to collect, route, and detain stormwater runoff from the Facility in an environmentally sound manner. The Plan for the landfill expansion contains design features that meet or exceed the regulations applicable to stormwater management, including 35 Ill. Admin. Code, Section 811.103, effluent standards, 35 Ill. Admin. Code, Part 304, and the Lake County Watershed Development Ordinance (LCWDO), effective November 18, 2008.

The proposed system is designed to manage stormwater in the area of the landfill and reduce the flooding potential of downstream areas. Stormwater will be directed away from the landfill waste boundary. Stormwater which contacts waste will be contained and treated as leachate and will not discharge to off-site waterways.

A portion of the proposed expansion described in this Application vertically overlies the previously permitted Site 2 expansion. As such, select areas of the existing stormwater management plan have been revised, and/or partially or wholly integrated into the proposed Plan. These stormwater features include benches, downslope flumes, perimeter ditches, stormwater detention basins, and outlet structures. The proposed Plan only discusses stormwater facilities utilized and/or affected by the proposed Site 2 East expansion. An overview of the proposed stormwater management system is shown on D16.

In general, stormwater will be directed along either terrace berms or benches to downslope flume pipes along the side slopes of the final landform. The downslope flumes will discharge into energy dissipator structures and then into perimeter ditches located at the toe of the sideslopes. Stormwater runoff will then be conveyed to stormwater basins designed to detain the 100-year, 24-hour storm event. The Plan incorporates two existing basins located along the south side of the landfill and one proposed basin to the east of the proposed expansion. The detention basins will allow the controlled and gradual release of stormwater to offsite drainage areas. Water from the proposed Detention Basin 5R will discharge into a vegetated bioswale prior to draining offsite. Each feature is described in further detail within this Plan.

A summary of the major stormwater management features are listed below:

1. *Terrace Berms and Benches.* Both terrace berms and benches have been designed to intercept stormwater flow down the slope in order to reduce flow speed. This reduction in flow speed minimizes the potential for erosion and scour.

   Due to the width of the terrace berms, they have been modeled assuming sheet flow conditions. The terrace berms have been designed to convey the 100-year 1-hour storm events with velocities less than 5 feet per second (fps). The 100-year, 1-hour storm event was used because this event produces the highest discharge rate of modeled storm events. The stormwater flow velocities were designed to remain below 5 fps to minimize the potential for erosion of the terrace berms and to prevent scour.

2. *Downslope Flumes*. The terrace berms and benches direct stormwater to HDPE downslope flume pipes that discharge into energy dissipator structures and in turn to perimeter ditches in a controlled flow manner. The flume pipe diameters have been selected to pass the peak discharge generated by the 100-year, 1-hour storm event.

3. *Perimeter Ditches.* Perimeter ditches have been designed to pass the peak discharge generated by the 100-year, 1-hour storm event. The perimeter ditch design exceeds the requirements contained in 35 Ill Admin. Code, Section 811.103.

The drainage ditches have typically been designed to maintain flow velocities below 5 feet per second (fps) during the 100-year storm event. These low velocities help minimize the potential for erosion of the drainage ditches, and prevent scour. Ditch or pipe discharge points where flow velocities exceed 5 fps will be protected using riprap, sodding, erosion control matting, or other control measures to minimize erosion.

4. *Detention Basins.* The detention basins have been designed to detain and control the release of the 100-year, 24-hour storm event. The 100-year, 24-hour storm event was used to size the detention basins because it generates the highest storage volume of modeled storm events.

   Detention basin requirements listed in the LCWDO have been incorporated into the design, such as live and dead storage volume, freeboard, overflow design, etc. These design components are described within this Plan. Detention volume and basin design principles exceed both the IEPA and LCWDO requirements.

   The stormwater basins are designed to improve water quality prior to discharge by facilitating sedimentation and supporting aquatic vegetation. The proposed Detention Basin 5R utilizes a sedimentation trap within the basin that will minimize particulate matter from migrating to the basin outlets.

5. *Staged Outlet Structures.* The detention basins have been designed to pass the 100-year 24-hour storm event. The 100-year, 24-hour storm event was selected for design to ensure that discharge rates were sufficient to prevent overtopping of the detention basins during this peak volume producing event.

   Stormwater will be discharged with outlets at staged elevations to provide a controlled release rate, thereby reducing the flooding potential of areas located downstream of the proposed landfill.

6. *Spillways.* Basins are designed with spillways capable of passing the 100-year, 1-hour storm event entering the basins while maintaining one foot of freeboard within the spillway, as required in the LCWDO. It is noted that the base of the spillways are located above the highest elevation determined for each basin for the 100-year, 24-hour storm event, which produces the highest basin elevation of modeled storm events.

7. *Bio-Swale Discharge Filtering.* Discharge for the proposed Detention Basin 5R will enter a bioswale channel that incorporates vegetation and a minimal slope. These design qualities maximize time of flow concentrations, thus improving stormwater quality before discharging off-site.

Stormwater Requirements

This Plan was developed to meet or exceed the runoff requirements of the Illinois Environmental Protection Agency and the LCWDO. The existing facility has a NPDES permit in accordance with 35 Ill. Admin. Code, Part 309, which will be modified for the proposed landfill expansion. The existing Facility also has a Lake County Watershed Development Permit that will be followed in addition to any future LCWDO Permits secured for the construction and operation of this Plan. A copy of the existing LCWDO and NPDES Permits are provided in Appendix M.

The applicable state regulations regarding surface water drainage include:

- ❏ 35 Ill. Admin. Code, Section 811.103.
- ❏ 35 Ill. Admin. Code, Section 812.110.

Title 35 Ill. Admin. Code, Section 811.103 establishes several requirements for stormwater runoff from disturbed areas.

- ❑ Runoff from disturbed areas during a 25-year, 24-hour storm or smaller is subject to the water quality standards contained in 35 Ill. Admin. Code, Part 304.

- ❑ All discharges from disturbed areas are subject to the permitting requirements within 35 Ill. Admin. Code, Part 309.

- ❑ Finally, all discharge structures must be designed to have flow velocities that will not cause erosion and scouring of the natural or constructed lining.

This same section also outlines requirements for the diversion of runoff from undisturbed areas.

- ❑ Diversion facilities must be designed to prevent runoff from the 25-year, 24-hour storm from entering disturbed areas to the extent practical.

- ❑ The diversion structures must be designed to have flow velocities that will not cause erosion and scouring of the natural or constructed channel lining.

Title 35 Ill. Admin Code, Section 812.110 outlines the specific details that need to be included in the permit application, including a map of the location of structures affected by stormwater runoff from disturbed areas and detailed designs of structures to be constructed. These are included in the Design Drawings and in Appendix M.

The LCWDO outlines stormwater design parameters required to be provided. These design components must be met to be granted a Watershed Development Permit, which calculations is required for stormwater management development:

- ❑ Existing depressional storage volume shall be maintained. The volume of detention storage required to handle the 100-year, 24-hour storm event must be in addition to existing depressional storage.

- ❑ Stormwater management systems shall not result in the interbasin transfer of drainage, unless no reasonable alternative exists.

- ❑ Sediment basins shall have both a permanent pool (dead storage) and additional volume (live storage) such that each volume is equal to the runoff amount of a 2-year, 24-hour event over the on-site hydrologically disturbed area.

- ❑ Wet detention basins must provide a minimum permanent pool volume equal to the calculated sediment volume accumulated over a one-year period for the entire upstream watershed and an average water depth of at least four feet.

- ❑ Release rates from detention basins shall not exceed 0.15 cfs/acre of area drained for the 100-yr, 24-hr storm event and 0.04 cfs/acre of area drained for the 2-yr, 24-hr storm event.

- ❑ The 10-yr storm event shall be used as a minimum for the design of swales .

- ❑ Spillways shall be sized to pass the 100-year, 1-hour storm event and maintain one foot of freeboard.

- ❑ Various general design considerations for ditches, detention basins, and all other necessary stormwater control structures.

Physiography and Topography

The Site 2 East expansion includes a horizontal expansion of the currently permitted waste boundary to the east and a vertical expansion over the previously permitted Subtitle-D liner area of Site 2. The proposed Facility boundary expands on the existing facility boundary to the east. The horizontal expansion area of the Facility currently consists of residential properties and a landscaping business.

The residential properties generally have grassed lots with stands of trees. The landscaping business contains multiple greenhouses, nursery rows, and a fallow field that has natural prairie vegetation. Portions of the nursery property appear to have been previously used for agriculture based on a review of historic aerial photographs. The existing elevation across the proposed Facility ranges from approximately 688 feet MSL to 845 feet MSL.

