SKYLINE LANDFILL
CITY OF FERRIS
DALLAS AND ELLIS COUNTIES, TEXAS
TCEQ PERMIT NO. MSW 42D

PERMIT AMENDMENT APPLICATION

PART III – FACILITY INVESTIGATION AND DESIGN
ATTACHMENT C
FACILITY SURFACE WATER DRAINAGE REPORT

Prepared for

Waste Management of Texas, Inc.

April 2012

Revised August 2012

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED
PROFESSIONAL ENGINEER
8/21/2012

Prepared by

BIGGS & MATHEWS ENVIRONMENTAL
1700 Robert Road, Suite 100 • Mansfield, Texas 76063 • 817-563-1144

TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NO. F-256

TEXAS BOARD OF PROFESSIONAL GEOSCIENTISTS
FIRM REGISTRATION NO. 50222

CONTENTS

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED
PROFESSIONAL ENGINEER

8/21/2012

1 NARRATIVE

30 TAC §330.63(c) and §§330.301-330.307

The facility surface water drainage report is prepared as part of a permit application for the Skyline Landfill, consistent with 30 TAC Chapter 330. This facility surface water drainage report has been prepared consistent with the requirements of §330.63(c) and §§330.301 through 330.307. Attachment C – Facility Surface Water Drainage Report is organized to include the drainage analysis and design, flood control and analysis, and drainage system plans and details. The facility design complies with the requirements of §330.303(a)-(b) concerning the management of runon and runoff during peak discharge of a 25-year rainfall event, the prevention of off-site discharge of waste and feedstock materials, and the control of surface water discharge in and around the facility. The following is a brief description of each of the attachments.

Attachment C1 – Permit Boundary Drainage Analysis and Design

Attachment C1 is the permit boundary drainage analysis and design of the facility, which includes calculations and demonstrations consistent with the requirements of §330.63(c), and §§330.301-330.~~307~~305. This attachment includes a comparison of surface water runoff from the current permitted condition to the postdevelopment condition at each location where surface water enters or exits the permit boundary for the 25-year, 24-hour rainfall event. The current permitted condition for this evaluation is defined as the permitted landfill completion plan for the current Skyline Landfill permit boundary. The comparison between the current permitted condition and the postdeveloped condition demonstrates that the proposed expansion of the Skyline Landfill will not adversely alter the current permitted drainage patterns. In addition, this attachment includes the drainage design for the final cover system, drainage swales, chutes, perimeter channels, and detention ponds.

Attachment C2 – Flood Control Analysis

Attachment C2 is the flood control analysis, which includes calculations and demonstrations consistent with the requirements of §330.63(c)(2) and §§330.301-330.307. The flood control analysis demonstrates that the proposed expansion of the Skyline Landfill will not adversely impact the flooding conditions of the receiving channel and that the landfill footprint will not be located within the 100-year floodplain. Since the landfill footprint will not be located within the 100-year floodplain, the levees required by §330.307 are not necessary to protect the facility from a 100-year frequency flood or to otherwise prevent the washout of solid waste from the facility.

Attachment C3 – Drainage System Plans and Details

This attachment includes the permit level site plans and details for the drainage system consistent with §330.63(c) and §§330.301-330.~~307~~305.

SKYLINE LANDFILL
CITY OF FERRIS
DALLAS AND ELLIS COUNTIES, TEXAS
TCEQ PERMIT APPLICATION NO. MSW 42D

PERMIT AMENDMENT APPLICATION

PART III – FACILITY INVESTIGATION AND DESIGN
ATTACHMENT C1
PERMIT BOUNDARY DRAINAGE ANALYSIS AND DESIGN

Prepared for

Waste Management of Texas, Inc.

April 2012

Revised August 2012

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED PROFESSIONAL ENGINEER
8/21/2012

Prepared by

BIGGS & MATHEWS ENVIRONMENTAL
1700 Robert Road, Suite 100 • Mansfield, Texas 76063 • 817-563-1144

TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NO. F-256

TEXAS BOARD OF PROFESSIONAL GEOSCIENTISTS
FIRM REGISTRATION NO. 50222

CONTENTS

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED PROFESSIONAL ENGINEER
8/21/2012

CONTENTS (Continued)

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED
PROFESSIONAL ENGINEER

8/21/2012

1 INTRODUCTION

30 TAC §330.63(c) and §§330.301-330.~~307~~305

1.1 Purpose

The permit boundary drainage analysis and design is prepared as part of a permit amendment application for the Skyline Landfill and includes the demonstrations consistent with the requirements of 30 TAC Chapter 330, §330.63(c) and §§330.301-~~307~~305. The permit boundary drainage analysis and design is organized to include a narrative description of the current permitted and postdevelopment conditions, the proposed drainage system design, the erosion and sedimentation control, and a discussion of the current permitted/postdevelopment comparison at the permit boundary. Drainage calculations are included in the appendices. Drainage design plans and details are included in Attachment C3. The following is a brief description of each of the appendices.

Appendix C1-A – Current Permitted/Postdevelopment Comparison

Appendix C1-A includes drainage area maps that delineate the drainage areas that contribute surface water runon and runoff at the permit boundary and provide a summary of the peak flow rate, volume of runoff, and runoff velocity at locations along the permit boundary for the current permitted and postdevelopment conditions. Appendix C1-A also includes a table summarizing the current permitted/postdevelopment boundary analysis comparison.

Appendix C1-B – Current Permitted Hydrologic Calculations

The current permitted hydrologic and hydraulic evaluation included in Appendix C1-B represents the current permitted final closure configuration. The current permitted analysis includes delineations of drainage areas that contribute surface water runon and runoff at comparison locations along the current permit boundary.

