

WELSH POWER PLANT
ASH LANDFILL
Run-on and Run-off
Control System Plan Update

August 19, 2026

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WELSH POWER PLANT - ASH LANDFILL
Run-on and Run-off Control System Plan

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1.0 Introduction

The Welsh Power Plant has a deed recorded ash landfill (see Figure 1- Fly Ash Storage Area Phase I (WEPX-88) and Figure 2 - Current TCEQ NOR Landfill Site Development Plan). The Landfill currently receives ash materials from two 528 MW coal fired boilers. The plant annually produces fly ash, bottom ash and economizer ash. Typically, bottom and economizer ash are sluiced to the Primary Bottom Ash Pond, which was periodically dredged or excavated to remove accumulations.

Welsh Units 1 and 3 were retrofitted in 2016 to capture mercury in order to comply with EPA Mercury and Air Toxics Standard (MATS) emissions regulations. Activated carbon injection (ACI) captures the mercury and is mixed with fly ash to form an ACI byproduct, which is captured in a Pulse Jet Fabric Filter (PJFF).

The Ash Landfill has traditionally been operated in two sections, with a portion of the landfill being primarily composed of dredged bottom ash, economizer ash, and fly ash material sluiced to the ash landfill between approximately 1986 and 2000. The western portion of the Ash Landfill was previously used to reclaim ash materials for beneficial reuse, but that was discontinued in 2025. Ash sales to the construction industry have helped to extend the Ash Landfill life.

Modifications to the Ash Landfill cap, cover and dewatering systems were incorporated into an updated landfill site development plan and implemented in 2023 through 2026 (two separate efforts). These modifications were submitted to the Texas Commission on Environmental Quality (TCEQ) Industrial Hazardous Waste Permits Section and each were acknowledged by same (See Current TCEQ NOR Landfill Site Development Plan). The modifications included provisions for a revised closure cover system consisting of 18-inches of compacted soil cover in combination with the Closure Turf System (50 mil Structured geomembrane with Microdrain System on top slopes and Super Gripnet System on side slopes). In addition, a 3-feet thickness compacted clay lined Contact Storm Water Basin was constructed, complete with culvert systems, for managing contact storm water until the closure of the Landfill (anticipated in 2028 through 2030). The Contact Storm Water Basin, as shown in Figure 2 - Current TCEQ NOR Landfill Site Development Plan, is outside the boundaries of the landfill and within the boundaries of the Primary Bottom Ash Pond.

30 TAC 352.811 (and by reference 40 CFR 257.81) requires that the owner or operator of an existing or new landfill or any lateral expansion of a landfill used for Coal Combustion Residuals (CCR) must comply with the following:

- Design, construct, operate, and maintain:
    - A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.
    - A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

- Run-off from the active portion of the CCR unit must be handled in accordance with the associated surface water requirements.
- Prepare initial and periodic run-on and run-off control system plans for the CCR unit according to the following timeframes:
    - For existing CCR landfills, the owner or operator of the CCR unit must prepare the initial run-on and run-off control system plan no later than October 17, 2016.
    - The owner or operator of the CCR unit must prepare periodic run-on and run-off control system plans every five (5) years.
- Obtain a certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of this section.
- Comply with the recordkeeping requirements specified in 30 TAC 352.1301, the notification requirements specified in 30 TAC 352.1311, and the Publicly Accessible Website requirements specified in 30 TAC 352.1321.

This Run-on and Run-off Control System Plan presents the regulatory-required materials as noted above for the Welsh Ash Landfill. Though design of permanent run-on and run-off control measures were prepared for the Welsh Ash Landfill in the previously submitted/approved design modifications, this Run-on and Run-off Control System Plan addresses a combination of both interim and permanent systems which are hereafter described.

2.0 Run-on Controls

Run-on Controls are provided and accomplished for the interim condition of the Welsh Ash Landfill by a combination of perimeter grading conditions and interim/permanent perimeter drainage systems. The design and function of these systems are as follows:

2.1 Perimeter Grading Conditions

As shown in Figure 1 – Fly Ash Storage Area Phase I (WEPX-88), the Welsh Ash Landfill was constructed with a screen dike on the entire west, north and east sides with drainage culverts located on the north and the southeast areas. A berm of minimal length was constructed on the eastern side of the south boundary. The net effect of this original construction is a perimeter grading condition that is an average of fifteen feet above the surrounding area. As a result of this perimeter grading condition and the hydraulic and hydrological conditions demonstrated in perimeter drainage systems hereafter, a run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm has been in place from the outset.

2.2 Interim & Permanent Perimeter Drainage Systems

As shown in Figure 2 – Current TCEQ NOR Site Development Plan, the future condition of the Welsh Ash Landfill provides for a perimeter drainage system consisting of varying depth perimeter drainage systems (ditches). These perimeter drainage systems are designed as both a run-on and run-off control system to prevent flow onto or away from the active portion of the landfill during the peak discharge from a 24-hour, 25-year storm (Design Event).

In the interim condition, as shown in Figure 3 – Composite Existing Conditions (Merged Field & LiDAR Topography) and the associated Figure 4 – Existing & Proposed Condition - Drainage Area Map, interim/permanent perimeter drainage systems have been provided. Due to the revised closure cover system (Closure Turf System), currently the Run-on and Run-off Control System includes only interim components of the perimeter drainage systems, other than culverts. These perimeter ditches are designed to prevent flow onto the active portion of the landfill during the peak discharge from the Design Event.

2.3 Summary of Design Requirements & Justifications

Both Table 1 – Drainage Area Summaries and Table 2 – Q25 Run-on and Run-off Analysis Justifications with Backup Hydrological & Hydraulic Studies (and supporting design calculations), as contained in Appendix 2, provide a summary of hydraulic and hydrologic capacity of the interim run-on/run-off control system. These analyses demonstrate that, in all instances, the currently implemented (and maintained) drainage system functions to control run-on for the peak discharge from a 24-hour, 25-year storm.

3.0 Run-off Control Systems

Run-off Controls are provided and accomplished for the interim condition of the Welsh Ash Landfill by a combination of perimeter grading conditions and interim/permanent perimeter drainage systems. The design, operation and maintenance of these perimeter drainage systems provide for conveyance of all 24-hour, 25-year storm run-off from within the Welsh Landfill either to culverts in the Northeast and Northwest corners of the landfill, for non-contact runoff, or to the Contact Stormwater Basin, for contact runoff. The design and function of these systems are summarized as follows:

3.1 Perimeter Grading Conditions

As previously noted, the original construction resulted in a perimeter grading condition that is an average of fifteen feet above the surrounding area. Currently, in below grade areas of the landfill, all of the originally constructed dikes have been removed and are currently being replaced with permanent compacted clay stability dikes. As a result of this perimeter grading condition and the hydraulic and hydrological conditions demonstrated in perimeter drainage systems hereafter, a run-off control system is in place to prevent flow away from the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.

3.2 Interim Top Slope Diversion Berms and Swales

Due to proximity to interim perimeter drainage systems, all top slopes currently require either stability dikes or top slope containment berms to ensure contact runoff is managed within the landfill. As shown in Figure 3 – Composite Existing Conditions (Merged Field & LiDAR Topography) and the associated Figure 4 –Drainage Area Map, these drainage features are configured with the purpose of preventing run-off from the adjacent perimeter drainage areas during a 24-hour, 25-year storm event.

3.3 Interim Side Slope Terraces and Letdowns

Currently the Run-on and Run-off Control System includes earthen side slope terraces and HDPE geomembrane letdowns along a portion of the east and northeast sides of the Welsh Ash Landfill. The future side slopes of the landfill will extend at a 3H:1V slope to a height of approximately 75-feet above the flowline of the perimeter drainage systems (ditch). These systems or similar will be extended as the landfill continues to fill and will eventually be replaced with the Closure Turf System, over the grading plan as shown in Figure 2 – Current Site Development Plan.

3.4 Perimeter Drainage Systems

As shown in Figure 2 – Current Site Development Plan, the future condition of the Welsh Ash Landfill provides for a perimeter drainage system consisting of varying depth perimeter drainage systems (ditches). These perimeter ditches are designed as both a run-on and run-off control system to prevent flow onto or away from the active portion of the landfill during the peak discharge from a 24-hour, 25-year storm (Design Event).

In the interim condition, as shown in Figure 3 – Composite Existing Conditions (Merged Field & LiDAR Topography) and the associated Figure 4 –Drainage Area Map, some of these perimeter drainage systems (ditches) have been provided in the interim. Currently the Run-on and Run-off Control System includes only interim components of the perimeter drainage systems. These interim perimeter ditches are designed to likewise prevent flow onto the active portion of the landfill during the peak discharge from the Design Event.

3.5 Culvert Systems

Permanent Culvert Systems, designed to control run-on and run-off equal to or greater than the 25-year, 24-hour design storm event and conveying same either to the Contact Storm Water Basin or the Primary Basin Canal, north of the landfill are in place per Figure 2 – Current Site Development Plan.

3.6 Low Water Crossing System

The run-on and run-off designs provide for portions of storm water run-off to be routed south via a low water crossing. This low water crossing is comprised of a textured reinforced concrete trapezoidal broadcrest section, 10-feet wide by 2.76’ deep with 12H:1V side slopes and a -1.1% slope along the flowline. The crossing is sized and configured for “in excess of” the 25-year, 24-hour storm event for future landfill sideslope, terraces and letdowns.

At present, this low water crossing is blocked by perimeter berms to ensure that contact stormwater is routed to the culverts serving the Contact Storm Water Basin.

3.7 Contact Stormwater Basin

The Contact Stormwater Basin is designed to contain and allow gravity settling of stormwater runoff from the active (uncovered) portions of the landfill where CCR materials are being placed. It was generally designed to be able to hold the runoff from two consecutive 25-year storms from the largest active area of the landfill. Since it is outside of the Landfill footprint, the operation of this basin is not otherwise addressed.

3.8 Summary of Design Requirements & Justifications

Both Table 1 – Drainage Area Summaries and Table 2 – Q25 Run-on and Run-off Analysis Justifications With Backup Hydrological & Hydraulic Studies (and supporting design calculations), as contained in Appendix 2, provide a summary of hydraulic and hydrologic capacity of the interim run-on/run-off control system. These analyses demonstrate that, in all instances, the currently implemented (and maintained) drainage system functions to control run-off for the peak discharge from a 24-hour, 25-year storm.