The Facility sits on a topographic and hydrologic high and drains to two different regional watersheds, namely the Lake Michigan and Des Plaines River Watersheds. The existing Detention Basin 6 drains to an off-site area that ultimately drains to Lake Michigan. The existing Detention Pond 3 discharges into an 18-inch culvert beneath Ninth Street to the Des Plaines River via unnamed tributaries. It is noted that Detention Basin 3 collects stormwater from both the Des Plaines and Lake Michigan regional watersheds (i.e. interbasin drainage) as part of the currently approved stormwater management plan for the permitted facility. As discussed and supported by the Lake County Stormwater Management Commission (SMC), the proposed Plan has maintained this general stormwater collection area for Detention Basin 3 to minimize variation of existing property stormwater discharges. The total watershed drainage area to existing Detention Basins 3 and 6 have both been maintained from existing to proposed conditions.

Soil Conditions

Local surficial soils that influence the current rate of runoff within the general project area were defined by the soil survey of Lake County prepared by the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA), last updated in 2005. However, surficial soils were not fully delineated across portions of the expansion area because the land had been disturbed prior to the 2005 soil survey. Based on the recommendations of the SMC, it is assumed that the surficial soils within the disturbed areas were similar in nature to the adjacent soils that were classified in 2005.

The SMC provides conservative soil curve number assumptions for stormwater modeling of proposed conditions. For existing conditions, the soil curve numbers for the permitted facility were reviewed based on surficial soil type, as requested by the SMC. The curve numbers determined for the areas where surficial soils were defined were assumed to also represent the disturbed areas that were not classified. The determination of appropriate curve numbers is provided in Appendix M.

Based on guidance by the SMC, curve numbers for areas that drain to the Isolated Waters of Lake County, but will not be developed as part of the proposed expansion, have been modeled with the same curve numbers determined for existing conditions as part of the 1998 Zion Sanitary Landfill Watershed Development Permit, prepared by CH2MHill. This report also delineated the areas draining to the Isolated Waters of Lake County, both on and off of Veolia's property. Please refer to the report in Appendix M for further detail.

Climate

Annual precipitation in Lake County averages 34.7 inches (water equivalent) and the average yearly temperature is 47.2 degrees Fahrenheit, with a minimum average temperature of 13.2 degrees Farenheit and a maximum average temperature of 78.7 degrees Fahrenheit. More than half the annual precipitation normally falls during the growing season from April through August. Refer to Section 2.2 and Appendix G of this Application for more detailed climate information.

Precipitation Data

Precipitation data used to determine stormwater impacts for the study area was obtained from Appendix I of the LCWDO. The total precipitation and storm durations are summarized in Table 2.4-1. Rainfall distributions are summarized in Appendix M.

TABLE 2.4-1
STORM FREQUENCIES AND VOLUMES

Recurrence Interval	24-Hour (inches)	1-Hour (inches)
100-Year	6.50	3.06
25-Year	4.75	2.23
10-Year	3.88	1.82
2-Year	2.80	1.32

FEMA Regulatory 100-Year Floodplain Limits

The most recent flood maps for the proposed Facility are the FEMA Flood Insurance Rate Maps for Lake County, Illinois, Panel No. 17097C0057 G, revised effective date September 7, 2000 and Panel No. 17097C0076 F, effective date September 3, 1997. As indicated on the maps, the expansion area is not located within a FEMA-defined regulatory floodplain or regulatory floodway. Copies of the maps are provided in Appendix F.

Isolated Waters of Lake County

An Isolated Waters of Lake County (IWLC) is located both inside and outside of the southeast Facility boundary. The IWLC collects stormwater both from within the Facility boundary and from surrounding property not owned by Veolia. The location of the IWLC within the Facility Boundary was determined by Natural Resources, Consulting, Inc. in its report, Wetland Delineation Report: Veolia Zion Landfill and Adjacent Areas, September 22, 2006. The approximate location of the IWLC limits outside of the Facility Boundary is available from the Lake County Geographic Information System (GIS). Please see Appendix M for a copy of the report and a map generated by the Lake County GIS System, as provided by the SMC.

The stormwater management system for the Facility has been designed to minimize disturbance to the IWLC, as discussed in later sections of this narrative. Areas disturbed as part of proposed Facility development will be mitigated through the purchase of credits at a mitigation bank within Lake County. Any hydraulically disturbed areas within a 50-foot buffer of the IWLC due to construction or as part of a re-vegetation plan shall be re-vegetated using the Native Plant Guide for Streams and Stormwater Facilities in NE Illinois as a minimum standard. The stormwater management plan has been developed to discharge stormwater to the preserved IWLC similar to existing conditions per the LCWDO. Further information regarding the IWLC is provided in Appendix M.

Depressional Survey

The potential stormwater storage volume of topographic depressions has been considered in sizing the stormwater retention basins. The LCWDO requires that the total storage volume of the retention basins be sized to include the storage volume of on-site depressional areas in addition to the total stormwater retention volume required to handle the 100-year, 24-hour storm event. A field survey was completed to delineate the topographic depressions and determine their maximum storage capacity, in addition to a review of existing site topography from an aerial flyover.

The area field surveyed for potential depressional areas was based on recommendations by the SMC after review of topographic maps and surface drainage features. The survey area selected included property owned by both Veolia and the City of Zion Park District, generally near the southeast portion of the Facility. Off-site surveys were completed to determine whether depressional areas within the Park District property are connected to the Veolia property if completely filled to their overtopping elevation. No depressional areas were determined to lie within areas proposed to be disturbed. Therefore, no additional stormwater storage is required.

Field Tile Survey

A field tile survey was completed in a 100' inside buffer along the inside portion of the southeast Facility boundary and through a 180' by 280' property along Kenosha Road. The survey area was requested by the SMC to determine whether downstream drainage may be impacted by the development of this proposed expansion. The results generally show that drain tile networks do not extend into the Facility. The exception is one drain tile to the southeast, which will not be impacted by construction activities. In the unlikely event that any unknown field tiles are encountered during the development of the landfill, they will be managed to ensure proper drainage and discharge so as not to adversely impact downstream property owners. Any drain tiles impacted during construction shall be repaired or replaced such that the original flow capacity and function are restored. A full size drawing of the Drain Tile Survey results is provided in Appendix M. A detail of a typical drain tile repair is shown on the Drain Tile Survey.

Developed Site Conditions

The proposed expansion will expand the currently permitted Site 2 landfill vertically on the current top “plateau” area and horizontally to the east. The existing Site 2 design incorporates 3:1sideslopes with benches spaced approximately every 25 to 30 vertical feet. The proposed expansion design will utilize 4:1 sideslopes on both the vertical and horizontal areas with 10:1 topslopes. A portion of the slope will be 3:1 in the proximity of the leachate loadout area. The overall design will tie into Site 2 as shown on Drawing No. D16.

The maximum elevation of the landfill will be approximately 930 feet MSL. Above grade portions of the landfill will be covered with a final cover which satisfies the requirements of 35 Ill. Admin. Code, Section 811.314. Such a cover will form a barrier to prevent infiltration of rainfall into the landfill. To minimize erosion, hearty, quick-growing grasses will be planted.

The Plan has been designed to accommodate fully-developed conditions of the landfill and ancillary facilities. Runoff from the landfill expansion will be directed into the existing Basins 3 and 6 and the proposed Detention Basin 5R through a series of terrace berms and/or benches, downslope flume pipes, energy dissipators, and perimeter ditches. Hydraulically disturbed areas that are not directed to a detention basin (such as the backside of berms) are included in the stormwater model to ensure that off-site discharge requirements of the LCWDO are met.

Terrace Berms and Benches

Terrace berms and benches will be used to intercept stormwater sheet flow, collect runoff, and control erosion along the sideslopes of the landfill. Terrace berms in the 4:1 sideslope areas will be constructed as part of the closure of the landfill in the approximate locations shown on Drawing D16. Terrace berms and benches are typically located approximately every 50 vertical feet. Benches will be utilized in the currently permitted 3:1 sideslope areas outside of the proposed waste expansion area, and are spaced

approximately every thirty vertical feet. Terrace berms and benches have been designed to transport the 100-year, 1-hour storm event, as previously noted. The terrace berms are named according to the watershed that they receive stormwater from. Terrace berms and benches will typically be developed as shown on Drawing No. D16. Refer to the Final Cover Detail Design Drawing for typical terrace and bench details.

All benches have the same dimensions and slope. One representative bench has been modeled using the peak 100-year, 1-hour storm event flow rate for Watershed I13, which has the highest discharge rate of any watershed with benches. It is noted that the stormwater passing through this watershed may travel both along a terrace berm and bench. Both stormwater diversion features are conservatively modeled assuming peak discharge rate through the watershed. Table 2.4-2 provides the general design parameters for the terrace berms and representative bench.