The results of the current permitted hydrologic evaluation are provided on the current permitted boundary analysis summary, which shows the 25-year peak flow rate, volume of runoff, and runoff velocity at comparison locations along the current permit boundary.

Appendix C1-B also includes the hydrologic calculations for the 100-year storm event for the drainage areas that contribute surface water runoff to Ten Mile Creek. The purpose of the 100-year hydrologic calculations is to perform a current permitted 100-year hydraulic analysis of Ten Mile Creek, which is included in Attachment C2, Appendix C2-B. The current permitted hydraulic evaluation of Ten Mile Creek in ~~Attachment C2-B~~, Appendix C2-B references the current permitted hydrologic evaluation in Appendix C1-B.

Appendix C1-C – Postdevelopment Hydrologic Calculations

The postdevelopment hydrologic and hydraulic evaluation included in Appendix C1-C represents the proposed final closure landfill configuration. The postdevelopment analysis includes delineations of drainage areas that contribute surface water runon and runoff at comparison points along the proposed permit boundary.

The results of the postdevelopment hydrologic evaluation are provided on the postdevelopment boundary analysis summary, which shows the 25-year peak flow rate, volume of runoff, and runoff velocity at the comparison locations along the proposed permit boundary.

Appendix C1-C also includes the hydrologic calculations for the 100-year storm event for the drainage areas that contribute surface water runoff to Ten Mile Creek. The purpose of the 100-year hydrologic calculation is to perform a postdeveloped 100-year hydraulic analysis of Ten Mile Creek, which is included in Attachment C2, Appendix C2-C. The postdeveloped hydraulic evaluation of Ten Mile Creek in ~~Attachment C2-B~~, Appendix C2-C references the postdeveloped hydrologic evaluation in Appendix C1-C.

Appendix C1-D – Perimeter Drainage System Design

Appendix C1-D presents the hydraulic design of the perimeter drainage system. The perimeter drainage plan shows the locations of the perimeter drainage channels and detention ponds. The detention ponds are designed to provide the necessary storage and outlet control to mitigate impacts to the receiving channels downstream of the Skyline Landfill. The perimeter channels are designed for the 25-year, 24-hour storm event and will convey the 100-year, 24-hour storm event.

Appendix C1-E – Final Cover Drainage Structure Design

Appendix C1-E is limited to the design of the permanent final cover drainage structures (i.e., chute and swale system). The calculations demonstrate that the structures are designed to convey runoff produced from the 25-year storms, to provide erosion protection, and to minimize sediment loss from the final cover condition.

Appendix C1-F – Intermediate Cover Erosion and Sedimentation Control Plan

Appendix C1-F provides a detailed erosion and sediment control plan during the intermediate cover phase of development.

Appendix C1-G – Intermediate Cover Erosion Control Structure Design

Appendix C1-G provides the supporting documentation to evaluate and design temporary erosion and sediment control structures for the intermediate cover phase of landfill development.

2 METHODOLOGY

30 TAC §330.305(f) and §330.~~307~~305

2.1 Concepts and Methods

The hydrologic and hydraulic methods employed in this study are consistent with the TCEQ regulations. The United States Army Corps of Engineers (COE) HEC-HMS and HEC-RAS computer programs were used to compute peak flow rates and to determine water surface profiles, respectively. The Rational Method and the methods defined in the TxDOT *Hydraulic Design Manual*, October 2011, were used to design the final cover drainage system and erosion control features. Analyses of the peak flow rates, water surface profiles, and drainage design for these conditions proceeded in the following sequence:

- Maps were prepared that provided information about the surface runoff characteristics of the current permitted final cover drainage conditions and contributing drainage areas. These maps are included in Appendix C1-B.
- Surface water runoff hydrographs for the current permitted condition, including the perimeter drainage channels and detention ponds, were developed using HEC-HMS. The current permitted HEC-HMS evaluation is included in Appendix C1-B.
- Hydraulic models for the current permitted condition were developed to evaluate water surface elevations for Ten Mile Creek, which coincides with the north end of the site, under peak flow conditions using HEC-RAS. The current permitted HEC-RAS evaluation is included in Attachment C2, Appendix C2-B.
- Maps were prepared that provide information about the surface water runoff characteristics of the postdeveloped final cover drainage conditions for the expansion of the Skyline Landfill. These maps are included in Appendix C1-C.
- Surface water hydrographs for the postdeveloped condition, including the perimeter drainage channel and detention ponds, were evaluated using HEC-HMS. The postdeveloped evaluation is included in Appendix C1-C.
- Hydraulic models for the postdeveloped condition were developed to evaluate water surface elevations for Ten Mile Creek, which coincides with the north end of the site, under peak flow conditions using HEC-RAS. The postdeveloped HEC-RAS evaluation is included in Attachment C2, Appendix C2-C.
- The existing East and West Ditches (perimeter channels) were modeled using HEC-HMS and Manning's Equation. Runoff hydrographs from drainage areas that contribute surface water runoff to the perimeter drainage system were routed

through the existing East and West Ditches, which include ponds and surface water impoundments, using HEC-HMS. Peak flow rates at specific stations were taken directly from HEC-HMS. Portions of the East and West Ditches which flow as open channels unobstructed by surface water impoundments, the flow depth and velocity were calculated using the Manning's Equation. Narrative discussing the perimeter drainage system design, which includes the evaluation of the existing perimeter drainage features, is included in Appendix C1-D.

- Final cover drainage systems were evaluated for capacity and erosion loss using the Rational Method and the methods defined in the TxDOT *Hydraulic Design Manual*, October 2011. Final cover drainage systems calculations are included in Appendix C1-E.