4.0 Summary of Requirements, Justifications and Conclusions

As previously stated, 30-TAC 352.811 (and by reference Federal Regulation Title 40, Part 257.81) requires the owner or operator of an existing or new landfill or any lateral expansion of a landfill used for Coal Combustion Residuals (CCR) to comply with design, construction, operation, maintenance, certification and recordkeeping requirements that are summarized as follows:

- Design, construct, operate, and maintain:
    - A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.
    - A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.
- Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under 30 TAC 352.2.
- Prepare initial and periodic run-on and run-off control system plans for the CCR unit according to the following timeframes:
    - For existing CCR landfills, the owner or operator of the CCR unit must prepare the initial run-on and run-off control system plan no later than October 17, 2016.
    - The owner or operator of the CCR unit must prepare periodic run-on and run-off control system plans every five (5) years.
- Obtain a certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of this section.
- Comply with the recordkeeping requirements specified in 30 TAC 352.1310, the notification requirements specified in 30 TAC 352.1311, and the Publicly Accessible Website requirements specified in 30 TAC 352.1321.

Both Table 1 – Drainage Area Summaries and Table 2 – Q25 Run-on and Run-off Analysis Justifications With Backup Hydrological & Hydraulic Studies (and supporting design calculations), as contained in Appendix 2, provide a summary of hydraulic and hydrologic capacity of the interim run-on/run-off control system. These analyses demonstrate that, in all instances, the currently implemented (and maintained) drainage system functions to control both run-off and run-on for the peak discharge from a 24-hour, 25-year storm.

5.0 Plan Review and Changes in Welsh Ash Landfill Configuration

Landfill Owner and/or Operator will review and evaluate this Plan every five (5) years from initial plan preparation and when there are changes in the facility design, construction, operation, or maintenance that materially affect the facility's potential for run-on and run-off control. Amendments to the Plan made to address changes of this nature are referred to as technical or major amendments, and must be certified by a P.E.. Non-technical amendments can be performed by the facility owner and/or operator. Non-technical amendments include the following:

Technical and administrative amendments to the Plan will be documented on the Plan Review Log. Owner/Operator will make the necessary revisions to the Plan as soon as possible, but no later than six months after the change occurs. The Plan must be implemented as soon as possible following a technical amendment, but no later than six months from the date of the amendment. The Designated Person is responsible for initiating and coordinating revisions to the Spill Prevention, Control, and Countermeasure (SPCC) Plan.

Scheduled reviews and Plan amendments will be recorded in the Plan Review Log provided in Appendix 3. The log will be completed even if no amendment is made to the Plan as a result of the review.

6.0 Professional Engineer Certification

The original plan and all reviews and amended plans must obtain certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of TAC 352.811 (and by reference 40 CFR 257.81). This certification in no way relieves the owner or operator of the facility of his/her duty to fully implement this Plan. The Profession Engineer Certification page is provided in Appendix 4.

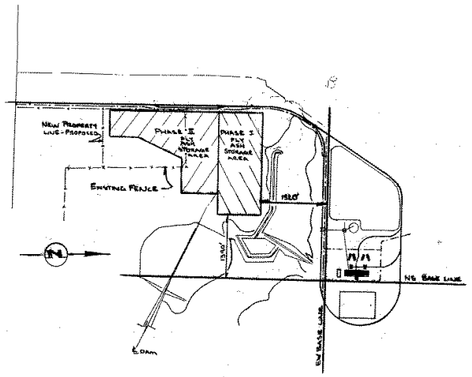
Appendix 1: Figures

Figure 1 – Fly Ash Storage Area Phase I (WEPX-88)

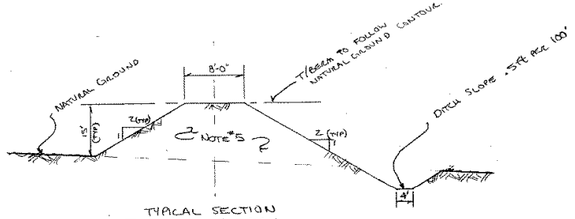
Figure 2 – Current TCEQ NOR Site Development Plan

Figure 3 – Composite Existing Conditions (Merged Field & LiDAR Topography

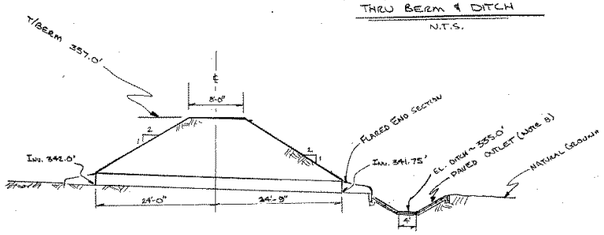
Figure 4 – Existing & Proposed Condition - Drainage Area Map



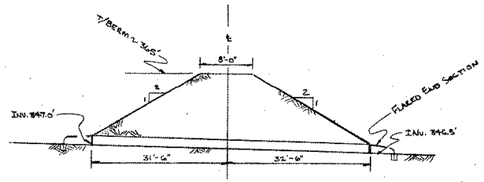
PLAN



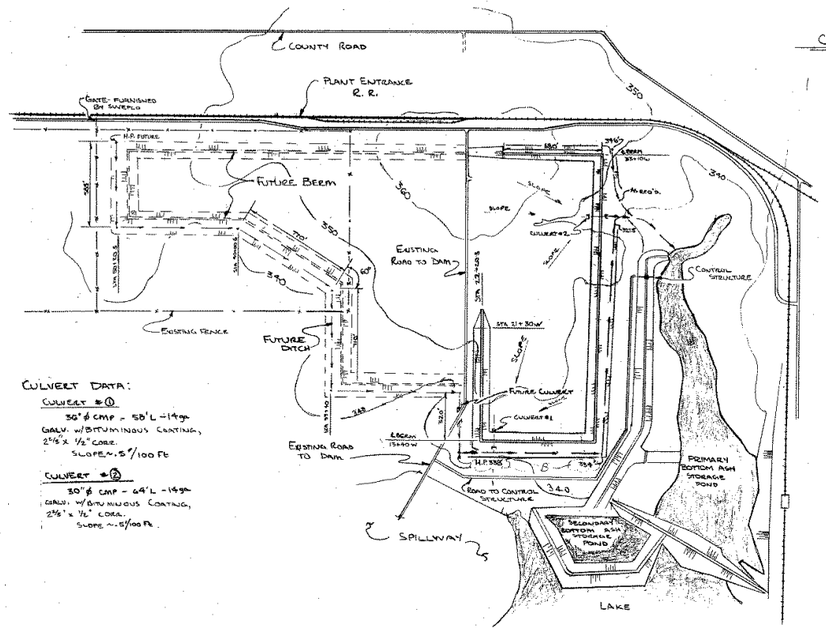
TYPICAL SECTION THRU BERM & DITCH
N.T.S.



SECTION THRU CULVERT # 1
N.T.S.



SECTION THRU CULVERT # 2
N.T.S.



ENLARGED PLAN
1" = 400'

CULVERT DATA:

CULVERT #①
30" ϕ CMP - 58'L - 14ga
GALV. W/BITUMINOUS COATING, 2⅔" x ½" CORR.
SLOPE ~.5%/100 FT

CULVERT #②
30" ϕ CMP - 69'L - 14ga
GALV. W/BITUMINOUS COATING, 2⅔" x ½" CORR.
SLOPE ~.5%/100 FT.

NOTES:

1) PHASE I FLY ASH STORAGE AREA CONSTRUCTION WILL INCLUDE CONSTRUCTION OF BERM AND DRAINAGE DITCH AS SHOWN ON THIS DRAWING. NO WORK WILL BE DONE AT THIS TIME ON PHASE II.
2) ENTIRE AREA UNDER BERM SHALL BE STRIPPED, GRUBBED AND ALL UNSUITABLE MATERIAL ENCOUNTERED SHALL BE WASTED IN SPECIFIED AREAS.
3) ALL TOPSOIL SHALL BE STOCKPILED AS DIRECTED BY FIELD ENGINEERS.
4) EMBANKMENT SHALL BE CONSTRUCTED FROM SUITABLE MATERIAL EXCAVATED FROM DITCH CONSTRUCTION AND FROM WITHIN STORAGE AREA.
5) EMBANKMENT SHALL BE 90% MODIFIED PROCTOR COMPACTION IN ACCORDANCE W/ S&L STD. 17194.
6) ALL SLOPES SHALL BE TOPSOILED AND SEEDED UPON COMPLETION OF WORK.
7) CULVERTS SHALL BE FURNISHED AND INSTALLED BY EARTHWORK CONTRACTOR. BEDDING AND BACKFILLING SHALL BE IN ACCORDANCE WITH MANUFACTURERS SPECS.
8) OUTLET OF CULVERT #1 SHALL HAVE CONCRETE SLOPE PROTECTION OF 4" SLAB W/ 6"x 6" #6 MESH. BANKS OF DITCH SHALL BE PAVED FOR 10FT EITHER SIDE OF CULVERT ℄.

EXHIBIT A

REV.	DATE	BY	SUBJECT
B	1/3/77	AM	GEN. REVISION, ADD CULVERT #2, REVISE CHANNEL PER SURVEY.
A	9/6/76	AM	REVISE DITCH WIDTH TO 4'
	8/4/76	AM	FOR CONSTRUCTION

WELSH POWER PLANT - UNIT 1
FLY ASH STORAGE AREA
PHASE I

SOUTHWESTERN ELECTRIC POWER CO.
POWER CONSTRUCTION DEPARTMENT
DIVISION

APPROVED ENGR. IN CHARGE
APPROVED DIV. SUPT.
APPROVED CHIEF ENGR.

SHEET
DRWN. BY MELSON
TRAC. BY
DATE: 12-3-76
SCALE: As Noted
WORK ORDER
DRWG. NO. WEPX-88
FILE

Figure 1- Fly Ash Storage Area Phase I (WEPX-88)

NOTES:
1. TYPE A TERRACES/DOWNCHUTES ARE SHOWN; HOWEVER, TYPE B TERRACES/DOWNCHUTES WILL BE USED. SEE DRAWING 30230 & 30231.
2. FILL SEQUENCE IS FROM EAST TO WEST, WITH A SLOPE OF 1% TO 2% MAINTAINED TO DRAIN PLACED CCR ASH TO CONTACT STORMWATER DISCHARGE LOCATION.
3. FINAL GRADING PLAN WILL BE ADJUSTED ON THE WEST END OF LANDFILL TO ADDRESS VARIATIONS IN CCR MATERIALS REMOVED FROM PBAP AND OTHER.
4. COMPLETE COORDINATE FILES WILL BE SUPPLIED TO THE CONTRACTOR FOR STAKEOUT ALL CONSTRUCTION COMPONENTS.