TABLE 2.4-2
DESIGN PARAMETERS FOR PROPOSED TERRACE BERMS

Flowpath	**100-Year, 1-Hour Flow** (cfs)	**Sideslopes**	**Channel Slope** (ft/ft)	**Channel Depth** (ft)	**Base Channel Width (ft)**	**Channel Lining**
B1	5.4	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
B2	7.4	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
B9	8.6	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
B10	6.5	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
B11	5.8	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
B12	4.2	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
C1	7.2	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
C2	7.0	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
C3	6.0	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
C4	8.0	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
D1	3.6	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
D2	4.2	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
D3	4.0	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
E1	3.7	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
E2	7.9	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
I1	2.1	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
I2	2.1	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
I3	6.0	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass

TABLE 2.4-2 DESIGN PARAMETERS FOR PROPOSED TERRACE BERMS						
Flowpath	**100-Year, 1-Hour Flow** (cfs)	**Sideslopes**	**Channel Slope** (ft/ft)	**Channel Depth** (ft)	**Base Channel Width (ft)**	**Channel Lining**
I4	8.0	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
I5	7.0	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
I6	4.0	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
I7A	10.8	2H:1V and 4H:1V	0.0200	1.50	0 (V- Notch)	Grass
I7B	23.4	2H:1V and 4H:1V	0.0200	1.50	0 (V- Notch)	Rip-Rap
I9	10.4	2H:1V and 4H:1V	0.0200	1.50	0 (V- Notch)	Grass
I11	4.4	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
I13 Berm	11.2	2H:1V and 4H:1V	0.0200	1.50	0 (V- Notch)	Grass
I13 Bench	11.2	10H:1V and 3H:1V	0.0100	2.00	20'	Grass
I14	6.5	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
I15	8.2	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass
I16	2.2	2H:1V and 4H:1V	0.0200	1.25	0 (V- Notch)	Grass

Downslope Flume Pipes

Downslope flumes will be installed to convey the stormwater collected by the terrace berms and benches down the slope of the landfill into the energy dissipators. The downslope flumes consist of variable-diameter corrugated HDPE pipes with smooth inner walls. The pipes are designed to handle runoff flow rates from the peak 100-year, 1-hour storm event. The locations of the downslope flumes are shown on Drawing No. D16 and typical details of the downslope pipes are shown on Drawing No. D18.

There are multiple stormwater entry points along each flume due to the terrace berm and bench inlet locations. Each section is labeled on Drawing No. D16 (R-1, R-2, etc). Each section of the downslope flume pipe was analyzed to determine the pipe diameter required to pass the 100-year, 1-hour storm event. The entire downslope flume pipe was then sized to handle the peak discharge within any section. The downslope flume pipe sizing is summarized in Table 2.4-3.

TABLE 2.4-3 DESIGN PARAMETERS FOR PROPOSED DOWNSLOPE FLUME PIPES				
Pipe	**Slope (ft/ft)**	**100-Year, 1-Hour Flow Rate (cfs)**	**Required Diameter to Convey 100-Year, 1-hour Flow Rate (inches)**	**Proposed Design Diameter (inches)**
Flume 1: Pipe R-B5 (Stand Alone)				
R-B5	0.213	8.2	13.85	16
Flume 2: In-Line Pipes R-B1 through R-B4				
R-B1	0.242	12.7	10.34	24
R-B2	0.263	21.6	12.43	24
R-B3	0.256	27.6	20.98	24
R-B4	0.193	34.3	15.67	24
Flume 3: In-Line Pipes R-C1, R-C2				
R-C1	0.250	12.2	10.10	16
R-C2	0.250	27.4	13.69	16
Flume 4: Pipe R-LO-1 (Stand Alone)				
R-LO1	0.200	4.0	6.94	12
Flume 5: In-Line Pipes R-D1,R-D2				
R-D1	0.200	3.6	6.39	12
R-D2	0.250	11.4	9.85	12
Flume 6: In-Line Pipes R-E1 through R-E5				
R-E1	0.250	5.4	7.44	16
R-E2	0.250	9.1	9.05	16
R-E3	0.250	14.9	10.89	16
R-E4	0.250	22.8	12.77	16
R-E5	0.250	34.7	14.95	16
Flume 7: In-Line Pipes R-I4 through R-I7				
R-I4	0.212	27.1	13.63	24
R-I5	0.250	41.6	16.13	24
R-I6	0.240	49.1	17.03	24
R-I7	0.252	66.1	20.47	24
Flume 8: In-Line Pipes R-I2 and R-I3				
R-I2	0.250	18.1	15.01	18
R-I3	0.062	23.2	13.29	18
Flume 9: Pipe R-I1 (Stand Alone)				
R-I1	0.250	4.2	6.77	8

Energy Dissipators

Energy dissipators will be placed at the end of each flume run to slow the stormwater velocity exiting the flume. The energy dissipators are concrete vault structures with energy dissipating baffles. The dissipators have been sized to handle the stormwater velocities exiting the flume pipes based on the 100-year, 1-hour storm event. The energy dissipators are sized such that the discharge rate from the for the 100-year, 1-hour storm event is less than 5 ft/sec to minimize the potental for scour or erosion. Further information is provided in Appendix M.

Perimeter Ditches and Culverts

As shown on Drawing No. D16, ditches are used to convey stormwater around the perimeter of the landfill to the basins. A bioswale ditch is used to convey stormwater discharge from the Detention Basin 5R to the off-site discharge location. The bioswale is further discussed in following sections of this Plan.

The perimeter ditches have been designed with excess capacity to convey the flow rates of the 100-year, 1-hour storm event. Therefore, the design exceeds the requirements contained within 35 Ill. Admin. Code, Section 811.103, which requires that all ditches pass the 25-year, 24-hour storm event. LCWDO requirements are also satisfied for perimeter ditch sizing.

The perimeter ditches are designed for low maintenance after the landfill is vegetated. The perimeter ditch bottoms will vegetated with grasses or lined with riprap. The perimeter ditches are designed with side slopes no steeper than 3H:1V, and a bottom width between 0 (v-notch) and 10 feet. The perimeter ditches slope between 0.3% to 1.0% toward the basins. The wide grassed bottoms will promote sedimentation and foster a natural environment. Table 2.4-4 presents design parameters for the perimeter ditches. Calculations demonstrating that the perimeter ditches are sufficiently sized are presented in Appendix M.

Culverts that are in-line with stormwater ditches have been sized to handle the 100-year, 1-hour storm event, which is equal to the 100-year 1-hour discharge rate in the perimeter ditch at that location. Culverts, with the exception of Culvert LO, will be constructed of corrugated HDPE with smooth inner-walls. The design parameters for the culverts are provided in Table 2.4-5. Calculations demonstrating that the culverts are sufficiently sized are presented in Appendix M.

Stormwater from Ditch C is routed through concrete box culvert LO before discharging into Ditch D. The culvert has been sized to handle the maximum discharge rate for the 100-year, 1-hour storm event. Calculations on discharge rate capacity for culvert LO are included in Appendix M.

TABLE 2.4-4
DESIGN PARAMETERS FOR PROPOSED PERIMETER DITCHES

Flowpath	100-Year, 1-Hour Flow Rate (cfs)	Sideslopes	Channel Slope (ft/ft)	Channel Depth (ft)	Base Channel Width (ft)	Channel Lining
Stormwater Ditches						
A	58.3	3H:1V	0.0057	3.00	0 (V- Notch)	Grass
B1	64.6	3H:1V	0.0080	3.00	10	Grass
B2	90.9	3H:1V	0.0055	2.50	10	Grass
C1	92.3	3H:1V	0.0055	2.50	10	Grass
C2	110.9	3H:1V	0.0045	3.00	10	Grass
D1	117.6	3H:1V	0.0030	3.00	10	Grass
D2	51.7	3H:1V	0.0050	3.00	10	Grass
E1	48.4	3H:1V	0.0050	3.00	10	Grass
F1	20.8	3H:1V	0.0050	3.00	10	Grass
F2	20.7	3H:1V	0.0100	3.00	0	Grass
I1	71.7	3H:1V	0.0050	3.00	10	Grass
I2	75.1	3H:1V	0.0050	3.00	4	Grass
Bioswale*	6.7	3H:1V	0.0030	3.00	10	Grass

Note: The Bioswale peak discharge is based on 100-year, 24-hours storm event discharge rate, which is higher than the 100-year, 1-hour storm event.

TABLE 2.4-5 DESIGN PARAMETERS FOR PROPOSED CULVERTS				
Culvert	**Slope (ft/ft)**	**100-Year, 1-Hour Flow Rate (cfs)**	**Required Diameter to Convey 100-Year, 1-hour Flow Rate (inches)**	**Proposed Design Diameter (inches)**
Culvert A	0.010	58.3	33.2	36
Culverts D (D1, D2, and D3)	0.007	53.7	34.4	36
Culvert F	0.005	20.7	25.7	30
Culvert LO	0.002	112.2	2.84' (Required Height)	3' (Proposed Height)

Detention Basins

Three detention basins will be utilized to manage stormwater runoff. Two of the three basins, Basins 3 and 6, have already been constructed to handle stormwater from the existing facility. The third detention basin will be constructed to the east of the proposed expansion. The watershed area draining to both existing Basin 3 and Basin 6 have been maintained in the proposed design.