- Intermediate cover erosion and sediment control plan and structure design were evaluated for capacity and erosion loss using the Rational Method and the methods defined in the TxDOT *Hydraulic Design Manual*, October 2011. Intermediate cover erosion and sediment control plans are included in Appendix C1-F and C1-G.

2.2 Hydrologic and Hydraulic Modeling

2.2.1 HEC-HMS

The COE HEC-HMS program was developed to simulate the surface water runoff response of a watershed. The HEC-HMS model represents a watershed as a network of hydrologic and hydraulic components. The modeling process results in the computation of stream-flow hydrographs at desired locations in the watershed. HEC-HMS v3.5 was used to perform the hydrologic modeling. The following assumptions were made as part of the hydrologic modeling process:

- Excess precipitation is distributed uniformly and with constant intensity over the watershed.

- The watershed is divided into three separate processes: loss, transform, and baseflow. Part of the precipitation falling on the land surface is lost due to infiltration and is represented with a loss method. Rainfall that does not infiltrate becomes direct runoff and moves across the watershed surface or through the upper soil horizons and eventually reaches the watershed outlet. All runoff processes are represented as pure surface routing using a transform method. Groundwater contributions to channel flow are called baseflow and are not considered due to the brief duration of the hydrologic modeling simulation.

- The Espey "10-Minute Method" was used to estimate Snyder Parameters for watershed areas within the permit boundary and off-site areas with characteristics similar to watershed areas within the permit boundary. The synthetic unit hydrographs for watershed areas outside of the permit boundary were derived by the Fort Worth Method for estimating Snyder Parameters.

2.2.2 HEC-RAS

The COE HEC-RAS program was developed to simulate one-dimensional, steady or unsteady flow, water surface profile computations of streams and hydraulic structures. The HEC-RAS model represents drainage systems as a full network of reaches representing channels, streams, or river segments that may include confluences and obstructions such as bridges, culverts, and weirs. The program uses the energy and momentum equations to determine water surface profiles. HEC-RAS v4.1.0 was used to perform the hydraulic modeling. The following assumptions were made as part of the hydraulic modeling process:

- Flow is gradually varied, except at hydraulic structures.
- Flow is one dimensional, meaning velocity components in directions other than the direction of flow are not accounted for.
- River channels have slopes less than ten percent.

2.3 Hydrologic Elements Naming Convention

The following naming convention was used in the current permitted and postdeveloped hydrologic evaluations:

CA – drainage area within the current permit boundary, current permitted condition

DA – drainage area within the proposed permit boundary, postdeveloped condition

OS – drainage area outside of the permit boundary

R – designates a reach that conveys runoff through a given drainage area (examples: R28 conveys runoff through drainage area CA28, R13.1 is one of multiple reaches that conveys runoff through drainage area CA13, R-OS09 conveys runoff through off-site drainage area OS09)

CP – comparison point where surface water runoff enters or exits the permit boundary

J – junction

POND – designates a pond (example: Pond 05 is within drainage area CA05 in the current permitted condition and within drainage area DA05 in the postdeveloped condition.)

I – designates a drainage control structure (example: I-16 is a drainage control structure within drainage area CA16 in the current permitted condition and within drainage area DA16 in the postdeveloped condition.)

3 CURRENT PERMITTED CONDITIONS

The Skyline Landfill is an existing 667-acre, Type I Municipal Solid Waste Disposal Facility operated by Waste Management of Texas, Inc. The Skyline Landfill is located in Dallas and Ellis Counties, Texas, immediately north of the City of Ferris and west of Old U.S. Highway 75 (also referred to as Business 45).

The Skyline Landfill is located along Ten Mile Creek (or Tenmile Creek), which is part of the Trinity River Basin. The northern permit boundary of the Skyline Landfill generally coincides with the centerline meanders of the channel of Ten Mile Creek. Drawing C1-A-1 is a regional drainage area map depicting the location of the Skyline Landfill and the regional drainage areas contributing stormwater runoff to Ten Mile Creek.

The current permit boundary, as shown on Drawing C1-A-2, will be used to evaluate the current permitted and postdeveloped runoff conditions. The current permitted runoff summary is shown on Drawing C1-A-2. Refer to Appendix C1-B for the current permitted hydrology calculations. Peak discharges at the comparison points along the permit boundary, as shown on Drawing C1-A-2, were determined for the current permitted condition. These peak discharges were then used to design and evaluate the postdeveloped condition.

Stormwater runoff enters Skyline Landfill at six locations along the west permit boundary. The major portion of the stormwater runoff from the Skyline Landfill enters Ten Mile Creek at ten locations along the northern permit boundary. A minor portion of the stormwater runoff exits at five locations along the southern permit boundary and flows through existing culverts under Ferris Avenue. Another minor portion of the stormwater runoff exits at four locations along the southeastern permit boundary and flows through existing culverts under the T&HC Line of the Union Pacific Railroad and Old U.S. Highway 75 (OH75). A fifth potential point is listed in Table 1 for runoff along the eastern permit boundary, however, as shown in modeling, does not receive any flow contributing to runoff. OH75.1, OH75.2, and OH75.3 represent existing culvert discharge locations east of Old U.S. Highway 75. These have been included to confirm the capacity of the culverts conveying stormwater runoff from the permit boundary under the UPR and under OH75.

The locations where stormwater enters and exits the permit boundary are further discussed below in Table 1.