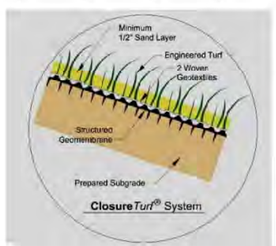
STATE OF TEXAS
ROBERT H. MURRAY
59111
REGISTERED
PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY ROBERT H. MURRAY, P.E. 59111 ON 09/25/24. ALTERATION OF A SEALED DOCUMENT WITHOUT PRIOR NOTIFICATION TO THE RESPONSIBLE ENGINEER IS AN OFFENSE UNDER THE TEXAS ENGINEERING PRACTICE ACT.

NOTES:
1. ALL TERRACES AND DOWNCHUTES SHOWN THIS DRAWING ARE "TYPE A".
2. FOR DETAILS REGARDING PERIMETER DRAINAGE CHANNELS/DITCHES, SIDESLOPE TERRACES, AND TOPSLOPE BERMS, SEE DRAWING 300230.

LEGEND
- TOE OF DITCH/SLOPE
- TOP OF BANK
- 345 PROPOSED CONTOUR INT.
- 342 EXISTING CONTOUR INT.
- 350.0 SPOT ELEVATION
- SURVEY CONTROL POINT
- POWER POLE
- GUY WIRE
- MONITOR WELL
- CULVERT
- LANDFILL LEGAL EXTENT
- F M PROPOSED FORCE MAIN
- F M EXISTING FORCE MAIN
- E EXISTING OH ELECTRIC
- U E PROPOSED UG ELECTRIC
- ANCHOR TRENCH
- DRAINAGE DIRECTION
- SUMP/CLEANOUT

GRAPHIC SCALE 1"=100'
0 100



CLOSURE TURF SYSTEM REQUIREMENTS:
1. THE STRUCTURED GEOMEMBRANE FOR ALL SLOPES LESS THAN 3H:1V (TOPSLOPE CLOSURE TURF SYSTEM) SHALL BE THE MICROSPIKE SYSTEM.
2. THE STRUCTURED GEOMEMBRANE FOR ALL SLOPES EQUAL TO OR STEEPER THAN 3H:1V (SIDESLOPE CLOSURE TURF SYSTEM) SHALL BE THE SUPER GRIPNET SYSTEM.
3. TRANSITION BETWEEN SYSTEMS WILL BE AT THE TOPSLOPE ANCHOR TRENCH

CLOSURE TURF SYSTEM REQUIREMENTS (CONT):
4. THE STRUCTURED GEOMEMBRANES FOR THE TOPSLOPE CLOSURETURF SYSTEM SHALL BE NOMINAL 40 MIL PLACED OVER 18-IN COMPACTED SOIL LAYER.
5. THE STRUCTURED GEOMEMBRANES FOR THE SIDESLOPE CLOSURETURF SYSTEM SHALL BE NOMINAL 50 MIL PLACED OVER 18-IN COMPACTED SOIL LAYER.
6. ALL INFILL SHALL BE 0.5-INCH THICK NOMINAL EXCEPT WHERE HYDROBINDER (OR EQUAL) IS SPECIFIED.

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

AS SHOWN

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AR FIRM NO. 100
MTG 2023

REVISIONS

Scale: AS SHOWN
Drawn By: R. H. MURRAY
Checked By: STAFF
File No.:

CLOSURE COVER GRADING PLAN W/ CONTROLS

WELSH ASH LANDFILL PHASE 2 CONSTRUCTION

Drawing Date: 09/25/2024
Project Number: 237008
Drawing Number: 30228

E:\2023 Projects\237008 AEP Welsh Landfill Phase 2\AEP Welsh Landfill Reviews Final Grading & Wtr\237008 Design 24 Revised Grading Plan 01.pro
Thu, Apr 24, 2025 9:07AM

Figure 2 - Current TCEQ NOR Site Development Plan

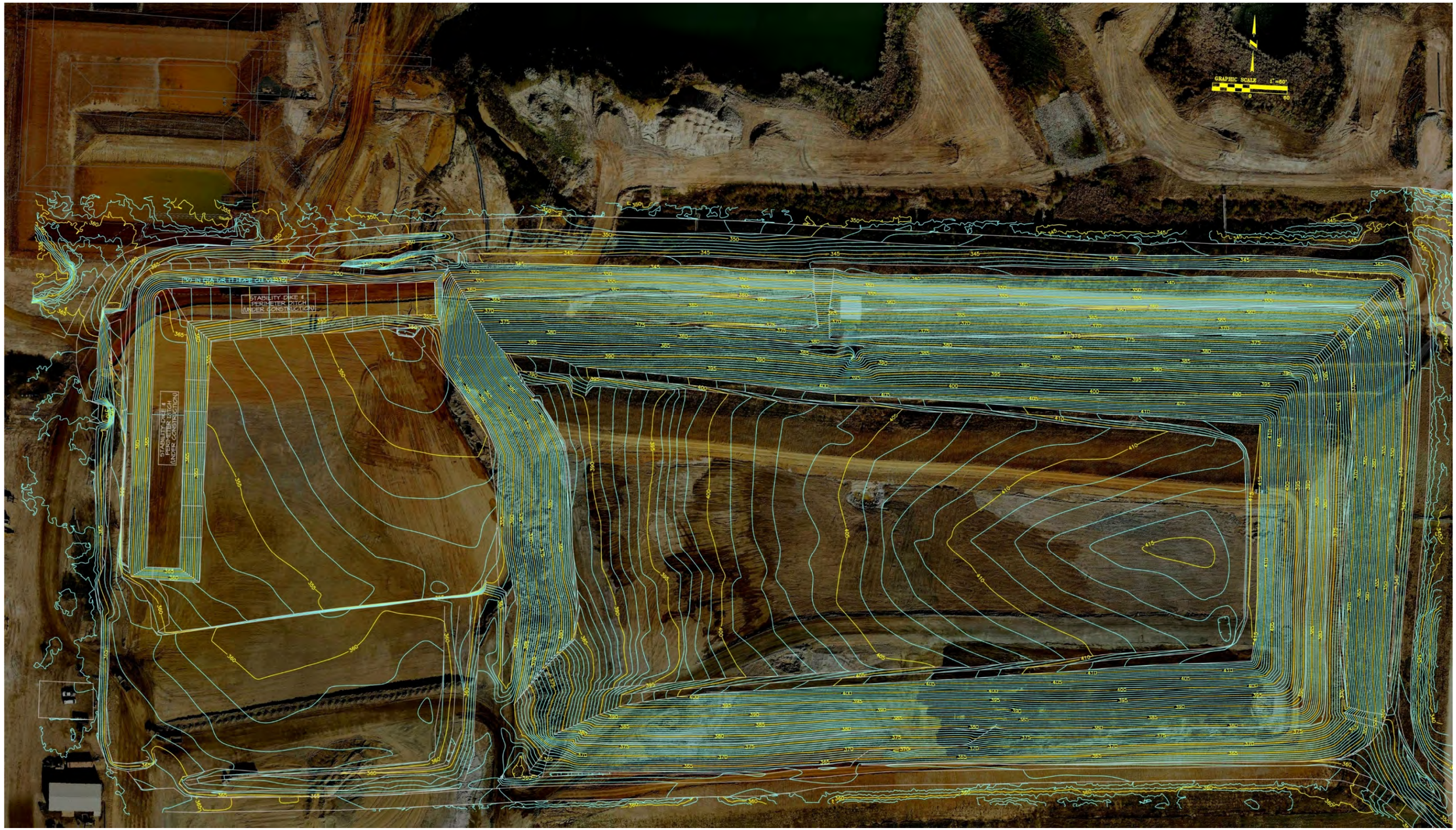


Figure 3 - Composite Existing Conditions (Merged Field & LiDAR Topography)

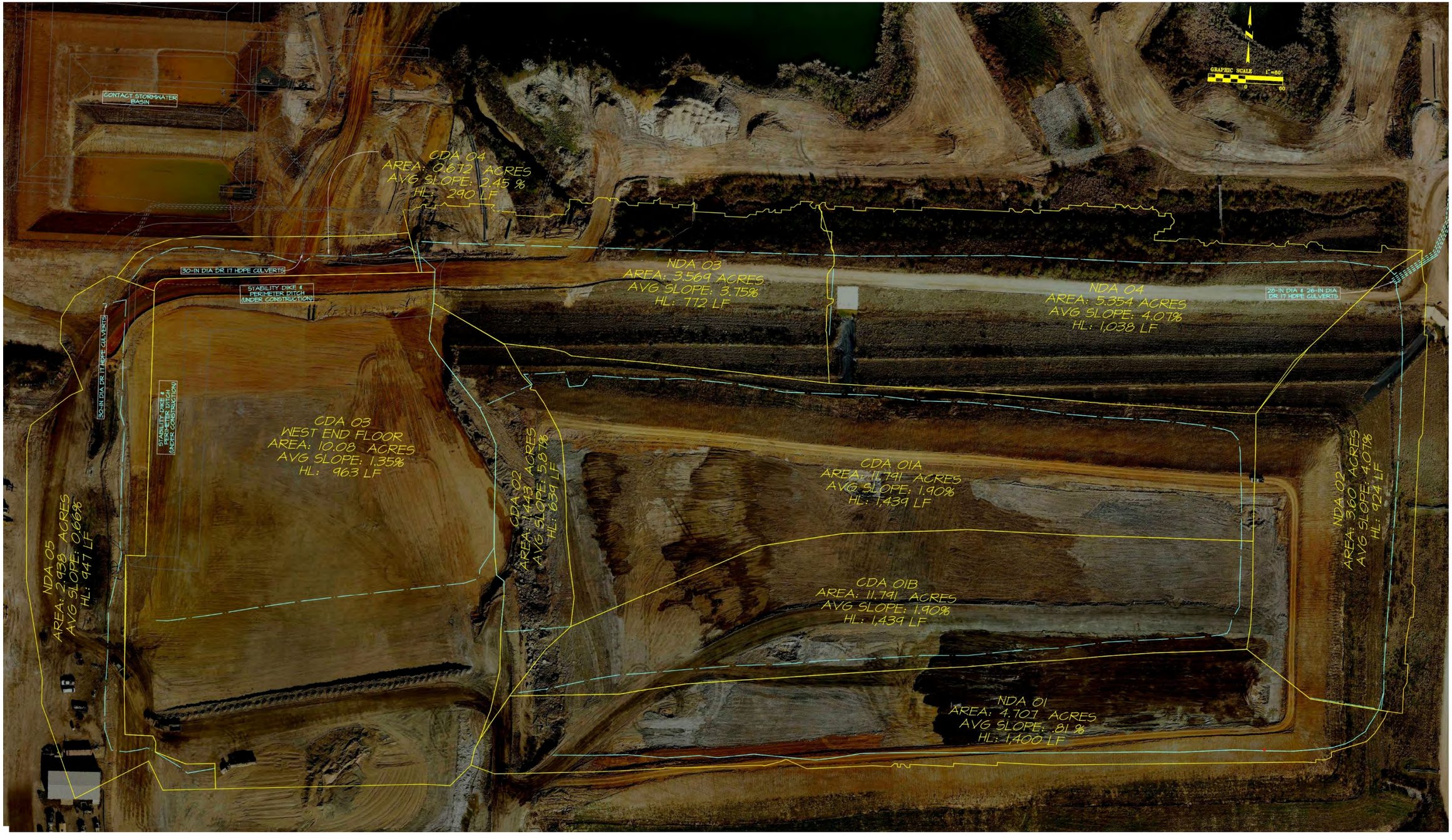


Figure 4 – Existing & Proposed Conditions - Drainage Area Map

Appendix 2: Tables

Table 1 – Drainage Area Summaries

Table 2 – Q25 Run-on and Run-off Analysis Justifications*

(*With Backup Hydrological & Hydraulic Study)

