RUN-ON/RUN-OFF CONTROL SYSTEM PLAN

CHESWICK ASH DISPOSAL FACILITY
INDIANA TOWNSHIP, ALLEGHENY COUNTY, PENNSYLVANIA

Prepared for:

NRG POWER MIDWEST LP
384 LEFEVER HILL ROAD
CHESWICK, PENNSYLVANIA 15024

Prepared by:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
333 BALDWIN ROAD
PITTSBURGH, PA 15205

CEC Project 154-532.0002

October 2016

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RUN-ON/RUN-OFF CONTROL SYSTEM PLAN
CHESWICK ASH DISPOSAL FACILITY

1.0 PURPOSE

On behalf of NRG Power Midwest LP (NRG), Civil & Environmental Consultants, Inc. (CEC) has prepared a Run-on/Run-off Control System Plan for the Cheswick Ash Disposal Facility (Site) in accordance with the United States Environmental Protection Agency (USEPA) Coal Combustion Residuals (CCR) Rule in 40 CFR 257.81 (§257.81) dated April 17, 2015.

§257.81 establishes requirements for run-on and run-off system controls for existing and new CCR landfills and requires an owner and operator to design, construct, operate and maintain:

1. 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; and
2. 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.

In addition, §257.81 requires that run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under §257.3-3 which relate to water quality standards for discharges of surface water.

A run-on and run-off control system plan must be prepared to document that the run-on and run-off control systems have been designed and implemented to meet the requirements. Each plan must be supported by appropriate engineering calculations. For existing CCR landfills, the plan must be prepared no later than October 17, 2016 and placed in the facility's operating record in accordance with §257.105(g)(3). The owner or operator of the CCR unit must obtain a written certification in accordance with §257.81(c)(5) from a qualified professional engineer that the design meets the requirements of this section. The professional engineer certification is provided in Appendix A.

2.0 BACKGROUND

The Site is a Class II residual waste landfill located at 384 Lefever Hill Road, Cheswick, Pennsylvania, 15024 shown on the 2015 Annual Topographic Survey Plan in Appendix B. The Site operates under Pennsylvania Department of Environmental Protection (PADEP) Solid Waste Permit No. 300720 issued March 24, 1982 and National Pollutant Discharge Elimination System (NPDES) Permit No. PA0001627. The Site currently accepts CCR and other residual wastes from the Cheswick Generating Station. The Site has a permitted stormwater management system designed and constructed to control run-on and run-off.

Stormwater run-on from non-contact areas upgradient of the disposal area is diverted away from the active CCR disposal area. Stormwater run-off from portions of the Site with soil cover is managed to control off-site discharge. Stormwater run-off from active portions of the CCR disposal area is managed in the leachate collection and treatment system.

CEC reviewed the stormwater design calculations for the Site included as part of the Solid Waste Permit Application dated November 1996. The design calculations are based on the 25-year, 24-hour storm event and have been completed in accordance with the Erosion and Sediment Pollution Control Program Manual, prepared by the PADEP Bureau of Soil and Water Conservation, dated 1991. The design calculations provide the basis for the existing stormwater run-on and run-off systems. The Permit Drawings depict the run-on and run-off controls. CEC has prepared a supplemental calculation associated with the benches. The design drawings are provided in Appendix B and the design calculations are provided in Appendix C.

3.0 RUN-ON CONTROL SYSTEM - §257.81(a)(1)

The stormwater run-on control system prevents flow from entering onto the active portion of the CCR unit. The run-on control system includes the perimeter diversion channels, the storm drain piping system and the sedimentation pond. Design calculations associated with run-on control system are provided in Appendix C.

3.1 PERIMETER DIVERSION CHANNELS

Channel capacity calculations are based on the 25-year, 24-hour storm event. Perimeter diversion channels are concrete-lined to prevent erosion and scour of the underlying soil. Perimeter diversion channels convey flow to the sedimentation pond from non-contact run-on areas outside the CCR disposal area as well as run-off from CCR disposal areas covered with final cover soil. The perimeter diversion channel is constructed as CCR are placed to design elevations.

3.2 STORM DRAIN PIPING SYSTEM

The storm drain piping system calculations are based on the 25-year, 24-hour storm event. The storm drain piping system diverts run-on from non-contact upgradient areas to a series of solid corrugated metal pipes beneath the Site. The size of the storm drain piping system varies based on the calculated peak discharge of run-on. There are multiple vertical chimney drains which are designed to convey run-off through the system after the final cover is installed on the entire landfill area.

Water discharging through the storm drain system is conveyed to an unnamed tributary of the Little Deer Creek as authorized by PADEP under NPDES Permit No. PA0001627.

3.3 SEDIMENTATION POND

The Sedimentation Pond capacity calculations are based on the 25-year, 24-hour storm event. The pond has a principal and emergency spillway. The sedimentation pond discharges to a culvert under the Bessemer & Lake Erie Railroad and is designed to convey the 25-year, 24-hour storm event. Discharge from the sedimentation pond is conveyed into an unnamed tributary of Little Deer Creek.

4.0 RUN-OFF CONTROL SYSTEM - §257.81(a)(2)

The run-off control system manages stormwater from portions of the landfill that have soil cover installed. The stormwater run-off control system for areas that have soil cover installed includes downchutes and benches on the exterior landfill slopes, which direct run-off to the perimeter diversion channels. Run-off from the active disposal area that contacts CCRs is managed as leachate. The active disposal area is managed to either promote infiltration into the residual waste or direct run-off towards the underdrain system. Run-off from active areas does not enter the perimeter run-off control system. A bottom ash blanket drain and underdrain system function as the leachate collection zone which conveys leachate to the Monarch Mine Dewatering Plant for treatment and discharge as authorized by PADEP under NPDES Permit No. PA0001627. Design calculations associated with run-off system controls for areas that have soil cover installed are provided in Appendix C.

4.1 DOWNCHUTES

Downchute capacity calculations are based on the 25-year, 24-hour storm event. Downchutes are designed to be concrete-lined to prevent erosion and scour of the underlying soil and CCR. Downchutes receive non-contact stormwater runoff from the benches and convey discharge to the perimeter diversion channels.

4.2 BENCHES

Permitted bench capacity calculations are based on the 25-year, 24-hour storm event and are designed with a 1.0% minimum slope. Constructed benches vary between 1% and 3% longitudinal slope. As shown in Attachment C, 3% longitudinal slopes will result in a flow velocity that will not cause erosion on grass-lined benches.

5.0 SURFACE WATER REQUIREMENTS- §257.81(b)

In accordance with §257.3-3, discharges from the Site are authorized by and in compliance with NPDES Permit No. PA0001627.

Dredged material or fill material is not discharged from the Site to waters of the United States in violation of the requirements under Section 404 of the Clean Water Act. Site operations have not caused non-point source pollution to waters of the United States in violation of the requirements under Section 208 of the Clean Water Act.

6.0 CONCLUSION

The Run-on/Run-off Control System Plan demonstrates that the Site is designed, constructed, operated and maintained in accordance with §257.81 of the CCR Rule. The certification statement by a qualified professional engineer is provided in Appendix A. Supporting drawings and calculations are provided in Appendices B and C. This demonstration will be placed in the operating record by October 17, 2016.

7.0 REFERENCES

1. Solid Waste Permit Application dated November 1996. Lefever Ash Disposal Site. Permit I.D. No. 300720.

APPENDIX A

ENGINEER'S CERTIFICATION STATEMENT

PROFESSIONAL ENGINEER CERTIFICATION

This Run-on/Run-off Control System Plan fulfills the CCR Rule requirements (§Parts 257 and 261) dated April 17, 2015. This Run-on/Run-off Control System Plan will be placed in the operating record by October 17, 2016.

I, Rick J. Buffalini, P.E., a registered professional engineer in the State of Pennsylvania certify that the Run-on/Run-off Control System Plan for the Cheswick Ash Disposal Facility fulfills the requirements of §257.81. This certification is based on my review of the Cheswick Ash Disposal Facility Run-on/Run-off Control System Plan.

Rick J. Buffalini, P.E.

Printed Name of Professional Engineer

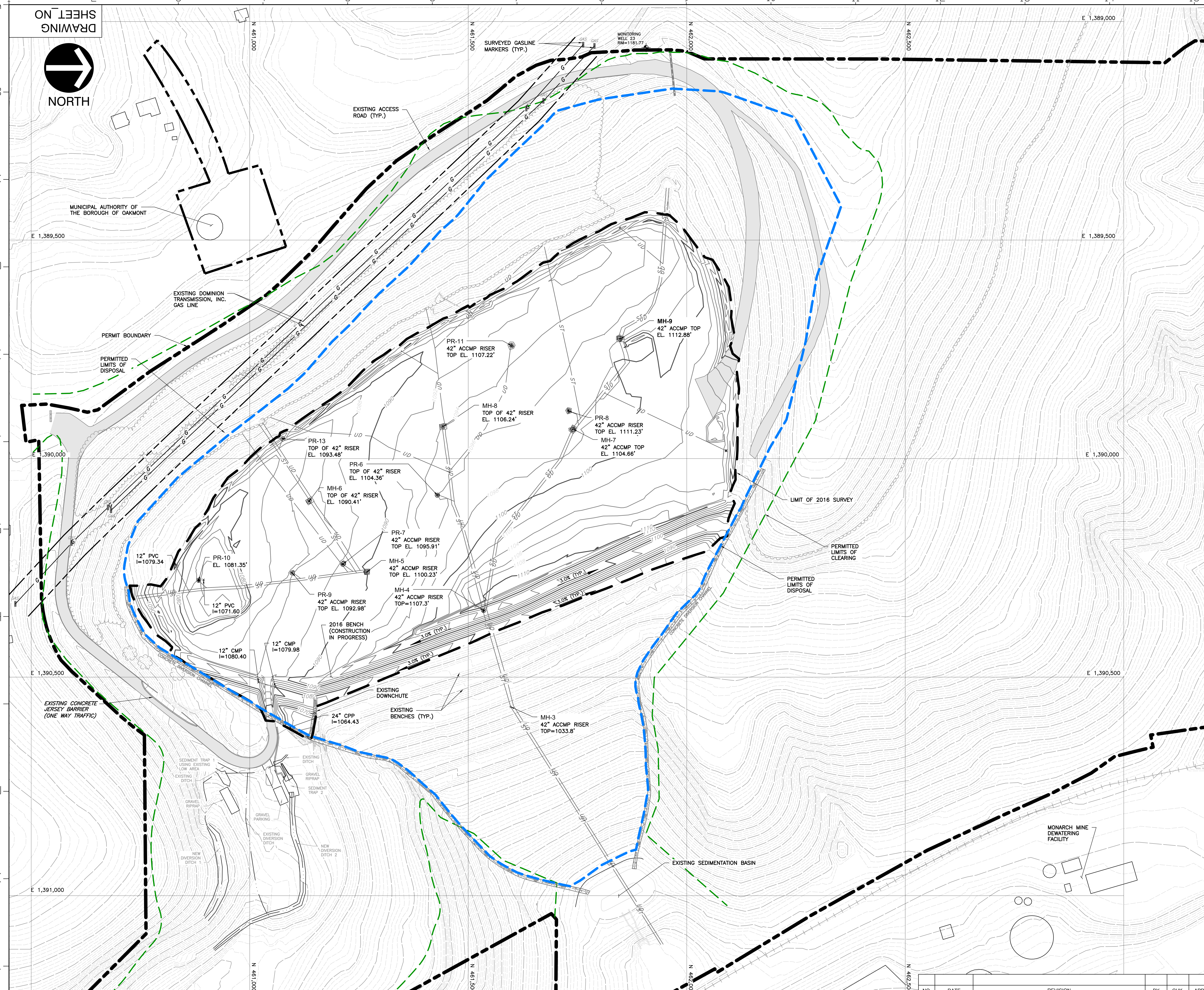
Signature

041196-E	Pennsylvania	10-14-16
Registration No.	Registration State	Date

Stamp/Seal:

APPENDIX B

DRAWINGS



LEGEND

	PERMIT BOUNDARY
1080	EXISTING CONTOUR
1090	SURVEYED CONTOUR
	LIMIT OF 2016 SURVEY
	PERMITTED LIMITS OF WASTE DISPOSAL
ST	EXISTING STORM DRAIN PIPING
UD	EXISTING UNDERDRAIN PIPING
	EXISTING CONCRETE CHANNEL/DOWNCHUTE
MH-7	MANHOLE
	EXISTING ACCESS ROAD
G	EXISTING GAS LINE
	GAS LINE RIGHT-OF-WAY
GAS	SURVEYED GASLINE MARKER
	TREE LINE
ST	EXISTING CULVERT
	EXISTING JERSEY BARRIER
	EXISTING RAILROAD TRACKS
	PERMITTED LIMIT OF CLEARING AND GRUBBING

REFERENCE

1. FIELD SURVEY BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC. DATED 1-5-2016. SURVEY INCLUDES TOPOGRAPHY INSIDE THE 2016 LIMIT OF SURVEY AND TOP OF EXISTING MANHOLES. PLAN NORTH IS BASED UPON PENNSYLVANIA STATE PLANE NAD83 AND VERTICAL DATUM IS BASED UPON NAVD88.
2. THE EXISTING TOPOGRAPHY, THE EXISTING UNDERDRAIN AND STORMDRAIN PIPING AND CORRESPONDING MANHOLES, SHOWN WERE REFERENCED FROM THE 2014 ALOR TOPOGRAPHIC MAP FOR JANUARY 2014 THROUGH DECEMBER 2015 PREPARED BY MORRIS KNOWLES & ASSOCIATES, INC. THE EXISTING CONTOURS SHOWN ON THE ASH DISPOSAL FACILITY ARE DATED JANUARY 2015.
3. THE EXISTING PERMITTED LIMIT OF DISPOSAL WAS REFERENCED FROM DUQUESNE LIGHT COMPANY PERMIT DRAWING 12079-B10, DATED 3/1/79.
4. THE APPROXIMATE LOCATION OF THE TREELINE IS BASED ON INFORMATION PROVIDED BY CHARAH, INC IN MAY 2015.
5. DOMINION TRANSMISSION, INC. (DTI) GAS LINES LN-30 AND TL-469 HAVE AN ASSUMED RIGHT-OF-WAY WIDTH ON THE OUTSIDE OF EACH GAS LINE OF 25 FEET.
6. RAILROAD ALIGNMENT WAS OBTAINED FROM AERIAL IMAGERY.

SCALE IN FEET
0 100 200

nrg

CHESWICK GENERATION STATION
UNIT NO.

CHESWICK ASH DISPOSAL SITE
2015 ANNUAL TOPOGRAPHIC SURVEY

DRAWN	1/20/2016	JAS		DRAWING NUMBER
CHECKED	DMD	CHK		DRAWING NO. 1
APPROVED	RJB	APP		SHEET: SHEET
SIZE:	24X36			REV: REVNO
DISCIPLINE:	CIVIL	SCALE:	NTS	FILE: FILENAME

NO.	DATE	REVISION	BY	CHK.	APP.

P:\2014\144-083\--CADD\Dwg\SW02 - Task0002\144083-SW02-Annual Survey - 2015.dwg[ANNUAL SURVEY] LS:(1/13/2016 - swhite) - LP: 6/13/2016 3:30 PM

APPROXIMATE TOTAL CAPACITY	
PHASE I (SOUTH VALLEY)	6,000,000 Y
PHASE II (NORTH VALLEY)	3,346,000 Y

REV-5

NOTE: PERMIT DRAWING ONLY, SEE DRAWINGS AA12079-B12 THRU B26 FOR PHASE I, STEP 1 AS BUILT CHANGES

SOIL DESCRIPTION

SYMBOL	SOIL	BRIEF DESCRIPTION
34-D-2	GILPIN-UPSHUR COMPLEX, 15 TO 25% SLOPES	MODERATELY DEEP AND DEEP, WELL DRAINED SOILS FORMED FROM RELATIVELY ACID SHALE AND SOME SANDSTONE INTERBEDDED WITH NONACID RED CLAY SHALE.
34-F-1	GILPIN-UPSHUR COMPLEX, 25 TO 80% SLOPES	(SAME AS 34-D-2)
34-E-2	COMPLEX OF 34-D-2 AND 34-F-1	(SAME AS 34-D-2)
65-C-2	GURNSEY-VANDERGRIFT SILT LOAMS 8 TO 15% SLOPES	DEEP, MODERATELY WELL DRAINED SOILS FORMED FROM INTERBEDDED SHALE, LIMESTONE & RED CLAY SHALE BEDROCK. THEY OCCUR ON UPLAND SLOPES.
65-D-2	GURNSEY-VANDERGRIFT SILT LOAMS, 15 TO 25% SLOPES	(SAME AS 65-C-2)
26-B-2	GURNSEY SILT LOAM, FINE LOAMY VARIANT, 2 TO 8% SLOPES	DEEP, MODERATELY WELL DRAINED SOILS FORMED FROM INTERBEDDED SHALE AND LIMESTONE BEDROCK. THEY OCCUR ON UPLAND SLOPES. THEY HAVE SLOW PERMEABILITY AND HAVE A WATER TABLE WITHIN 2 TO 3 FT. OF THE SURFACE IN THE WINTER.
26-C-2	GURNSEY SILT LOAM, FINE LOAMY VARIANT, 8 TO 15% SLOPES	(SAME AS 26-B-2)

GENERAL NOTES

1. CLEARING-ALL TREES, ROOTS, AND ORGANIC MATERIAL INCLUDING TOPSOIL SHALL BE REMOVED FROM THE AREA WITHIN THE CLEARING LINES.
2. CONSTRUCTION OF THE ROADWAYS INCLUDING ALL CLEARING, GRUBBING, INSTALLATION OF DRAINAGE STRUCTURES AND PLACEMENT OF FILLS SHALL BE IN ACCORDANCE WITH FORM 408, LATEST REVISION OF THE PENNSYLVANIA DEPARTMENT OF TRANSPORTATION SPECIFICATIONS UNLESS OTHERWISE NOTED, OR AS DIRECTED BY THE ENGINEER.
3. ALL STRIPPED ORGANIC TOPSOIL AND SUBSOIL (SILTS AND SILTY CLAYS ONLY) SHALL BE STORED ON THE SITE AT THE DESIGNATED STOCKPILE AREAS. MATERIAL UNSUITABLE FOR USE AS ROADWAY FILL, EMBANKMENTS FOR THE SEDIMENTATION BASIN OR TOPSOIL COVER SHALL BE STOCKPILED IN AREAS DIRECTED BY THE ENGINEER AT THE TIME OF CONSTRUCTION.
4. SEEDING-ALL DISTURBED AREAS, EARTH DIVERSIONS, TOPSOIL STOCKPILES, AND THE COVERED SLOPE AREAS SHALL BE SEEDED IN ACCORDANCE WITH THE 1976 PENNSYLVANIA DEPT. OF TRANSPORTATION FORM 408, SECTION 804, AS AMENDED TO DATE.
5. SEEDING MIXTURE PER ACRE SHALL BE AS FOLLOWS:

KENTUCKY-31 TALL FESCUE	35 LBS.	FERTILIZER (12-12-12)	420 LBS.
PERENNIAL RYEGRASS	15 LBS.	LIME (AGRICULTURAL GRADE)	6000 LBS.
CROWN VETCH	28 LBS.	GRASS HAY AND CEREAL	4000-5000 LBS.
(MIN. 35% HARD SEED)		GRAIN STRAW MULCH	
		WATER	3500 LBS.

AN INOCULANT FOR THE CROWN VETCH IS TO BE USED. IF HYDRO-SEEDING, USE FOUR (4) TIMES THE RATE OF INOCULANT RECOMMENDED ON THE PACKAGE BY THE MANUFACTURE. FOR THE STOCKPILE AREAS AND EARTH DIVERSIONS, USE ABOVE MIX WITH THE FOLLOWING EXCEPTIONS: ELIMINATE THE CROWN VETCH; AND THE RYEGRASS MAY BE SUBSTITUTED WITH REDTOP AT 5 LBS./ACRE.

6. ALL BENCHES SHALL BE SLOPED A MINIMUM OF 1% TOWARDS THE CONCRETE DIVERSION DITCH. THE MAXIMUM LENGTH OF THE BENCH SLOPE SHALL BE 600 FEET. RUNOFF ON THE BENCHES WILL BE COLLECTED IN THE CONCRETE DIVERSION DITCH, VERTICAL MANHOLE, OR BENCH CATCH BASINS. RUNOFF ON THE FINISHED PLATEAU AT ELEV. 1200 WILL BE DIRECTED TO THE VERTICAL MANHOLES NOS. 6, 8, 10, AND 11 FOR PHASE 1, AND DIRECTED TO THE DIVERSION DITCH FOR PHASE II.

LEGEND

M.H. ●	MANHOLE
P.R. ▲	PERFORATED RISER
S.D.	STORM DRAIN
U.D.	UNDERDRAIN
HW	HEADWALL
EW	ENDWALL

DUQUESNE LIGHT COMPANY
ENGINEERING & CONSTRUCTION DIVISION — PITTSBURGH, PA.

CHESWICK POWER STATION
LAND ACQUISITION FOR FLY ASH DISPOSAL
INDIANA TOWNSHIP — ALLEGHENY COUNTY, PA.

CONSERVATION PLAN
FOR DISPOSAL AREA

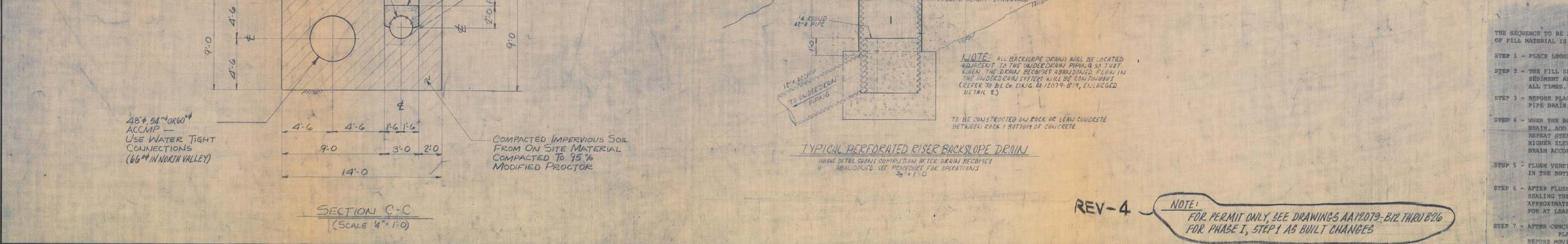
SCALE 1"=100'	DATE FEB. 14, 1979	ARCH. APP.	
	DRAWN	ELECT. APP.	
	CHECKED	MECH. APP.	
	INSPECTED	STRUCT. APP. 3/1/79	3-1-79

APP. COMPLETE WHEN INITIALED HERE
O.F.E.No. 12079
E.O.No. SWO 758
AA No. 12079-B10

FORM D-16-1964

RETURN TO VAULT

No. 12079-B9



PROCEDURE FOR OPERATING BACKSLOPE DRAINS

THE SEQUENCE TO BE ADHERED TO DURING THE OPERATION OF THE DRAINS AND THE PLACEMENT OF FILL MATERIAL IS AS FOLLOWS:

STEP 1 - PLACE LOOSE BOTTOM ASH AROUND THE VERTICAL 42" Ø PIPE AND MANHOLE.