Skyline Landfill
Table 1 – Current Permitted Boundary Analysis Summary

Boundary Comparison Point	25-Year Flow Rate (cfs)	25-Year Volume (ac-ft)	Runon / Runoff	Drainage Areas
Points Contributing to the Northern Boundary and into Ten Mile Creek				
CP01	66.1	11.1	Runoff	CA01 contributes directly to CP01.
CP02	15.4	1.9	Runoff	CA02 contributes directly to CP02.
CP03	5.4	0.6	Runoff	CA03 contributes directly to CP03.
CP04	479.2	97.6	Runoff	CA04, CA05, CA06, CA07, CA08, CA09, CA10, CA11, CA12, CA13, CA14, CA15, CA16, CA17.A, CA17.B, CA18, CA19, CA20.A, CA20.B, CA21.A, CA21.B, CA22.A and CA22.B contribute to CP04. CP04 has a complex drainage system that is described in the narrative.
CP05	96.9	12.1	Runoff	CA23 contributes directly to CP05. CA24 and CA25 contribute to CP05 via Pond 24. Pond 24 has a spillway elevation of 445.
CP06	112.7	18.0	Runoff	CA26 directly and CA27 routing through CA26 contribute to CP06.
CP07	161.0	61.3	Runoff	CA28 contributes directly to CP07. CA29, CA30, CA31.A, CA31.B, CA32.A, CA32.B, CA33, and CA34 contribute to CP07 via Pond 29. Pond 29 has morning glory inlet elevation of 427 and a spillway elevation of 428.
CP08	6.7	0.7	Runoff	CA35 directly contributes CP08, which sheet flows through OS03.
CP09	15.7	1.8	Runoff	CA36 contributes directly to CP09.
CP10	358.4	91.5	Runoff	CA37 directly and CA38 and CA39 routing through CA37 contribute to CP10. CP11 routed through CA37 also contributes to CP10.
CP11	254.4	75.3	Runon	OS06 contributes directly to CP11. CP12 routed through OS06 also contributes to CP11.
CP12	213.2	62.9	Runoff	CA40 contributes directly to CP12. CA41, CA42, CA43, CP13, CP14, and CP15 contribute to CP12. CA44, CA45, CA46.A, CA46.B, CA47, and CP16 contribute to CP12 via Pond 44. Pond 44 has a 24-inch culvert with headwall.
CP13	4.2	0.4	Runon	OS07.C contributes directly to CP13.
CP14	4.2	0.4	Runon	OS07.B contributes directly to CP14.
CP15	45.2	11.3	Runon	OS07.A directly and OS08 routed through OS07.A contribute to CP15.
CP16	129.4	11.4	Runon	OS09 directly and OS10 routed through OS09 contribute to CP16.

Skyline Landfill
Table 1 – Current Permitted Boundary Analysis Summary (Continued)

Boundary Comparison Point	25-Year Flow Rate (cfs)	25-Year Volume (ac-ft)	Runon / Runoff	Drainage Areas
Points Contributing to the Southern Boundary and to the Culverts under Ferris Avenue				
CP17	113.0	9.5	Runon	OS11 contributes directly to CP17.
CP18	124.8	32.4	Runoff	CA48 contributes directly to CP18, which discharges via a 48-inch culvert underneath Ferris Avenue. CA49 contributes to CP18 via two 36-inch culverts. CP17 also contributes to CP18.
CP19	14.6	1.7	Runoff	CA50 contributes directly to CP19.
CP19a	25.5	3.8	Runoff	CA50a contributes directly to CP19a.
CP20	23.2	3.4	Runoff	CA51 contributes directly to CP20.
CP21	2.7	0.3	Runoff	CA52 contributes directly to CP21.
CP22	29.6	4.4	Runoff	CA53 contributes directly to CP22.
FA	323.5	37.8	Runoff	OS12 contributes directly to FA. CP19, CP19a, CP20, CP21, and CP22 contribute to FA.
Points Contributing to the Eastern and Southeastern Boundary ~~under UPR and OH75~~and to the Culverts under the Union Pacific Railroad and Old Highway 75				
CP23	15.1	1.8	Runoff	CA54 contributes directly to CP23.
CP24	18.6	2.3	Runoff	CA55 contributes directly to CP24.
CP25	41.3	6.1	Runoff	CA56 directly contributes to CP25.
CP26	5.1	0.7	Runoff	CA57 contributes directly to CP26.
CP27*	0.0	0.0	Runoff	CA09 overflow exceeding the drop inlet capacity contributes to CP27.
OH75.1	68.3	11.9	Runoff	CA54, CA55, OS13, and OS14 contribute to OH75.1.
OH75.2	53.1	8.1	Runoff	CA56, OS15, and OS16 contribute to OH75.2.
OH75.3	24.0	2.1	Runoff	CA57, OS17, and OS18 contribute to OH75.3.

*Potential comparison point

CP04 has a complex contributing drainage system that collects runoff from most of the eastern portion of the facility. The following describes how stormwater runoff is collected and routed to CP04.