DRAINAGE AREA SUMMARIES

DRAINAGE AREA ID	DISCHARGE STATUS	DRAINAGE AREA LOCATION	AREA (ACRES)	SLOPE (%)	HYDRAULIC LENGTH (FEET)	RATIONAL C FACTOR	CALCULATED TC (MIN)	USED TC (MIN)	CALCULATED Q25 RUNOFF (CFS)
CDA 01A	CONTACT	LANDFILL INTERIOR	6.805	1.90%	1,439	0.40	9.7	9.7	24.6
CDA 01B	CONTACT	LANDFILL INTERIOR	4.986	3.95%	1,235	0.40	3.4	5.0	22.6
CDA 02	CONTACT	LANDFILL INTERIOR	1.443	5.87%	639	0.40	3.4	N/A	N/A
CDA 03	CONTACT	LANDFILL INTERIOR	10.080	1.35%	963	0.40	8.1	N/A	N/A
CDA 01 - 03	CONTACT	LANDFILL INTERIOR	23.314	3.64%	1,838	0.40	10.0	10.0	83.4
CDA 04	CONTACT	LANDFILL INTERIOR	0.612	2.45%	290	0.40	2.6	N/A	N/A
CDA 01 - 04	**CONTACT**	**LANDFILL INTERIOR**	**23.926**	**3.33%**	**2,010**	**0.40**	**10.1**	**10.1**	**85.2**
NDA 01	NON-CONTACT	LANDFILL PERIMETER DITCH	4.707	0.81%	1,400	0.50	13.2	13.2	18.7
NDA 02	NON-CONTACT	LANDFILL PERIMETER DITCH	3.600	4.07%	924	0.50	5.1	N/A	N/A
NDA 01 - 02	NON-CONTACT	LANDFILL PERIMETER DITCH	8.307	1.05%	2,050	0.50	16.0	16.0	30.0
NDA 03	NON-CONTACT	LANDFILL PERIMETER DITCH	3.569	3.75%	772	0.50	4.5	5.0	20.2
NDA 04	NON-CONTACT	LANDFILL PERIMETER DITCH	5.354	4.07%	1,038	0.50	5.6	N/A	N/A
NDA 03 - 04	NON-CONTACT	LANDFILL PERIMETER DITCH	8.923	1.40%	1,630	0.50	11.8	11.8	37.2
NDA 01 - 04	**NON-CONTACT**	**LANDFILL PERIMETER DITCH**	**17.230**	**1.05%**	**2,050**	**0.50**	**16.0**	**16.0**	**62.3**
NDA 05	NON-CONTACT	LANDFILL PERIMETER DITCH	2.938	0.68%	947	0.50	10.4	10.4	12.9

Table 1 – Drainage Area Summaries

Q-25 RUN-ON/RUN-OFF ANALYSIS JUSTIFICATIONS

ANALYSIS ID	JUSTIFICATION ANALYSIS DRAINAGE AREAS INCLUDED	DRAINAGE STATUS	ANALYSIS TYPE	ANALYSIS AREA (ACRES)	ANALYSIS SLOPE (%)	BASIN SLOPE (%)	HYDRAULIC LENGTH (FEET)	ANALYSIS C FACTOR	ANALYSIS TC (MIN)	REQUIRED Q25 CAPACITY (CFS)	ANALYSIS JUSTIFICATION CONFIGURATION	AVAILABLE DEPTH (FT)	ANALYSIS DEPTH (FT)
INTERNAL CONTACT DRAINAGE RUNOFF													
I-01	CDA 01A	CONTACT	TOP SLOPE PERIMETER BERM/SWALE	6.805	1.25%	1.90%	1,439	0.40	9.70	27.09	1.25% along 2:1 Berm & 1.8% (55:1) Topslope	2.50	0.54
I-02	CDA 01B	CONTACT	TOP SLOPE PERIMETER BERM/SWALE	4.986	1.99%	3.95%	1,235	0.40	3.36	22.6	1.1% along 2:1 Berm & 3% (33:1) Topslope	2.00	0.65
I-03	CDA 01 - 03	CONTACT	INTERNAL BERMED BASIN (PUMP & CHANNEL)	23.314	3.64%	3.64%	1,838	0.40	10.00	83.4	BASIN ATTENUATES & ROUTES Q25 FROM 83.4 CFS TO 12.38 CFS W/ 0.12-FT OVERFLOW	N/A 2.00	N/A 0.12
I-04	CDA 01 - 04	CONTACT	PERIMETER DITCH & CULVERT TO CSWB	23.926	3.33%	3.33%	2,010	0.40	10.1	85.2	CULVERTS ANALYSIS	6.71	4.68
PERIMETER NON-CONTACT RUNOFF													
P-01	NDA 01	NON-CONTACT	PERIMETER DITCH & GRASSED SIDE SLOPES	4.707		0.81%	1,400	0.50	13.20	18.7	DRAINAGE DITCH ANALYSIS	2.50	1.65
P-02	NDA 01 - 02	NON-CONTACT	PERIMETER DITCH & GRASSED SIDE SLOPES	8.307	1.05%	2,050	0.50	16.00	30	DRAINAGE DITCH ANALYSIS	4.00	1.97	
P-03	NDA 03	NON-CONTACT	PERIMETER DITCH & GRASSED SIDE SLOPES	3.569	3.75%	772	0.50	5.00	20.2	DRAINAGE DITCH ANALYSIS	7.70	0.54	
P-04	NDA 03 - 04	NON-CONTACT	PERIMETER DITCH & GRASSED SIDE SLOPES	8.923	1.40%	1,630	0.50	11.8	37.2	DRAINAGE DITCH ANALYSIS	6.50	0.92	
P-05	NDA 01 - 04	NON-CONTACT	PERIMETER DITCH & GRASSED SIDE SLOPES	17.230	1.05%	2,050	0.50	16.0	62.3	CULVERTS ROUTING ATTENUATED ANALYSIS	7.00	1.44	
P-06	NDA 05	NON-CONTACT	PERIMETER DITCH & GRASSED SIDE SLOPES TO CULVERTS OUTFALL	2.938	0.68%	947	0.50	10.4	12.9	DRAINAGE DITCH ANALYSIS CULVERTS ANALYSIS			

Table 2 - Q25 Run-on and Run-off Analysis Justifications

HYDRAULIC AND HYDROLOGICAL ANALYSIS

INTERNAL LANDFILL CONTACT STORM WATER RUNOFF &

PERIMETER NON-CONTACT STORM WATER RUNOFF

Analysis Justification – Section I-01 Perimeter Berm & Topslope
1.25% along 2:1 Berm & 1.8% Topslope, 2.5-feet minimum depth available,
Manning N Value = 0.024 (compacted bottom ash)

HYDROLOGIC REPORT - SUMMARY OF PEAK FLOW RATES

--
BASIN: CDA 01A
ID: NORTH TOP OF LANDFILL

AREA	=	6.80
AVERAGE BASIN SLOPE	=	1.90
HYDRAULIC LENGTH	=	1439.00
TIME OF CONCENTRATION	=	9.70
BASIN C FACTOR	=	0.40

Given

- Drainage Area = **11.791 acres**
- Hydraulic Length (L) = **1,439 ft**
- Average Slope (S) = **1.90% = 0.019 ft/ft**

Kirpich Equation (U.S. customary units)

$$T_c = 0.0078 L^{0.77} S^{-0.385}$$

where:

- T_c = time of concentration (minutes)
- L = hydraulic length (ft)
- S = watershed slope (ft/ft)

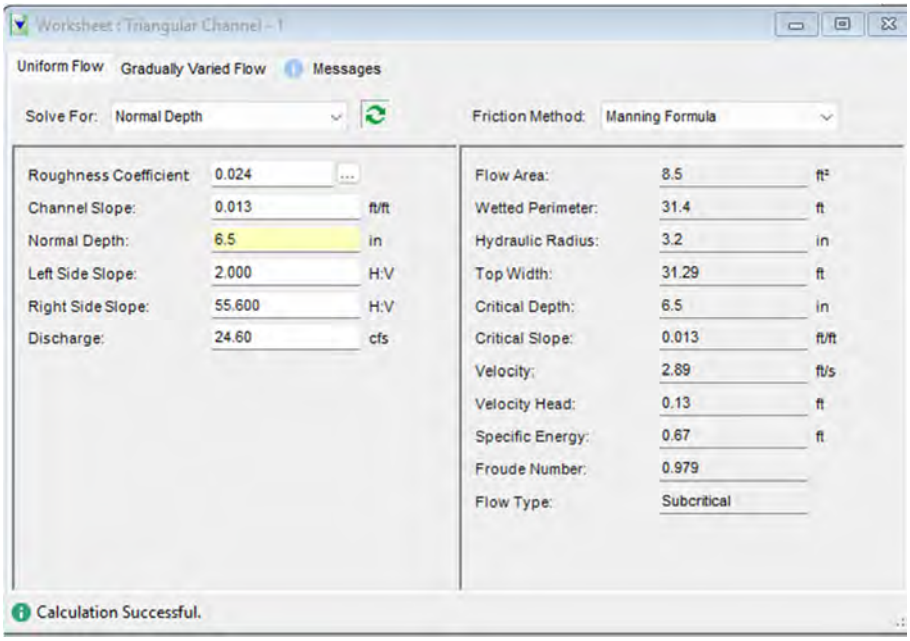
Calculation

$$T_c = 0.0078(1439)^{0.77}(0.019)^{-0.385}$$

$$T_c \approx 9.69 \text{ minutes}$$

Frequency (years)	Pre-developed Peak Q (cfs)	By-pass area Peak Q (cfs)	Developed Peak Q (cfs)	Allowable peak Peak Q (cfs)
2	15.1	0.0	15.1	15.1
5	14.7	0.0	14.7	14.7
10	21.6	0.0	21.6	21.6
25	**24.6**	**0.0**	**24.6**	**24.6**
50	27.2	0.0	27.2	27.2
100	29.9	0.0	29.9	29.9