STEP 2 - THE FILL SHALL BE PLACED BEHIND THE DIKES AND SHALL BE GRADED SO THAT SEDIMENT AND RUNOFF WILL DRAIN TO AND AROUND THE VERTICAL 42" Ø PIPE AT ALL TIMES.

STEP 3 - BEFORE PLACING ADDITIONAL LOOSE BOTTOM ASH AROUND THE VERTICAL 42" Ø PIPE DRAIN, REMOVE ANY SEDIMENT COLLECTED.

STEP 4 - WHEN THE BOTTOM ASH PLACED IS 5'-0" BELOW THE TOP OF THE VERTICAL 42" Ø DRAIN, ADD A NEW 10'-0" SECTION OF PIPE WITH A COLLAPSIBLE JOINT, AND REPEAT STEPS 1 THROUGH 4 UNTIL A NEW VERTICAL 42" Ø PIPE DRAIN AT A HIGHER ELEVATION IS READY TO USE. AT THIS TIME ABANDON THE PREVIOUS DRAIN ACCORDING TO STEPS 5 THROUGH 7.

STEP 5 - FLUSH VERTICAL 42" Ø PIPE DRAIN TO WASH AWAY ANY SEDIMENT COLLECTED IN THE BOTTOM OF THE MANHOLE AND UNDERDRAIN PIPELINE.

STEP 6 - AFTER FLUSHING, PLACE A QUARTER ROUND PIECE OF 42" Ø PIPE IN THE MANHOLE SEALING THE OPENING TO THE 12" Ø PIPE. PLACE CONCRETE IN THE MANHOLE TO APPROXIMATELY 1'-0" ABOVE TOP OF 12" Ø PIPE. ALLOW CONCRETE TO DRY FOR AT LEAST 3 DAYS.

STEP 7 - AFTER CONCRETE HAS DRIED, FILL PIPE WITH BOTTOM ASH. PLACE AT LEAST 5'-0" OF LOOSE BOTTOM ASH AROUND AND ABOVE PIPE BEFORE MOVING COMPACTION AND HEAVY EQUIPMENT OVER THE AREA.

REV-4 NOTE: FOR PERMIT ONLY, SEE DRAWINGS AA12079-B12 THRU B26 FOR PHASE I, STEP 1 AS BUILT CHANGES

REVISIONS
1 - REVISED DETAIL OF TYPICAL EARTH DIVERSION (VEE DITCH)
2 - [illegible]
3 - REVISED PIPE DIAMETERS IN NORTH VALLEY STORM DRAIN, SECT. B-B
4 - ADDED NOTE REFERING TO AS BUILT CHANGES

Approved: [signature]
Registered Professional Engineer No. 5109E
Commonwealth of Pennsylvania

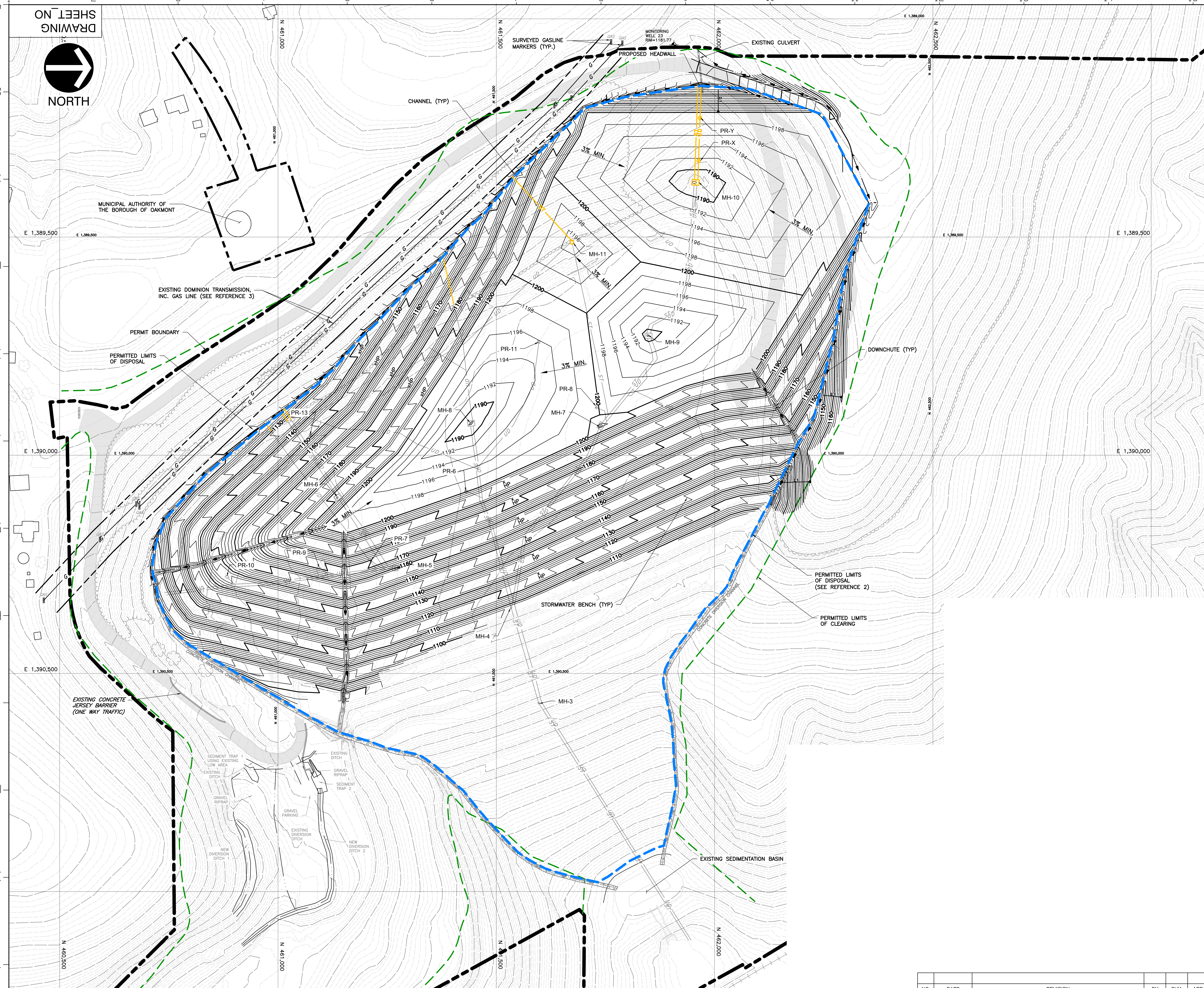
DUQUESNE LIGHT COMPANY
ENGINEERING & CONSTRUCTION DIVISION — PITTSBURGH, PA.

CHESWICK POWER STATION
LAND AQUISITION FOR FLY ASH DISPOSAL
INDIANA TOWNSHIP — ALLEGHENY COUNTY, PA.

PERMIT DRAWING
CROSS-SECTIONS & MISCELLANEOUS DETAILS

SCALE AS NOTED	DATE FEB 14, 1979	ARCH. APP.	
	DRAWN	ELECT. APP.	
	CHECKED	MECH. APP.	3-1-79
	INSPECTED	STRUCT. APP. 3/1/79	

APP. COMPLETE WHEN INITIALED HERE — O.F.E.No. 12079 — E.O.No. 50 758 — AA No. 12079-B9



LEGEND

- PERMIT BOUNDARY
- EXISTING CONTOUR
- PROPOSED CONTOUR (TOP OF CCR)
- PERMITTED LIMITS OF DISPOSAL
- EXISTING SURFACE WATER CHANNEL
- PROPOSED SURFACE WATER CHANNEL
- EXISTING STORM DRAIN PIPING
- EXISTING UNDERDRAIN PIPING
- PROPOSED STORM DRAIN PIPING
- PROPOSED UNDERDRAIN PIPING
- PROPOSED SURFACE WATER SUMP
- EXISTING CONCRETE CHANNEL/DOWNCHUTE
- PROPOSED CONCRETE CHANNEL/DOWNCHUTE
- COMPOSITE FILTER SOCK OR APPROVED EQUAL
- MH-7
- PROPOSED MANHOLE
- EXISTING TREELINE
- PERMITTED LIMIT OF CLEARING AND GRUBBING
- EXISTING ACCESS ROAD
- DETAIL NUMBER / SHEET NUMBER WHERE DETAIL IS SHOWN
- EXISTING GAS LINE
- GAS LINE RIGHT-OF-WAY
- SURVEYED GASLINE MARKER
- TREE LINE
- EXISTING CULVERT
- EXISTING JERSEY BARRIER
- EXISTING RAILROAD TRACKS

REFERENCE:

1. THE EXISTING TOPOGRAPHY, THE EXISTING UNDERDRAIN AND STORMDRAIN PIPING AND CORRESPONDING MANHOLES, SHOWN WERE REFERENCED FROM THE 2014 ALOR TOPOGRAPHIC MAP FOR JANUARY 2014 THROUGH DECEMBER 2015 PREPARED BY MORRIS KNOWLES & ASSOCIATES, INC. THE CONTOURS SHOWN ON THE ASH DISPOSAL FACILITY ARE DATED JANUARY 2015.
2. THE EXISTING PERMITTED LIMIT OF DISPOSAL WAS REFERENCED FROM DUQUESNE LIGHT COMPANY PERMIT DRAWING 12079-B10, DATED 3/1/79. LOCATIONS SHOWN ARE APPROXIMATE.
3. DOMINION TRANSMISSION, INC. (DTI) GAS LINES LN-30 AND TL-469 HAVE AN ASSUMED RIGHT-OF-WAY WIDTH ON THE OUTSIDE OF EACH GAS LINE OF 25 FEET.

ONE CALL SERIAL NO.: X

CALL BEFORE YOU DIG!
PENNSYLVANIA LAW REQUIRES 3 WORKING DAYS NOTICE FOR CONSTRUCTION PHASE AND 10 WORKING DAYS IN DESIGN STAGE-STOP CALL PENNSYLVANIA ONE CALL SYSTEM, INC.
1-800-242-1776

PENNSYLVANIA ACT 38 (1991) REQUIRES NO LESS THAN 3 WORKING DAYS NOTICE NOR MORE THAN 10 WORKING DAYS NOTICE FROM EXCAVATORS WHO ARE ABOUT TO: DIG, DRILL, BLAST, AUGER, BORE, GRADE, TRENCH, OR DEMOLISH WHEN IN THE CONSTRUCTION PHASE. FOR LOCATION REQUESTS IN THE STATE OF PENNSYLVANIA, CALL TOLL FREE 1-800-242-1776.
UNDERGROUND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE INFORMATION AND THE LOCATION MUST BE CONSIDERED APPROXIMATE, OTHER UNDERGROUND UTILITIES MAY EXIST WHICH ARE NOT SHOWN. IT WILL BE THE CONTRACTOR'S RESPONSIBILITY TO ASCERTAIN ALL PHYSICAL LOCATIONS OF UTILITY LINES PRIOR TO THE TIME OF CONSTRUCTION. IN NO WAY SHALL THE CONTRACTOR HOLD THE SURVEYOR RESPONSIBLE FOR ANY UTILITY LOCATION SHOWN ON THIS PLAN.

SCALE IN FEET
0 100 200

nrg
CHESWICK GENERATION STATION
UNIT NO.

CHESWICK ASH DISPOSAL SITE PROPOSED FINAL COVER GRADING PLAN

DRAWN 9/2/2015		DRAWING NUMBER
CHECKED DMD	CHK	DRAWING NO. 1
APPROVED RJB	APP	SHEET: SHEET
SIZE: 24X36		REV: REVNO
DISCIPLINE: CIVIL	SCALE: NTS	FILE: 154532-SW02-001-PROPOSED FINAL GRADING PLAN

NO.	DATE	REVISION	BY	CHK.	APP.

APPENDIX C

DESIGN CALCULATIONS

ATTACHMENT 1

PERIMETER DIVERSION CHANNELS AND DOWNCHUTES

Form I
Attachment A

Lefever Road Disposal Site
Diversion System and Sedimentation Pond
Hydrologic Evaluation

Prepared By: MAZ Date: 10/3/95
Checked By: gju Date: 10/4/95

Form I
Attachment A

Lefever Road Disposal Site
Diversion System and Sedimentation Pond
Hydrologic Evaluation

Purpose:

Determine the peak runoff for the 25-year, 24-hour storm event from on-site stabilized drainage areas and off-site undisturbed drainage areas contributing surface water runoff to the site diversion ditches, culverts, and sedimentation pond.

References:

1. The computer program SEDCAD which models overland surface water flow and channel flow, based on Technical Release Number 55 (TR-55) and Technical Release Number 20 (TR-20), to develop peak runoff rates (hydrology) for each subwatershed.

2. Technical Release Number 55 (TR-55), Urban Hydrology for Small Watersheds, prepared by the U.S. Department of Agriculture, Soil Conservation District, dated 1982.

3. Pennsylvania Department of Environmental Resources Environmental Quality Board, July 4, 1992, Residual Waste Management.

4. Duquesne Light Company, Drawing No. 16691-C9, prepared by Earth Sciences Consultants, Inc. August 1995, "Diversion Ditch Hydrology Watershed Map".

5. Daugherty, Robert L. et. al. 1985, Fluid Mechanics with Engineering Applications, Eighth Edition.

6. The Erosion and Sediment Pollution Control Program manual, prepared by the Pennsylvania Department of Environmental Resources (DER), Bureau of Soil and Water Conservation, dated 1991.

Description of SEDCAD + Version 3.1

The program SEDCAD + Version 3.1, written by Civil Software Design in 1992, assists in the design and evaluation of stormwater, erosion, and sediment control structures. In this case, SEDCAD was used to assist in the evaluation of the stormdrain system and its various components at the Lefever Road Disposal Site. SEDCAD works by prompting the user for information on subwatersheds in question such as total area, time of concentration paths (T_c), and average land use conditions (SCS Curve Number). SEDCAD takes this information along with design storm information supplied by the user (frequency, duration, and rainfall distribution type) and computes a hydrograph for that subwatershed based on U.S. Soil Conservation Service Dimensionless Unit Hydrograph methods. Many subwatersheds can be linked together through the use of junctions, branches, and structures. A structure can be either null, meaning it has no effect on the flow, or it can be any number of hydraulic components such as a detention basin or channel which affects in-flow/out-flow relationships at that structure. Between-structure routing of hydrographs in SEDCAD is accomplished by the Muskingum method. The Muskingum routing parameters of K and X, which are functions of channel geometry, are computed by SEDCAD with user-supplied information on between-structure conveyance features such as slope and length. Up to 3 separate hydrographs from different areas (branches) can be combined at a junction. A junction represents the confluence of separate branches and is the point at which SEDCAD combines either 2 or 3 hydrographs to compute a total flow.

Methodology:

The computer program SEDCAD + Version 3.1 models the hydrology of each watershed to determine the runoff peak flow rates.

The hydrology includes:

1. Determine each subwatershed area and time of concentration paths (overland, concentrated, and channel flows).

2. Determine the curve number for each subwatershed.

3. Input this data into SEDCAD to develop the peak runoff for each subwatershed.

The 25-year, 24-hour peak flows were determined for each subwatershed identified. The surface water runoff was routed to diversion channels around the perimeter of site and conveyed to a storm water management Sedimentation Pond.

Criteria:

1. Total contributing area = 53.78 acres. (Planimetered from Reference 4).

2. Design rainfall for Allegheny County, Indiana Township is the 25-year, 24-hour period, with a Type II rainfall distribution of 4.5 inches of precipitation. (Refer to Reference 2 and Reference 3, §288.151).

3. Surface water runoff from contributing watersheds will be conveyed to a series of diversion channels.

4. Curve Number (CN) of 70 was used to represent the average land conditions of off-site undisturbed wooded areas. A CN of 65 was used to represent the average land conditions of on-site stabilized areas. (Refer to Reference 2 attached).

5. Freeboard will be 0.5 feet, or 25% of the design depth, whichever is greater. (Reference 6, Chapter 4, Section D (2), p. 4-23).

Assumptions:

1. Post-closure conditions (vegetation has been established) is assumed to represent the greatest area contributing to the concrete diversion ditches.

Input:

Computer modeling (SEDCAD + Version 3.1) of TR-55.

1. Determine drainage areas. (Planimetered from Reference 4).

Subwatershed Area	Acres
1	1.51
2	3.85
3	4.33
4	3.42
5	2.50
6	5.10
7	4.85
8	1.50
9	7.12
10	5.40
11	2.35
12	2.05
13	6.60
14	3.20
Total	**53.78**

2. Determine the time of concentration, T_c (Refer to Reference 4).

The time of concentrations were input into the computer model SEDCAD + Version 3.1.

3. The above information was input into the SEDCAD + Version 3.1 computer model and the following runoff volumes and peak discharge flow rates were determined:

Diversion Ditch Reach	Peak Runoff Volume (ac-ft)	Design Flow (cfs)
1	1.35	18
2	1.35	18
3	1.35	18
4	1.35	18
5	1.83	24
6	2.82	32
7	2.82	32
8	3.56	42
9	5.31	57
10	5.31	57
11	0.26	2
12	0.49	5
13	1.22	14
14	1.22	14
15	1.22	14
Groin Ditch No. 1	0.28	4
Groin Ditch No. 2	0.54	7

Diversion Ditch Evaluation

For ease of construction, all concrete diversion ditches will be have the same design dimensions as well as all vegetated ditches, unless calculations done justify the need for other dimensions. The above calculated design flow rates, along with the ditch design criteria, were input into SEDCAD Channel Utility program. The SEDCAD output was compared against permissible velocities and minimum freeboard requirements.

Computer modeling (SEDCAD + Version 3.1) Channel Design Utility.

1. Refer to Reference 4 for location and slopes of ditches.

2. Refer to attached sheets for ditch dimensions and ditch performance.

CMP Culvert Evaluations

At approximately Station 9+50 along Haul Road No. 1, a CMP arch culvert exists to carry flow from the diversion ditch underneath the road. A 24-inch CMP culvert also exists under the entrance to the soil cover stockpile area to carry flow from upslope undisturbed areas to the diversion ditch.

1. Refer to Reference 4 for location and slopes of culverts.

2. Refer to attached sheets for culvert dimensions, and culvert performance.

Sedimentation Pond Evaluation

The concrete diversion ditches are routed through the Sedimentation Pond prior to discharging to the energy dissipator and ultimately the stone and concrete culvert that runs under the Bessemer and Lake Erie Railroad. The as-built dimensions for the Sedimentation Pond were input into SEDCAD. The pond was checked to determine if it is capable of handling flows from the 25-year, 24-hour design storm event. Based on the attached SEDCAD output the peak stage for the 25-year, 24-hour storm event reaches el. 897.0. This is less than the elevation of the emergency spillway, el. 897.50.

Diversion Ditches Evaluation

SEDCAD + Version 3.1
Channel Utility Program
(25 year, 24 hour storm)

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

SOUTHERN AND NORTHERN DIVERSION DITCHES HYDROLOGIC EVALUATION
(25 year, 24 hour storm)

by

Name: MAZ

Company Name: EARTH SCIENCES CONSULTANTS, INC.
File Name: C:\2779\DITCHES

Date: 10-04-1995

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\DITCHES User: MAZ
Date: 10-04-1995 Time: 08:07:51
Southern and Northern Diversion Ditches Hydrologic Evaluation
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
1	1	2	1	8	570.55	4.40	6.29	0.03	0.025	0.393
1	1	3	1	8	351.89	10.40	9.67	0.01		
			2	8	185.07	2.70	4.93	0.01	0.020	0.412
1	1	4	1	8	244.20	18.80	13.01	0.01	0.005	0.442
2	1	1	1	8	304.37	25.40	15.12	0.01		
			2	8	219.65	20.90	13.71	0.00	0.009	0.447
2	2	2	1	8	231.36	10.90	9.90	0.01	0.006	0.426
2	2	3	1	8	213.62	29.30	16.24	0.00		
			2	8	365.85	18.10	12.76	0.01		
			3	8	409.24	31.80	16.92	0.01	0.017	0.449

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\DITCHES User: MAZ
Date: 10-04-1995 Time: 08:07:51
Southern and Northern Diversion Ditches Hydrologic Evaluation
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111 1 Area 1	1.51	70	S	0.051	0.000	0.000	0.0	0.21	2.75
111 2 Area 2	3.85	70	S	0.090	0.000	0.000	0.0	0.54	7.01
111 3 Area 3	4.33	70	S	0.060	0.000	0.000	0.0	0.60	7.88
	Type: Null			Label: Areas 1, 2, and 3					
111 Structure	9.69							1.35	
111 Total IN/OUT	9.69				Reaches 1,2,3 & 4			1.35	17.64
112 1 Area 4	3.42	70	S	0.053	0.000	0.000	0.0	0.48	6.23
		Type: Null			Label: Area 4				
112 Structure	3.42							1.83	
112 Total IN/OUT	13.11					Reach 5		1.83	23.87
111 to 112 Routing					0.025	0.393			
113 1 Area 5	2.50	65	S	0.098	0.000	0.000	0.0	0.28	3.69[1]
113 2 Area 6	5.10	70	S	0.128	0.000	0.000	0.0	0.71	4.87
	Type: Null			Label: Areas 5 and 6					
113 Structure	7.60							2.82	
113 Total IN/OUT	20.71					Reaches 6 & 7		2.82	31.65
112 to 113 Routing					0.020	0.412			
114 1 Area 7	4.85	65	S	0.111	0.000	0.000	0.0	0.54	7.15[2]
114 2 Area 8	1.50	70	S	0.028	0.000	0.000	0.0	0.21	2.73
	Type: Null			Label: Areas 7 and 8					
114 Structure	6.35							3.56	
114 Total IN/OUT	27.06					Reach 8		3.56	41.54
113 to 114 Routing					0.005	0.442			
121 1 Area 9	7.12	70	S	0.169	0.000	0.000	0.0	0.99	6.76
		Type: Null			Label: Area 9				
121 Structure	7.12							0.99	
121 Total IN/OUT	7.12							0.99	6.76
211 1 Area 10	5.40	70	S	0.058	0.000	0.000	0.0	0.75	9.83
		Type: Null			Label: Area 10				
211 Structure	5.40							5.31	