The sediment basins have been designed with both permanent pool (dead storage) and additional volume (live storage) such that each volume is equal to the runoff amount of a 2-year, 24-hour event over the on-site hydrologically disturbed area. The detention basins have additionally been designed to provide a minimum permanent pool volume equal to the calculated sediment volume accumulated over a one-year period for the entire upstream watershed and an average water depth of at least four feet. The basins contain an eight foot wide ledge a maximum of three feet below the normal water level. Please refer to Appendix M for calculations related to the detention basin volume determinations. An erosion control blanket will be placed between the normal and high water levels on the proposed Detention Basin 5R to minimize erosion potential prior to vegetation growth.

Staged Outlet Structures

The basins have been designed with excess capacity to detain and release the 100-year, 24-hour storm event. The outlet structures have been designed so that the release rates will not exceed 0.15 cfs/acre of area drained for the 100-yr, 24-hr storm event and 0.04 cfs/acre of area drained for the 2-yr, 24-hr storm event, per LCWDO requirements 80-150% of the stormwater discharge volume to the IWLC for the 2-year, 24 hour event will be maintained. Emergency spillways have been designed to pass the 100-year, 1-hour storm event while maintaining 1-foot of freeboard, meeting LCWDO requirements. Supporting calculations are provided in Appendix M. Further information about the sedimentation characteristics of the basin design is discussed within the erosion and sediment control section of the report.

The invert elevation of the low level outlet will dictate the normal water surface elevation within the detention basins. The proposed Basin 5R contains an outlet structure with four 4-inch orifices at elevation 733.50 feet MSL , four 4-inch orifices at elevation 737.50 feet MSL, and four 4-inch orifices at 738.5 feet MSL. The existing Basin 3 outlet structure has four 4-inch orifices at elevations 735.00 feet MSL, four 4-inch orifices at elevation 736.00 feet MSL, four 4-inch orifices at elevation 737.00 feet MSL, four 4-inch orifices at elevation 738.00 feet MSL, and four 4-inch orifices at elevation 739.00 feet MSL. Two of the 4-inch orifices at elevation 735.00 will be plugged as part of the proposed design. The existing Basin 6 outlet structure contains an outlet structure with four 3-inch orifices at elevation 730.45 feet MSL and four 4-inch orifices at elevation 731.40 feet MSL. One of the 3-inch orifices at elevation 730.45 will be plugged as part of the proposed design.

The basins will also be designed with an eight foot ledge at a maximum of three feet below the normal water level. General detention basin outlet structure parameters are provided in Table 2.4-7. Additional information is provided in Appendix M.

TABLE 2.4-6
BASIN DESIGN PARAMETERS

Basin Characteristic:	Basin 5R	Basin 6	Basin 3
Top of Berm Elevation (feet MSL)	742.00	734.00	743.00
Emergency Spillway Elevation (feet MSL)	740.00	732.00	740.00
Inlet Culvert Elevation (feet MSL)	738.00	731.50	738.00
Low Level Outlet Invert Elevation (feet MSL)	733.50	730.45	735.00
High Level Outlet Invert Elevation (feet MSL)	738.50	731.40	739.00
Ledge Elevation (feet MSL)	731.00	727.40	732.00
Normal Water Level (feet MSL)	733.50	730.45	735.00
2-Year, 24-Hour High Water Level (feet MSL)	735.00	731.00	736.90
100-Year, 24-Hour High Water Level (feet MSL)	738.30	732.00	739.80

TABLE 2.4-7
DESIGN PARAMETERS FOR PROPOSED DETENTION BASIN OUTLET STRUCTURES

Culvert	Slope (ft/ft)	100-Year, 24-Hour Flow Rate (cfs)	Required Diameter to Convey 100-Year, 24-hour Flow Rate (inches)	Proposed/ Constructed Diameter (inches)
Detention Basin 3	0.005	14.7	29.3	30
Detention Basin 5R	0.003	6.5	23.7	30
Detention Basin 6	0.005	2.6	15.3	18

Bioswale

Stormwater from the Detention Basin 5R discharges into a 670' bioswale that drains to the Isolated Waters of Lake County. The bioswale exhibits a shallow slope (0.3% slope) to maximize time of flow concentrations, thus improving stormwater quality before discharging off-site to the IWLC. The bioswale has been sized to handle the 100-year, 1-hour peak discharge, which exceeds the LCWDO requirement of using the 10-year, 1-hour storm event. Calculations on stormwater discharge rate and depth for the 100-year, 1-hour storm event are provided in Appendix M.

Runoff Volume Reduction Hierarchy

The proposed Expansion layout has been strategically developed to meet the waste disposal needs of Zion and the surrounding communities, meet the release rate requirements of the LCWDO, and minimize the increase in runoff volumes and rates from the development. Project considerations to meeting the Runoff Volume Reduction Hierarchy established by the LCWDO are summarized below:

Preserving Natural Resource Features (Isolated Waters of Lake County).

The location of the proposed site development was developed to preserve significant portions of the on-site Isolated Waters of Lake County. Site development was not proposed to the west of the adjacent Zion Park District property, where approximately half of the on-site IWLC is located. The proposed Site development to the North of the Zion Park district property was developed with increased property boundary setbacks to minimize impact to the IWLC.

Preserving Existing Drainageways

The existing drainageways of the proposed hydraulically-disturbed areas generally flow to the IWLC. The proposed site design was developed such that stormwater that currently drains to the IWLC continues to discharge to these areas at volumes similar to existing conditions. In fact, volume for the proposed conditions to the preserved IWLC is within one percent of existing conditions (see Appendix M).

Minimizing Impervious Surfaces

The proposed final cover system of the landfill includes a pervious vegetated surface that overlies a minimum of two and a half feet of soil. Proposed impervious surfaces to be constructed are generally limited to the road that will follow the perimeter of the waste boundary. This road has been developed to be as narrow as practical while still allowing safe driving conditions.

Use of Open Vegetated Channels

All stormwater conveyance ditches, terrace berms, benches, and the bioswale have been designed to be vegetated.

Preservation of Natural Infiltration and Storage Characteristics of the Site

The majority of the area to be developed includes vegetated areas that drain toward the IWLC. The proposed development will also provide large, open vegetated areas that drain toward the IWLC.

Structural measures that provide Water Quality and Quantity Control

Detention Basins have been designed with sedimentation areas to improve water quality prior to off-site discharge. The discharge structure of Basin 5R has been strategically designed to work in concert with the proposed bioswale. The outlet structures of Detention Basins 3 and 6 will be modified to meet discharge rate requirements. The discharge structures will restrict the flow rate to meet acceptable discharge rates, as defined by the LCSMC.

Hydrologic Analysis

A hydrologic analysis of the Facility was performed to evaluate the effectiveness of the Plan. The computer model HEC-HMS Verison 3.2 was used to develop discharges for various storm events for each stormwater feature described in this Plan. Runoff was evaluated for 24-hour and 1-hour durations and for the 100, 25, 10, and 2-year storm frequencies. This analysis meets or exceeds local, state, and federal requirements for landfills.

Rainfall data from Bulletin 70 was used, based on LCWDO requirements. Both 1-hour and 24-hour durations were analyzed to determine which storm duration produces the larger peak discharge and detention requirements. The Huff 3rd quartile distribution was used in the analysis for the 24-hour storm, while the Huff 1st quartile distribution was used for the 1-hour storm event. Time of concentration (Tc) and SCS lag time for each watershed was also calculated using distances, slopes, and surface types of the longest flow path through each watershed. Detailed calculations are presented in Appendix M.

For the analysis of the proposed landfill expansion, the study area was subdivided into multiple watersheds. Drainage Areas A1, B1-B12, C1-C6, LO1-LO3, D1-D5, E1-E3, and H1-H3 drain to Detention Basin 5R. Drainage Areas F1 and G1 drain to Detention Basin 6. Drainage Areas I1-I16, J1,

and K1 drain to Detention Basin 3. Watersheds U1-U3 and the Bioswale Watershed represent watersheds of proposed hydraulically disturbed areas that will not drain to a detention basin prior to off-site discharge.

It is noted that the Isolated Waters of Lake County Watershed (IWLC Watershed) is also modeled to characterize areas that drain to the IWLC, but are not hydraulically modified as part of the proposed Expansion. Additional information is provided in Appendix M.

Both Detention Basin 5R and Basin 6 drain to the Lake Michigan watershed through overland flow, while Detention Basin 3 discharges into an 18-inch culvert below 9th Street and to the Des Plains River Watershed. Figure 2.4-1 shows the existing watersheds used in the analysis. Please see Drawing No. D16 for the final watershed configuration.