- CA04 is the drainage area that contributes directly to CP04.
- CA05 is the drainage area that contributes directly to Pond 05. Pond 05 has a spillway at elevation 412 feet. Runoff flows over the spillway and is routed through CA04 to CP04.
- CA06 is the drainage area that contributes directly to Pond 06. Pond 06 has a drop inlet at elevation 430 feet. A 48-inch culvert conveys runoff from the drop inlet to Pond 05.
- CA10 is the drainage area that contributes directly to Pond 10. Pond 10 has a spillway at elevation 430 feet. Runoff flows over the spillway into Pond 06.
- CA12 is a drainage area that includes the northern portion of the Permit 42-A area and the area south of the main entrance road. A 30-inch culvert with headwall conveys stormwater from the drop inlet to Pond 10.
- CA08 is the drainage area that contributes directly to Pond 08. Pond 08 has a drop inlet at elevation 420 feet. A 48-inch culvert conveys runoff from the drop inlet to Pond 05.
- CA09 is a drainage area located between the entrance road, existing gatehouse, and eastern permit boundary. CA09 has a drop inlet at elevation 421.5 feet. A 16-inch culvert with winged headwall conveys stormwater runoff from CA09 to Pond 08.
- CA11 is a drainage area that includes the eastern portion of the Permit 42-A area and the area up to the entrance road near the existing gatehouse. A 42-inch culvert with headwall conveys stormwater to drainage area CA08 and is routed to Pond 08.
- CA13 is drainage area that contributes directly to the east channel between the entrance road and Pond 05. Drainage areas CA14 and CA15 are final cover areas and are routed through CA13.
- CA16 is the drainage area that contributes directly to the east channel between the entrance road and the access road between the main landfill and the Permit 42-A area. Three 48-inch corrugated metal pipe culverts convey stormwater from CA16 under the entrance road, and are routed through CA13 to Pond 05. CA17 is a final cover area and is routed through CA16. CA18 is a drainage area that includes the southern portion of the Permit 42-A area and is routed through CA16.

- CA19 is the drainage area that contributes directly to the east channel south of the access road between the main landfill and the Permit 42-A area. A 48-inch concrete pipe culvert conveys stormwater under the access road and is routed through CA19. CA20 and CA21 are final cover areas and are routed through CA19. CA22 is a final cover area routed through CA21.

This concludes the description of the drainage system contributing to CP04.

4 POSTDEVELOPMENT CONDITIONS

Drawing C1-A-3 of Appendix C1-A delineates the postdevelopment drainage areas that contribute runoff to the proposed permit boundary. Peak discharges at the comparison points along the proposed permit boundary, as shown on Drawing C1-A-3, were determined for the postdevelopment condition. Refer to Appendix C1-C for postdevelopment hydrology calculations.

Stormwater runoff enters Skyline Landfill at six locations along the west permit boundary. The major portion of the stormwater runoff from the Skyline Landfill enters Ten Mile Creek at ten locations along the northern permit boundary. A minor portion of the stormwater runoff exits at five locations along the southern permit boundary and flows through existing culverts under Ferris Avenue.

The current permit boundary, which includes 666.95 acres, was reduced by 5.21 acres as a result of a gift deed from Waste Management of Texas, Inc. to Ferris Memorial Park, Inc. The proposed permit boundary includes 661.74 acres. Comparison point CP19 is on the proposed permit boundary approximately 250 feet west of CP19a, which is on the current permit boundary.

Another minor portion of the stormwater runoff exits at four locations along the southeastern permit boundary and flows through existing culverts under the T&HC Line of the Union Pacific Railroad and Old State Highway 75 (OH75). A fifth potential point is listed in Table 1 for runoff along the eastern permit boundary, however, as shown in modeling, does not receive any flow contributing to runoff. OH75.1, OH75.2, and OH75.3 represent existing culvert discharge locations east of Old U.S. Highway 75. These have been included to confirm the capacity of the culverts conveying stormwater runoff from the permit boundary under the UPR and under OH75.

The locations where stormwater enters and exits the permit boundary are further discussed below in Table 2.

Skyline Landfill
Table 2 – Postdeveloped Boundary Analysis Summary

Boundary Comparison Point	25-Year Flow Rate (cfs)	25-Year Volume (ac-ft)	Runon / Runoff	Drainage Areas
Points Contributing to the Northern Boundary and into Ten Mile Creek				
CP01	66.1	11.1	Runoff	DA01 contributes directly to CP01.
CP02	15.4	1.9	Runoff	DA02 contributes directly to CP02.
CP03	5.4	0.6	Runoff	DA03 contributes directly to CP03.
CP04	465.4	96.7	Runoff	DA04, DA05, DA06, DA07, DA08, DA09, DA10, DA11, DA12, DA13, DA14, DA15, DA16, DA17.A, DA17.B, DA18, DA19, DA20.A, DA20.B, DA21.A, DA21.B, DA22.A and DA22.B contribute to CP04. CP04 has a complex drainage system that is described in the narrative following this table.
CP05	93.7	20.1	Runoff	DA23 contributes directly to CP05. DA24, DA25, DA25A, and DA25B contribute to CP05 via Pond 24. Pond 24 has a 30-inch culvert discharge and a spillway elevation of 434.
CP06	80.0	13.6	Runoff	DA26 contributes directly to CP06.
CP07	204.6	71.9	Runoff	DA28 contributes directly to CP07. DA29, DA30A, DA30B, DA31A, and DA31B contribute to CP07 via Pond 29. Pond 29 has a 36-inch culvert discharge and a spillway elevation of 419.5. DA27, DA32A, DA32B, DA33A, DA33B, DA34A, and DA34B contribute to CP07 via Pond 27. Pond 27 has a 30-inch culvert discharge and a spillway elevation of 426.
CP08	5.4	0.6	Runoff	DA35 directly contributes to CP08.
CP09	15.0	1.6	Runoff	DA36 directly contributes to CP09.
CP10	278.9	82.9	Runoff	DA37 directly contributes to CP10. CP11 routed through CA37 also contributes to CP10.
CP11	249.2	74.1	Runon	OS06 contributes directly to CP11. CP12 routed through OS06 also contributes to CP11.
CP12	187.6	61.7	Runoff	DA40 contributes directly to CP12. DA41 and DA42 contribute to CP12. DA44, DA45, DA46.A, DA46.B, DA47, CP13, CP14, CP15, and CP16 contribute to CP12 via Pond 44. Pond 44 has a 24-inch culvert with headwall.
CP13	4.2	0.4	Runon	OS07.A directly contributes to CP13.
CP14	4.2	0.4	Runon	OS07.B directly contributes to CP14.
CP15	45.2	11.3	Runon	OS07.A directly and OS08 routed through OS07.A contribute to CP15.
CP16	129.3	11.4	Runon	OS09 directly and OS10 routed through OS09 contribute to CP16.