211 Total IN/OUT	39.58						Reaches 9 & 10	5.31	57.06
114 to 211 Routing					0.009	0.447			
221 1 Area 11	2.35	65	S	0.170	0.000	0.000	0.0	0.26	1.68
	Type: Null		Label: Area 11						
221 Structure	2.35							0.26	
221 Total IN/OUT	2.35						Reach 11	0.26	1.68
222 1 Area 12	2.05	65	S	0.117	0.000	0.000	0.0	0.23	3.02
	Type: Null		Label: Area 12						
222 Structure	2.05							0.49	
222 Total IN/OUT	4.40						Reach 12	0.49	4.37
221 to 222 Routing					0.006	0.426			
223 1 Area 13	6.60	65	S	0.114	0.000	0.000	0.0	0.73	9.73
	Type: Null		Label: Area 13						
223 Structure	6.60							1.22	
223 Total IN/OUT	11.00						Reaches 13,14, & 15	1.22	14.10
222 to 223 Routing					0.017	0.449			
311 1 Area 14	3.20	70	S	0.044	0.000	0.000	0.0	0.45	5.83
	Type: Pond		Label: Sedimentation Pond						
311 Structure	3.20							6.98	
311 Total IN	53.78							6.98	76.99
311 Total OUT								6.98	72.12
211 to 311 Routing					0.000	0.000			

1 Represents design flow for Groin Ditch No. 1

2 Represents design flow for Groin Ditch No. 2

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\DITCHES User: MAZ
Date: 10-04-1995 Time: 08:07:51
Southern and Northern Diversion Ditches Hydrologic Evaluation
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J B S SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	X
1 1 1 1	-a	1	100.00	10.00	0.80	0.03			
	-b	1	50.00	40.00	1.60	0.01			
	-c	8	250.00	8.00	8.49	0.01	0.051		
1 1 1 2	-a	1	100.00	5.00	0.57	0.05			
	-b	1	50.00	20.00	1.13	0.01			
	-c	7	180.00	22.00	9.44	0.01			
	-d	8	400.00	2.40	4.65	0.02	0.090		
1 1 1 3	-a	1	100.00	25.00	1.26	0.02			
	-b	8	160.00	1.30	3.42	0.01			
	-c	8	270.00	10.40	9.67	0.01			
	-d	8	265.00	1.94	4.18	0.02	0.060		
1 1 2 1	-a	1	150.00	33.30	1.46	0.03			
	-b	8	570.00	4.40	6.29	0.03	0.053		
1 1 3 1	-a	2	30.00	50.00	3.54	0.00			
	-b	6	490.00	1.00	1.50	0.09			
	-c	8	330.00	30.00	16.43	0.01	0.098		
1 1 3 2	-a	1	150.00	8.70	0.75	0.06			
	-b	7	530.00	9.40	6.17	0.02			
	-c	1	150.00	30.00	1.39	0.03			
	-d	8	540.00	7.40	8.16	0.02	0.128		
1 1 4 1	-a	2	30.00	50.00	3.54	0.00			
	-b	6	560.00	1.00	1.50	0.10			
	-c	8	305.00	30.00	16.43	0.01	0.111		
1 1 4 2	-a	1	100.00	20.00	1.13	0.02			
	-b	8	170.00	18.80	13.01	0.00	0.028		
1 2 1 1	-a	1	150.00	6.70	0.65	0.06			
	-b	7	400.00	18.80	8.73	0.01			
	-c	8	540.00	10.20	9.58	0.02			
	-d	1	320.00	20.30	1.14	0.08	0.169		
2 1 1 1	-a	1	150.00	16.70	1.03	0.04			
	-b	7	300.00	25.00	10.06	0.01			
	-c	8	295.00	25.40	15.12	0.01			
	-d	8	215.00	20.90	13.71	0.00	0.058		
2 2 1 1	-a	2	30.00	50.00	3.54	0.00			
	-b	6	850.00	1.00	1.50	0.16			

	-c	8	240.00	4.70	6.50	0.01	0.170
2 2 2 1	-a	2	30.00	50.00	3.54	0.00	
	-b	6	600.00	1.00	1.50	0.11	
	-c	8	150.00	10.90	9.90	0.00	0.117
2 2 3 1	-a	2	30.00	50.00	3.54	0.00	
	-b	6	520.00	1.00	1.50	0.10	
	-c	8	420.00	17.80	12.66	0.01	
	-d	8	390.00	31.80	16.92	0.01	0.114
3 1 1 1	-a	1	150.00	26.70	1.31	0.03	
	-b	7	500.00	31.00	11.21	0.01	0.044

Land Flow Condition Use Categories

1 Forest with heavy ground litter (overland flow)
2 Minimum tillage cultivation (overland flow)
3 Short grass pasture (overland flow)
4 Cultivated straight row (overland flow)
5 Nearly bare and untilled and alluvial valley fans (overland flow)
6 Grassed waterway
7 Paved area (sheet flow) and small upland gullies
8 Large gullies, diversions, and low flowing streams
9 Small streams flowing bankfull

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 1

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	18.00 cfs	
Slope	8.40 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.50 ft
with Freeboard	1.00 ft
Top Width	3.25 ft
with Freeboard	4.75 ft
Velocity	14.36 fps
Cross Sectional Area	1.25 sq ft
Hydraulic Radius	0.35 ft
Froude Number	4.08

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 2

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	18.00 cfs	
Slope	1.33 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.82 ft
with Freeboard	1.32 ft
Top Width	4.20 ft
with Freeboard	5.70 ft
Velocity	7.39 fps
Cross Sectional Area	2.44 sq ft
Hydraulic Radius	0.52 ft
Froude Number	1.71

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 3

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	18.00 cfs	
Slope	10.40 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.47 ft
with Freeboard	0.97 ft
Top Width	3.17 ft
with Freeboard	4.67 ft
Velocity	15.50 fps
Cross Sectional Area	1.16 sq ft
Hydraulic Radius	0.34 ft
Froude Number	4.51

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 4

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	18.00 cfs	
Slope	1.94 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.74 ft
with Freeboard	1.24 ft
Top Width	3.97 ft
with Freeboard	5.47 ft
Velocity	8.48 fps
Cross Sectional Area	2.12 sq ft
Hydraulic Radius	0.48 ft
Froude Number	2.04

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 5

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	24.00 cfs	
Slope	4.40 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.70 ft
with Freeboard	1.20 ft
Top Width	3.84 ft
with Freeboard	5.34 ft
Velocity	12.35 fps
Cross Sectional Area	1.94 sq ft
Hydraulic Radius	0.46 ft
Froude Number	3.06

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 6

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	31.65 cfs	
Slope	10.00 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.65 ft
with Freeboard	1.15 ft
Top Width	3.69 ft
with Freeboard	5.19 ft
Velocity	17.94 fps
Cross Sectional Area	1.76 sq ft
Hydraulic Radius	0.43 ft
Froude Number	4.58

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 7

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	31.65 cfs	
Slope	2.70 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.91 ft
with Freeboard	1.41 ft
Top Width	4.48 ft
with Freeboard	5.98 ft
Velocity	11.14 fps
Cross Sectional Area	2.84 sq ft
Hydraulic Radius	0.56 ft
Froude Number	2.47

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 8

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	41.54 cfs	
Slope	18.80 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.63 ft
with Freeboard	1.13 ft
Top Width	3.65 ft
with Freeboard	5.15 ft
Velocity	24.30 fps
Cross Sectional Area	1.71 sq ft
Hydraulic Radius	0.42 ft
Froude Number	6.26

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 9

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	57.06 cfs	
Slope	25.40 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.69 ft
with Freeboard	1.19 ft
Top Width	3.83 ft
with Freeboard	5.33 ft
Velocity	29.59 fps
Cross Sectional Area	1.93 sq ft
Hydraulic Radius	0.45 ft
Froude Number	7.34

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 10

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	57.06 cfs	
Slope	20.90 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.73 ft
with Freeboard	1.23 ft
Top Width	3.93 ft
with Freeboard	5.43 ft
Velocity	27.57 fps
Cross Sectional Area	2.07 sq ft
Hydraulic Radius	0.47 ft
Froude Number	6.70

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 11

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	2.00 cfs	
Slope	4.70 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.17 ft
with Freeboard	0.67 ft
Top Width	2.26 ft
with Freeboard	3.76 ft
Velocity	5.91 fps
Cross Sectional Area	0.34 sq ft
Hydraulic Radius	0.14 ft
Froude Number	2.69

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 12

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	5.00 cfs	
Slope	10.90 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.23 ft
with Freeboard	0.73 ft
Top Width	2.43 ft
with Freeboard	3.93 ft
Velocity	10.61 fps
Cross Sectional Area	0.47 sq ft
Hydraulic Radius	0.18 ft
Froude Number	4.24

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 13

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	14.00 cfs	
Slope	29.30 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.31 ft
with Freeboard	0.81 ft
Top Width	2.67 ft
with Freeboard	4.17 ft
Velocity	20.64 fps
Cross Sectional Area	0.68 sq ft
Hydraulic Radius	0.24 ft
Froude Number	7.21

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 14

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	14.00 cfs	
Slope	18.10 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.35 ft
with Freeboard	0.85 ft
Top Width	2.81 ft
with Freeboard	4.31 ft
Velocity	17.46 fps
Cross Sectional Area	0.80 sq ft
Hydraulic Radius	0.27 ft
Froude Number	5.76

SEDCAD+ NONERODIBLE CHANNEL DESIGN

DIVERSION DITCH REACH 15

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	14.00 cfs	
Slope	31.80 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.30 ft
with Freeboard	0.80 ft
Top Width	2.65 ft
with Freeboard	4.15 ft
Velocity	21.21 fps
Cross Sectional Area	0.66 sq ft
Hydraulic Radius	0.23 ft
Froude Number	7.49

SEDCAD+ NONERODIBLE CHANNEL DESIGN

GROIN CHANNEL NO. 1

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	4.00 cfs	
Slope	22.20 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.16 ft
with Freeboard	0.66 ft
Top Width	2.23 ft
with Freeboard	3.73 ft
Velocity	12.45 fps
Cross Sectional Area	0.32 sq ft
Hydraulic Radius	0.14 ft
Froude Number	5.80

SEDCAD+ NONERODIBLE CHANNEL DESIGN

GROIN CHANNEL NO. 2

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	7.00 cfs	
Slope	31.70 %	
Sideslopes	1.50:1 (L)	1.50:1 (R)
Bottom Width	1.75 ft	
Manning's n	0.015	
Material	CONCRETE	
Freeboard	.5 ft	

RESULTS:

Depth	0.20 ft
with Freeboard	0.70 ft
Top Width	2.35 ft
with Freeboard	3.85 ft
Velocity	16.95 fps
Cross Sectional Area	0.41 sq ft
Hydraulic Radius	0.17 ft
Froude Number	7.13

Supporting References

different design can meet the requirements of subsection (f), slopes shall be designed, installed and maintained as follows:

(1) The grade of the final surface of the facility may not be less than 3%.

(2) If the Department approves final grades of more than 15%:

(i) The operator shall construct a horizontal terrace at least 15 feet wide on the slope for every 25 feet maximum rise in elevations on the slope. The terrace width shall be measured as the horizontal distance between slope segments.

(ii) The gradient of the terrace shall be 5% into the landfill.

(iii) Drainage ditches shall be constructed on each horizontal terrace to convey flows.

(3) An operator may not leave final slopes that have a grade exceeding 33%, including slopes between benched terraces.

§ 288.235. Noncontiguous borrow areas.

Extraction and removal of cover and related material from offsite borrow areas shall be subject to a permit from the Department under the Noncoal Surface Mining Conservation and Reclamation Act (52 P. S. §§ 3301—3326), The Clean Streams Law and regulations promulgated thereunder, including Chapter 102 (relating to erosion control). Borrow areas located less than 300 feet from the disposal area shall be included in the permit area for the disposal facility as part of the permit application under this article.

§ 288.236. Revegetation.

(a) Vegetation shall be established on land affected by a residual waste landfill.

(b) Revegetation shall provide for an effective and permanent vegetative cover of the same seasonal variety as vegetation native to the site and capable of self-regeneration and plant succession. Introduced species may be used when desirable and necessary to achieve the approved postclosure land use. Vegetative cover shall be considered of the same seasonal variety when it consists of a mixture of species that is of equal or superior utility to native vegetation during each season of the year.

(c) Revegetation shall provide a quick-germinating, fast-growing vegetative cover capable of stabilizing the soil surface from erosion.

(d) Disturbed areas shall be seeded and planted when weather and planting conditions permit, but the seeding and planting of disturbed areas shall be performed no later than the first normal period for favorable planting after final grading.

(e) Fertilizer and lime shall be applied to disturbed areas as necessary to maintain plant growth.

(f) Mulch shall be applied to regraded areas where necessary to control erosion, promote germination of seeds and increase the moisture retention of the soil.

§ 288.237. Standards for successful revegetation.

(a) The standard for successful revegetation shall be the percent of groundcover of the vegetation which exists [illegible] the site. The Department will not approve less than a [illegible]% groundcover of permanent plant species. No more than 1% of the total area may have less than 30% groundcover. A single or contiguous area exceeding 3,000 square [illegible]

(b) Trees, woody shrubs or deep-rooted plants may not be planted or allowed to grow on the revegetated area of capped sites, unless otherwise allowed by the Department in the permit based on a demonstration that roots will not penetrate the cap or drainage layer.

WATER QUALITY PROTECTION

§ 288.241. General requirements.

(a) The operator may not cause or allow a point or nonpoint source discharge in violation of The Clean Streams Law from or on the facility to surface waters of this Commonwealth.

(b) A residual waste landfill shall be operated to prevent and control water pollution. An operator shall operate and maintain necessary water treatment facilities until water pollution from the facility has been permanently abated.

(c) The operator may not cause or allow water pollution within or outside the site.

§ 288.242. Soil erosion and sedimentation control.

(a) The operator shall manage surface water and control soil erosion and sedimentation, based on the 24-hour precipitation event in inches to be expected once in 25 years.

(b) The operator shall do the following:

(1) Prevent or minimize surface water percolation into the solid waste deposited at the facility.

(2) Meet the requirements of Chapter 102 (relating to erosion control).

(3) Prevent soil erosion and sedimentation to the maximum extent possible.

(c) When rills or gullies deeper than 9 inches form in areas that have been regraded and planted, the rills and gullies shall be filled, graded or otherwise stabilized and the area reseeded or replanted under §§ 288.236 and 288.237 (relating to revegetation; and standards for successful revegetation). Rills or gullies of lesser size shall be stabilized and the area reseeded or replanted if the rills or gullies are disruptive to the approved postclosure land use or may result in additional erosion and sedimentation.

§ 288.243. Sedimentation ponds.

(a) Surface drainage from the disturbed area, including areas that have been graded, seeded or planted, shall be passed through a sedimentation pond or a series of sedimentation ponds before leaving the site. The Department may, in the permit, waive the required use of sedimentation ponds when a person or municipality demonstrates to the satisfaction of the Department that sedimentation ponds are not necessary to meet the requirements of § 288.241 (relating to general requirements).

(b) Sedimentation ponds shall be constructed, operated and maintained under this section and Chapters 102 and 105 (relating to erosion control; and dam safety and waterway management) and the minimum design criteria contained in the United States Soil Conservation Service's Engineering Standard 378, 'Pond' Pa.

(c) Sedimentation ponds and other treatment facilities shall be maintained until removal of the ponds and facilities is approved by the Department.

(d) Ponds shall include a nonclogging dewatering device approved by the Department that will permit the [illegible] The dewatering

Reference)Pennsylvania Department of Envirnmental Resources Environmental Quality Board, "Residual Waste Management", July 4, 1992.

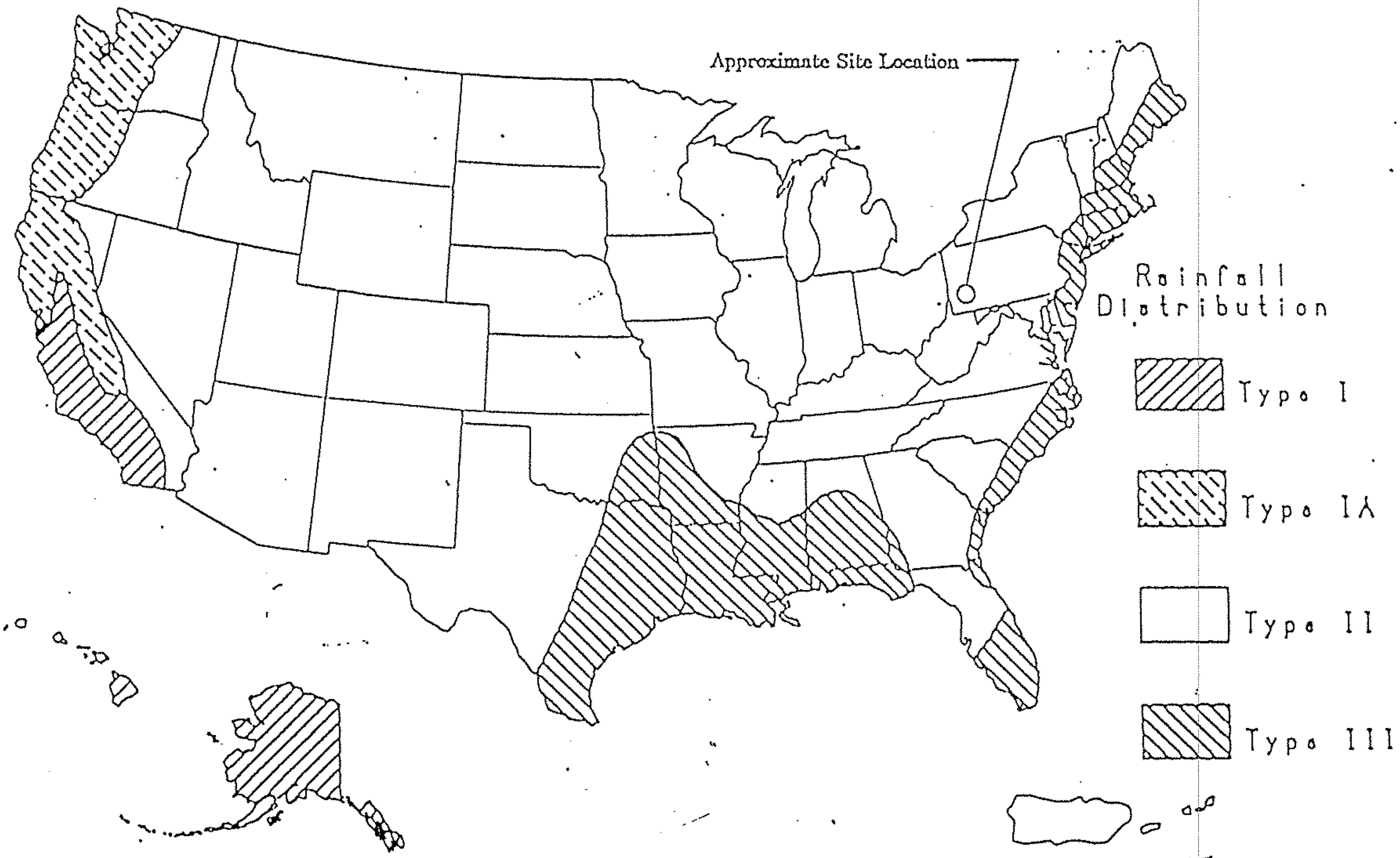
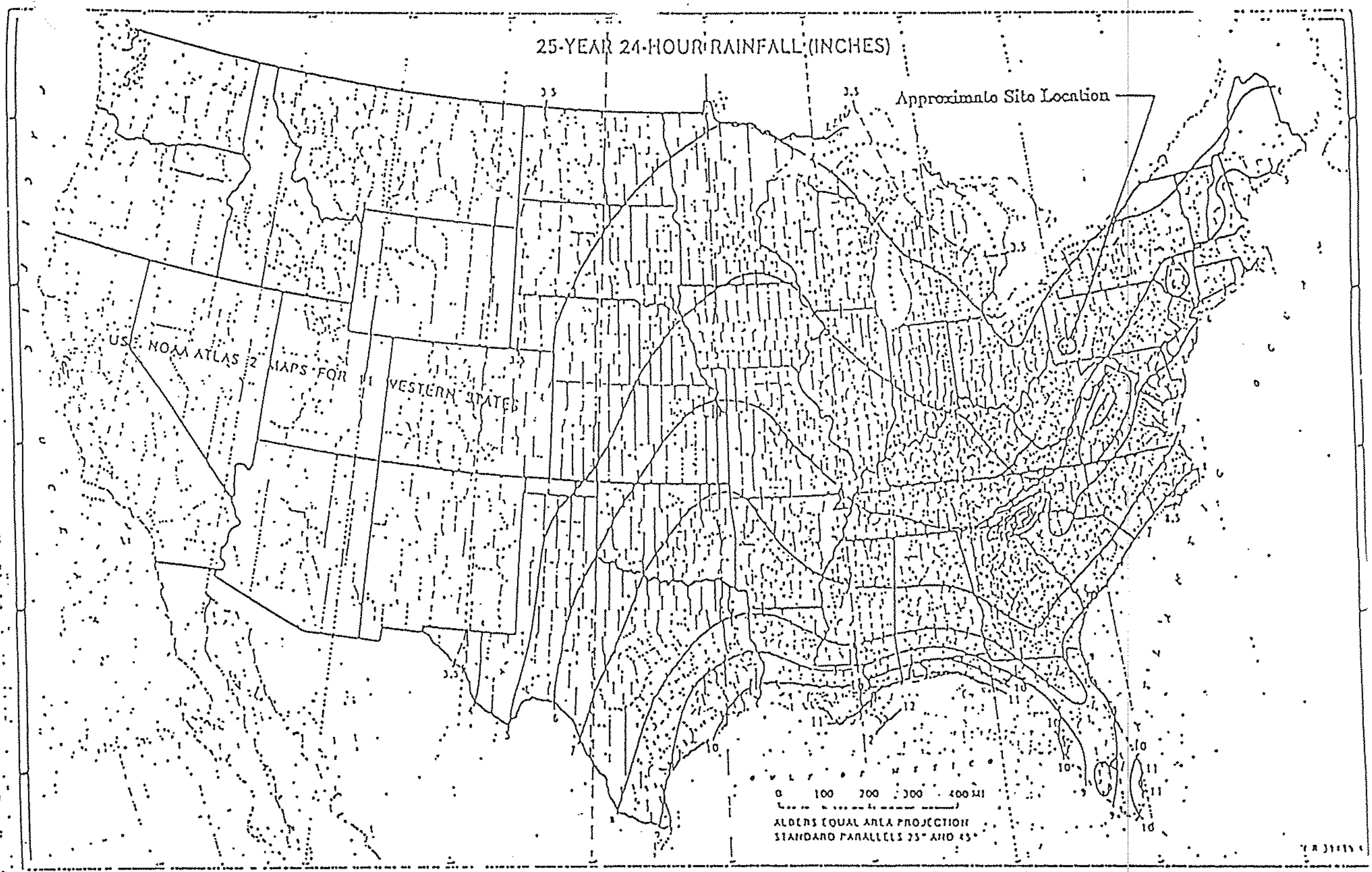


Figure B-2.—Approximate geographic boundaries for SCS rainfall distributions.