Hydrologic Results

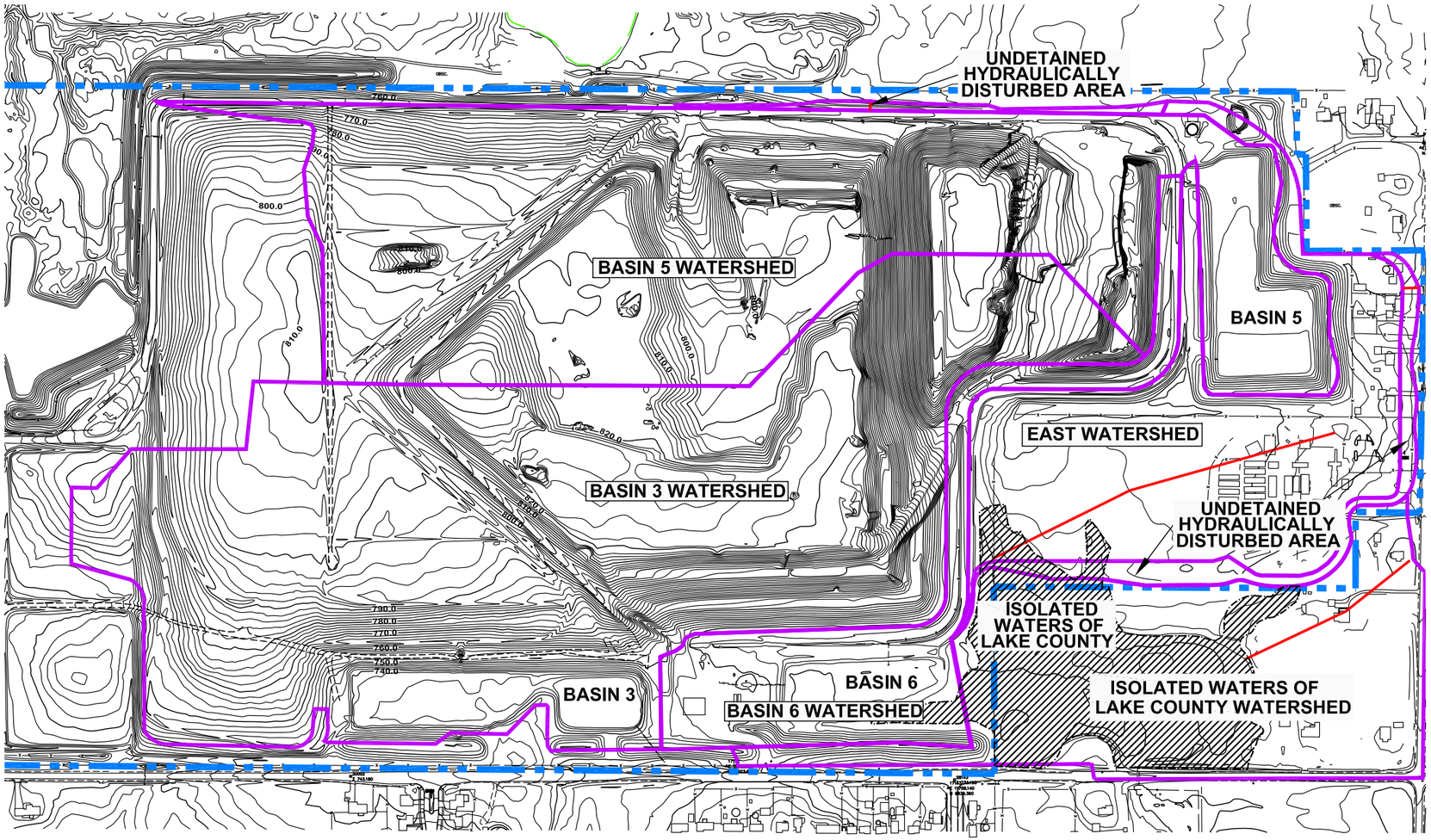
Hydrologic results showing discharge-frequency relationships for each subarea on the final landform are presented in Table 2.4-8(a) and (b). Tables 2.4-9 and 2.4-10 illustrate results for the detention basins. The existing area east of the current watershed boundaries was also modeled to determine pre-and post expansion discharge rates.

Results of the hydrologic analysis indicate that the 1-hour duration produces a larger peak discharge. Therefore,stormwater structures were designed to handle the peak 100-year, 1-hour storm event. However, since the 24-hour storm produces the higher water level elevations in the basins, the 24-hour duration was used for the design of the basins. References for total rainfall and rainfall distributions are presented in Appendix M.

The results demonstrate that the design of the drainage ditches/terraces will convey the 100-year storm event. The maximum velocity of the drainage ditches has been modeled to evaluate the potential for erosion and scour of the ditches and berms. Rip-rap or erosion control materials (ECMs) will be placed in ditches that have a peak velocity that exceeds 5 feet per second in order to minimize potential erosion and scour.

The basins will have sufficient capacity to detain the 100-year storm event without accessing the emergency spillway, as required by 35 Ill. Admin. Code, Section 811.103. The basins and ditches are designed to exceed state and LCWDO requirements. For larger events, discharge will pass through the emergency spillway of the basin, and will not overtop basin sidewalls.

Results indicate that the basins meet the LCWDO requirements for both dead and live storage. The basins have additionally been shown to contain one year of sedimentation volume. The wet detention portion of the basins maintains a minimum 4' depth.



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GRAPHIC SCALE

LEGEND

- APPROXIMATE PROPOSED FACILITY BOUNDARY
- TIME OF CONCENTRATION FLOW PATH
- EXISTING DRAINAGE SUBAREAS
- EXISTING ISOLATED WATERS OF LAKE COUNTY

NOTES

1. WATERSHEDS 3, 5, AND 6 REFLECT THE PERMITTED WATERSHED BOUNDARIES FROM THE 1995 EXPANSION PERMIT APPLICATION OVERLAIN ON THE MOST RECENT TOPOGRAPHIC SURVEY.
2. THE EAST WATERSHED REFLECTS THE NEW AREA WITHIN THE SITE 2 EAST EXPANSION STORMWATER MANAGEMENT SYSTEM THAT IS NOT CURRENTLY MANAGED AS PART OF THE CURRENT STORMWATER MANAGEMENT SYSTEM.
3. THE ISOLATED WATERS OF LAKE COUNTY WATERSHED REFLECTS ALL AREAS NOT MODIFIED OR CONTROLLED BY THE PROPOSED EXPANSION THAT DRAIN TO THE ISOLATED WATERS OF LAKE COUNTY EXISTING CONDITIONS, AS DETERMINED IN ZION SANITARY LANDFILL WATERSHED DEVELOPMENT PERMIT APPLICATION, CH2MHILL, NOVEMBER 1998.
4. THE UNDETAINED HYDRAULICALLY DISTURBED AREAS REFLECT AREAS THAT ARE HYDRAULICALLY DISTURBED AS PART OF THE PROPOSED EXPANSION, BUT ARE NOT DIRECTED TO A STORMWATER BASIN (SUCH AS THE BACK SIDE OF BERMS).
5. EXISTING CONTOURS DEVELOPED FROM SITE AERIAL TOPOGRAPHIC SURVEY BY MARTINEZ CORPORATION ON 4/16/07.
6. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
7. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.

REV. NO.	DATE	DESCRIPTION

VEOLIA ENVIRONMENTAL SERVICES

Shaw® Shaw Environmental, Inc.