Bentley FlowMaster Channel Analysis



Calculated Normal Depth .54-feet – Meets Q-25 requirement

Analysis Justification – Section I-01 Perimeter Berm & Topslope

1.1% along 2:1 Berm & 3% Topslope, 2-feet minimum depth available, Manning N Value = 0.024 (compacted bottom ash)

HYDROLOGIC REPORT - SUMMARY OF PEAK FLOW RATES

BASIN: CDA 01B
ID: SOUTH TOP OF LANDFILL

AREA	=	4.99
AVERAGE BASIN SLOPE	=	3.95
HYDRAULIC LENGTH	=	1235.00
TIME OF CONCENTRATION	=	5.00
BASIN C FACTOR	=	0.40

Given

- Drainage Area: 1.443 acres
- Hydraulic Length (L): 639 ft
- Average Slope (S): 5.87% = 0.0587 ft/ft

Kirpich Equation

$$T_c = 0.0078 L^{0.77} S^{-0.385}$$

where:

- T_c = time of concentration (minutes)
- L = hydraulic flow length (ft)
- S = average watershed slope (ft/ft)

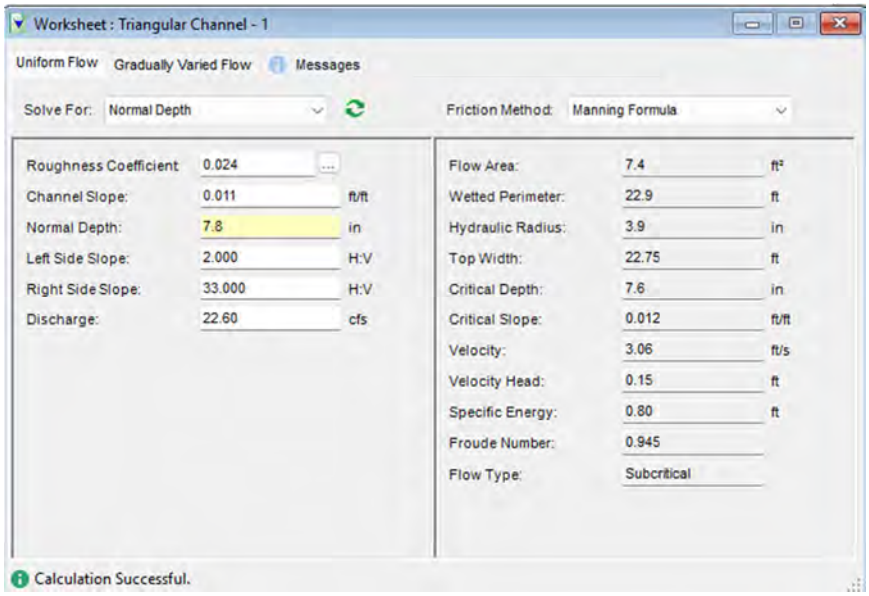
Calculation

$$T_c = 0.0078(639)^{0.77}(0.0587)^{-0.385}$$

$$T_c \approx 3.36 \text{ minutes}$$

Frequency (years)	Pre-developed Peak Q (cfs)	By-pass area Peak Q (cfs)	Developed Peak Q (cfs)	Allowable peak Peak Q (cfs)
2	14.1	0.0	14.1	14.1
5	13.5	0.0	13.5	13.5
10	19.8	0.0	19.8	19.8
25	**22.6**	**0.0**	**22.6**	**22.6**
50	24.9	0.0	24.9	24.9
100	27.4	0.0	27.4	27.4

Bentley FlowMaster Channel Analysis



Calculated Normal Depth .65-feet – Meets Q-25 requirement

Analysis Justification – Section I-03
Basin Attenuates & Routes Q25 via Pump
And Broadcrest Weir at Berm

HYDROLOGIC REPORT - SUMMARY OF PEAK FLOW RATES

BASIN: CDA 01-03
ID: WEST LINED/BERMED CATCH BASIN: CDA 01-03

AREA	=	23.31
AVERAGE BASIN SLOPE	=	3.64
HYDRAULIC LENGTH	=	1838.00
TIME OF CONCENTRATION	=	10.00
BASIN C FACTOR	=	0.40

Frequency (years)	Pre-developed Peak Q (cfs)	By-pass area Peak Q (cfs)	Developed Peak Q (cfs)	Allowable peak Peak Q (cfs)
2	51.0	0.0	51.0	51.0
5	49.6	0.0	49.6	49.6
10	73.0	0.0	73.0	73.0
25	**83.4**	**0.0**	**83.4**	**83.4**
50	92.2	0.0	92.2	92.2
100	101.3	0.0	101.3	101.3

HYDROLOGIC REPORT - STAGE, STORAGE, AND DISCHARGE

WEST LINED/BERMED CATCH BASIN: CDA 01-03

1=USER DEFINED

1)	**347.000 - 351.00**	**Pump Flow**	**Q = 2.79 cfs**
12)	**351.160**	Q 13.09 cfs	**Broadcrest Weir + Pump Flow**
13)	351.270	Q 68.89 cfs	"
14)	351.500	Q 134.49 cfs	"
15)	351.670	Q 219.79 cfs	"
16)	351.830	Q 324.79 cfs	"
17)	352.000	Q 449.89 cfs	"
18)	352.170	Q 595.69 cfs	"
19)	352.330	Q 762.59 cfs	"
20)	352.500	Q 951.49 cfs	"
21)	352.670	Q 1162.99 cfs	"
22)	352.830	Q 1397.69 cfs	"
23)	353.000	Q 1656.59 cfs	"
24)	**353.170**	Q 1940.19 cfs	"

ELEV	STORAGE (CU.FT.)	OUTFLOW (CFS)	2S/T+O (CFS)
347.00	0.0	2.8	2.8
347.17	41.1	2.8	3.1
347.33	82.3	2.8	3.3
347.50	123.4	2.8	3.6
347.67	400.8	2.8	5.5
347.83	678.2	2.8	7.3
348.00	955.6	2.8	9.2
348.17	1955.8	2.8	15.8
348.33	2956.0	2.8	22.5
348.50	3956.2	2.8	29.2
348.67	5982.3	2.8	42.7
348.83	8008.4	2.8	56.2
349.00	10034.5	2.8	69.7
349.17	13237.1	2.8	91.0
349.33	16439.7	2.8	112.4
349.50	19642.3	2.8	133.7
349.67	24438.6	2.8	165.7
349.83	29234.9	2.8	197.7
350.00	34031.2	2.8	229.7
350.17	40737.6	2.8	274.4
350.33	47444.1	2.8	319.1
350.50	54150.5	2.8	363.8
350.67	62819.0	2.8	421.6
350.83	71487.5	2.8	479.4
351.00	80156.0	2.8	537.2
351.17	90893.5	16.5	622.4
351.33	101631.1	87.0	764.5
351.50	112368.6	134.5	883.6
351.67	125338.4	218.1	1053.7
351.83	138308.3	327.2	1249.3
352.00	151278.1	449.9	1458.4
352.17	166554.7	592.8	1703.2
352.33	181831.4	766.3	1978.5
352.50	197108.0	951.5	2265.5
352.67	215137.8	1158.8	2593.1
352.83	233167.7	1402.8	2957.2
353.00	251197.5	1656.6	3331.2
353.05	257986.9	1745.6	3465.5
353.11	264776.3	1834.5	3599.7
353.16	271565.7	1923.5	3733.9

HYDROGRAPH BASIN ROUTING
WEST LINED/BERMED CATCH BASIN: CDA 01-03
25 YEAR STORM FREQUENCY

5.00	0.0	41.7	0.0	0.0	41.7	2.8	38.9
10.00	41.7	83.4	38.9	2.8	161.2	2.8	158.4
15.00	83.4	60.1	158.4	2.8	299.1	2.8	296.3
20.00	60.1	36.9	296.3	2.8	390.6	2.8	387.8
25.00	36.9	30.2	387.8	2.8	452.2	2.8	449.4
30.00	30.2	23.5	449.4	2.8	500.3	2.8	497.5
35.00	23.5	20.4	497.5	2.8	538.6	3.0	535.6
40.00	20.4	17.3	535.6	3.0	570.4	8.1	562.2
45.00	17.3	15.5	562.2	8.1	587.0	10.8	576.2
50.00	15.5	13.7	576.2	10.8	594.7	12.0	582.6
55.00	13.7	12.6	582.6	12.0	596.9	12.4	584.5
60.00	12.6	11.5	584.5	12.4	596.2	12.3	584.0
65.00	11.5	10.5	584.0	12.3	593.7	11.9	581.8
70.00	10.5	9.5	581.8	11.9	589.9	11.3	578.7
75.00	9.5	9.0	578.7	11.3	586.0	10.6	575.4
80.00	9.0	8.6	575.4	10.6	582.4	10.0	572.3
85.00	8.6	8.3	572.3	10.0	579.1	9.5	569.6
90.00	8.3	7.9	569.6	9.5	576.2	9.1	567.2
95.00	7.9	4.0	567.2	9.1	570.0	8.1	562.0
100.00	4.0	0.0	562.0	8.1	557.9	6.1	551.7
105.00	0.0	0.0	551.7	6.1	545.6	4.1	541.5
110.00	0.0	0.0	541.5	4.1	537.3	2.8	534.5
115.00	0.0	0.0	534.5	2.8	531.7	2.8	528.9
120.00	0.0	0.0	528.9	2.8	526.1	2.8	523.3
125.00	0.0	0.0	523.3	2.8	520.5	2.8	517.8
130.00	0.0	0.0	517.8	2.8	515.0	2.8	512.2
135.00	0.0	0.0	512.2	2.8	509.4	2.8	506.6
140.00	0.0	0.0	506.6	2.8	503.8	2.8	501.0
145.00	0.0	0.0	501.0	2.8	498.2	2.8	495.4
150.00	0.0	0.0	495.4	2.8	492.6	2.8	489.9
155.00	0.0	0.0	489.9	2.8	487.1	2.8	484.3
160.00	0.0	0.0	484.3	2.8	481.5	2.8	478.7
165.00	0.0	0.0	478.7	2.8	475.9	2.8	473.1
170.00	0.0	0.0	473.1	2.8	470.3	2.8	467.5
175.00	0.0	0.0	467.5	2.8	464.7	2.8	462.0
180.00	0.0	0.0	462.0	2.8	459.2	2.8	456.4
185.00	0.0	0.0	456.4	2.8	453.6	2.8	450.8
190.00	0.0	0.0	450.8	2.8	448.0	2.8	445.2
195.00	0.0	0.0	445.2	2.8	442.4	2.8	439.6
200.00	0.0	0.0	439.6	2.8	436.8	2.8	434.1