Reference: Technical Release Number 55 (TR-55), Urban Hydrology for Small Watersheds, prepared by the U.S. Department of Agriculture, Soil Conservation District, dated 1982.



Reference Technical Release Number 55 (TR-55), Urban Hydrology for Small Watersheds, prepared by the U.S Department of Agriculture, Soil Conservation District, 1982.

25-Year, 24-Hour Storm Event = 4.5 inches

041

Table 2-2c.—Runoff curve numbers for other agricultural lands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	[4]30	48	65	73
Woods—grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	[4]30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

verage runoff condition, and $I_a = 0.2S$.

[2]*Poor:* <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.

[3]*Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4]Actual curve number is less than 30; use CN = 30 for runoff computations.

[5]CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6]*Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

The revegetated areas of the watersheds are assumed to be brush-brush-weed-grass mixture with brush the major element. Curve number for good hydrologic condition, soil group C = 65.

The undisturbed areas of the watershed are assumed to be brush-brush-weed-grass mixture with brush the major element. Curve number for fair hydrologic condition, soil group C = 70

Reference: Technical Release Number 55 (TR-55), Urban Hydrology for Small Watersheds, prepared by the U.S. Department of Agriculture, Soil Conservation District, dated 1982.

ATTACHMENT 2

STORM DRAIN PIPING SYSTEM

Form I
Attachment B

Lefever Road Disposal Site
Storm Drain Evaluation

Prepared by: MZ Date: 10/3/95
Checked by: 9hv Date: 10/4/95

Form I
Attachment B

Lefever Road Disposal Site
Storm Drain Evaluation

Purpose:

To determine if the storm drain system and various culverts running under Haul Road #1 at the Lefever Road Disposal Site are capable of safely managing the runoff from the 25 year, 24 hour storm event.

References:

1) Duquesne Light Company Drawing No. 12079-B17, "Plan and Sections of Storm Drain and Underdrains Phase 1, Step 1"

2) Duquesne Light Company Drawing No. 12079-B18, "Structural Design and Details of Manholes #2 thru #4"

3) Duquesne Light Company Drawing No. 12079-B20, "Structural Design and Details of Manhole #1, Headwall and Endwall Structures"

4) Technical Release No. 55 (TR-55), "Urban Hydrology for Small Watersheds", U.S. Department of Agriculture, Soil Conservation District, 1982.

5) The computer program SEDCAD, by Civil Software Design, 1992.

6) Pennsylvania Department of Environmental Resources Environmental Quality Board, "Residual Waste Management", July 4, 1992.

7) Earth Sciences Consultants, Inc., Drawing No. 16691-C7, "Step 1 Storm Drain - Watershed Area Hydrology Map."

8) Daugherty, Robert L., et. al. 1985, Fluid Mechanics with Engineering Applications, Eighth Edition.

Methodology:

First, all subwatersheds that drain to storm drain inlets were identified on the map in Reference 7. The subwatersheds were planimetered to determine their area and the time of concentration paths (which include overland, swale, and channel flow) of each subwatershed were identified and measured. Next, based on Table 2-2c from Reference 4, a Curve Number of 70 was chosen to represent the average land conditions of each subwatershed. At this point, the above information was input to SEDCAD and the program developed runoff hydrographs for each subwatershed involved. These hydrographs were routed through the storm drain inlets and combined at the junction of the South, North, and Main storm drain branches, which is Manhole #4. At this manhole and all subsequent manholes, detention storage was accounted for by inputing to SEDCAD a stage-storage relationship for the manhole (developed from References 2 and 3) and allowing SEDCAD to compute the discharge from the manhole by supplying information on the outlet storm drain pipe (obtained from Reference 1). Runoff from the 25 year, 24 hour storm was routed through the entire storm drain system using the above methodology to obtain peak flows in each reach of the storm drain system. Each reach was analyzed by computing the amount of headwater required to pass the peak flow and determining whether that headwater could be safely provided at the up-stream end of the storm drain reach.

In addition, four culverts which run under haul road #1 and convey flow to the storm drain system were evaluated. Subwatersheds draining to these culverts were identified and information on their areas and T_c paths were entered into SEDCAD to develop peak flow rates. Once the peak flows to each culvert were computed, the culvert was analyzed using SEDCAD to determine if it could safely manage the design flow with minimal headwater. Areas involved in the culvert analysis are shown on Figure 1, attached.

SEDCAD Input/Subwatershed Data:

Subwatershed	Area (Acres)	Curve Number
A1	11.41	70
A2	8.23	70
A3	29.9	70
A-MH 2	0.23	70
A-MH 1	0.17	70

Assumptions:

1) The storm drain system was evaluated in Step 1 because this step represents the worst-case conditions under which the storm drain system will have to perform. The area contributing runoff to the storm drain system is greater in Step 1 than in any other step, thus the peak flows which the storm drain will have to handle will be greatest during this step of landfill development.

2) Design rainfall for Indiana Township, Allegheny County.

   25 year, 24 hour storm = 4.5 inches of total precipitation.(See rainfall distribution map, Reference 4 and excerpt from Reference 6, attached)

3) Manning's roughness coefficient for corrugated metal pipe is equal to 0.024. (See Table 11.1 from Reference 8, attached)

4) Travel time for flow between reaches of the storm drain was assumed to be zero. This assumption is reasonable due to the short reach lengths and steep slopes of the storm drain pipes. This assumption is conservative because shorter travel times ultimately result in higher peak flow rates.

5) Tailwater depth for each reach of storm drain was assumed to be equal to the diameter of the receiving pipe (i.e. full flow conditions).

6) All watersheds were assigned a curve number of 70 representing woods in good condition. Refer to Table 2-2c of Reference 4, attached, for justification of this value.

Conclusion:

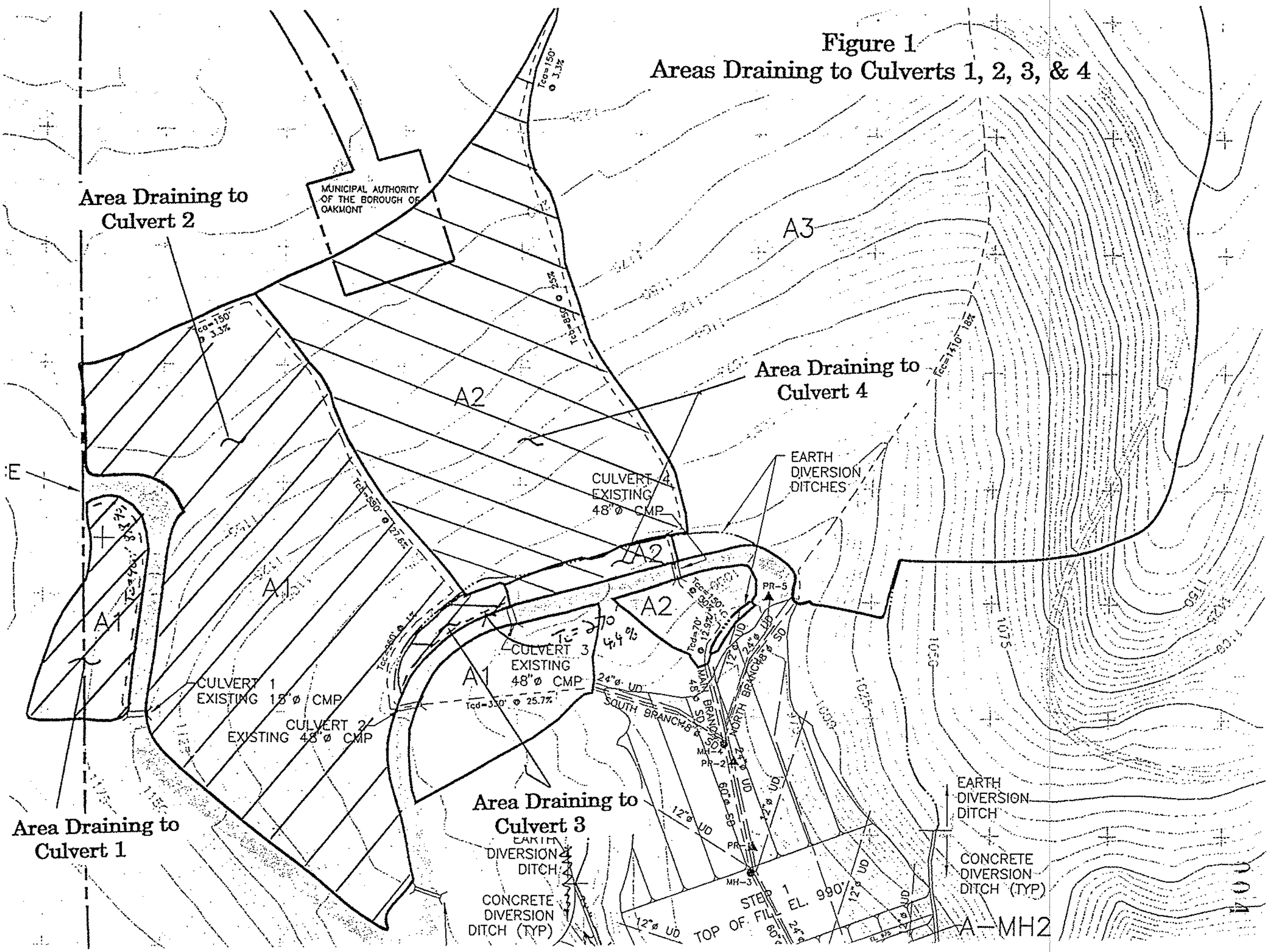
All reaches of the storm drain system as well as each culvert are capable of safely managing the runoff from the 25 year, 24 hour storm. The following tables summarize the performance of the each reach of storm drain and each culvert:

Stormdrain Reach (diameter)	Design Flow	Required Headwater
South Branch (48 in.)	16.33 cfs	1.6 ft.
North Branch (48 in.)	54.5 cfs	3.5 ft.
Main Branch (48 in.)	15 cfs	1.5 ft.
Main Branch (60 in.)	83.81 cfs.	4.1 ft.
Main Branch (60 in.)	83.41 cfs.	4.1 ft.
Main Branch (60 in)	83.39 cfs.	4.1 ft.
Main Branch (84 in.)	83.30 cfs.	3.3 ft.

Culvert (diameter)	Design Flow	Required Headwater
1 (15 in.)	2.2 cfs	0.9 ft.
2 (48 in.)	12.7 cfs	1.3 ft.
3 (48 in.)	0.5 cfs	approx. 0
4 (48 in.)	14.3 cfs	0.85 ft.

The complete SEDCAD output is attached in the pages that follow.

Figure 1
Areas Draining to Culverts 1, 2, 3, & 4



CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

LEFEVER DISPOSAL SITE: STORM DRAIN EVALUATION (STEP 1)
(25 year, 24 hour storm)

by

Name: MAZ

Company Name: EARTH SCIENCES CONSULTANTS, INC.
File Name: C:\2779\STMDRN2

Date: 09-28-1995

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\STMDRN2 User: MAZ
Date: 09-28-1995 Time: 14:39:19
LeFever Disposal Site: Storm Drain Evaluation (Step 1)
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111 1 Area A1	11.41	70	M	0.138	0.000	0.000	0.0	1.59	16.33
Type: Culvert Label: South Branch									
111 Structure	11.41							1.59	
111 Total IN/OUT	11.41							1.59	16.33
121 1 Area A2	8.23	70	M	0.086	0.000	0.000	0.0	1.15	14.98
Type: Culvert Label: Main Branch (48 inch)									
121 Structure	8.23							1.15	
121 Total IN/OUT	8.23							1.15	14.98
131 1 Area A3	29.90	70	M	0.092	0.000	0.000	0.0	4.17	54.44
Type: Culvert Label: North Branch									
131 Structure	29.90							4.17	
131 Total IN/OUT	29.90							4.17	54.44
Type: Pond Label: Manhole 4									
211 Structure	29.90							6.91	
211 Total IN	49.54							6.91	83.81
211 Total OUT								6.91	83.41
111 to 211 Routing					0.000	0.000			
Type: Pond Label: Manhole 3									
212 Structure	29.90							6.91	
212 Total IN	49.54							6.91	83.41
212 Total OUT								6.91	83.05
211 to 212 Routing					0.000	0.000			
213 1	0.23	65	M	0.019	0.000	0.000	0.0	0.03	0.34
Type: Pond Label: Manhole 2									
213 Structure	0.23							6.94	
213 Total IN	49.77							6.94	83.39
213 Total OUT								6.94	83.05
212 to 213 Routing					0.000	0.000			

```
214  1                 0.17   65  M   0.014  0.000 0.000     0.0      0.02       0.25
                          Type: Pond    Label: Manhole 1
214 Structure          0.17                                           6.95
-------------------------------------------------------------------------------
214 Total IN          49.94                                           6.95      83.30
214 Total OUT                                                         6.95      83.02
===============================================================================
213 to 214 Routing                           0.000 0.000
===============================================================================
```

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\STMDRN2 User: MAZ
Date: 09-28-1995 Time: 14:39:19
LeFever Disposal Site: Storm Drain Evaluation (Step 1)
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J B S SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	X
1 1 1 1	-a	1	150.00	3.30	0.46	0.09			
	-b	7	580.00	27.60	10.58	0.02			
	-c	8	250.00	1.00	3.00	0.02			
	-d	7	330.00	25.70	10.20	0.01	0.138		
1 2 1 1	-a	2	150.00	3.30	0.91	0.05			
	-b	7	850.00	25.00	10.06	0.02			
	-c	2	150.00	30.00	2.74	0.02			
	-d	8	70.00	12.90	10.77	0.00	0.086		
1 3 1 1	-a	1	150.00	16.70	1.03	0.04			
	-b	7	150.00	10.00	6.37	0.01			
	-c	7	1410.00	18.40	8.63	0.05	0.092		
2 1 3 1	-a	2	30.00	50.00	3.54	0.00			
	-b	6	90.00	1.00	1.50	0.02	0.019		
2 1 4 1	-a	2	40.00	50.00	3.54	0.00			
	-b	6	60.00	1.00	1.50	0.01	0.014		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\STMDRN2 User: MAZ
Date: 09-28-1995 Time: 14:39:19
LeFever Disposal Site: Storm Drain Evaluation (Step 1)
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

NON-POND STRUCTURE INPUT/OUTPUT TABLE

J1, B1, S1
South Branch

Drainage Area from J1, B1, S1, SWS(s)1: 11.4 acres
Total Contributing Drainage Area: 11.4 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	4.0	245.4	16.7	0.024	5.0

Minimum Pipe Diameter Required: 21.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	1.59	16.33

****

J1, B2, S1
Main Branch (48 inch)

Drainage Area from J1, B2, S1, SWS(s)1: 8.2 acres
Total Contributing Drainage Area: 8.2 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	4.0	112.0	32.0	0.024	5.0

Minimum Pipe Diameter Required: 18.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	1.15	14.98

****

J1, B3, S1
North Branch

Drainage Area from J1, B3, S1, SWS(s)1: 29.9 acres
Total Contributing Drainage Area: 29.9 acres

Entrance Loss Coefficient	Maximum Headwater (ft)	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Tailwater (ft)
0.50	20.0	300.9	7.5	0.024	5.0

Minimum Pipe Diameter Required: 30.0 inches
(See Culvert Utility Program for full performance curves)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	4.17	54.44

****

SEDCAD+ CULVERT SIZING UTILITY

Stormdrain - South Branch

Design Discharge	=	16.330 cfs
Entrance Loss Coefficient	=	0.5
Pipe Length	=	245.400 feet
Pipe Slope	=	16.700 %
Manning's n	=	0.024
Maximum Headwater	=	2.000 feet
Tailwater Depth	=	5.000 feet

PERFORMANCE CURVE:

Diameter: 48 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.82	Inlet (Supercritical)	3
0.40	2.13	Inlet (Supercritical)	4
0.60	3.90	Inlet (Supercritical)	4
0.80	5.99	Inlet (Supercritical)	4
1.00	8.38	Inlet (Supercritical)	4
1.20	11.01	Inlet (Supercritical)	4
1.40	13.87	Inlet (Supercritical)	4
1.60	16.95	Inlet (Supercritical)	4
1.80	20.23	Inlet (Supercritical)	4
2.00	23.69	Inlet (Supercritical)	4
2.20	27.33	Inlet (Supercritical)	4
2.40	31.14	Inlet (Supercritical)	4
2.60	35.11	Inlet (Supercritical)	4
2.80	39.24	Inlet (Supercritical)	4
3.00	43.52	Inlet (Supercritical)	4

To pass the design flow of 16.33 cfs, the 48 inch pipe needs only 1.6 feet of headwater.

SEDCAD+ CULVERT SIZING UTILITY

Stormdrain - North Branch Inlet

Design Discharge	=	54.500 cfs
Entrance Loss Coefficient	=	0.5
Pipe Length	=	300.900 feet
Pipe Slope	=	7.500 %
Manning's n	=	0.024
Maximum Headwater	=	4.000 feet
Tailwater Depth	=	5.000 feet

Smallest Diameter Required to Pass Flow is 42 inches

PERFORMANCE CURVE:

Diameter: 48 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	2.13	Inlet (Supercritical)	4
0.80	5.99	Inlet (Supercritical)	4
1.20	11.01	Inlet (Supercritical)	4
1.60	16.95	Inlet (Supercritical)	4
2.00	23.69	Inlet (Supercritical)	4
2.40	31.14	Inlet (Supercritical)	4
2.80	39.24	Inlet (Supercritical)	4
3.20	47.94	Inlet (Supercritical)	4
3.60	57.21	Inlet (Supercritical)	4
4.00	67.00	Inlet (Supercritical)	4
4.40	77.30	Inlet (Supercritical)	4
4.80	87.11	Outlet	6
5.20	95.23	Inlet	8
5.60	103.11	Inlet	8
6.00	110.44	Inlet	8

To pass the design flow of 54.5 cfs, the 48 inch pipe needs approximately 3.5 feet of headwater.

SEDCAD+ CULVERT SIZING UTILITY

Stormdrain - Main Branch Inlet

Design Discharge	=	15.000 cfs
Entrance Loss Coefficient	=	0.5
Pipe Length	=	112.000 feet
Pipe Slope	=	32.000 %
Manning's n	=	0.024
Maximum Headwater	=	2.000 feet
Tailwater Depth	=	5.000 feet

Smallest Diameter Required to Pass Flow is 36 inches

PERFORMANCE CURVES:

Diameter: 48 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.20	0.82	Inlet (Supercritical)	3
0.40	2.13	Inlet (Supercritical)	4
0.60	3.90	Inlet (Supercritical)	4
0.80	5.99	Inlet (Supercritical)	4
1.00	8.38	Inlet (Supercritical)	4
1.20	11.01	Inlet (Supercritical)	4
1.40	13.87	Inlet (Supercritical)	4
1.60	16.95	Inlet (Supercritical)	4
1.80	20.23	Inlet (Supercritical)	4
2.00	23.69	Inlet (Supercritical)	4
2.20	27.33	Inlet (Supercritical)	4
2.40	31.14	Inlet (Supercritical)	4
2.60	35.11	Inlet (Supercritical)	4
2.80	39.24	Inlet (Supercritical)	4
3.00	43.52	Inlet (Supercritical)	4

To pass the design flow of 15 cfs, the 48 inch diameter pipe needs approximately 1.5 feet of headwater.