VEOLIA E.S. ZION LANDFILL-SITE 2 EAST EXPANSION ZION, ILLINOIS

FIGURE 2.4-1
EXISTING WATERSHED DELINEATION

DRAWN BY:	BM	APPROVED BY:	RDS	PROJ. NO.:	122150	DATE:	OCTOBER 2009

T:\AutoCAD\Projects\122150\dwg\Figures\Stormwater\watershed delineation_existing_121509.dwg 12/17/2008 11:22:01 AM CST

TABLE 2.4-8(a) DISCHARGE FOR THE 1-HOUR STORM EVENT (CFS)				
Watershed	**100-year**	**25-year**	**10-year**	**2-year**
Existing Conditions				
Bioswale Existing	0.7	0.2	0.0	0.0
East Area Existing	6.8	1.5	0.2	0.0
U1 Existing	0.4	0.1	0.0	0.0
U2 Existing	0.4	0.1	0.0	0.0
U3 Existing	0.3	0.1	0.0	0.0
Watersheds				
A1	58.9	33.8	23.1	11.6
B1	5.4	3.0	2.1	1.0
B2	7.4	4.2	2.8	1.4
B3	4.5	2.5	1.7	0.9
B4	6.0	3.5	2.3	1.1
B5	4.4	2.5	1.7	0.9
B6	3.0	1.7	1.2	0.6
B7	4.4	2.5	1.7	0.9
B8	3.0	1.7	1.2	0.6
B9	8.6	5.0	3.3	1.6
B10	6.5	3.8	2.5	1.2
B11	5.8	3.3	2.3	1.1
B12	4.2	2.4	1.6	0.8
Bioswale WS	6.1	3.6	2.4	1.1
C1	7.2	4.1	2.8	1.4
C2	7.0	4.0	2.7	1.3
C3	6.0	3.4	2.3	1.1
C4	8.0	4.6	3.0	1.5
C5	6.0	3.5	2.3	1.1
C6	8.0	4.6	3.1	1.5
D1	3.6	2.1	1.4	0.7
D2	4.2	2.4	1.6	0.8
D3	4.0	2.3	1.5	0.7
D4	10.1	5.8	3.9	1.9
D5	4.0	2.3	1.5	0.8
E1	3.7	2.1	1.4	0.7
E2	7.9	4.5	3.0	1.5
E3	14.3	8.2	5.5	2.7
F1	21.4	12.3	8.1	3.9
G1	17.5	10.0	6.9	3.4
H1	5.4	3.1	2.1	1.0
H2	6.2	3.5	2.4	1.2
H3	11.9	6.8	4.5	2.2
I1	2.1	1.2	0.8	0.4
I2	2.1	1.2	0.8	0.4
I3	6.0	3.5	2.3	1.1
I4	8.0	4.6	3.1	1.5
I5	7.0	4.0	2.7	1.4
I6	4.0	2.3	1.5	0.8
I7A	10.8	6.1	4.1	2.0
I7B	12.9	7.3	4.9	2.4
I8	6.2	3.5	2.4	1.2
I9	10.4	6.0	4.1	2.0

TABLE 2.4-8(a) DISCHARGE FOR THE 1-HOUR STORM EVENT (CFS)				
Watershed	**100-year**	**25-year**	**10-year**	**2-year**
I10	4.3	2.5	1.7	0.8
I11	4.4	2.5	1.7	0.9
I12	6.0	3.4	2.3	1.2
I13	11.2	6.4	4.4	2.2
I14	6.5	3.7	2.5	1.2
I15	8.2	4.7	3.1	1.5
I16	2.2	1.3	0.8	0.4
IWLC	71.0	38.1	24.6	10.8
J1	43.7	25.2	17.2	8.6
K1	50.5	29.1	19.8	9.9
LO1	2.0	1.2	0.8	0.4
LO2	2.1	1.2	0.8	0.4
LO3	4.2	2.4	1.6	0.8
U1	3.5	2.0	1.3	0.6
U2	4.1	2.4	1.6	0.8
U3	2.7	1.6	1.1	0.5
Undisturbed IWLC WS	64.3	34.2	21.7	9.3
Perimeter Ditches/ Bioswale/ Terrace Berm I7B				
PD-A1	58.3	33.8	23.0	11.5
PD-B1	64.6	37.4	25.4	12.8
PD-B2	90.9	52.5	35.8	18.2
PD-C1	92.3	53.7	36.6	18.7
PD-C2	110.9	63.8	43.5	22.8
PD-D1	117.6	67.5	46.2	24.2
PD-D2	51.7	28.9	19.4	9.5
PD-E1	48.4	27.2	18.2	9.0
PD-F1	20.8	11.9	7.9	3.9
PD- F2	20.7	11.7	7.9	3.8
PD-I1	71.7	41.0	28.1	14.0
PD-I2	75.1	43.2	29.3	14.6
Bioswale	6.1	3.6	2.4	1.1
Terrace Berm I7B	23.4	13.3	9.0	4.4
Downdrains (Reaches)				
R-B1	12.7	7.2	4.9	2.4
R-B2	21.6	12.2	8.3	4.1
R-B3	27.6	15.7	10.8	5.4
R-B4	34.3	19.7	13.5	6.7
R-B5	8.2	4.8	3.2	1.6
R-C1	14.2	8.0	5.5	2.7
R-C2	27.4	15.6	10.4	5.2
R-D1	3.6	2.0	1.4	0.7
R-D2	11.4	6.5	4.3	2.1
R-E1	5.4	3.1	2.1	1.0
R-E2	9.1	5.2	3.5	1.7
R-E3	14.9	8.4	5.7	2.8
R-E4	22.8	12.8	8.6	4.3
R-E5	34.7	19.5	13.1	6.4
R-I1	4.2	2.4	1.6	0.8
R-I2	18.1	10.4	6.9	3.4

TABLE 2.4-8(a) DISCHARGE FOR THE 1-HOUR STORM EVENT (CFS)				
Watershed	**100-year**	**25-year**	**10-year**	**2-year**
R-I3	23.2	13.1	8.8	4.4
R-I4	27.1	15.2	10.3	5.1
R-I5	41.6	23.6	16.2	8.0
R-I6	49.1	28.3	19.3	9.6
R-I7	66.1	37.9	25.9	12.8
R-LO1	4.0	2.3	1.5	0.8
Culverts / Stormwater Junctions				
Culvert A	58.3	33.7	23.0	11.5
Culverts D	161.2	90.0	60.5	30.0
Culvert F	20.7	11.7	7.8	3.8
Culvert LO	112.2	64.6	44.1	23.1
J-5R (Culvert D)	161.3	90.0	60.6	30.0
Stormwater Detention Basins				
Basin 3	5.8	2.9	1.6	0.8
Basin 5R	3.0	2.2	1.8	1.0
Basin 6	0.8	0.6	0.4	0.3
Regional Watersheds				
Des Plaines WS	5.8	2.9	1.6	0.8
Lake Mich. WS (includes IWLC flow not associated with the Facility)	73.7	39.7	25.8	11.4

TABLE 2.4-8(b) DISCHARGE FOR THE 24-HOUR STORM EVENT (CFS)				
Watershed	**100 year**	**25 year**	**10 year**	**2 year**
Existing Conditions				
Bioswale Existing	0.5	0.3	0.2	0.0
East Area Existing	8.4	4.0	2.3	0.7
U1 Existing	0.3	0.1	0.0	0.0
U2 Existing	0.4	0.2	0.0	0.0
U3 Existing	0.2	0.1	0.0	0.0
Watersheds				
A1	18.2	12.5	9.7	6.0
B1	1.2	0.8	0.7	0.4
B2	1.6	1.1	0.9	0.5
B3	1.2	0.8	0.7	0.4
B4	1.2	0.8	0.7	0.4
B5	1.2	0.8	0.7	0.4
B6	0.8	0.6	0.4	0.3
B7	1.2	0.8	0.7	0.4
B8	0.8	0.6	0.4	0.3
B9	1.6	1.1	0.9	0.5
B10	1.2	0.8	0.7	0.4
B11	1.6	1.1	0.9	0.5
B12	0.8	0.6	0.4	0.3
Bioswale WS	1.1	0.8	0.6	0.4

TABLE 2.4-8(b) DISCHARGE FOR THE 24-HOUR STORM EVENT (CFS)				
Watershed	**100 year**	**25 year**	**10 year**	**2 year**
C1	1.6	1.1	0.9	0.5
C2	1.6	1.1	0.9	0.5
C3	1.2	0.8	0.7	0.4
C4	1.6	1.1	0.9	0.5
C5	1.2	0.8	0.7	0.4
C6	1.6	1.1	0.9	0.5
D1	0.8	0.6	0.4	0.3
D2	0.8	0.6	0.4	0.3
D3	0.8	0.6	0.4	0.3
D4	2.0	1.4	1.1	0.7
D5	0.8	0.6	0.4	0.3
E1	0.8	0.6	0.4	0.3
E2	1.6	1.1	0.9	0.5
E3	2.9	2.0	1.5	0.9
F1	4.1	2.8	2.2	1.4
G1	4.9	3.4	2.6	1.6
H1	1.2	0.8	0.7	0.4
H2	1.2	0.8	0.7	0.4
H3	2.5	1.7	1.3	0.8
I1	0.4	0.3	0.2	0.1
I2	0.4	0.3	0.2	0.1
I3	1.2	0.8	0.7	0.4
I4	1.6	1.1	0.9	0.5
I5	2.0	1.4	1.1	0.7
I6	0.8	0.6	0.4	0.3
I7A	2.5	1.7	1.3	0.8
I7B	2.9	2.0	1.5	0.9
I8	1.6	1.1	0.9	0.5
I9	2.8	2.0	1.5	1.0
I10	1.2	0.8	0.7	0.4
I11	1.2	0.8	0.7	0.4
I12	1.6	1.1	0.9	0.5
I13	2.8	2.0	1.5	0.9
I14	1.2	0.8	0.7	0.4
I15	1.6	1.1	0.9	0.5
I16	0.4	0.3	0.2	0.1
IWLC	28.0	19.1	14.9	8.8
J1	14.1	9.7	7.5	4.6
K1	15.4	10.6	8.2	5.0
LO1	0.4	0.3	0.2	0.1
LO2	0.4	0.3	0.2	0.1
LO3	0.8	0.6	0.4	0.3
U1	0.6	0.4	0.3	0.2
U2	0.8	0.5	0.4	0.3
U3	0.5	0.4	0.3	0.2
Undisturbed IWLC WS	21.9	14.6	11.1	6.3
Perimeter Ditches/ Bioswale/ Terrace Berm I7B				
PD-A1	18.1	12.4	9.6	5.9
PD-B1	20.4	14.0	10.9	6.7
PD-B2	31.3	21.4	16.7	10.2