Skyline Landfill
Table 2 – Postdeveloped Boundary Analysis Summary (Continued)

Boundary Comparison Point	25-Year Flow Rate (cfs)	25-Year Volume (ac-ft)	Runon / Runoff	Drainage Areas
Points Contributing to the Southern Boundary and to the Culverts under Ferris Avenue				
CP17	113.0	9.5	Runon	OS11 contributes directly to CP17.
CP18	124.8	32.4	Runoff	DA48 contributes directly to CP18, which discharges via a 48-inch culvert underneath Ferris Avenue. DA49 contributes to CP18 via two 36-inch culverts. CP17 also contributes to CP18.
CP19	14.6	1.7	Runoff	DA50 directly contributes to CP19.
CP19a	25.5	3.8	Runoff	OS12a directly contributes to CP19a.
CP20	23.2	3.4	Runoff	DA51 directly contributes to CP20.
CP21	2.7	0.3	Runoff	DA52 directly contributes to CP21.
CP22	29.6	4.4	Runoff	DA53 directly contributes to CP22.
FA	323.5	37.8	Runoff	OS12 contributes directly to FA. CP19, CP19a, CP20, CP21, and CP22 contribute to FA.
Points Contributing to the Eastern and Southeastern Boundary ~~under~~ UPR and OH75 and to the Culverts under the Union Pacific Railroad and Old Highway 75				
CP23	15.1	1.8	Runoff	DA54 directly contributes to CP23.
CP24	18.6	2.3	Runoff	DA55 directly contributes to CP24.
CP25	41.3	6.1	Runoff	DA56 directly contributes to CP25.
CP26	5.1	0.7	Runoff	DA57 directly contributes to CP26.
CP27*	0.0	0.0	Runoff	DA09 overflow exceeding the drop inlet capacity contributes to CP27.
OH75.1	68.3	11.9	Runoff	DA54, DA55, OS13, and OS14 contribute to OH75.1.
OH75.2	53.1	8.1	Runoff	DA56, OS15, and OS16 contribute to OH75.2.
OH75.3	24.0	2.1	Runoff	DA57, OS17, and OS18 contribute to OH75.3.

*Potential comparison point

CP04 has a complex contributing drainage system that collects runoff from most of the eastern portion of the facility. The following describes how stormwater runoff is collected and routed to CP04.

- DA04 is the drainage area that contributes directly to CP04.

- DA05 is the drainage area that contributes directly to Pond 05. Pond 05 has a spillway at elevation 412 feet. Runoff flows over the spillway and is routed through CA04 to CP04.

- DA06 is the drainage area that contributes directly to Pond 06. Pond 06 has a drop inlet at elevation 430 feet. A 48-inch culvert conveys runoff from the drop inlet to Pond 05.

- DA10 is the drainage area that contributes directly to Pond 10. Pond 10 has a spillway at elevation 430 feet. Runoff flows over the spillway into Pond 06.

- DA12 is a drainage area that includes the northern portion of the Permit 42-A area and the area south of the main entrance road. A 30-inch culvert with headwall conveys stormwater from the drop inlet to Pond 10.

- DA08 is the drainage area that contributes directly to Pond 08. Pond 08 has a drop inlet at elevation 420 feet. A 48-inch culvert conveys runoff from the drop inlet to Pond 05.

- DA09 is a drainage area located between the entrance road, existing gatehouse, and eastern permit boundary. CA09 has a drop inlet at elevation 421.5 feet. A 16-inch culvert with winged headwall conveys stormwater runoff from DA09 to Pond 08.

- DA11 is a drainage area that includes the eastern portion of the Permit 42-A area and the area up to the entrance road near the existing gatehouse. A 42-inch culvert with headwall conveys stormwater to drainage area DA08 and is routed to Pond 08.

- DA13 is drainage area that contributes directly to the east channel between the entrance road and Pond 05. Drainage areas DA14 and DA15 are final cover areas and are routed through DA13.

- DA16 is the drainage area that contributes directly to the east channel between the entrance road and the access road between the main landfill and the Permit 42-A area. Three 48-inch corrugated metal pipe culverts convey stormwater from DA16 under the entrance road, and are routed through DA13 to Pond 05. DA17 is a final cover area and is routed through DA16. DA18 is a drainage area that includes the southern portion of the Permit 42-A area and is routed through DA16.

- DA19 is the drainage area that contributes directly to the east channel south of the access road between the main landfill and the Permit 42-A area. A 48-inch concrete pipe culvert conveys stormwater under the access road and is routed through DA19. DA20 and DA21 are final cover areas and are routed through DA19. DA22 is a final cover area routed through CA21.

This concludes the description of the drainage system contributing to CP04.

5 PROPOSED DRAINAGE SYSTEM DESIGN

30 TAC §330.63(c)(1), §330.303 and §330.305(a)–(f)

The proposed drainage system for the Skyline Landfill will consist of drainage swales, downchutes, perimeter channels, detention ponds and outlet structures.

The facility has been designed to prevent discharge of pollutants into waters in the state or waters of the United States, as defined by the Texas Water Code and the Federal Clean Water Act, respectively. WMTX has been authorized by the TCEQ to discharge stormwater runoff consistent with Texas Pollutant Discharge Elimination System (TPDES) Permit No. TXR05U147, consistent with General Permit No. TXR050000 relating to stormwater discharges associated with industrial activity. Landfills are authorized under the General Permit.