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\STMDRN2 User: MAZ
Date: 09-28-1995 Time: 14:39:19
LeFever Disposal Site: Storm Drain Evaluation (Step 1)
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J2, B1, S1
Manhole 4

Drainage Area from J2, B1, S1 29.9 acres
Total Contributing Drainage Area: 49.5 acres

DISCHARGE OPTIONS:

	Trickle Tube
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	60.0
Barrel Length (ft)	227.10
Barrel Slope (%)	7.90
Manning's n of Pipe	0.024
Spillway Elevation	0.1
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	0.5
Tailwater Depth (ft)	5.0

POND RESULTS:

Permanent Pool (ac-ft)
0.0

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	6.91	83.81
OUT	6.91	83.41

Peak Elevation	Hydrograph Detention Time (hrs)
4.1	0.00

****

J2, B1, S2
Manhole 3

Drainage Area from J2, B1, S2		29.9 acres
Total Contributing Drainage Area:		49.5 acres

DISCHARGE OPTIONS:

	Trickle Tube
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	60.0
Barrel Length (ft)	227.00
Barrel Slope (%)	4.40
Manning's n of Pipe	0.024
Spillway Elevation	0.1
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	0.5
Tailwater Depth (ft)	5.0

POND RESULTS:

Permanent Pool (ac-ft)
0.0

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	6.91	83.41
OUT	6.91	83.05

Peak Elevation	Hydrograph Detention Time (hrs)
4.1	0.00

****

J2, B1, S3
Manhole 2

Drainage Area from J2, B1, S3, SWS(s)1: 0.2 acres
Total Contributing Drainage Area: 49.8 acres

DISCHARGE OPTIONS:

	Trickle Tube
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	60.0
Barrel Length (ft)	200.00
Barrel Slope (%)	7.90
Manning's n of Pipe	0.024
Spillway Elevation	0.1
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	0.5
Tailwater Depth (ft)	7.0

POND RESULTS:

Permanent Pool (ac-ft)
0.0

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	6.94	83.39
OUT	6.94	83.05

Peak Elevation	Hydrograph Detention Time (hrs)
4.1	0.00

****

J2, B1, S4
Manhole 1

Drainage Area from J2, B1, S4, SWS(s)1: 0.2 acres
Total Contributing Drainage Area: 49.9 acres

DISCHARGE OPTIONS:

	Trickle Tube
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	84.0
Barrel Length (ft)	200.00
Barrel Slope (%)	3.01
Manning's n of Pipe	0.024
Spillway Elevation	0.1
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	0.5
Tailwater Depth (ft)	0.0

POND RESULTS:

Permanent Pool (ac-ft)
0.0

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	6.95	83.30
OUT	6.95	83.02

Peak Elevation	Hydrograph Detention Time (hrs)
3.3	0.00

****

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\STMDRN2 User: MAZ
Date: 09-28-1995 Time: 14:39:19
LeFever Disposal Site: Storm Drain Evaluation (Step 1)
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J2, B1, S1
Manhole 4

Drainage Area from J2, B1, S1 29.9 acres
Total Contributing Drainage Area: 49.5 acres

SW#1: Trickle Tube

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
0.00	0.00	0.00	0.00	0.00	
0.10	0.10	0.00	0.00	0.00	Stage of SW#1
0.50	0.50	0.00	0.00	2.66	
1.00	1.00	0.00	0.00	8.94	
1.50	1.50	0.00	0.00	17.34	
2.00	2.00	0.00	0.00	27.42	
2.50	2.50	0.00	0.00	38.92	
3.00	3.00	0.00	0.00	51.75	
3.50	3.50	0.00	0.00	65.70	
4.00	4.00	0.00	0.00	80.64	
4.09	4.09	0.00	0.00	83.41	Peak Stage
4.50	4.50	0.00	0.01	96.66	
5.00	5.00	0.00	0.01	113.59	
5.10	5.10	0.00	0.01	117.08	
5.50	5.50	0.00	0.01	131.39	
6.00	6.00	0.00	0.01	150.02	
6.50	6.50	0.00	0.01	163.40	
7.00	7.00	0.00	0.01	177.41	
7.50	7.50	0.00	0.01	190.43	
8.00	8.00	0.00	0.01	202.53	

J2, B1, S2
Manhole 3

Drainage Area from J2, B1, S2 29.9 acres
Total Contributing Drainage Area: 49.5 acres

SW#1: Trickle Tube

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
0.00	0.00	0.00	0.00	0.00	
0.10	0.10	0.00	0.00	0.00	Stage of SW#1
0.50	0.50	0.00	0.00	2.66	
1.00	1.00	0.00	0.00	8.94	
1.50	1.50	0.00	0.00	17.34	

2.00	2.00	0.00	0.00	27.42	
2.50	2.50	0.00	0.00	38.92	
3.00	3.00	0.00	0.00	51.75	
3.50	3.50	0.00	0.00	65.70	
4.00	4.00	0.00	0.00	80.64	
4.08	4.08	0.00	0.00	83.05	Peak Stage
4.50	4.50	0.00	0.01	96.66	
5.00	5.00	0.00	0.01	113.59	
5.10	5.10	0.00	0.01	117.08	
5.50	5.50	0.00	0.01	131.39	
6.00	6.00	0.00	0.01	150.02	
6.50	6.50	0.00	0.01	163.40	
7.00	7.00	0.00	0.01	177.41	
7.50	7.50	0.00	0.01	190.43	
8.00	8.00	0.00	0.01	202.53	

****

J2, B1, S3
Manhole 2

Drainage Area from J2, B1, S3, SWS(s)1: 0.2 acres
Total Contributing Drainage Area: 49.8 acres

SW#1: Trickle Tube

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
0.00	0.00	0.00	0.00	0.00	
0.10	0.10	0.00	0.00	0.00	Stage of SW#1
0.50	0.50	0.00	0.00	2.66	
1.00	1.00	0.00	0.00	8.94	
1.50	1.50	0.00	0.00	17.34	
2.00	2.00	0.00	0.00	27.42	
2.50	2.50	0.00	0.00	38.92	
3.00	3.00	0.00	0.00	51.75	
3.50	3.50	0.00	0.00	65.70	
4.00	4.00	0.00	0.00	80.64	
4.07	4.07	0.00	0.00	83.05	Peak Stage
4.50	4.50	0.00	0.01	96.66	
5.00	5.00	0.00	0.01	113.59	
5.10	5.10	0.00	0.01	117.08	
5.50	5.50	0.00	0.01	131.39	
6.00	6.00	0.00	0.01	150.02	
6.50	6.50	0.00	0.01	163.40	
7.00	7.00	0.00	0.01	177.41	
7.50	7.50	0.00	0.01	190.43	
8.00	8.00	0.00	0.01	202.53	

****

J2, B1, S4
Manhole 1

Drainage Area from J2, B1, S4, SWS(s)1: 0.2 acres
Total Contributing Drainage Area: 49.9 acres

SW#1: Trickle Tube

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
0.00	0.00	0.00	0.00	0.00	
0.10	0.10	0.00	0.00	0.00	Stage of SW#1
0.50	0.50	0.00	0.00	3.72	

1.00	1.00	0.00	0.00	12.52	
1.50	1.50	0.00	0.00	24.28	
2.00	2.00	0.00	0.00	38.39	
2.50	2.50	0.00	0.00	54.57	
3.00	3.00	0.00	0.00	72.42	
3.27	3.27	0.00	0.00	83.02	Peak Stage
3.50	3.50	0.00	0.00	91.91	
4.00	4.00	0.00	0.01	112.91	
4.50	4.50	0.00	0.01	135.30	
5.00	5.00	0.00	0.01	158.99	
5.50	5.50	0.00	0.01	183.94	
6.00	6.00	0.00	0.01	210.05	
6.10	6.10	0.00	0.01	215.43	
6.50	6.50	0.00	0.01	237.32	
7.00	7.00	0.00	0.01	265.67	
7.50	7.50	0.00	0.01	295.06	
8.00	8.00	0.00	0.01	325.46	
8.50	8.50	0.00	0.01	353.81	
9.00	9.00	0.00	0.02	376.16	
9.50	9.50	0.00	0.02	399.82	
10.00	10.00	0.00	0.02	422.10	
10.50	10.50	0.00	0.02	443.28	
11.00	11.00	0.00	0.02	463.50	

****

SEDCAD Culvert Evaluation

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

LEFEVER ROAD DISPOSAL SITE: HAUL ROAD #1 CULVERT EVALUATION
(25 year, 24 hour storm)

by

Name: MAZ

Company Name: EARTH SCIENCES CONSULTANTS, INC.
File Name: C:\2779\CULVERTS

Date: 09-28-1995

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\CULVERTS User: MAZ
Date: 09-28-1995 Time: 15:03:33
LeFever Road Disposal Site: Haul Road #1 Culvert Evaluation
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1 Culvert 1	1.18	70	M	0.012	0.000	0.000	0.0	0.16	2.15
111	2 Culvert 2	8.86	70	M	0.129	0.000	0.000	0.0	1.24	12.68
		Type: Null			Label: Area draining to culverts 1 & 2					
111	Structure	10.04							1.40	
111	Total IN/OUT	10.04							1.40	13.32
121	1 Culvert 3	0.23	70	M	0.011	0.000	0.000	0.0	0.03	0.42
		Type: Null			Label: Area- Culvert 3					
121	Structure	0.23							0.03	
121	Total IN/OUT	0.23							0.03	0.42
131	1 Culvert 4	7.82	70	M	0.069	0.000	0.000	0.0	1.09	14.24
		Type: Null			Label: Area- Culvert 4					
131	Structure	7.82							1.09	
131	Total IN/OUT	7.82							1.09	14.24

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\CULVERTS User: MAZ
Date: 09-28-1995 Time: 15:03:33
LeFever Road Disposal Site: Haul Road #1 Culvert Evaluation
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	1	1	-a	8	400.00	8.80	8.90	0.01	0.012		
1	1	1	2	-a	1	150.00	3.30	0.46	0.09			
				-b	7	580.00	27.60	10.58	0.02			
				-c	8	250.00	1.00	3.00	0.02	0.129		
1	2	1	1	-a	8	270.00	4.40	6.29	0.01	0.011		
1	3	1	1	-a	2	150.00	3.30	0.91	0.05			
				-b	7	850.00	25.00	10.06	0.02	0.069		

SEDCAD+ CULVERT SIZING UTILITY

Culvert 1

Design Discharge	=	2.200 cfs
Entrance Loss Coefficient	=	0.5
Pipe Length	=	80.000 feet
Pipe Slope	=	6.000 %
Manning's n	=	0.024
Maximum Headwater	=	1.250 feet
Tailwater Depth	=	0.000 feet

Smallest Diameter Required to Pass Flow is 12 inches

PERFORMANCE CURVE:

Diameter: 15 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.13	0.24	Outlet (Subcritical)	1
0.25	0.47	Outlet (Subcritical)	1
0.38	0.71	Outlet (Subcritical)	2
0.50	0.95	Inlet (Supercritical)	3
0.63	1.32	Inlet (Supercritical)	3
0.75	1.72	Inlet (Supercritical)	3
0.88	2.15	Inlet (Supercritical)	3
1.00	2.63	Inlet (Supercritical)	3
1.13	3.13	Inlet (Supercritical)	3
1.25	3.67	Inlet (Supercritical)	3
1.38	4.20	Inlet (Supercritical)	3
1.50	4.71	Inlet (Supercritical)	4
1.63	5.18	Inlet	5
1.75	5.61	Inlet	5
1.88	6.03	Inlet	5

SEDCAD+ CULVERT SIZING UTILITY

Culvert 2

Design Discharge	=	12.700 cfs
Entrance Loss Coefficient	=	0.5
Pipe Length	=	80.000 feet
Pipe Slope	=	6.000 %
Manning's n	=	0.024
Maximum Headwater	=	1.500 feet
Tailwater Depth	=	0.000 feet

Smallest Diameter Required to Pass Flow is 42 inches

Performance Curve:

Diameter: 48 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.15	0.62	Outlet (Subcritical)	2
0.30	1.40	Inlet (Supercritical)	3
0.45	2.54	Inlet (Supercritical)	3
0.60	3.90	Inlet (Supercritical)	3
0.75	5.45	Inlet (Supercritical)	3
0.90	7.15	Inlet (Supercritical)	3
1.05	9.01	Inlet (Supercritical)	3
1.20	11.01	Inlet (Supercritical)	3
1.35	13.14	Inlet (Supercritical)	3
1.50	15.39	Inlet (Supercritical)	3
1.65	17.75	Inlet (Supercritical)	3
1.80	20.23	Inlet (Supercritical)	3
1.95	22.81	Inlet (Supercritical)	3
2.10	25.49	Inlet (Supercritical)	3
2.25	28.27	Inlet (Supercritical)	3

SEDCAD+ CULVERT SIZING UTILITY

Culvert 3

Design Discharge	=	0.500 cfs
Entrance Loss Coefficient	=	0.5
Pipe Length	=	50.000 feet
Pipe Slope	=	3.000 %
Manning's n	=	0.024
Maximum Headwater	=	4.000 feet
Tailwater Depth	=	0.000 feet

Smallest Diameter Required to Pass Flow is 6 inches

PERFORMANCE CURVE:

Diameter: 6 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.40	0.08		0
0.80	0.16	Outlet (Subcritical)	1
1.20	0.24	Outlet (Subcritical)	1
1.60	0.32	Outlet (Subcritical)	2
2.00	0.40	Outlet (Subcritical)	2
2.40	0.49	Inlet (Supercritical)	3
2.80	0.57	Inlet (Supercritical)	3
3.20	0.65	Inlet (Supercritical)	4
3.60	0.73	Inlet (Supercritical)	4
4.00	0.81	Inlet	5
4.40	0.89	Inlet	5
4.80	0.97	Outlet	6
5.20	1.01	Outlet	6
5.60	1.04	Outlet	6
6.00	1.06	Outlet	6

*** SEDCAD will not compute a performance curve for a 48 inch diameter pipe with a design flow this small (0.5 cfs).**

SEDCAD+ CULVERT SIZING UTILITY

Culvert 4

Design Discharge	=	14.300 cfs
Entrance Loss Coefficient	=	0.5
Pipe Length	=	50.000 feet
Pipe Slope	=	1.000 %
Manning's n	=	0.024
Maximum Headwater	=	1.500 feet
Tailwater Depth	=	0.000 feet

Smallest Diameter Required to Pass Flow is 36 inches

PERFORMANCE CURVES:

Diameter: 48 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.15	4.75	Outlet (Subcritical)	1
0.30	6.82	Outlet (Subcritical)	1
0.45	9.04	Outlet (Subcritical)	1
0.60	11.33	Outlet (Subcritical)	1
0.75	13.62	Outlet (Subcritical)	1
0.90	15.88	Outlet (Subcritical)	1
1.05	18.09	Outlet (Subcritical)	1
1.20	20.23	Outlet (Subcritical)	1
1.35	22.31	Outlet (Subcritical)	1
1.50	24.32	Outlet (Subcritical)	1
1.65	26.27	Outlet (Subcritical)	1
1.80	28.16	Outlet (Subcritical)	1
1.95	29.99	Outlet (Subcritical)	1
2.10	31.76	Outlet (Subcritical)	1
2.25	33.48	Outlet (Subcritical)	1

Supporting References

Table 2-2c.—Runoff curve numbers for other agricultural lands[1]

Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	[4]30	48	65	73
Woods—grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	[4]30	55	$\boxed{70}$	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

Cover description: Cover type, Hydrologic condition. Curve numbers for hydrologic soil group— A, B, C, D.

[1]Average runoff condition, and $I_a = 0.2S$.

[2]*Poor:* <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.

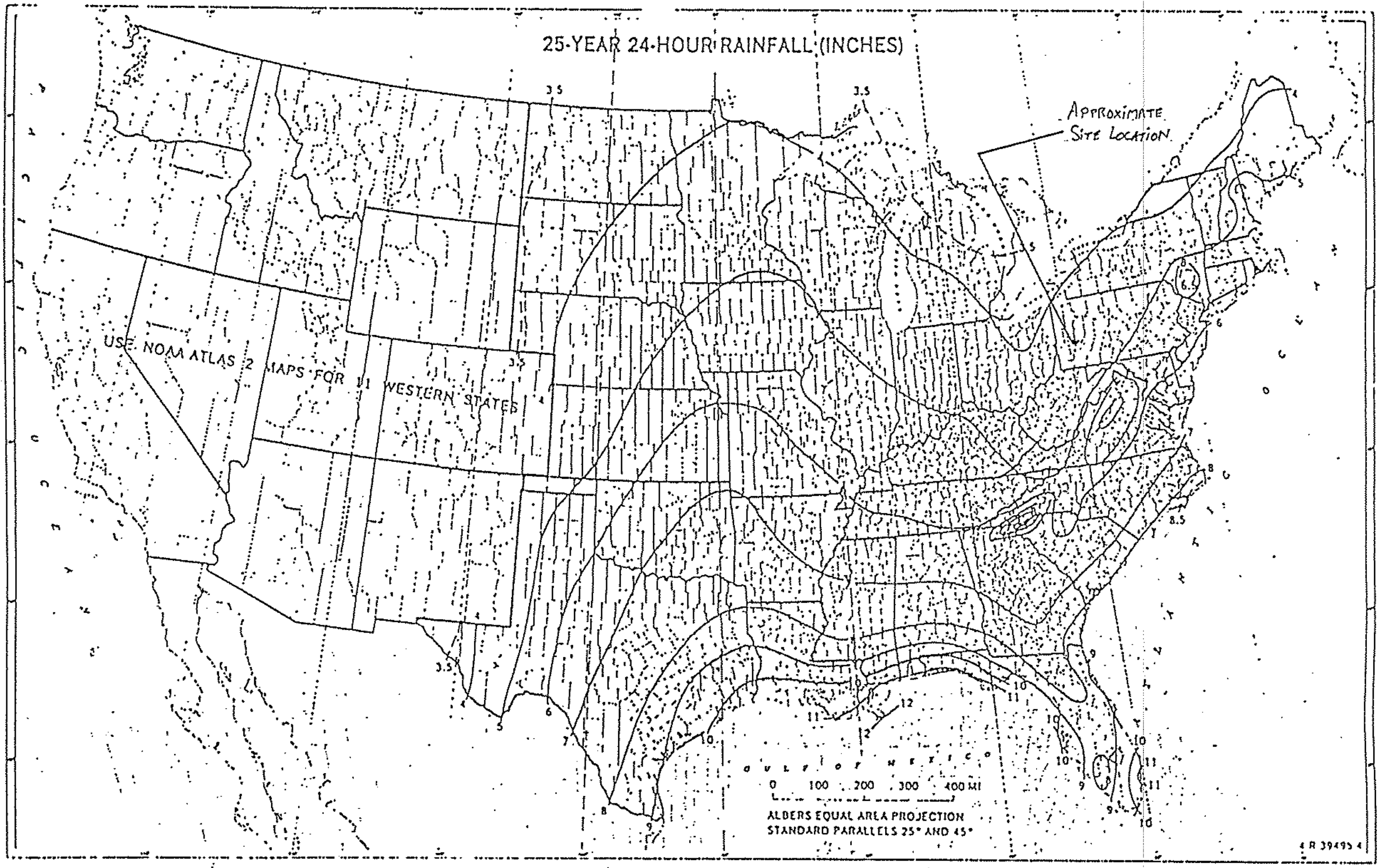
[3]*Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4]Actual curve number is less than 30; use CN = 30 for runoff computations.

[5]CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6]*Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Reference 4. Technical Release Number 55 (TR-55), "Urban Hydrology for Small Watersheds", prepared by the U.S. Department of Agriculture, Soil Conservation District, 1982.



Reference 4)Technical Release No. 55 (TR-55), "Urban Hydrology for Small Watersheds", U.S. Department of Agricultue, Soil Conservation District, 1982.

different design can meet the requirements of subsection), slopes shall be designed, installed and maintained as follows:

(1) The grade of the final surface of the facility may not be less than 3%.

(2) If the Department approves final grades of more than 15%:

(i) The operator shall construct a horizontal terrace at least 15 feet wide on the slope for every 25 feet maximum rise in elevations on the slope. The terrace width shall be measured as the horizontal distance between slope segments.

(ii) The gradient of the terrace shall be 5% into the landfill.

(iii) Drainage ditches shall be constructed on each horizontal terrace to convey flows.

(3) An operator may not leave final slopes that have a grade exceeding 33%, including slopes between benched terraces.

§ 288.235. Noncontiguous borrow areas.

Extraction and removal of cover and related material from offsite borrow areas shall be subject to a permit from the Department under the Noncoal Surface Mining Conservation and Reclamation Act (52 P. S. §§ 3301—3326), The Clean Streams Law and regulations promulgated thereunder, including Chapter 102 (relating to erosion control). Borrow areas located less than 300 feet from the disposal area shall be included in the permit area for the disposal facility as part of the permit application under this article.

§ 288.236. Revegetation.

(a) Vegetation shall be established on land affected by a residual waste landfill.

(b) Revegetation shall provide for an effective and permanent vegetative cover of the same seasonal variety as vegetation native to the site and capable of self-regeneration and plant succession. Introduced species may be used when desirable and necessary to achieve the approved postclosure land use. Vegetative cover shall be considered of the same seasonal variety when it consists of a mixture of species that is of equal or superior utility to native vegetation during each season of the year.

(c) Revegetation shall provide a quick-germinating, fast-growing vegetative cover capable of stabilizing the soil surface from erosion.

(d) Disturbed areas shall be seeded and planted when weather and planting conditions permit, but the seeding and planting of disturbed areas shall be performed no later than the first normal period for favorable planting after final grading.

(e) Fertilizer and lime shall be applied to disturbed areas as necessary to maintain plant growth.

(f) Mulch shall be applied to regraded areas where necessary to control erosion, promote germination of seeds and increase the moisture retention of the soil.

§ 288.237. Standards for successful revegetation.

(a) The standard for successful revegetation shall be e percent of groundcover of the vegetation which exists . the site. The Department will not approve less than a 70% groundcover of permanent plant species. No more than 1% of the total area may have less than 30% groundcover. A single or contiguous area exceeding 3,000 square

(b) Trees, woody shrubs or deep-rooted plants may not be planted or allowed to grow on the revegetated area of capped sites, unless otherwise allowed by the Department in the permit based on a demonstration that roots will not penetrate the cap or drainage layer.

WATER QUALITY PROTECTION

§ 288.241. General requirements.

(a) The operator may not cause or allow a point or nonpoint source discharge in violation of The Clean Streams Law from or on the facility to surface waters of this Commonwealth.

(b) A residual waste landfill shall be operated to prevent and control water pollution. An operator shall operate and maintain necessary water treatment facilities until water pollution from the facility has been permanently abated.

(c) The operator may not cause or allow water pollution within or outside the site.

§ 288.242. Soil erosion and sedimentation control.

(a) The operator shall manage surface water and control soil erosion and sedimentation, based on the 24-hour precipitation event in inches to be expected once in 25 years.

(b) The operator shall do the following:

(1) Prevent or minimize surface water percolation into the solid waste deposited at the facility.

(2) Meet the requirements of Chapter 102 (relating to erosion control).

(3) Prevent soil erosion and sedimentation to the maximum extent possible.

(c) When rills or gullies deeper than 9 inches form in areas that have been regraded and planted, the rills and gullies shall be filled, graded or otherwise stabilized and the area reseeded or replanted under §§ 288.236 and 288.237 (relating to revegetation; and standards for successful revegetation). Rills or gullies of lesser size shall be stabilized and the area reseeded or replanted if the rills or gullies are disruptive to the approved postclosure land use or may result in additional erosion and sedimentation.

§ 288.243. Sedimentation ponds.

(a) Surface drainage from the disturbed area, including areas that have been graded, seeded or planted, shall be passed through a sedimentation pond or a series of sedimentation ponds before leaving the site. The Department may, in the permit, waive the required use of sedimentation ponds when a person or municipality demonstrates to the satisfaction of the Department that sedimentation ponds are not necessary to meet the requirements of § 288.241 (relating to general requirements).

(b) Sedimentation ponds shall be constructed, operated and maintained under this section and Chapters 102 and 105 (relating to erosion control; and dam safety and waterway management) and the minimum design criteria contained in the United States Soil Conservation Service's Engineering Standard 378, 'Pond', Pa.

(c) Sedimentation ponds and other treatment facilities shall be maintained until removal of the ponds and facilities is approved by the Department.

(d) Ponds shall include a nonclogging dewatering device approved by the Department that will permit the

Reference 6)Pennsylvania Department of Envirnmental Resources Environmental Quality Board, "Residual Waste Management", July 4, 1992.

Table 11.1 Values of n in Manning's formula
Prepared by R. E. Horton and others

Nature of surface	n Min	n Max
Neat cement surface	0.010	0.013
Wood-stave pipe	0.010	0.013
Plank flumes, planed	0.010	0.014
Vitrified sewer pipe	0.010	0.017
Metal flumes, smooth	0.011	0.015
Concrete, precast	0.011	0.013
Cement mortar surfaces	0.011	0.015
Plank flumes, unplaned	0.011	0.015
Common-clay drainage tile	0.011	0.017
Concrete, monolithic	0.012	0.016
Brick with cement mortar	0.012	0.017
Cast iron—new	0.013	0.017
Cement rubble surfaces	0.017	0.030
Riveted steel	0.017	0.020
Corrugated metal pipe	0.021	0.025
Canals and ditches, smooth earth	0.017	0.025
Metal flumes, corrugated	0.022	0.030
Canals:		
Dredged in earth, smooth	0.025	0.033
In rock cuts smooth	0.025	0.035
Rough beds and weeds on sides	0.025	0.040
Rock cuts, jagged and irregular	0.035	0.045
Natural streams:		
Smoothest	0.025	0.033
Roughest	0.045	0.060
Very weedy	0.075	0.150

[1] As it is unreasonable to suppose that the roughness coefficient should contain the dimension T, the Manning equation would be more properly adjusted so as to contain $\sqrt{g}$ within the constant in the numerator, thus yielding the dimension of $L^{1/6}$ for n.