TIME TO PEAK = 0.92 HOURS
MAXIMUM OUTFLOW = 12.38 CFS
MAXIMUM STORAGE = 87682 CU FT
MAXIMUM ELEVATION = 351.12 FT
INFLOW VOLUME = 127406 CU FT
OUTFLOW VOLUME = 62717 CU FT

HYDROLOGIC REPORT - SUMMARY OF PEAK FLOW RATES

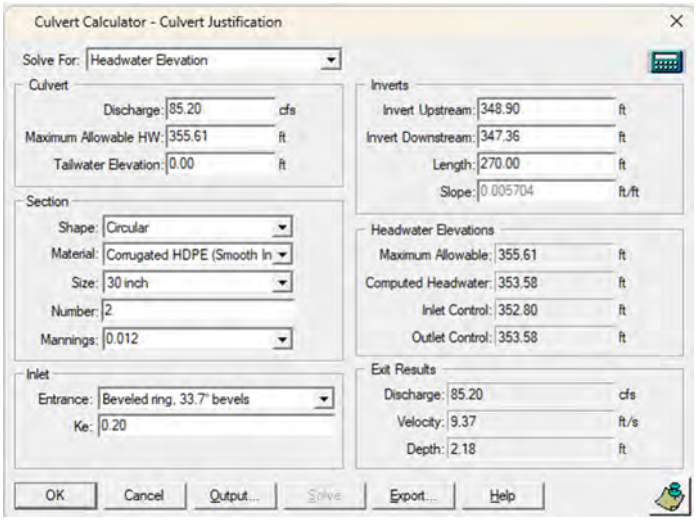
BASIN: CDA 01-04

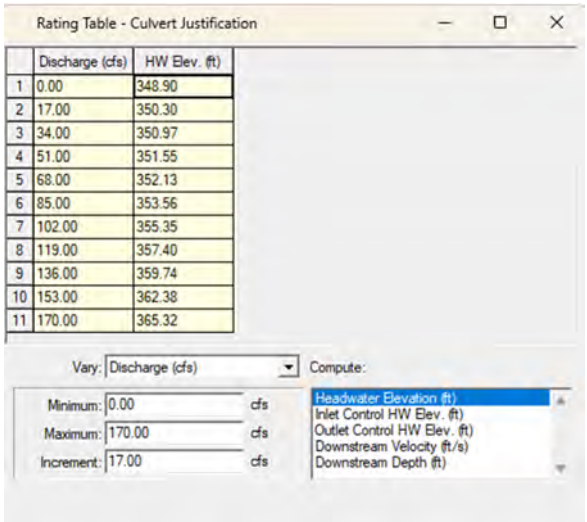
ID: TOTAL CONTACT WATER RUNOFF FROM LANDFILL – DISCHARGING THROUGH TWO 30-IN TWO 30-IN DIA X 270-FT DR 17 HDPE CULVERTS

AREA	=	23.93
AVERAGE BASIN SLOPE	=	3.33
HYDRAULIC LENGTH	=	2010.00
TIME OF CONCENTRATION	=	10.10
BASIN C FACTOR	=	0.40

Frequency (years)	Pre-developed Peak Q (cfs)	By-pass area Peak Q (cfs)	Developed Peak Q (cfs)	Allowable peak Peak Q (cfs)
2	52.1	0.0	52.1	52.1
5	50.7	0.0	50.7	50.7
10	74.6	0.0	74.6	74.6
25	**85.2**	**0.0**	**85.2**	**85.2**
50	94.3	0.0	94.3	94.3
100	103.5	0.0	103.5	103.5

Bentley CulvertMaster Analysis





Analysis Justification – Section P-01 Ditch
0.3% V-Ditch, 3:1 Sides, 2.5-feet minimum depth available,
Manning N Value = 0l03 (grassed)

```
HYDROLOGIC REPORT - SUMMARY OF PEAK FLOW RATES
-----------------------------------------------
BASIN: NDA 01
   ID: NON-CONTACT RUNOFF

   AREA                    =       4.71
   AVERAGE BASIN SLOPE     =       0.81
   HYDRAULIC LENGTH        =    1400.00
   TIME OF CONCENTRATION   =      13.20
   BASIN C FACTOR          =       0.50
```

Given

- **Drainage Area:** 4.707 acres
- **Hydraulic Length (L):** 1,400 ft
- **Average Slope (S):** 0.81% = 0.0081 ft/ft

Kirpich Equation

$$T_c = 0.0078 L^{0.77} S^{-0.385}$$

where:

- T_c = time of concentration (minutes)
- L = hydraulic flow length (ft)
- S = average watershed slope (ft/ft)

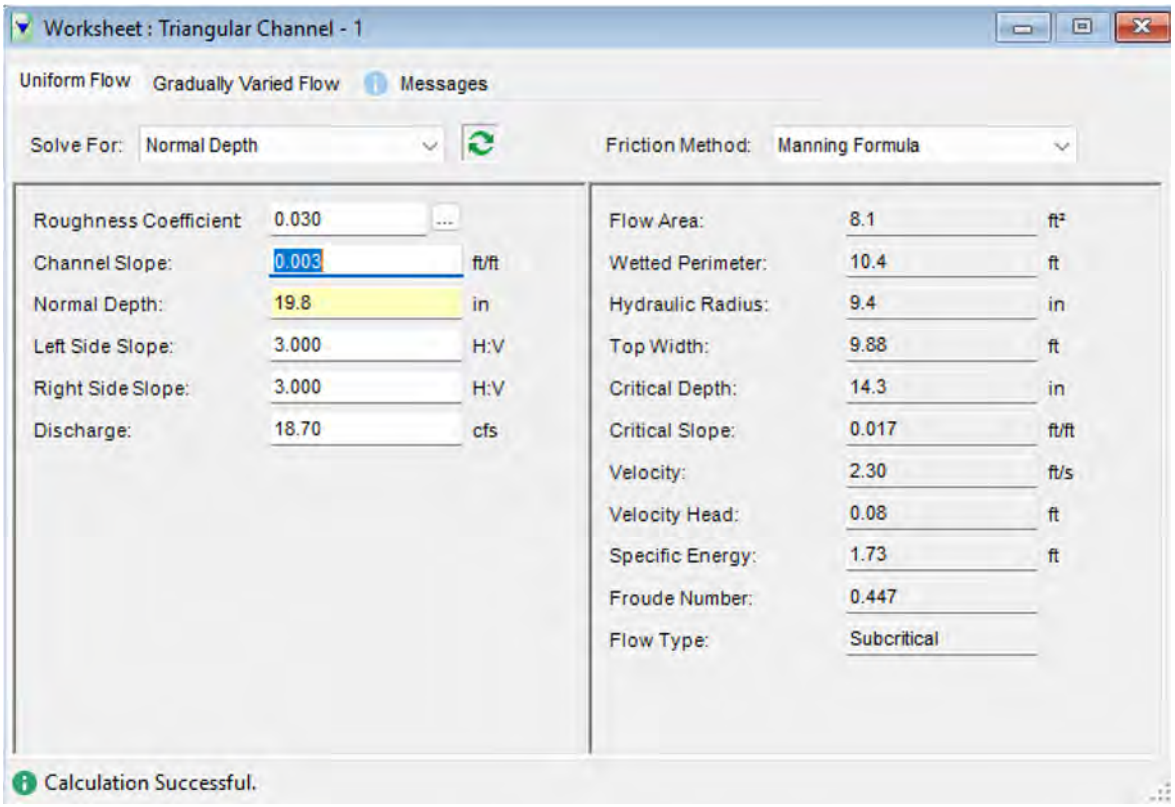
Calculation

$$T_c = 0.0078(1400)^{0.77}(0.0081)^{-0.385}$$

$$T_c \approx 13.2 \text{ minutes}$$

```
HYDROLOGIC REPORT - SUMMARY OF PEAK FLOW RATES
Frequency  Pre-developed  By-pass area  Developed     Allowable peak
(years)    Peak Q (cfs)   Peak Q (cfs)  Peak Q (cfs)  Peak Q (cfs)
-------------------------------------------------------------------
BASIN: NDA 01  ID: NON-CONTACT RUNOFF
     2           11.3           0.0          11.3          11.3
     5           11.1           0.0          11.1          11.1
    10           16.3           0.0          16.3          16.3
    25           18.7           0.0          18.7          18.7
    50           20.7           0.0          20.7          20.7
   100           22.7           0.0          22.7          22.7
```

Bentley FlowMaster Channel Analysis



Calculated Normal Depth 19.8-inches (1.65-feet) calculated – Meets Q-25 requirement

Analysis Justification – Section P-02 Ditch
0.3% V-Ditch, 3:1 Sides, 4.0-feet minimum depth available,
Manning N Value = 0.03 (grassed)