5.1 Perimeter Drainage System Design

The perimeter drainage system is designed to convey the 25-year runoff from the developed landfill consistent with TCEQ regulations. In addition, the perimeter channels have been designed to convey the runoff from a 100-year rainfall event. The perimeter channel system design calculations are referenced in Appendix C1-D. The perimeter drainage structure plans are included in Attachment C3.

The detention ponds are designed to provide the necessary storage and outlet control to mitigate impacts to the receiving channels downstream of the Skyline Landfill. Detention pond design parameters are referenced in Appendix C1-D, as included in the hydraulic modeling for postdeveloped conditions in Appendix C1-C. The detention pond details are shown in Attachment C3. The detention pond outlet structures are designed as energy dissipators to reduce the velocity and turbulence of the flow leaving the detention ponds.

5.2 Final Cover Drainage Structure Design

Stormwater runoff will be collected in swales located near the upper grade break on the landfill and on the 4:1 (horizontal to vertical) side slopes, leading to drainage letdown structures or chutes on the 4:1 side slopes and to the perimeter drainage system. The perimeter drainage system will be constructed as each sector is developed.

The final cover drainage system swales and chutes are designed to convey the 25-year peak flow rate. These swales, channels, and chutes will also reduce maintenance at the site after closure by minimizing erosion. The final cover erosion control design calculations are included in Appendix C1-E. The final cover design, showing the locations of the drainage swales, downchutes, and final cover drainage structure details, is illustrated in Appendix C1-E.

The chute/letdown structures are designed to convey the 25-year, 24-hour peak flow rate. The chutes are designed with 40-mil textured FML to minimize erosive conditions along the chute and at swale/chute confluences. There is a slope transition between the chute and perimeter road low water crossing. A hydraulic jump occurs at the chute/low water crossing transition that dissipates the energy and reduces the velocity across the perimeter road. Concrete is used at the chute/low water crossing transitions to minimize erosion. The letdown structures continue and convey stormwater into the perimeter channels or directly into the detention ponds. The letdown structures are designed using gabions or riprap to provide erosion protection at the letdown/perimeter road confluence. The gabion elevations are staggered in order to remove excess energy created down the embankment slopes at the transition with the perimeter channel or detention ponds. The chute design calculations are included in Appendix C1-E. Final cover drainage system details including the chute details are shown in Attachment C3. A typical detail of the low water crossing depicting where the chute crosses the perimeter road is also shown in Attachment C3.

5.3 Surface Water Runon Controls

Surface water from offsite drainage areas which contribute to the permit boundary is routed around the waste disposal area by the West Perimeter Ditch. Surface water drainage in and around the facility will be controlled by the perimeter drainage system described in Section 5.1 and will be prevented from entering the waste disposal area. Containment and diversion berms as described in Part III, Attachment D6, Section 3.1 through 3.4, will minimize surface water from running onto, into, and off of the treatment area.

6 EROSION AND SEDIMENTATION CONTROL

30 TAC §330.305

6.1 Final Cover Stormwater System Control Plan

Perimeter drainage channels and detention ponds will be constructed as the subsequent phased development of the landfill progresses. Erosion will be minimized in these structures by establishment of vegetation or with rock riprap, gabions, or other materials as provided for in the drainage design calculations for these permanent structures.

Swales and chutes will be constructed upon placement of the final cover. The final cover includes, among other things, an erosion layer that is a minimum of 36 inches of earthen material with the top 6 inches capable of sustaining native plant life and will be seeded with native and introduced grasses immediately following the application of final cover in order to minimize erosion. A soil loss demonstration for the erosion layer is included in Appendix C1-E of this attachment. The swales and chutes include establishment of vegetation, rock riprap, gabions, and other materials as provided in the drainage calculations for these permanent structures.

6.2 Final Cover Stormwater System Maintenance Plan

The Skyline Landfill will inspect, restore, and repair constructed permanent stormwater systems such as channels, drainage swales, chutes, and flood control structures in the event of wash-out or failure from extreme storm events. Excessive sediment will be removed, as needed, so that the drainage structures, such as the perimeter channels and detention ponds, function as designed. Site inspections by landfill personnel will be performed weekly or within 48 hours of a rainfall event of 0.5 inches or more. Documentation of the inspection will be included in the site operating record.

The following items will be evaluated during the inspections:

- Erosion of final cover areas, perimeter ditches, chutes, swales, detention ponds, berms, and other drainage features
- Settlement of final cover areas, perimeter ditches, chutes, swales, and other drainage features
- Silt and sediment build-up in perimeter ditches, chutes, swales, and detention ponds
- Obstructions in drainage features

- Presence of erosion or sediment discharge at perimeter stormwater discharge locations

- Presence of sediment discharges along the site boundary in areas that have been disturbed by site activities

Maintenance activities will be performed to correct damaged or deficient items noted during the site inspections. These activities will be performed as soon as reasonably possible after the inspection. The time frame for correction of damaged or deficient items will vary based on weather, ground conditions, and other site-specific conditions.

Maintenance activities will consist of the following, as needed:

- Placement of additional temporary or permanent vegetation

- Placement, grading, and stabilization of additional soils in eroded areas or in areas that have experienced settlement

- Replacement of riprap or other structural lining

- Placement of additional riprap in eroded areas or in areas that have experienced settlement

- Removal of obstructions from drainage features

- Removal of silt and sediment build-up ~~from drainage features~~in perimeter ditches, chutes, swales and detention ponds.