TABLE 2.4-8(b) DISCHARGE FOR THE 24-HOUR STORM EVENT (CFS)				
Watershed	**100 year**	**25 year**	**10 year**	**2 year**
PD-C1	32.5	22.2	17.3	10.6
PD-C2	41.3	28.3	22.1	13.5
PD-D1	44.8	30.7	23.9	14.6
PD-D2	10.9	7.6	5.9	3.6
PD-E1	10.1	7.0	5.4	3.3
PD-F1	4.1	2.8	2.2	1.3
PD- F2	4.1	2.8	2.2	1.3
PD-I1	19.0	13.1	10.2	6.3
PD-I2	20.2	14.0	10.9	6.7
Bioswale	6.7	4.1	3.5	2.6
Terrace Berm I7B	5.3	3.6	2.8	1.8
Downdrains (Reaches)				
R-B1	2.9	2.0	1.5	0.9
R-B2	5.3	3.6	2.8	1.8
R-B3	7.3	5.0	3.9	2.4
R-B4	9.3	6.4	5.0	3.1
R-B5	2.4	1.7	1.3	0.8
R-C1	3.3	2.2	1.8	1.1
R-C2	6.1	4.2	3.3	2.0
R-D1	0.8	0.6	0.4	0.3
R-D2	2.5	1.7	1.3	0.8
R-E1	1.2	0.8	0.7	0.4
R-E2	2.0	1.4	1.1	0.7
R-E3	3.3	2.2	1.8	1.1
R-E4	4.9	3.4	2.6	1.6
R-E5	7.4	5.1	3.9	2.4
R-I1	0.8	0.6	0.4	0.3
R-I2	3.7	2.5	2.0	1.2
R-I3	6.1	4.2	3.3	2.0
R-I4	6.1	4.2	3.3	2.0
R-I5	10.5	7.3	5.7	3.5
R-I6	13.0	9.0	7.0	4.3
R-I7	17.4	12.0	9.4	5.8
R-LO1	0.8	0.6	0.4	0.3
Culverts / Stormwater Junctions				
Culvert A	18.1	12.4	9.6	5.9
Culverts D	58.2	39.9	31.1	19.0
Culvert F	4.1	2.8	2.2	1.3
Culvert LO	42.1	28.8	22.5	13.7
J-5R (Culvert D)	58.2	39.9	31.1	19.0
Stormwater Detention Basins				
Basin 3	14.7	9.0	6.3	3.3
Basin 5R	4.8	3.9	3.3	2.5
Basin 6	2.6	1.0	0.8	0.6
Regional Watersheds				
Des Plaines WS	14.7	9.0	6.3	3.3
Lake Mich. WS (includes IWLC flow not associated with the Facility)	29.4	20.1	15.7	9.3

TABLE 2.4-9
STORMWATER DETENTION BASIN DESIGN HYDROLOGIC RESULTS)

Location	*Maximum Elevation [1] (ft)*				*Maximum Inflow [2] (cfs)*				*Maximum Outflow [1] (cfs)*			
	100-yr	*25-Yr*	*10-Yr*	*2-Yr*	*100-yr*	*25-Yr*	*10-Yr*	*2-Yr*	*100-yr*	*25-Yr*	*10-Yr*	*2-Yr*
Basin 3	739.8	738.5	737.8	736.9	179.0	103.8	70.8	35.6	14.7	9.0	6.3	3.3
Basin 5R	738.3	736.7	735.9	735.0	161.2	90.0	60.5	30.0	4.8	3.9	3.3	2.5
Basin 6	732.0	731.6	731.3	731.0	34.8	20.1	13.8	7.0	2.6	1.0	0.8	0.6

Notes:
1. Maximum Elevations and Maximum Outflow for 24-hour storm event from HEC-HMS.
2. Maximum Inflow is based on the HEC-HMS results for a 1 hour storm event.

Review of Release Rates to Regional Watersheds

The proposed hydraulically disturbed area draining to the Lake Michigan Watershed is 119.65 acres. This area includes all watersheds draining to Detention Basins 5R and 6, the Bioswale Watershed, and Watersheds U1, U2, and U3. Based on a maximum allowable release rate of 0.15 cfs/acre for the 100-year, 24-hour storm event and 0.04 cfs/acre for the 2-year, 24-hour storm event, the allowable release rates to the Lake Michigan Watershed are 17.9 cfs and 4.8 cfs for the 100-year, 24-hour and 2-year, 24-hour storm events, respectively.

It is noted that the flow passing through the Bioswale Channel accounts for flow discharging from Detention Basin 5R and the Bioswale Watershed. Thus, the determination of the total discharge for the hydraulically disturbed areas to the Lake Michigan Watershed is determined by adding the discharge from the Bioswale Channel, Detention Basin 6, and Watersheds U1, U2, and U3.

The proposed hydraulically disturbed area draining to the Des Plaines River Watershed is 98.44 acres. This area includes all watersheds draining to Detention Basin 3. Based on a maximum allowable release rate of 0.15 cfs/acre for the 100-year, 24-hour storm event and 0.04 cfs/acre for the 2-year, 24-hour storm event, the allowable release rates to the Des Plaines River Watershed are 14.8 cfs and 3.9 cfs for the 100-year, 24-hour and 2-year, 24-hour storm events, respectively.

The following tables summarize the release rates the the Lake Michigan and Des Plaines River Watersheds due to the proposed hydraulically disturbed areas.

TABLE 2.4-10 DISCHARGE RATES FROM PROPOSED HYDRAULICALLY DISTURBED AREAS TO REGIONAL WATERSHEDS			
Watershed	**Proposed Contributing Discharge**	**Release Rates(cfs)**	
		100-Yr, 24-Hr	**2-Yr, 24-Hr**
Lake Michigan	Bioswale (Including Basin 5R discharge and Bioswale Watershed)	6.7	2.6
	Basin 6	0.8	0.6
	U1	1.3	0.2
	U2	1.6	0.3
	U3	1.1	0.2
	Total:	11.5	3.9
	Allowable:	17.9	4.8
	Acceptable Release Rate?	Yes	Yes
Des-Plaines	Basin 3	14.7	3.3
	Total:	14.7	3.3
	Allowable:	14.8	3.9
	Acceptable Release Rate?	Yes	Yes

Comparison of Existing to Proposed Release Rates

The 100-year, 24-hour and 2-year, 24-hour storm event discharge rates for Detention Basins 3, 5, and 6 for the existing, permitted landfill design were presented in the 1995 Application. Proposed hydraulically disturbed areas that are not included in the permitted stormwater model (Bioswale, U1, U2, U3, and East Area) have been modeled to compare existing to proposed release rates, as summarized in the following table. The results indicate that the proposed model provides reduced discharge rates from existing conditions, reducing the likelihood of downstream flooding.

TABLE 2.4-11 COMPARISON OF EXISTING TO PROPOSED DISCHARGE TO REGIONAL WATERSHEDS FROM PROPOSED HYDRAULICALLY DISTURBED AREAS				
Watershed	**Condition**	**Contributing Discharge**	**Release Rates (cfs)**	
			100-Yr, 24-Hr	**2-Yr, 24-Hr**
Lake Michigan	Existing	Basin 5 (from 1995 Permit Application)	11.8	3.2
		Basin 6 (from 1995 Permit Application)	2.6	0.7
		Existing East Area	8.4	0.7
		Existing U1	0.3	0.0
		Existing U2	0.4	0.0
		Existing U3	0.2	0.0
		Existing Bioswale	0.5	0.0
		Total:	24.2	4.6
	Proposed	(See Previous Table)	11.5	3.9
Des-Plaines	Existing	Basin 3 (from 1995 Permit Application)	14.8	3.9
	Proposed	Detention Basin 3	14.7	3.3

Stormwater Controls During Cell Development

The development of the basins will be phased to correspond with development of the landfill Facility. Runoff from disturbed areas will be directed to the developed basins or temporary stormwater management structures prior to discharge. In addition, temporary berming and ditching may be incorporated to divert stormwater runoff from undeveloped areas.