Manning's number for corrugated metal pipe was assumed to equal <u>0.024</u>

Manning's number for a concrete pipe was assumed to equal <u>0.013.</u>

Reference 8)Daugherty, Robert L., et. al. 1985, <u>Fluid Mechanics with Engineering Applications, Eight Edition.</u>

ATTACHMENT 3

SEDIMENTATION POND

Sedimentation Pond

SEDCAD + Version 3.1 Computer Program
(25 year, 24 hour storm)

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\DITCHES User: MAZ
Date: 10-04-1995 Time: 08:07:51
Southern and Northern Diversion Ditches Hydrologic Evaluation
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J3, B1, S1
Sedimentation Pond

Drainage Area from J3, B1, S1, SWS(s)1: 3.2 acres
Total Contributing Drainage Area: 53.8 acres

DISCHARGE OPTIONS:

	Drop Inlet	Emergency Spillway	Emergency Spillway
Riser Diameter (in)	48.0	----	----
Riser Height (ft)	22.00	----	----
Barrel Diameter (in)	42.0	----	----
Barrel Length (ft)	95.00	----	----
Barrel Slope (%)	5.00	----	----
Manning's n of Pipe	0.024	----	----
Spillway Elevation	895.5	----	----
Emergency Spillway Elevation	----	897.5	897.5
Crest Length (ft)	----	30.0	30.0
Z:1 (Left and Right)	-- --	0 0	0 0
Bottom Width (ft)	----	7.0	7.0

POND RESULTS:

Permanent Pool (ac-ft)
1.1

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	6.98	76.99
OUT	6.98	72.12

Peak Elevation	Hydrograph Detention Time (hrs)
897.0	0.07

****

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\DITCHES User: MAZ
Date: 10-04-1995 Time: 08:07:51
Southern and Northern Diversion Ditches Hydrologic Evaluation
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J3, B1, S1
Sedimentation Pond

Drainage Area from J3, B1, S1, SWS(s)1: 3.2 acres
Total Contributing Drainage Area: 53.8 acres

SW#1: Drop Inlet
SW#2: Emergency Spillway
SW#3: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
885.00	0.00	0.03	0.00	0.00	
885.50	0.50	0.03	0.02	0.00	
886.00	1.00	0.04	0.03	0.00	
886.50	1.50	0.04	0.05	0.00	
887.00	2.00	0.05	0.08	0.00	
887.50	2.50	0.06	0.10	0.00	
888.00	3.00	0.06	0.13	0.00	
888.50	3.50	0.07	0.17	0.00	
889.00	4.00	0.08	0.20	0.00	
889.50	4.50	0.08	0.25	0.00	
890.00	5.00	0.09	0.29	0.00	
890.50	5.50	0.10	0.34	0.00	
891.00	6.00	0.11	0.39	0.00	
891.50	6.50	0.12	0.45	0.00	
892.00	7.00	0.13	0.51	0.00	
892.50	7.50	0.14	0.57	0.00	
893.00	8.00	0.15	0.65	0.00	
893.50	8.50	0.16	0.72	0.00	
894.00	9.00	0.17	0.80	0.00	
894.50	9.50	0.18	0.89	0.00	
895.00	10.00	0.19	0.98	0.00	
895.50	10.50	0.20	1.08	0.00	Stage of SW#1
896.00	11.00	0.21	1.18	13.77	
896.50	11.50	0.22	1.29	38.96	
897.00	12.00	0.23	1.40	71.57	
897.02	12.02	0.23	1.40	72.12	Peak Stage
897.50	12.50	0.24	1.52	85.57	Stage of SW#2, SW#3
898.00	13.00	0.26	1.64	106.60	
898.20	13.20	0.26	1.69	114.62	
898.30	13.30	0.26	1.72	120.76	
898.40	13.40	0.27	1.75	127.24	
898.50	13.50	0.27	1.77	134.04	
899.00	14.00	0.28	1.91	175.16	
899.50	14.50	0.29	2.06	218.72	
900.00	15.00	0.31	2.21	269.76	

****

Culvert Evaluation

SEDCAD + Version 3.1
Culvert Utility Program
(25 year, 24 hour storm event)

Culvert Evaluation

Purpose:

To determine whether the two culverts that carry runoff flow under Haul Road #1 can safely manage the peak flow from the 25 year, 24 hour storm.

References:

1. Duquesne Light Drawing No. 12079-B20, "Structural Design & Details of Manhole #1, Headwall & Endwall Structures"

2. "Hydraulic Design of Highway Culverts", U.S. Department of Transportation, Federal Highway Administration, September 1985.

3. Earth Sciences Consultants, Inc. Drawing No. 16691-C9, "Diversion Ditch Watershed Area Hydrology Map"

Evaluation of the Pipe-Arch Culvert at Station 9+50 under Haul Road #1:

From Reference 1, dimensions of the culvert are 43 inches wide by 27 inches high with a maximum headwater depth of 30 inches.

The design flow through the culvert is 32 cfs, taken from Reach 7 of the diversion ditch.

From Chart 34 in Reference 2:

$$\frac{HW}{D} = 1.07 \qquad \text{where } D = 27 \text{ inches}$$

Therefore HW = 28.89 inches

Although this number is close to the availible (static) head of 30 inches, if the approach velocity of the water is taken into consideration and the velocity head ($V^2/2g$) is subtracted from the static head, a 30 inch high entrance is more than adequate to pass the design flow. (See Reference 2 for justification of including the velocity head.)

In conclusion, the pipe-arch culvert is capable of passing the 32 cfs design flow.

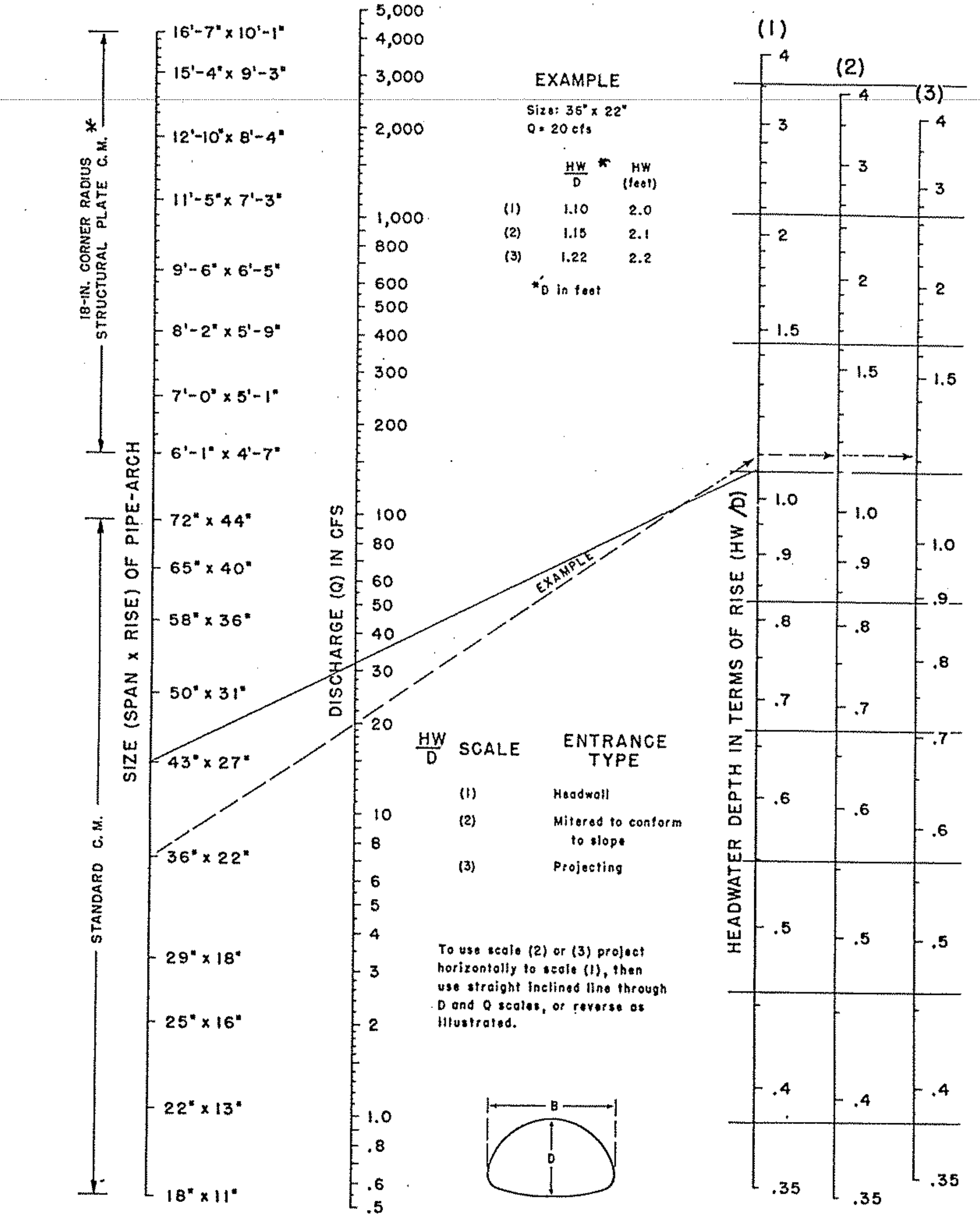
Evaluation of the 24 inch CMP culvert running under the soil stockpile access road:

From Reference 3, the following information concerning the 24 inch CMP was estimated

Slope = 12 %
Length = 40 feet
Max. Headwater = 3 feet
Design flow = 7 cfs (from Area 9 of diversion ditch calculation)

Upon inputing the above information into SEDCAD's Culvert Utility, it was computed that a headwater of approximately 1.5 feet is needed to pass the design flow of 7 cfs. It appears, based on topographic maps and site visit photographs, that the entrance to the culvert can supply at least this amount of headwater. And because of the culverts distance from any property improvements, minor ponding at the entrance will pose no problems. In conclusion, the 24 inch CMP is capable of safely managing the peak flow from the 25 year, 24 hour storm.

CHART 34



*ADDITIONAL SIZES NOT DIMENSIONED ARE LISTED IN FABRICATOR'S CATALOG

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR C. M. PIPE-ARCH CULVERTS WITH INLET CONTROL

SEDCAD+ CULVERT SIZING UTILITY

24 INCH CMP SOIL STOCKPILE CULVERT

Design Discharge	=	7.000 cfs
Entrance Loss Coefficient	=	0.5
Pipe Length	=	40.000 feet
Pipe Slope	=	12.000 %
Manning's n	=	0.024
Maximum Headwater	=	3.000 feet
Tailwater Depth	=	0.000 feet

Smallest Diameter Required to Pass Flow is 15 inches

PERFORMANCE CURVE:

Diameter: 24 inches

Headwater (ft)	Discharge (cfs)	Control	Flow Type
0.30	0.78	Outlet (Subcritical)	2
0.60	1.95	Inlet (Supercritical)	3
0.90	3.59	Inlet (Supercritical)	3
1.20	5.51	Inlet (Supercritical)	3
1.50	**7.70**	**Inlet (Supercritical)**	**3**
1.80	10.11	Inlet (Supercritical)	3
2.10	12.75	Inlet (Supercritical)	3
2.40	15.40	Inlet (Supercritical)	4
2.70	17.54	Inlet	5
3.00	19.52	Inlet	5
3.30	21.31	Inlet	5
3.60	22.97	Inlet	5
3.90	24.51	Inlet	5
4.20	25.97	Inlet	5
4.50	27.34	Inlet	5

Supporting References

different design can meet the requirements of subsection (f), slopes shall be designed, installed and maintained as follows:

(1) The grade of the final surface of the facility may not be less than 3%.

(2) If the Department approves final grades of more than 15%:

(i) The operator shall construct a horizontal terrace at least 15 feet wide on the slope for every 25 feet maximum rise in elevations on the slope. The terrace width shall be measured as the horizontal distance between slope segments.

(ii) The gradient of the terrace shall be 5% into the landfill.

(iii) Drainage ditches shall be constructed on each horizontal terrace to convey flows.

(3) An operator may not leave final slopes that have a grade exceeding 33%, including slopes between benched terraces.

§ 288.235. Noncontiguous borrow areas.

Extraction and removal of cover and related material from offsite borrow areas shall be subject to a permit from the Department under the Noncoal Surface Mining Conservation and Reclamation Act (52 P. S. §§ 3301—3326), The Clean Streams Law and regulations promulgated thereunder, including Chapter 102 (relating to erosion control). Borrow areas located less than 300 feet from the disposal area shall be included in the permit area for the disposal facility as part of the permit application under this article.

§ 288.236. Revegetation.

(a) Vegetation shall be established on land affected by a residual waste landfill.

(b) Revegetation shall provide for an effective and permanent vegetative cover of the same seasonal variety as vegetation native to the site and capable of self-regeneration and plant succession. Introduced species may be used when desirable and necessary to achieve the approved postclosure land use. Vegetative cover shall be considered of the same seasonal variety when it consists of a mixture of species that is of equal or superior utility to native vegetation during each season of the year.

(c) Revegetation shall provide a quick-germinating, fast-growing vegetative cover capable of stabilizing the soil surface from erosion.

(d) Disturbed areas shall be seeded and planted when weather and planting conditions permit, but the seeding and planting of disturbed areas shall be performed no later than the first normal period for favorable planting after final grading.

(e) Fertilizer and lime shall be applied to disturbed areas as necessary to maintain plant growth.

(f) Mulch shall be applied to regraded areas where necessary to control erosion, promote germination of seeds and increase the moisture retention of the soil.

§ 288.237. Standards for successful revegetation.

(a) The standard for successful revegetation shall be the percent of groundcover of the vegetation which exists the site. The Department will not approve less than a % groundcover of permanent plant species. No more than 1% of the total area may have less than 30% groundcover. A single or contiguous area exceeding 3,000 square [illegible]

(b) Trees, woody shrubs or deep-rooted plants may not be planted or allowed to grow on the revegetated area of capped sites, unless otherwise allowed by the Department in the permit based on a demonstration that roots will not penetrate the cap or drainage layer.

WATER QUALITY PROTECTION

§ 288.241. General requirements.

(a) The operator may not cause or allow a point or nonpoint source discharge in violation of The Clean Streams Law from or on the facility to surface waters of this Commonwealth.

(b) A residual waste landfill shall be operated to prevent and control water pollution. An operator shall operate and maintain necessary water treatment facilities until water pollution from the facility has been permanently abated.

(c) The operator may not cause or allow water pollution within or outside the site.

§ 288.242. Soil erosion and sedimentation control.

(a) The operator shall manage surface water and control soil erosion and sedimentation, based on the 24-hour precipitation event in inches to be expected once in 25 years.

(b) The operator shall do the following:

(1) Prevent or minimize surface water percolation into the solid waste deposited at the facility.

(2) Meet the requirements of Chapter 102 (relating to erosion control).

(3) Prevent soil erosion and sedimentation to the maximum extent possible.

(c) When rills or gullies deeper than 9 inches form in areas that have been regraded and planted, the rills and gullies shall be filled, graded or otherwise stabilized and the area reseeded or replanted under §§ 288.236 and 288.237 (relating to revegetation; and standards for successful revegetation). Rills or gullies of lesser size shall be stabilized and the area reseeded or replanted if the rills or gullies are disruptive to the approved postclosure land use or may result in additional erosion and sedimentation.

§ 288.243. Sedimentation ponds.

(a) Surface drainage from the disturbed area, including areas that have been graded, seeded or planted, shall be passed through a sedimentation pond or a series of sedimentation ponds before leaving the site. The Department may, in the permit, waive the required use of sedimentation ponds when a person or municipality demonstrates to the satisfaction of the Department that sedimentation ponds are not necessary to meet the requirements of § 288.241 (relating to general requirements).

(b) Sedimentation ponds shall be constructed, operated and maintained under this section and Chapters 102 and 105 (relating to erosion control; and dam safety and waterway management) and the minimum design criteria contained in the United States Soil Conservation Service's Engineering Standard 378, 'Pond' Pa.

(c) Sedimentation ponds and other treatment facilities shall be maintained until removal of the ponds and facilities is approved by the Department.

(d) Ponds shall include a nonclogging dewatering device approved by the Department that will permit the [illegible] The dewatering

Reference)Pennsylvania Department of Envirnmental Resources Environmental Quality Board, "Residual Waste Management", July 4, 1992.

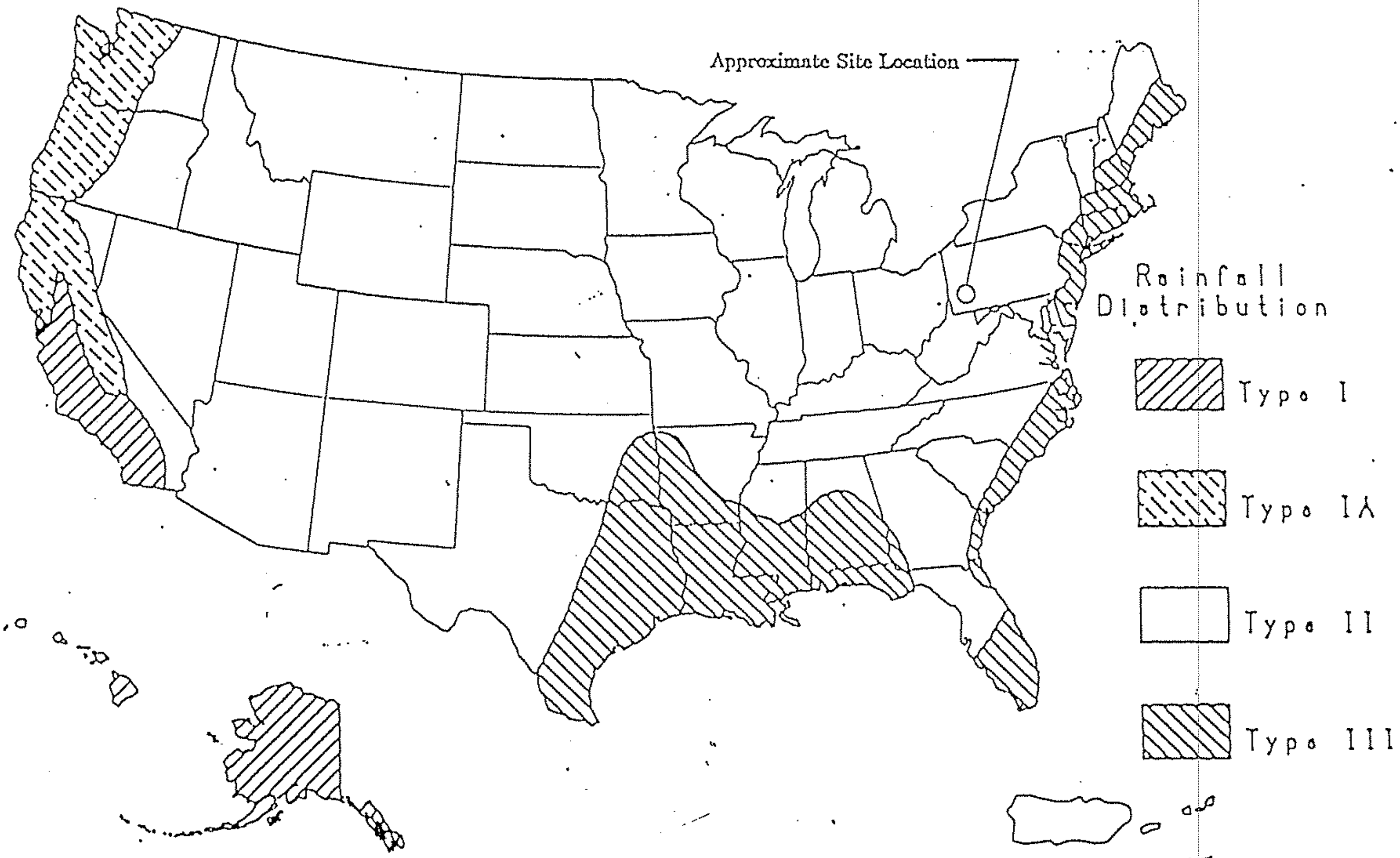
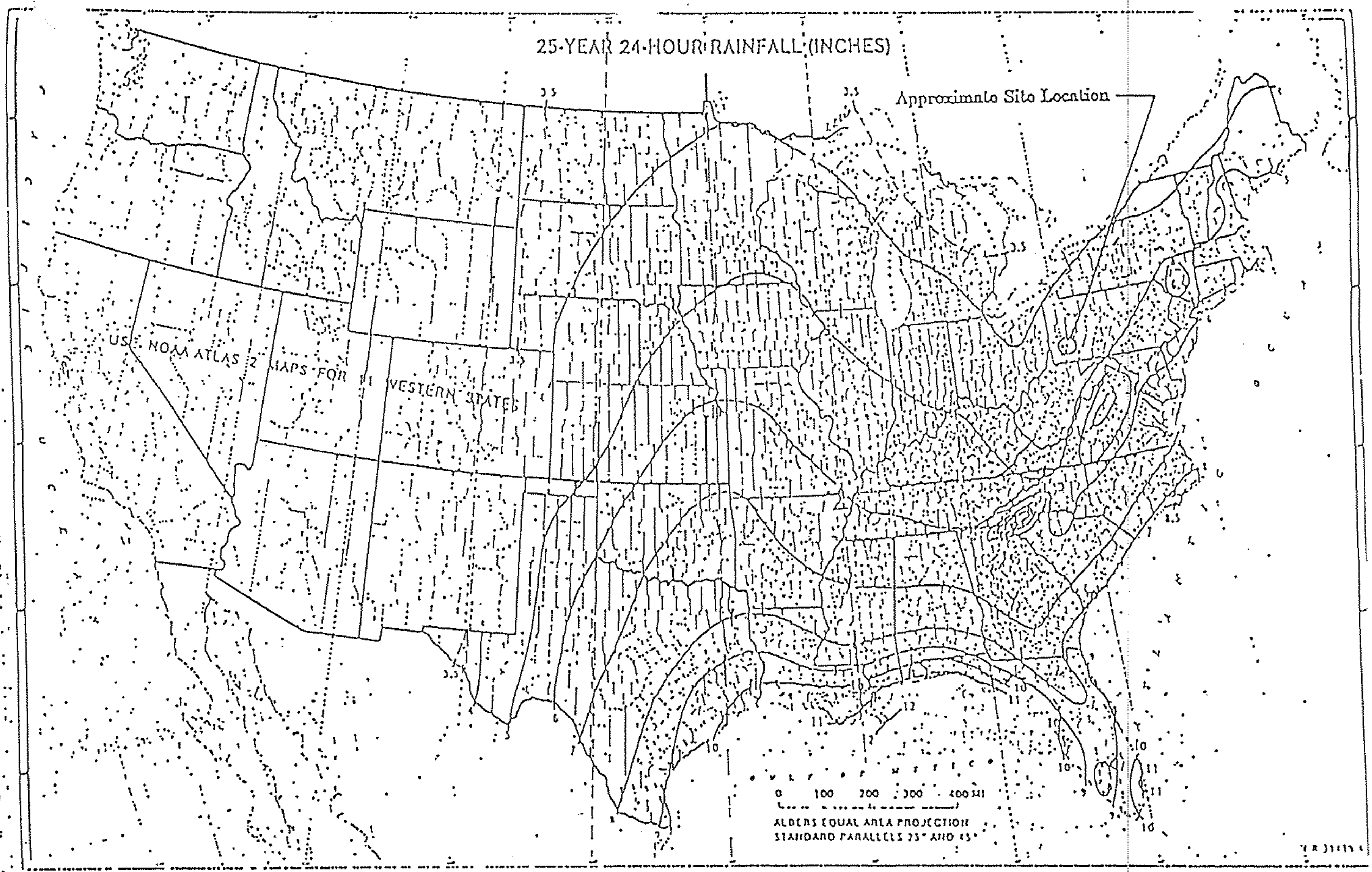


Figure B-2.—Approximate geographic boundaries for SCS rainfall distributions.