- Repairs to erosion and sedimentation controls

- Installation of additional erosion and sedimentation controls

6.3 Intermediate Cover Erosion and Sedimentation Control Plan

Erosion and sediment controls have been designed for the intermediate cover phase of landfill development. The intermediate cover erosion and sedimentation control plan includes temporary structures and establishment of vegetation to minimize erosion of the intermediate cover and documentation requirements. Refer to Appendix C1-F – Intermediate Cover Erosion and Sedimentation Control Plan, and Appendix C1-G – Intermediate Cover Erosion Control Structure Design.

6.4 Daily Cover Erosion and Sedimentation Control Plan

Erosion and sediment controls for the daily cover phase of landfill development will be consistent with the requirements of Part IV – Site Operating Plan, Section 8.18 – Landfill

Cover. Daily cover will be placed over all solid waste at the end of each operating day as required by Part IV, Section 8.18.2 – Daily Cover. The daily cover will be sloped to drain. Runoff from areas that have intact daily cover is considered uncontaminated stormwater runoff. Erosion and sediment controls for daily cover will include the following procedures:

- Areas with daily cover will be inspected daily for erosion that may cause contaminated runoff from the daily cover.
- After each rainfall event all daily cover areas will be inspected for erosion or other damage and repaired as necessary. Runoff from damaged or eroded areas will be handled as contaminated water until repairs are completed.
- Daily cover will be compacted and sloped to drain.
- Should erosion of daily cover be observed, the daily cover will be replaced so that no solid waste is exposed at the end of the operating day. In the event that additional soil stabilization or erosion control measures are deemed necessary, one or more of the following measures will be constructed: temporary sediment control fence, silt fence, swales, or filter berms.

7 CURRENT PERMITTED/POSTDEVELOPMENT COMPARISON

30 TAC §330.63(c)(1)(D)(iii) and §330.305(a)

Consistent with 30 TAC §330.63(c)(1)(D)(iii) and §330.305(a), the proposed landfill development will not adversely alter existing or permitted drainage patterns. A summary of the current permitted and postdevelopment drainage conditions analyzed is included as Drawing C1-A-2 – Current Permitted Boundary Analysis Summary and Drawing C1-A-3 – Postdeveloped Boundary Analysis Summary. Supporting calculations are presented in Appendix C1-B and C1-C. The current permitted boundary analysis to postdevelopment boundary analysis comparison is also summarized in tabular format in Appendix C1-A on page C1-A-4. As required by the regulations, a summary of drainage patterns and flows produced by the 25-year storm event is presented on the following drawings.

- Drawing C1-B-2 – Current Permitted Boundary Analysis Summary: This drawing depicts the current permitted stormwater runon and runoff locations along the permit boundary. Each location is identified with flows, velocities, and volume of runoff as appropriate in the summary table.

- Drawing C1-C-2 – Postdeveloped Boundary Analysis Summary: This drawing depicts the postdevelopment stormwater runon and runoff locations along the proposed permit boundary. Each postdevelopment discharge point is at the same location as the current permitted discharge point and is identified in the summary table.

For the postdevelopment site configuration shown on Drawing C1-C-2, the stormwater outfall locations along the proposed permit boundary remain consistent with the current permitted outfall locations shown on Drawing C1-B-2.

Comparison point CP05 has an 8 acre-feet increase in runoff volume from the current permitted condition to the postdeveloped condition. Pond 24, which discharges to CP05, is a retention pond in the current permitted condition. In the postdeveloped condition Pond 24 is a detention pond.

CP07 is the only comparison point that has an increased peak flow rate in the postdeveloped condition. The peak flow rate at CP07 was increased to maintain the regional current permitted drainage patterns for Ten Mile Creek. Decreasing the peak flow rate at CP07 increased the detention time at CP07. The increased detention time caused CP07 to still be discharging at the time of the peak flow rate for Ten Mile Creek. This resulted in a 0.01 foot increase in the 100-year water surface of Ten Mile Creek. 44 Code of Federal Regulations (CFR) 60.3(d)(3) prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard of engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge. For this reason, the peak flow rate at CP07 was increased by 43.6 cubic feet per second resulting in no increases in the 100-year water surface for Ten Mile Creek.

The current permitted and postdevelopment surface water runoff has been evaluated for the peak flow rate, volume of runoff, and velocity at each comparison point. A comparison table is included in Appendix C1-A. The increased volume of runoff at CP05 and the increased flow rate at CP07, which flows into Ten Mile Creek, has been evaluated in Attachment C2, Appendix C2-C and does not alter existing or permitted drainage patterns.

Conclusion

Given that: (1) drainage from the permit boundary or property boundary does not adversely alter the peak flow rate, velocity, or runoff volumes at the permit boundary and receiving channels, and (2) the stormwater discharge outfalls are consistent with the current permitted site configuration, except as noted, it is concluded that the proposed landfill development will not adversely alter existing or permitted drainage patterns consistent with §330.305(a).

8 CONCLUSIONS

The following conclusions summarize the results of the drainage analysis and design:

- The drainage design criteria and analyses used for these drainage calculations satisfy the requirements of 30 TAC Chapter 330.
- The final cover drainage structures (swales, chutes) are designed in accordance with the rules to convey peak flow rates from the 25-year rainfall event.
- Perimeter channels are designed in accordance with the rules for the 25-year rainfall event and will also accommodate the peak flow rate from the 100-year rainfall event.
- Detention pond capacities and outlets are designed in accordance with the rules for the 25-year rainfall event and will also accommodate the peak runoff from the 100-year rainfall event.
- Erosion will be minimized by using Best Management Practices.
- The proposed landfill development will not adversely alter existing or current permitted drainage patterns.