Construction of the basins may be done in phases such that the stormwater will be properly managed and released. Basins 3 and 6 have already been constructed to manage stormwater run-off from the existing facility. The outfall structures will be modified once new stormwater watershed areas are directed to these basins. The Detention Basin 5R will be constructed as development in the proposed expansion begins. A temporary outlet structure will be installed at Detention Basin 5R at the location of the proposed outlet structure in the event that stormwater cannot be diverted from this area during its construction. An erosion control blanket will be used on the interior side-slope of the proposed Detention Basin 5R between normal and high water levels to minimize the potential for erosion until vegetation is established. It is noted that Detention Basins 3 and 6 both currently have established vegetation between normal and high water levels.

During cell construction and filling, additional temporary measures will be incorporated to divert stormwater away from active landfilling and liner construction areas. Prior to the start of liner construction, diversion berms and drainage ditches will be developed to prevent runoff from impacting construction areas. These perimeter features will intercept the runoff from undisturbed areas before it reaches the construction areas (disturbed areas), and the runoff will be conveyed to the landfill perimeter as practical. Any stormwater that collects within the landfill excavation will be routed to temporary stormwater collection sumps. Similarly, any rainfall which ponds on the liner and leachate collection system prior to the placement of waste will be pumped into the stormwater management system.

Once landfilling begins within a new cell, stormwater which contacts waste or collects within the leachate collection system will be treated as leachate, in accordance with the leachate management section of this Application (Section 2.3). However, temporary diversion berms will be constructed around the active landfilling areas to the extent practical in order to divert stormwater from adjacent daily, intermediate and final cover slopes before it contacts any waste, thereby preventing it from coming into contact with waste. These temporary berms will divert stormwater runoff to the perimeter collection ditches or to below grade stormwater collection sumps located within the excavation. The temporary berms will complement the permanent perimeter trenches and berms which surround the active cell and prevent excavation side slope runoff from entering the active landfilling area.

NPDES Requirements

The Veolia E.S. Zion Landfill currently has a NPDES permit for the discharge of stormwater. In accordance with the NPDES construction permit regulations, a Notice of Intent (NOI) will be submitted at least 30 days prior to the commencement of any construction activities which disturb more than one acre. An application is required to be filed for stormwater discharge associated with industrial activity at least 180 days prior to the start of landfill operation. The landfill will be subject to the requirements of general or individual NPDES permits, and these permits will outline the sampling which may be required. The existing Stormwater Pollution Prevention Plan (SWPPP) for the Veolia E.S. Zion Landfill Expansion is provided in Appendix M and will be maintained on file at the Facility in accordance with the requirements of the NPDES permits. The SWPPP will be updated as needed in conjunction with development of the proposed Expansion.

Final Grading

The final slopes are designed at a grade capable of supporting vegetation to minimize erosion. These slopes will drain runoff from the cover and prevent ponding. Vegetation will be promoted on all reconstructed surfaces to minimize wind and water erosion of the final protective cover. In addition, terrace berms will be constructed on the final landform to collect runoff and control erosion along the slopes of the landfill as shown on Drawing No. D16.

Vegetative Soil Stabilization

A grass seed mixture will be incorporated into the upper surface of the protective soil layer. The mixture selected will be amenable to the soil quality/thickness, slopes and moisture/climatological conditions that exist without the need for continued maintenance and with minimal potential for root penetration into the compacted final cover. Areas of embankment having slopes grater than or equal to 3:H:1V shall be stabilized with sod, mat, or erosion control blanket in combination with seeding.

Landscaping or seeding professionals knowledgeable of Lake County's soil and climatological conditions will be consulted in determining the specific seed mixtures, necessary soil amendments and application rates based upon specific seasonal conditions at the time of closure. Finalized areas of the landfill will be seeded as soon as practical, with seeding usually conducted in the spring or fall.

Non-Vegetative Soil Stabilization

Aggregate cover will provide soil protection for both temporary waste haul roads and non-paved permanent roads. It may also be used at the outlets of storm drains where vegetation cannot protect the soil from high water velocities. Aggregate will be placed a minimum of three inches deep as soon as final grade or temporary grade is reached for the above mentioned areas.

Erosion and Sediment Control

In addition to the foregoing, the Veolia E.S. Zion Landfill Expansion will use erosion control techniques to minimize the generation of sediment in the runoff from disturbed areas. These techniques will not only minimize sediment erosion but will improve the water quality of the stormwater runoff. These may include, but not be limited to: 1) barrier filters, 2) vegetative filters, 3) terrace berms/benches, 4) a settlement basin; 5) energy dissipaters; and 6) a vegetated bioswale.

1. *Barrier Filters*. Barrier filters are intended to filter sediment from runoff and will be used for both sheet flow and channel flow. Barrier filters will be used at a minimum along the entire length of all disturbed slopes that are being directly discharged off-site until permanent vegetation has been established and sediment control is no longer necessary. Barrier filters will also be placed at least every 300 feet along all non-vegetated ditches perpendicular to the flow. When barriers are used along property lines or at the base of slopes, they shall be installed parallel to the contours. When used around inlets, as much filter area as possible will be provided. For channel flow application, the barrier shall be extended to such a length that the ends of the barrier are higher in elevation than the top of the expected flows. Barrier filters may be made of straw bales or silt fencing. Rock check dams may be utilized within the perimeter ditches. Barrier filters will be routinely inspected in accordance with the stormwater pollution prevention plan and best management practices.

2. *Vegetative Filter*. Vegetative filters provide biological filtration to improve water quality where concentrations of sediment are high and flow velocities are relatively low. Vegetative filters may be used along drainageways or property lines. Vegetative filters may also be used on the side slopes of the detention basin to filter sediment from overland flow and within the biofilter.

3. *Terrace Berming/Benches*. Terrace berms and benches will be constructed along the landfill side slopes to intercept sheet runoff and direct it into flumes. These flumes will convey the runoff down the final sideslopes and into energy dissipator structures and then the perimeter ditches, thereby reducing the potential for erosion from sheet runoff. Terrace berms and benches will be installed at locations selected by the site engineer. Details of the proposed terrace berms are located on Drawing No. D13.

4. *Sedimentation Basins*. Stormwater runoff from disturbed areas typically contains sediment. The sediment includes soil that erodes off of earth surfaces and aggregates that accumulate on paved surfaces. Stormwater runoff from the landfill Expansion area

will be directed to one of three stormwater detention basins. These basins have been designed to remove sediment from the stormwater runoff.

The three major factors considered when estimating sediment removal are particle fall velocity (particle size and weight), rate of flow through the reservoir, and period of retention. The proposed stormwater detention basins have been designed to have a slow rate of flow through the basin and a long period of retention. The period of retention is the time it takes for water flowing into the basin to reach the outflow. The inflow and outflow have been located on opposite ends of the basin. Elongated basins have been proposed to maximize the distance between the inflow and outflow. Water flowing into the basins will displace existing water before flowing out. The use of elongated stormwater detention basins with inflow and outflow structures separated by a great distance will provide effective sediment removal conditions. The proposed Detention Basin 5R additionally utilizes a sedimentation trap that minimizes particulate matter from migrating to the basin outlets.

5. *Energy Dissipators*. At points of concentrated flow (such as where there is a quick change in elevation or a change in material use), an energy dissipater or riprap will be used to prevent erosion and scouring.

6. Discharge for the proposed Detention Basin 5R will enter a bioswale channel that contains vegetation and is designed with minimal slope to maximize time of flow concentrations, thus improving stormwater quality before discharging off-site.

Sedimentation Basin Design

The stormwater detention basins have been designed to provide significant detention times for a variety of storm flows, in order to provide sedimentation of the stormwater runoff from the landfill prior to discharge. The basins have been designed to provide sedimentation for the 100-year 24-hour storm and also the smaller, more frequent storms. They are generally rectangular in shape, with the inlet located at the opposite end of the outlet to allow for longer flow lengths and thus longer detention times. This allows for the stormwater to spend the greatest time possible in the basins and for sediment to settle to the bottom.

Inspection and Maintenance

Temporary and permanent erosion control measures will be maintained and repaired as needed to assure continued performance of their intended function. This program will consist of performance checks of facilities and grades, remedial grading, sedimentation cleaning, vegetative care and maintenance. Inspections will be completed consistent with the LCWDO requirements. A written record of inspections and maintenance will be prepared and placed in the Facility Stormwater Pollution Prevention Plan (SWPPP), which will be kept at the site.

Conclusion

The stormwater management system has been designed and is proposed to be operated in a manner that protects the public health, safety and welfare. The discharge rates will be controlled to facilitate sedimentation and prevent flooding, and will not alter the drainage conditions of off-site areas located upstream or downstream of the Facility. Stormwater will be controlled to prevent contact with waste, and stormwater which contacts waste will be contained and treated as leachate.