Reference: Technical Release Number 55 (TR-55), Urban Hydrology for Small Watersheds, prepared by the U.S. Department of Agriculture, Soil Conservation District, dated 1982.



Reference Technical Release Number 55 (TR-55), Urban Hydrology for Small Watersheds, prepared by the U.S Department of Agriculture, Soil Conservation District, 1982.

25-Year, 24-Hour Storm Event = 4.5 inches

Table 2-2c.—Runoff curve numbers for other agricultural lands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	[4]30	48	65	73
Woods—grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	[4]30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

verage runoff condition, and $I_a = 0.2S$.

[2] *Poor:* <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.

[3] *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4] Actual curve number is less than 30; use CN = 30 for runoff computations.

[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6] *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

The revegetated areas of the watersheds are assumed to be brush-brush-weed-grass mixture with brush the major element. Curve number for good hydrologic condition, soil group C = 65.

The undisturbed areas of the watershed are assumed to be brush-brush-weed-grass mixture with brush the major element. Curve number for fair hydrologic condition, soil group C = 70

Reference: Technical Release Number 55 (TR-55), Urban Hydrology for Small Watersheds, prepared by the U.S. Department of Agriculture, Soil Conservation District, dated 1982.

ATTACHMENT 4 – BENCHES

4.1 1% LONGITUDINAL SLOPE

Form I
Attachment D

Lefever Road Disposal Site
Bench Channel Hydrologic Evaluation

Prepared By: MAZ Date: 9/1/95
Checked By: [illegible] Date: 9/1/95

Form I
Attachment D

Lefever Road Disposal Site
Bench Channel
Hydrologic Evaluation

Purpose:

To determine whether the proposed bench channels have adequate capacity and meet maximum flow velocity requirements when conveying the peak flow from the 25 year, 24 hour storm.

References:

1. The computer program SEDCAD, which models overland surface water flow and channel flow, is used to develop peak runoff rates for each subwatershed.

2. Duquesne Light Company Drawing No. 12079-B10, "Conservation Plan for Disposal Site"

3. Pennsylvania Department of Environmental Resources, April 1990, Erosion and Sediment Control Program Manual. pp.4.26.

4. Technical Release Number 55 (TR-55), "Urban Hydrology for Small Watersheds", prepared by the U.S. Department of Agriculture, Soil Conservation District, 1982.

5. Applied Hydrology, Chow, Maidment, Mays. McGraw Hill, 1988.

6. Pennsylvania Department of Environmental Resources Environmental Quality Board, July 4, 1992, Residual Waste Management.

7. Duquesne Light Company Drawing No. 12079-B9, "Cross-sections and Miscellaneous Details"

8. Earth Sciences Consultants, Inc., Drawing No. 16691-C9, "Diversion Ditch Hydrology Map", July 1995.

Methodology:

The computer program SEDCAD + Version 3.1 models the hydrology of the bench channel watershed to determine the runoff peak flow rate.

First, the worst case bench channel (i.e. the bench channel that would have the largest area contributing runoff to it) was chosen from Reference 8. This watershed area was planimetered and the longest time of concentration path chosen (refer to Figure 1). Next, a curve number for the watershed was obtained from Table 2-2c in Reference 4, attached. This information, along with the bench channel side-slopes and a Manning's roughness coefficient, was input into

SEDCAD to develop the peak flow rate on the bench channel. The bench channel was then evaluated using SEDCAD to determine the channel capacity and maximum flow velocity.

Criteria, Data, & Assumptions:

1. Total contributing area = 1.0 acres. (Refer to attached Figure 1, Worst Case Bench Scenario).

2. Design rainfall for Allegheny County, Indiana Township:

   25-yr 24-hr = 4.50" (Refer to Reference 4 and Reference 6, attached).

3. Horizontal slope of the bench channel is assumed to equal 1% according to Note 6 on the drawing in Reference 2.

4. The bench channel is assumed to slope back at 3% to meet the 2:1 slope that exists between benches, have a top width of 15 feet, and a depth of 0.45 feet. (See Figure 2, attached, Typical Soil and Fly Ash Dike Detail, from reference 7)

5. Curve Number (CN) of 65 was used to represent the land condition of the on-site stabilized areas. (See Table 2-2c from Reference 4, attached)

6. Maximum permissible velocities obtained from Table 4.7b in Reference 3, included in the Supporting References section.

8. A Manning's "n" value of 0.050 was used to represent conditions on the bench channel. (Refer to Table 2.5.1 from Reference 5, included in the Supporting References section)

Conclusion:

The above information was input into the SEDCAD + Version 3.1 computer model and the following runoff volume and peak discharge flow rate was determined:

Total runoff to the bench is :

Design Storm 24-Hour (yr.)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
25	0.11	1.11

The bench channel was analyzed and found to have sufficient capacity to handle the peak flow of 1.11 cfs. Depth of flow on the bench was found to be 0.28 feet, which is less than the available depth of 0.45 feet, at a velocity of 0.80 feet per second, which is less than the maximum permissible velocity of 4 to 5 feet per second for vegetated channels. SEDCAD output supporting the calculation of flow velocity and depth is attached following this narrative.

Worst-Case Bench Scenario

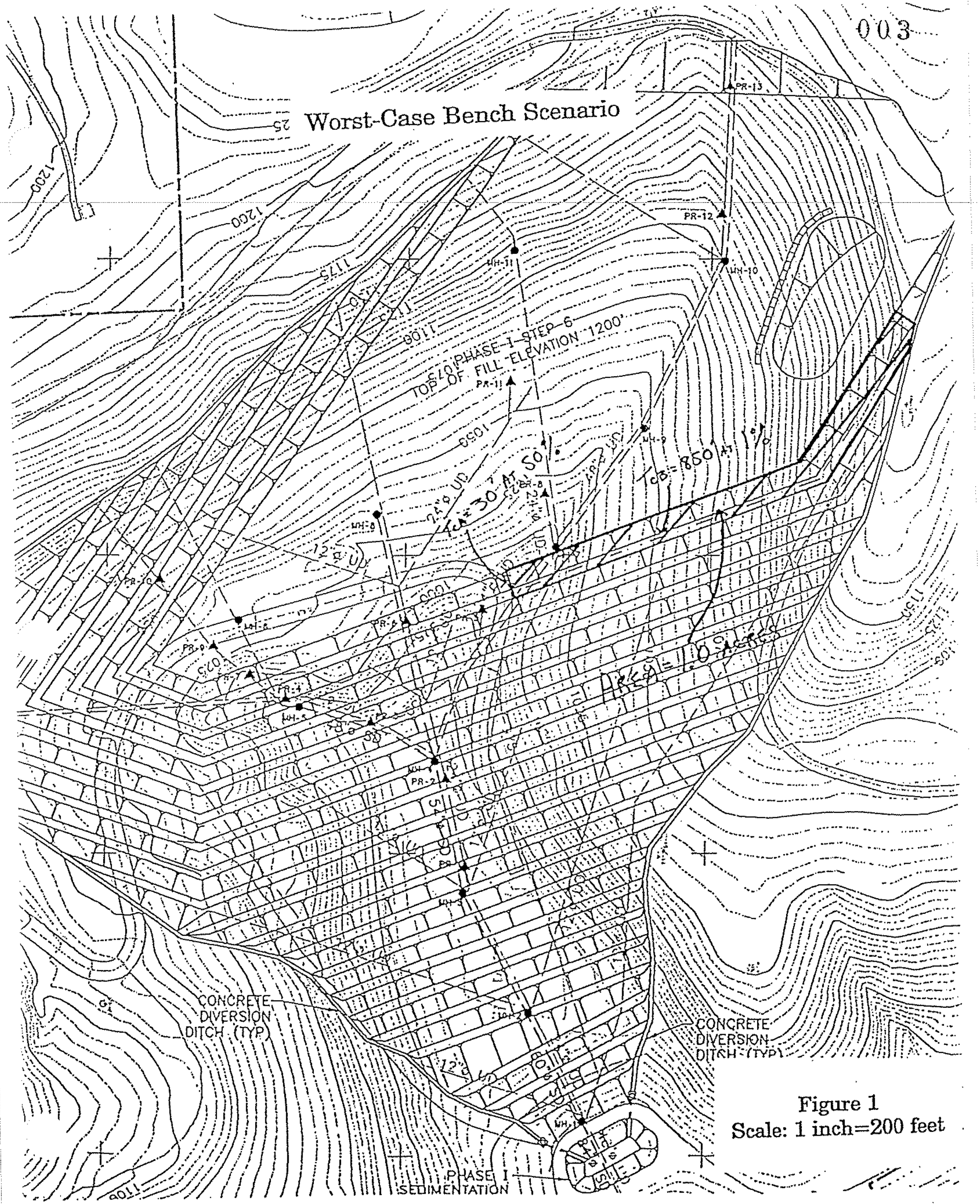


Figure 1
Scale: 1 inch=200 feet

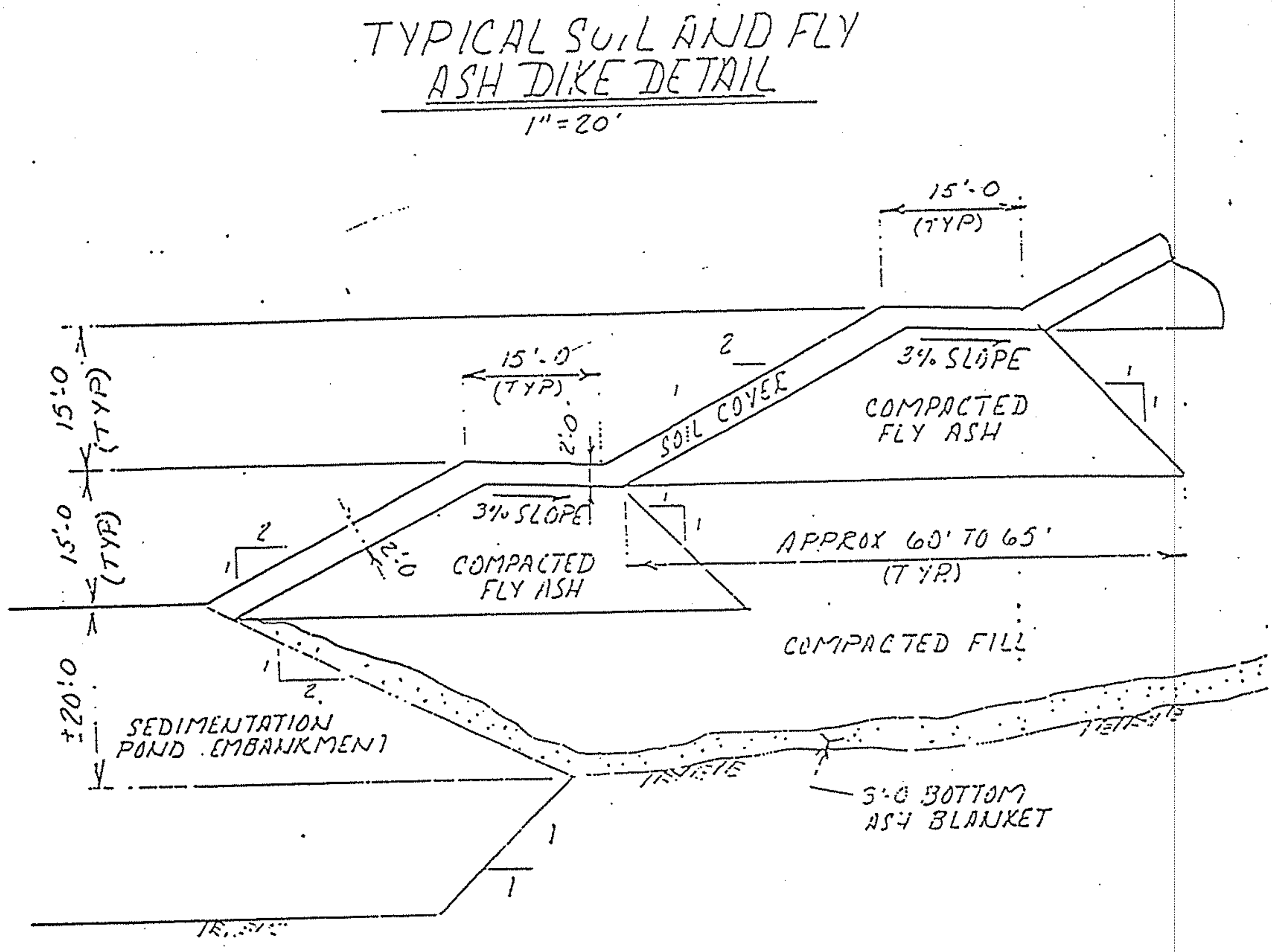


Figure 2

Taken from Reference 7

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

LEFEVER DISPOSAL SITE: BENCH CHANNEL HYDROLOGIC EVALUATION
25 year, 24 hour storm

by

Name: MAZ

Company Name: EARTH SCIENCES CONSULTANTS, INC.
File Name: C:\2779\BENCH

Date: 07-27-1995

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\BENCH User: MAZ
Date: 07-27-1995 Time: 16:08:09
LeFever Disposal Site: Bench Channel Hydrologic Evaluation
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	1.00	65	M	0.159	0.000	0.000	0.0	0.11	1.11
	Type: Nonerodible Channel Label: Worst-Case Bench									
111	Structure	1.00							0.11	
111	Total IN/OUT	1.00							0.11	1.11

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\BENCH User: MAZ
Date: 07-27-1995 Time: 16:08:09
LeFever Disposal Site: Bench Channel Hydrologic Evaluation
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	X
1	1	1	1	-a	2	30.00	50.00	3.54	0.00			
				-b	6	850.00	1.00	1.50	0.16	0.159		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: EARTH SCIENCES CONSULTANTS, INC.
Filename: C:\2779\BENCH User: MAZ
Date: 07-27-1995 Time: 16:08:09
LeFever Disposal Site: Bench Channel Hydrologic Evaluation
Storm: 4.50 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

NON-POND STRUCTURE INPUT/OUTPUT TABLE

J1, B1, S1
Worst-Case Bench

Drainage Area from J1, B1, S1, SWS(s)1: 1.0 acres
Total Contributing Drainage Area: 1.0 acres

MATERIAL: OTHER
Triangular Nonerodible Channel

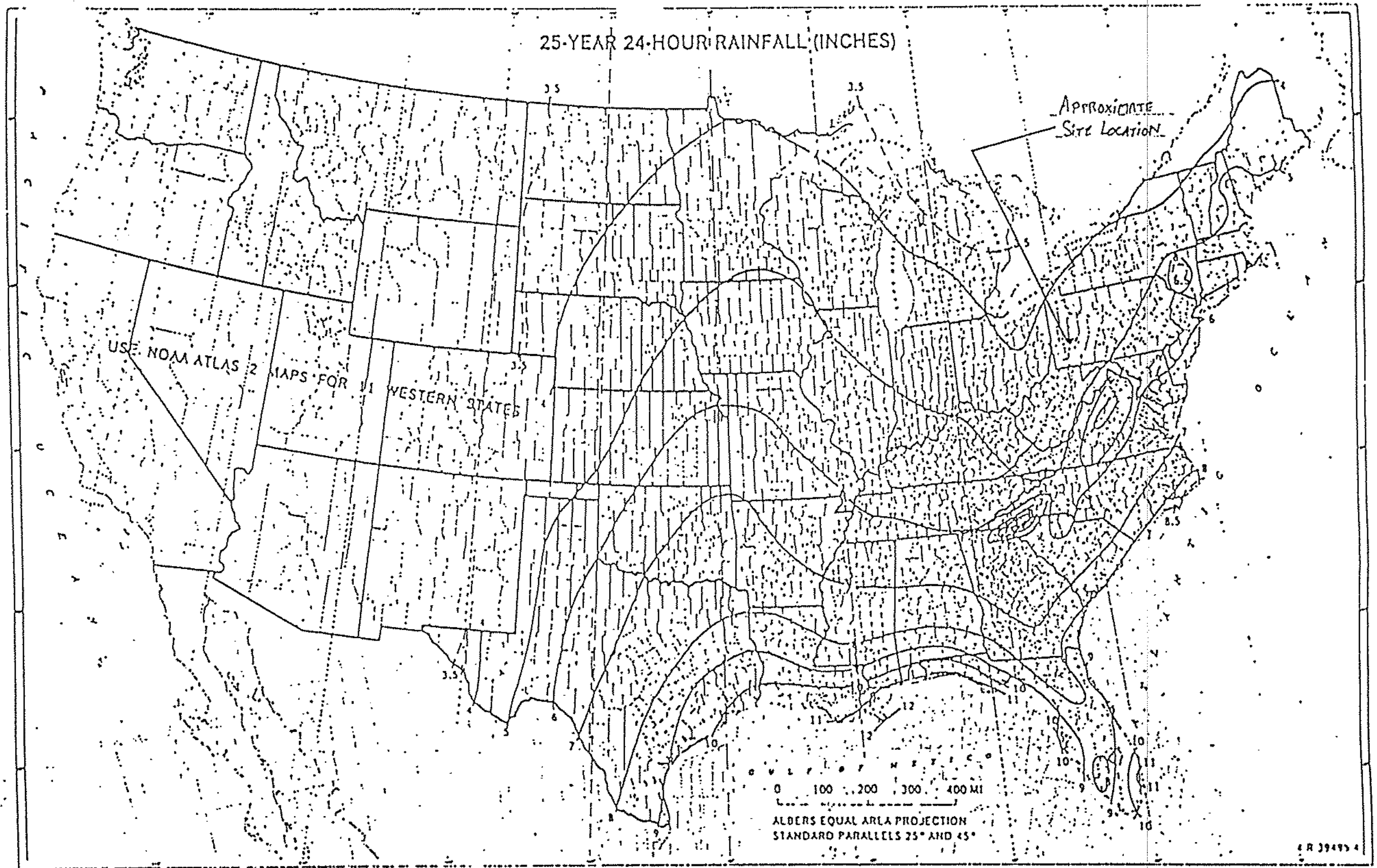
Design Discharge (cfs)	Bottom Width (ft)	ZLeft	ZRight	Slope (%)	Manning's n
1.11		2.0:1	33.3:1	1.0	0.050

	Depth (ft)	Velocity (fps)	Top Width (ft)	Hydraulic Radius	Froude Number
	0.28	0.80	9.9	0.140	0.38
w/ Freeboard:	0.28		9.9		

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN/OUT	0.11	1.11

****

Supporting References



Reference 4)Technical Release No. 55 (TR-55), "Urban Hydrology for Small Watersheds", U.S. Department of Agricultue, Soil Conservation District, 1982.

different design can meet the requirements of subsection (f) slopes shall be designed, installed and maintained as follows:

(1) The grade of the final surface of the facility may not be less than 3%.

(2) If the Department approves final grades of more than 15%:

(i) The operator shall construct a horizontal terrace at least 15 feet wide on the slope for every 25 feet maximum rise in elevations on the slope. The terrace width shall be measured as the horizontal distance between slope segments.

(ii) The gradient of the terrace shall be 5% into the landfill.

(iii) Drainage ditches shall be constructed on each horizontal terrace to convey flows.

(3) An operator may not leave final slopes that have a grade exceeding 33%, including slopes between benched terraces.

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Extraction and removal of cover and related material from offsite borrow areas shall be subject to a permit from the Department under the Noncoal Surface Mining Conservation and Reclamation Act (52 P. S. §§ 3301—3326), The Clean Streams Law and regulations promulgated thereunder, including Chapter 102 (relating to erosion control). Borrow areas located less than 300 feet from the disposal area shall be included in the permit area for the disposal facility as part of the permit application under this article.

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(a) Vegetation shall be established on land affected by a residual waste landfill.

(b) Revegetation shall provide for an effective and permanent vegetative cover of the same seasonal variety as vegetation native to the site and capable of self-regeneration and plant succession. Introduced species may be used when desirable and necessary to achieve the approved postclosure land use. Vegetative cover shall be considered of the same seasonal variety when it consists of a mixture of species that is of equal or superior utility to native vegetation during each season of the year.

(c) Revegetation shall provide a quick-germinating, fast-growing vegetative cover capable of stabilizing the soil surface from erosion.

(d) Disturbed areas shall be seeded and planted when weather and planting conditions permit, but the seeding and planting of disturbed areas shall be performed no later than the first normal period for favorable planting after final grading.

(e) Fertilizer and lime shall be applied to disturbed areas as necessary to maintain plant growth.

(f) Mulch shall be applied to regraded areas where necessary to control erosion, promote germination of seeds and increase the moisture retention of the soil.

§ 288.237. Standards for successful revegetation.

(a) The standard for successful revegetation shall be ... percent of groundcover of the vegetation which exists ... site. The Department will not approve less than a ...% groundcover of permanent plant species. No more than 1% of the total area may have less than 30% groundcover. A single or contiguous area exceeding 3,000 square ...

(b) Trees, woody shrubs or deep-rooted plants may not be planted or allowed to grow on the revegetated area of capped sites, unless otherwise allowed by the Department in the permit based on a demonstration that roots will not penetrate the cap or drainage layer.

WATER QUALITY PROTECTION

§ 288.241. General requirements.

(a) The operator may not cause or allow a point or nonpoint source discharge in violation of The Clean Streams Law from or on the facility to surface waters of this Commonwealth.

(b) A residual waste landfill shall be operated to prevent and control water pollution. An operator shall operate and maintain necessary water treatment facilities until water pollution from the facility has been permanently abated.

(c) The operator may not cause or allow water pollution within or outside the site.

§ 288.242. Soil erosion and sedimentation control.

(a) The operator shall manage surface water and control soil erosion and sedimentation, based on the 24-hour precipitation event in inches to be expected once in 25 years.