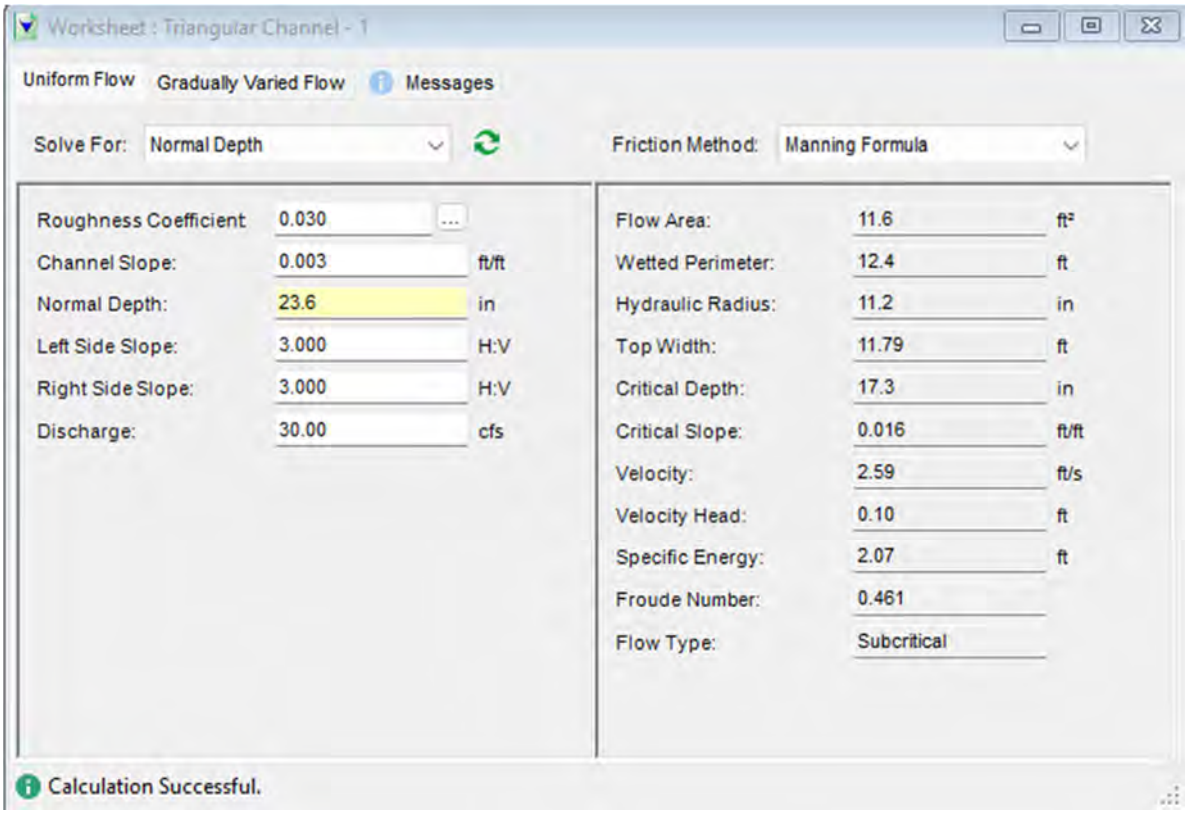
HYDROLOGIC REPORT - SUMMARY OF PEAK FLOW RATES

BASIN: NDA 01 - 02

ID: LANDFILL PERIMETER DITCH IN 02
AREA = 8.31
AVERAGE BASIN SLOPE = 1.05
HYDRAULIC LENGTH = 2050.00
TIME OF CONCENTRATION = 16.00
BASIN C FACTOR = 0.50

Frequency (years)	Pre-developed Peak Q (cfs)	By-pass area Peak Q (cfs)	Developed Peak Q (cfs)	Allowable peak Peak Q (cfs)
2	18.1	0.0	18.1	18.1
5	17.7	0.0	17.7	17.7
10	26.3	0.0	26.3	26.3
25	**30.0**	**0.0**	**30.0**	**30.0**
50	33.3	0.0	33.3	33.3
100	36.6	0.0	36.6	36.6

Bentley FlowMaster Channel Analysis



Calculated Normal Depth 23.6-inches (1.97-feet) calculated – Meets Q-25 requirement

Analysis Justification – Section P-03 Channel
20-ft Wide, 0.3% Channel, 3:1 Sides, 7.7-feet minimum depth available,
Manning N Value = 0.03 (grassed)

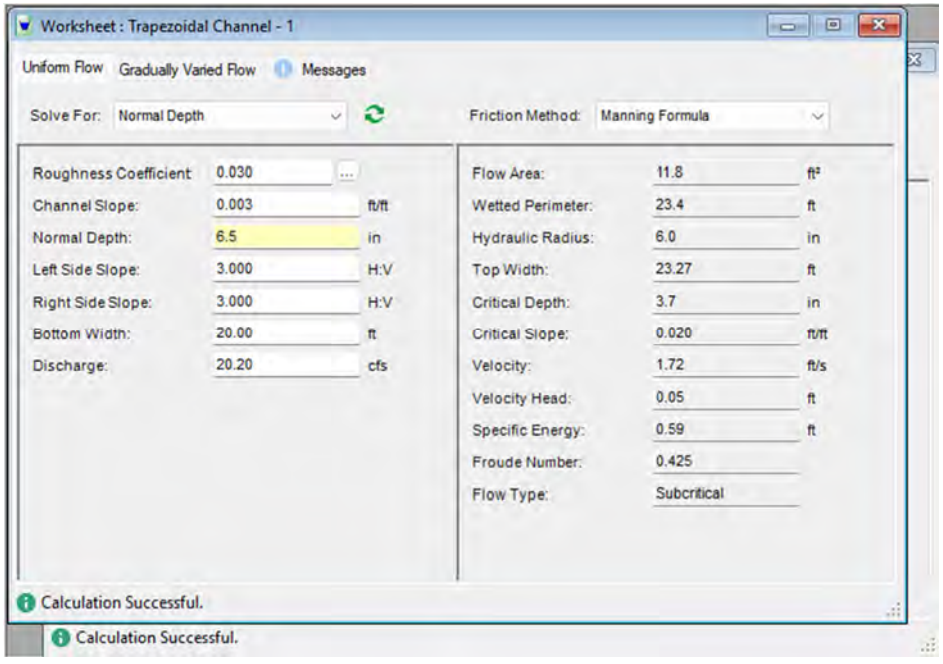
HYDROLOGIC REPORT - SUMMARY OF PEAK FLOW RATES

BASIN: NDA 03
ID: NORTH PERIMETER DITCH

AREA	=	3.57
AVERAGE BASIN SLOPE	=	3.75
HYDRAULIC LENGTH	=	772.00
TIME OF CONCENTRATION	=	5.00
BASIN C FACTOR	=	0.50

Frequency (years)	Pre-developed Peak Q (cfs)	By-pass area Peak Q (cfs)	Developed Peak Q (cfs)	Allowable peak Peak Q (cfs)
2	12.6	0.0	12.6	12.6
5	12.1	0.0	12.1	12.1
10	17.7	0.0	17.7	17.7
25	**20.2**	**0.0**	**20.2**	**20.2**
50	22.3	0.0	22.3	22.3
100	24.5	0.0	24.5	24.5

Bentley FlowMaster Channel Analysis



Calculated Normal Depth 6.5-inches (0.54-feet) calculated – Meets Q-25 requirement

Analysis Justification – Section P-04 Channel
15-ft Wide, 0.3% Channel, 3:1 Sides, 6.5-feet minimum HW depth available,
Manning N Value = 0.03 (grassed)

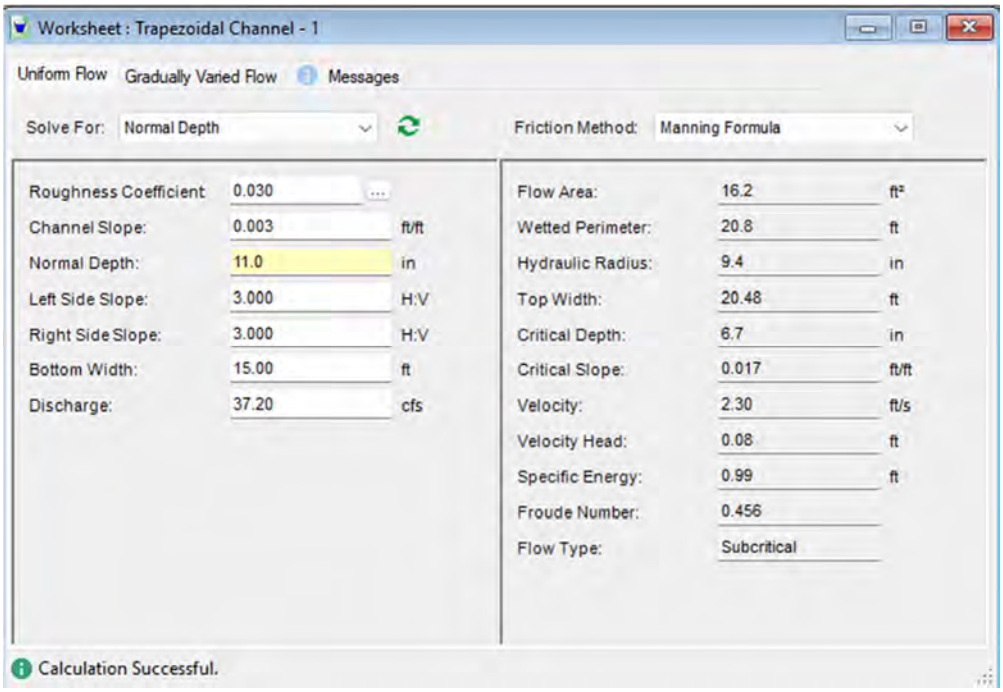
HYDROLOGIC REPORT - SUMMARY OF PEAK FLOW RATES

BASIN: NDA 03 - 04
ID: LANDFILL PERIMETER DITCH 03-04

AREA	=	8.92
AVERAGE BASIN SLOPE	=	1.40
HYDRAULIC LENGTH	=	1630.00
TIME OF CONCENTRATION	=	11.80
BASIN C FACTOR	=	0.50

Frequency (years)	Pre-developed Peak Q (cfs)	By-pass area Peak Q (cfs)	Developed Peak Q (cfs)	Allowable peak Peak Q (cfs)
2	22.7	0.0	22.7	22.7
5	22.1	0.0	22.1	22.1
10	32.6	0.0	32.6	32.6
25	**37.2**	**0.0**	**37.2**	**37.2**
50	41.2	0.0	41.2	41.2
100	45.2	0.0	45.2	45.2

Bentley FlowMaster Channel Analysis



Calculated Normal Depth 11-inches (0.92-feet) calculated – Meets Q-25 requirement

Analysis Justification – Section P-05 Culverts
One 28-inch & One 26-inch Diameter Culvert with 7-feet minimum HW depth available

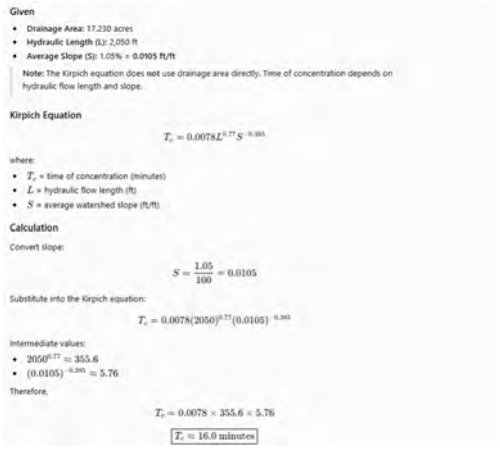
HYDROLOGIC REPORT - SUMMARY OF PEAK FLOW RATES

BASIN: NDA 01 - 04

ID: ALL LANDFILL NON-CONTACT SS & DITCH

AREA	=	17.23
AVERAGE BASIN SLOPE	=	1.05
HYDRAULIC LENGTH	=	2050.00
TIME OF CONCENTRATION	=	16.00
BASIN CURVE NUMBER	=	0.50

Frequency (years)	Pre-developed Peak Q (cfs)	By-pass area Peak Q (cfs)	Developed Peak Q (cfs)	Allowable peak Peak Q (cfs)
2	37.6	0.0	37.6	37.6
5	36.8	0.0	36.8	36.8
10	54.5	0.0	54.5	54.5
25	**62.3**	**0.0**	**62.3**	**62.3**
50	69.1	0.0	69.1	69.1
100	75.8	0.0	75.8	75.8



Given

- **Drainage Area:** 17.230 acres
- **Hydraulic Length (L):** 2,050 ft
- **Average Slope (S):** 1.05% = **0.0105 ft/ft**

> **Note:** The Kirpich equation does **not** use drainage area directly. Time of concentration depends on hydraulic flow length and slope.

Kirpich Equation

$$T_c = 0.0078 L^{0.77} S^{-0.385}$$

where:

- T_c = time of concentration (minutes)
- L = hydraulic flow length (ft)
- S = average watershed slope (ft/ft)

Calculation

Convert slope:

$$S = \frac{1.05}{100} = 0.0105$$

Substitute into the Kirpich equation:

$$T_c = 0.0078(2050)^{0.77}(0.0105)^{-0.385}$$

Intermediate values:

- $2050^{0.77} \approx 355.6$
- $(0.0105)^{-0.385} \approx 5.76$

Therefore,

$$T_c = 0.0078 \times 355.6 \times 5.76$$

$$\boxed{T_c \approx 16.0 \text{ minutes}}$$

Analysis Justification – Section P-05 Culverts
One 28-inch & One 26-inch Diameter Culvert with 7-feet minimum HW depth available

HYDROLOGIC REPORT - STAGE, STORAGE, AND DISCHARGE
BASIN: NDA 01 - 04

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1 28-inch Smooth HDPE
INVERT 339.06 D 28.00

2 26-inch Smooth HDPE
INVERT 343.45 D 26.00

ELEV	STORAGE (CU.FT.)	OUTFLOW (CFS)	2S/T+O (CFS)
339.06	0.0	0.0	0.0
339.15	0.0	0.2	0.2
339.25	0.0	0.6	0.6
339.38	51.9	1.2	1.5
339.50	103.8	2.0	2.5
339.75	413.8	4.0	5.7
340.00	723.7	6.4	9.4
340.25	1483.7	9.1	15.3
340.50	2243.6	12.1	21.4
340.75	3643.8	15.4	30.5
341.00	5043.9	18.9	39.9
341.25	7197.7	22.7	52.6
341.50	9351.5	23.2	62.1
341.75	12409.5	25.4	77.1
342.00	15467.6	27.4	91.8
342.25	19589.8	29.2	110.8
342.50	23712.0	31.0	129.8
342.97	23712.0	34.0	132.8
343.45	23712.0	36.8	135.6
343.45	23772.1	36.9	135.9
343.45	23832.2	36.9	136.2
343.48	24583.2	37.0	139.5
343.50	25334.2	37.2	142.8
343.75	33807.9	39.6	180.5
344.00	42281.7	42.5	218.7
344.25	52508.4	45.8	264.6
344.50	62735.2	49.4	310.8
344.75	75226.3	53.3	366.8
345.00	87717.4	57.4	422.9
345.25	102623.6	61.7	489.3
345.50	117529.8	66.2	555.9
345.75	134666.3	67.8	629.0
346.00	151802.8	70.8	703.4

Analysis Justification – Section P-05 Culverts
One 28-inch & One 26-inch Diameter Culvert with 7-feet minimum HW depth available

CULVERT(S) ROUTING
BASIN: NDA 01 - 04
PERIMETER DRAINAGE (NORTH AND SOUTH) CULVERT(S) ROUTING
PERIMETER DRAINAGE STORAGE: NDA 01 – 04 between Elevation 339.06-ft and 346.00-ft

25 YEAR STORM FREQUENCY

T	I1	I2	2S1/T	O1	2S2/T+O2	O2	2S2/T
8.00	0.0	31.1	0.0	0.0	31.1	15.6	15.6
16.00	31.1	62.3	15.6	15.6	93.4	27.5	65.9
24.00	62.3	42.6	65.9	27.5	143.2	37.3	106.0
32.00	42.6	23.0	106.0	37.3	134.3	35.5	98.8
40.00	23.0	18.6	98.8	35.5	104.8	28.6	76.2
48.00	18.6	14.2	76.2	28.6	80.4	25.8	54.6
56.00	14.2	12.3	54.6	25.8	55.3	22.8	32.5
64.00	12.3	10.4	32.5	22.8	32.4	16.1	16.4
72.00	10.4	9.3	16.4	16.1	20.0	11.4	8.6
80.00	9.3	8.2	8.6	11.4	14.7	8.8	5.9
88.00	8.2	7.6	5.9	8.8	12.8	8.0	4.9
96.00	7.6	7.0	4.9	8.0	11.5	7.3	4.1
104.00	7.0	6.5	4.1	7.3	10.3	6.8	3.5
112.00	6.5	6.0	3.5	6.8	9.2	6.2	2.9
120.00	6.0	5.6	2.9	6.2	8.2	5.6	2.6
128.00	5.6	5.1	2.6	5.6	7.7	5.3	2.4
136.00	5.1	4.8	2.4	5.3	7.1	4.9	2.2
144.00	4.8	4.4	2.2	4.9	6.6	4.5	2.0
152.00	4.4	2.2	2.0	4.5	4.1	3.0	1.1
160.00	2.2	0.0	1.1	3.0	0.3	0.3	0.0

TIME TO PEAK = 0.40 HOURS
MAXIMUM OUTFLOW = 37.26 CFS
MAXIMUM STORAGE = 25438 CU FT
MAXIMUM ELEVATION = 343.50 FT
INFLOW VOLUME = 134931 CU FT
OUTFLOW VOLUME = 134995 CU FT

Calculated Depth of Q25 is 4.44-ft (343.5-ft – 339.06-ft) versus 7-ft available – Meets Q-25 requirement

Analysis Justification – Section P-06 Channel
10-ft Wide, 0.3% Channel, 3:1 Sides, 6.4-feet minimum HW depth available,
Manning N Value = 0.03 (grassed)

HYDROLOGIC REPORT - SUMMARY OF PEAK FLOW RATES

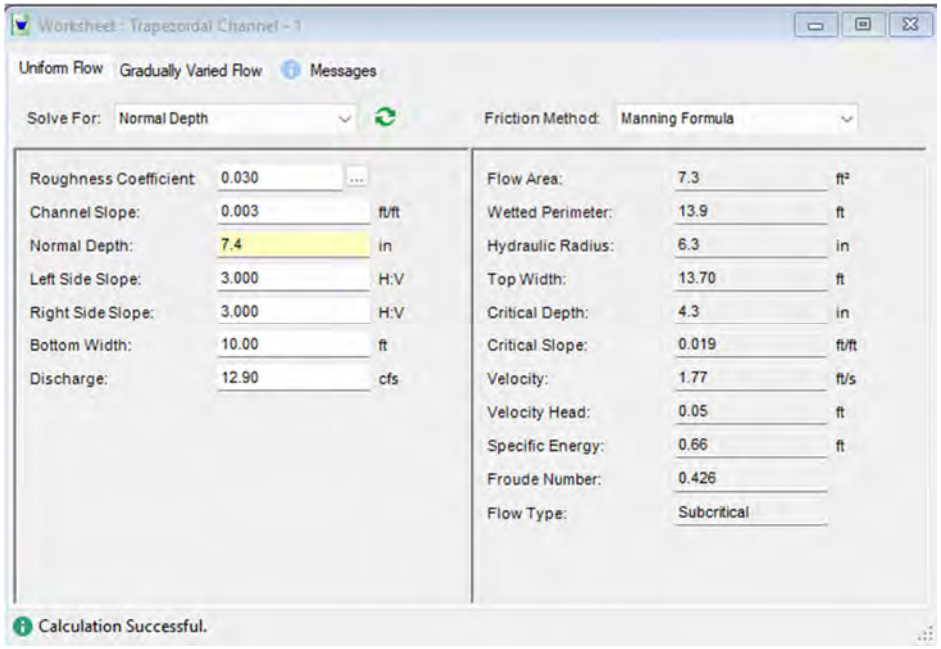


BASIN: NDA 05
ID: WEST PERIMETER DITCH

AREA	=	2.94
AVERAGE BASIN SLOPE	=	0.68
HYDRAULIC LENGTH	=	947.00
TIME OF CONCENTRATION	=	10.40
BASIN CURVE NUMBER	=	0.50

Frequency (years)	Pre-developed Peak Q (cfs)	By-pass area Peak Q (cfs)	Developed Peak Q (cfs)	Allowable peak Peak Q (cfs)
2	7.9	0.0	7.9	7.9
5	7.7	0.0	7.7	7.7
10	11.3	0.0	11.3	11.3
25	**12.9**	**0.0**	**12.9**	**12.9**
50	14.3	0.0	14.3	14.3
100	15.7	0.0	15.7	15.7

Bentley FlowMaster Channel Analysis



Calculated Normal Depth 7.4-inches (0.62-feet) calculated – Meets Q-25 requirement

Appendix 3: Plan Review Log

Plan Review and Changes in Facility Configuration

Scheduled reviews and Plan amendments shall be recorded in the Plan Review Log below. This log must be completed even if no amendment is made to the Plan as a result of the review.

By	Date	Amendment Description	P.E. Certification Required?	P.E. Name	Licensing State Registration No.
RHM	8/19/2026	Complete Reissue *	Yes	Robert H. Murray	Texas 59111

** Significant drainage modifications resulted in major differences require a complete reissue of the Plan*

Appendix 4: Professional Engineer Certification

Professional Engineer Certification Page

The undersigned licensed Professional Engineer (P.E.) attests that this Run-on and Run-off Control Plan has been prepared, reviewed, and/or revised in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR 257. This certification in no way relieves the owner or operator of the facility of his/her duty to fully implement this Plan.

Engineer: _____
Robert H. Murray, P.E.

Registration Number: 59111

State: Texas

Date: August 19, 2026



P.E. certification is required for the original Plan and Plan reviews and amendments.