(b) The operator shall do the following:

(1) Prevent or minimize surface water percolation into the solid waste deposited at the facility.

(2) Meet the requirements of Chapter 102 (relating to erosion control).

(3) Prevent soil erosion and sedimentation to the maximum extent possible.

(c) When rills or gullies deeper than 9 inches form in areas that have been regraded and planted, the rills and gullies shall be filled, graded or otherwise stabilized and the area reseeded or replanted under §§ 288.236 and 288.237 (relating to revegetation; and standards for successful revegetation). Rills or gullies of lesser size shall be stabilized and the area reseeded or replanted if the rills or gullies are disruptive to the approved postclosure land use or may result in additional erosion and sedimentation.

§ 288.243. Sedimentation ponds.

(a) Surface drainage from the disturbed area, including areas that have been graded, seeded or planted, shall be passed through a sedimentation pond or a series of sedimentation ponds before leaving the site. The Department may, in the permit, waive the required use of sedimentation ponds when a person or municipality demonstrates to the satisfaction of the Department that sedimentation ponds are not necessary to meet the requirements of § 288.241 (relating to general requirements).

(b) Sedimentation ponds shall be constructed, operated and maintained under this section and Chapters 102 and 105 (relating to erosion control; and dam safety and waterway management) and the minimum design criteria contained in the United States Soil Conservation Service's Engineering Standard 378, 'Pond' Pa.

(c) Sedimentation ponds and other treatment facilities shall be maintained until removal of the ponds and facilities is approved by the Department.

(d) Ponds shall include a nonclogging dewatering device approved by the Department that will permit the ... of the water from the pond. The dewatering

Reference 6)Pennsylvania Department of Envirnmental Resources Environmental Quality Board, "Residual Waste Management", July 4, 1992.

Table 2-2c.—Runoff curve numbers for other agricultural lands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	[4]30	48	$\boxed{65}$	73
Woods—grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	[4]30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

[1] Average runoff condition, and $I_a = 0.2S$.

[2] *Poor:* <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.

[3] *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4] Actual curve number is less than 30; use CN = 30 for runoff computations.

[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6] *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Reference 3. Pennsylvania Department of Environmental Resources, April 1990, Erosion and Sediment Control Program Manual. pp.4.26.

TABLE 4.7b Maximum Permissible Velocities for Channels Lined with Vegetation

Cover	Slope Range Percent	Permissible Velocity ft/sec.	
		Erosion Resistant Soil[1]	Easily Eroded Soil[2]
Kentucky Bluegrass Tall Fescue	< 5 5-10 > 10	7[3] 6 5	5 4 3
Grass Mixture Reed Canarygrass	< 5 5-10	5 4	4 3
Sericea Lespedeza Weeping Lovegrass Redtop Red Fescue	< 5	3.5	2.5
Annuals temporary cover only Sudangrass	< 5	3.5	2.5

[1] Cohesive (clayey) fine grain soils and coarse grain soils with a plasticity index of 10 to 40 (CL,CH,SC and GC).

[2] Soils that do not meet the requirements for erosion resistant soils.

[3] Use velocities exceeding 5 ft/sec only where good cover and proper maintenance can be obtained.

ADDITIONAL NOTES REGARDING USE OF TABLE 4.7b:

1. A velocity of 3.0 ft/sec should be the maximum if, because of shade, soils or climate, only a sparse cover can be established or maintained.
2. A velocity of 3.0 to 4.0 ft/sec should be used under normal conditions if the vegetation is to be established by seeding.
3. A velocity of 4.0 to 5.0 ft/sec should be used only in areas if a dense, vigorous sod is obtained quickly or if water can be diverted out of the waterway while vegetation is being established.
4. A velocity of 5.0 to 6.0 ft/sec may be used on well established, good quality sod. Special maintenance may be required.
5. A velocity of 6.0 to 7.0 ft/sec may be used only on established, excellent quality sod, and only under special circumstances in which the flow cannot be handled at a lower velocity. Under these conditions, special maintenance and appurtenant structures will be required.
6. If the vegetative lining is supplemented by stone centers, or other erosion resistant materials, the velocity in Table 4.7b may be increased by 2.0 ft/sec.
7. When a base flow exists, a rock lined low flow channel should be designed and incorporated into the vegetative lined channel section.

TABLE 2.5.1
Manning roughness coefficients for various open channel surfaces

Material	Typical Manning roughness coefficient
Concrete	0.012
Gravel bottom with sides — concrete	0.020
— mortared stone	0.023
— riprap	0.033
Natural stream channels	
Clean, straight stream	0.030
Clean, winding stream	0.040
Winding with weeds and pools	0.050
With heavy brush and timber	0.100
Flood Plains	
Pasture	0.035
Field crops	0.040
Light brush and weeds	$\boxed{0.050}$
Dense brush	0.070
Dense trees	0.100

Source: Chow, 1959.

$$n^6\sqrt{RS_f} \geq 1.9 \times 10^{-13} \text{ with R in feet} \tag{2.5.9a}$$

or

$$n^6\sqrt{RS_f} \geq 1.1 \times 10^{-13} \text{ with R in meters} \tag{2.5.9b}$$

Example 2.5.1 There is uniform flow in a 200-ft wide rectangular channel with bed slope 0.03 percent and Manning's n is 0.015. If the depth is 5 ft, calculate the velocity and flow rate, and verify that the flow is fully turbulent so that Manning's equation applies.

Solution. The wetted perimeter in the channel is $P = 200 + 2 \times 5 = 210$ ft. The hydraulic radius is $R = A/P = 200 \times 5/210 = 4.76$ ft. The flow velocity is given by Manning's equation with $n = 0.015$ and $S_f = S_0$ (for uniform flow) = 0.03% = 0.0003.

$$V = \frac{1.49}{n}R^{2/3}S_f^{1/2}$$

$$= \frac{1.49}{0.015}(4.76)^{2/3}(0.0003)^{1/2}$$

$$= 4.87 \text{ ft/s}$$

The flow rate is $Q = VA = 4.87 \times 200 \times 5 = 4870$ cfs. The criterion for fully turbulent flow is calculated from (2.5.9a):

Reference 5. Applied Hydrology, Chow, Maidment, Mays. McGraw Hill, 1988.

4.2 3% LONGITUDINAL SLOPE

1.0 OBJECTIVE

This calculation involves the determination of peak flows for the design of the proposed stormwater benches necessary to handle anticipated surface water flow. Peak flows utilized for stormwater bench design have been estimated by use of the SCS TR-55 (Soil Conservation Service Technical Release – 55) graphical peak method. All stormwater benches have been designed for the 25-year/24-hour storm event.

2.0 BACKGROUND

Stormwater design calculations were previously performed for the stormwater benches under final conditions and assume 1% longitudinal slopes. Based on CEC Proposed Final Grading Plan, Drawing 144063-SW03-PROPOSED FINAL GRADING PLAN dated September 2, 2015 the stormwater benches will be constructed with 3% longitudinal slopes. This calculation demonstrates the hydraulic capacity of the proposed stormwater benches with 3% longitudinal slopes.

3.0 METHODOLOGY

Peak flows have been estimated using SCS TR-55 by calculating the time of concentration of a model stormwater bench, the composite runoff curve number describing the stormwater bench's watershed, and the total area of the stormwater bench's watershed. The watersheds and time of concentration considered were estimated using proposed final topography based on CEC Proposed Final Grading Plan, Drawing 144063-SW03-PROPOSED FINAL GRADING PLAN dated September 2, 2015. Figure 1, provided in Attachment 1, presents the drainage areas and time of concentration (Tc) runs utilized in this calculation. A computer software package entitled HydroCAD 10.00 was utilized to perform the SCS TR-55 calculations.

In accordance with the TR-55 design methodology, times of concentration have been designed using the 2-year/24-hour storm event and were estimated as the sum of sheet flow and shallow flow for each drainage area. Sheet flow calculations use an average surface consisting of dense grass (n=0.24). Shallow flow times of concentration were estimated depending on paved/unpaved condition of the flow path.

The site is assumed to be located in an area of hydrologic soil group C. From common hydrologic references, the following runoff coefficient was utilized.

CN DATA	
Description	**CN**
Grass Cover >75% Good, HSG C	74

As mentioned above, the stormwater benches have been designed utilizing the 25-year/24-hour storm event. The estimated rainfall values summarized in the table shown below:

RAINFALL DATA		
Frequency	**Duration**	**Depth (in)**
2 yr	24 hr	2.41
25 yr	24 hr	4.00

4.0 STORMWATER BENCH CALCULATIONS

After the peak discharge for each applicable reach was estimated, the stormwater bench cross section was sized and a lining selected. Flow properties within the stormwater bench are estimated by HdroCAD using Manning's Equation:

$$V = \frac{Q}{A} = 1.49\frac{R^{2/3}\sqrt{S_f}}{n} = 1.49\frac{\left[\frac{A}{WP}\right]^{2/3}\sqrt{S_f}}{n}$$

Where:

V = Velocity, fps

Q = Flowrate, cfs

A = Cross – Sectional area of flow, sf

R = Hydraulic Radius, ft

WP = Wetted Perimeter, ft

S_f = Slope of channel, ft / ft

n = Manning's roughness coefficient

Figure 1, provided in Attachment 1, presents the drainage areas utilized and longest time of concentration (Tc) path for each drainage area. The table below summarizes the contributing area, inlet and outlet invert elevations, length, slope, and cross section for a typical stormwater bench shown on Figure 1.

Stormwater Bench	Drainage Area ID	Drainage Area (acres)	Invert Elevations		Channel Length (ft)	Slope (ft/ft)	Base Width (ft)	Depth (ft)	Side Slopes	Lining
			Inlet	Outlet						
Stormwater Bench	DA-1	0.62	1,166.0	1,148.0	600.0	0.03	0.0	0.45	2H:1V Left 30H:1V Right	GRASS

Stormwater benches have been designed for the 25-year, 24-hour design storm. The table below summarizes the cross section, contributing area, inlet and outlet invert elevations, slope, peak flow rate, discharge velocity, flow depth, and freeboard for a typical stormwater bench shown on Figure 1.

Channel	Drainage Area ID	Base Width (ft)	Depth (ft)	Side Slopes	Invert Elevations		Slope (ft/ft)	Peak Flow (cfs)	Discharge Velocity (fps)	Flow Depth (ft)
					Inlet	Outlet				
Stormwater Bench	DA-1	0.0	0.45	2H:1V Left 30H:1V Right	1,166.0	1,148.0	0.03	1.24	1.56	0.20

Grass will be used as the lining based on the maximum discharge velocity anticipated. The maximum allowable velocity value for grass is provided in the following table:

CHANNEL LININGS		
Material	N	Vmax (fps)
Grass	0.035	5.0

5.0 SUMMARY

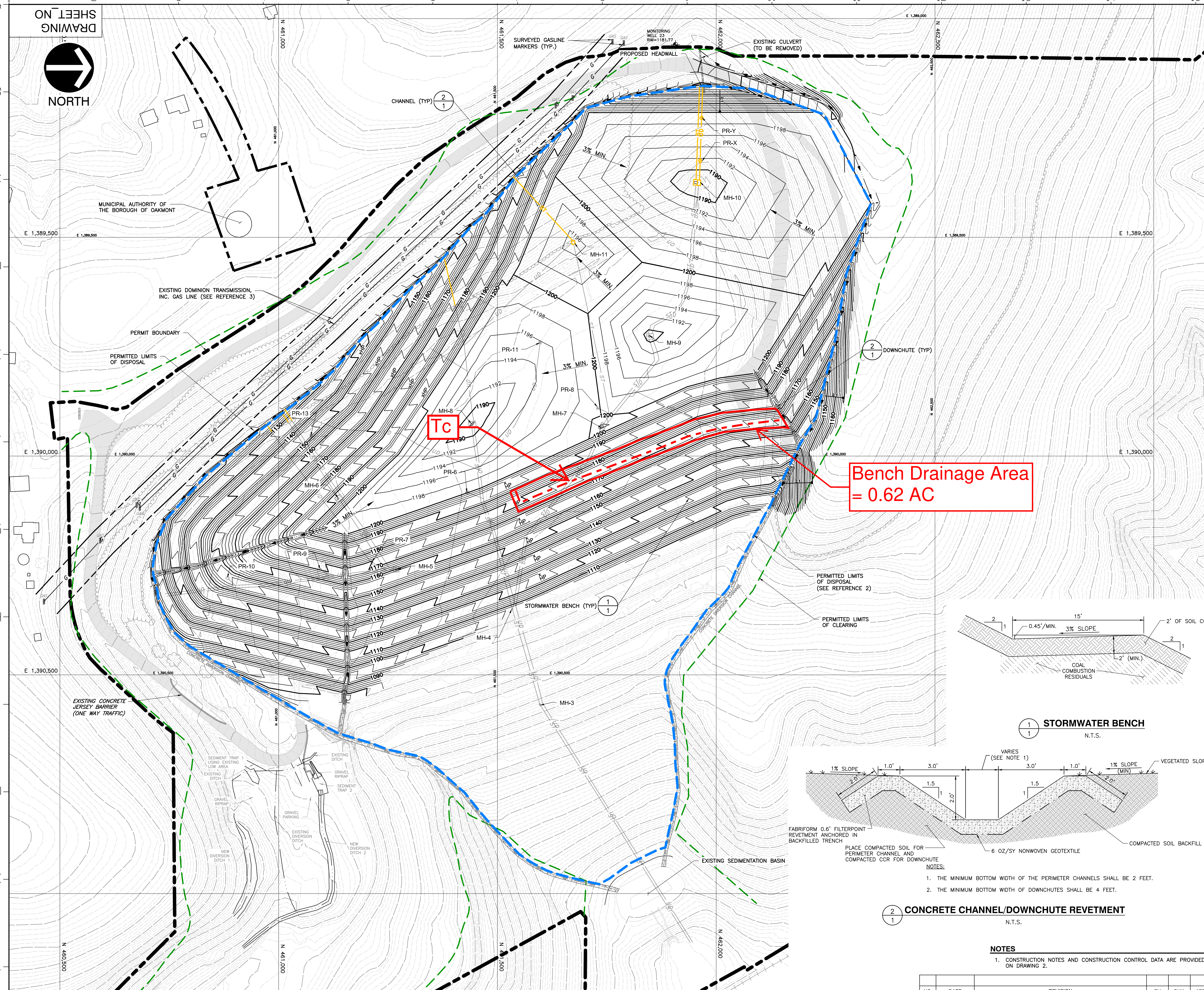
The stormwater benches were designed to handle the peak flows for a 25-year/ 24-hour storm event, and will function as intended. The proposed benches are very flat and will not result in an erosive discharge velocity.

REFERENCES

1. Soil Conservation Service, URBAN HYDROLOGY FOR SMALL WATERSHEDS, Technical Release 55, June 1986.
2. Soil Conservation Service, ENGINEERING FIELD MANUAL FOR CONSERVATION PRACTICES, November 1986.
4. HYDROCAD, Version 10.00, 2015, Computer Software Program.

ATTACHMENT 1

FIGURE(S)



LEGEND

- PERMIT BOUNDARY
- EXISTING CONTOUR
- PROPOSED CONTOUR (TOP OF CCR)
- PERMITTED LIMITS OF DISPOSAL
- EXISTING SURFACE WATER CHANNEL
- PROPOSED SURFACE WATER CHANNEL
- EXISTING STORM DRAIN PIPING
- EXISTING UNDERDRAIN PIPING
- PROPOSED STORM DRAIN PIPING
- PROPOSED UNDERDRAIN PIPING
- PROPOSED SURFACE WATER SUMP
- EXISTING CONCRETE CHANNEL/DOWNCHUTE
- PROPOSED CONCRETE CHANNEL/DOWNCHUTE
- COMPOSITE FILTER SOCK OR APPROVED EQUAL
- MH-7
- PROPOSED MANHOLE
- EXISTING TREELINE
- PERMITTED LIMIT OF CLEARING AND GRUBBING
- EXISTING ACCESS ROAD
- DETAIL NUMBER / SHEET NUMBER WHERE DETAIL IS SHOWN
- EXISTING GAS LINE
- GAS LINE RIGHT-OF-WAY
- SURVEYED GASLINE MARKER
- TREE LINE
- EXISTING CULVERT
- EXISTING JERSEY BARRIER
- EXISTING RAILROAD TRACKS

REFERENCE:

1. THE EXISTING TOPOGRAPHY, THE EXISTING UNDERDRAIN AND STORMDRAIN PIPING AND CORRESPONDING MANHOLES, SHOWN WERE REFERENCED FROM THE 2014 ALOR TOPOGRAPHIC MAP FOR JANUARY 2014 THROUGH DECEMBER 2015 PREPARED BY MORRIS KNOWLES & ASSOCIATES, INC. THE CONTOURS SHOWN ON THE ASH DISPOSAL FACILITY ARE DATED JANUARY 2015.
2. THE EXISTING PERMITTED LIMIT OF DISPOSAL WAS REFERENCED FROM DUQUESNE LIGHT COMPANY PERMIT DRAWING 12079-B10, DATED 3/1/79. LOCATIONS SHOWN ARE APPROXIMATE.
3. DOMINION TRANSMISSION, INC. (DTI) GAS LINES LN-30 AND TL-469 HAVE AN ASSUMED RIGHT-OF-WAY WIDTH ON THE OUTSIDE OF EACH GAS LINE OF 25 FEET.

ONE CALL SERIAL NO.: X

CALL BEFORE YOU DIG!
PENNSYLVANIA LAW REQUIRES 3 WORKING DAYS NOTICE FOR CONSTRUCTION PHASE AND 10 WORKING DAYS IN DESIGN STAGE-STOP CALL
PENNSYLVANIA ONE CALL SYSTEM, INC.
1-800-242-1776

PENNSYLVANIA ACT 38 (1991) REQUIRES NO LESS THAN 3 WORKING DAYS NOTICE FROM EXCAVATORS WHO ARE ABOUT TO: DIG, DRILL, BLAST, AUGER, BORE, GRADE, TRENCH, OR DEMOLISH WHEN IN THE CONSTRUCTION PHASE. FOR LOCATION REQUESTS IN THE STATE OF PENNSYLVANIA, CALL TOLL FREE 1-800-242-1776. UNDERGROUND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE INFORMATION AND THE LOCATION MUST BE CONSIDERED APPROXIMATE. OTHER UNDERGROUND UTILITIES MAY EXIST WHICH ARE NOT SHOWN. IT WILL BE THE CONTRACTOR'S RESPONSIBILITY TO ASCERTAIN ALL PHYSICAL LOCATIONS OF UTILITY LINES PRIOR TO THE TIME OF CONSTRUCTION. IN NO WAY SHALL THE CONTRACTOR HOLD THE SURVEYOR RESPONSIBLE FOR ANY UTILITY LOCATION SHOWN ON THIS PLAN.

NOT TO SCALE

NOTES

1. CONSTRUCTION NOTES AND CONSTRUCTION CONTROL DATA ARE PROVIDED ON DRAWING 2.

NO.	DATE	REVISION	BY	CHK.	APP.

nrg
CHESWICK GENERATION STATION
UNIT NO.

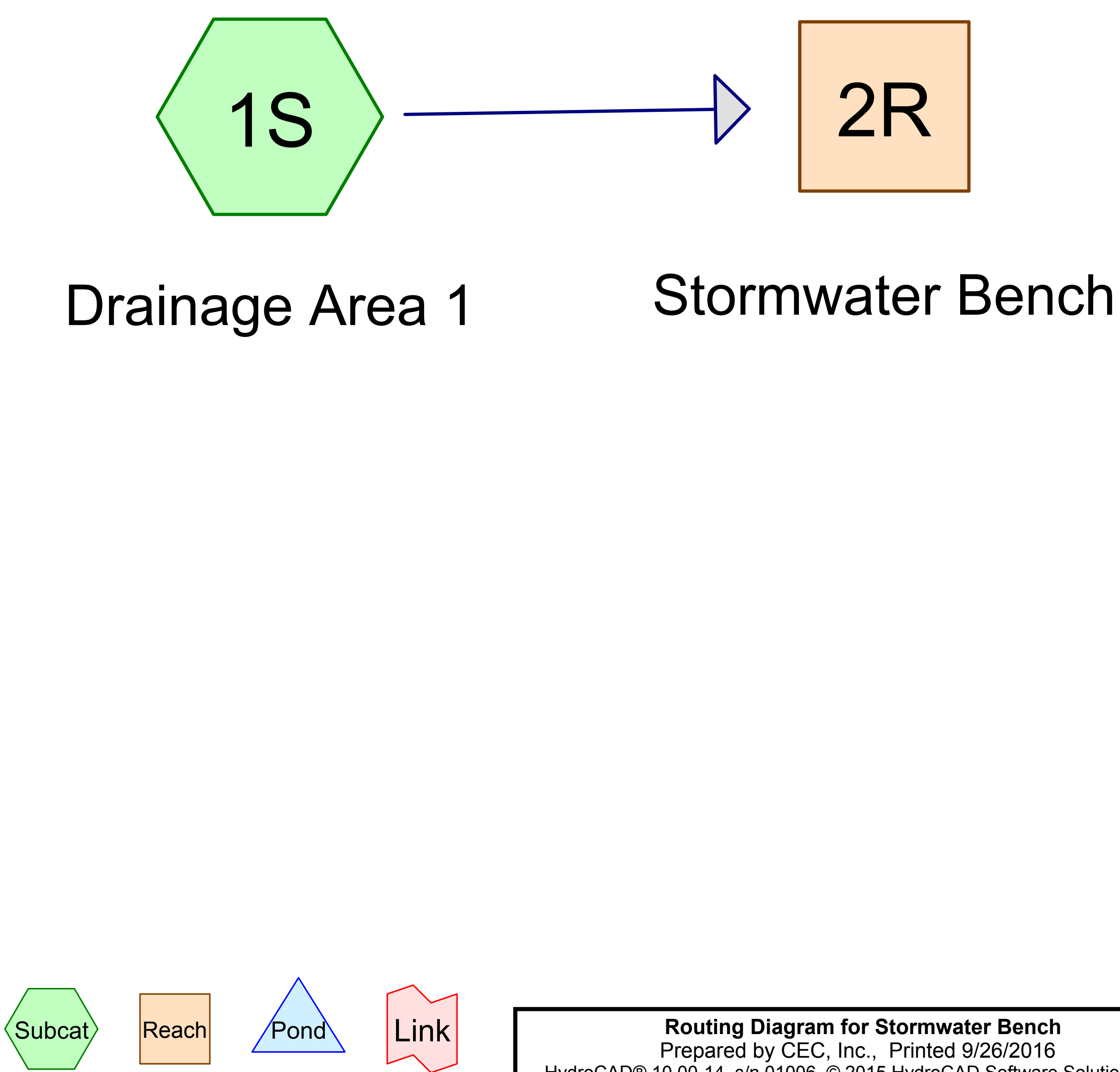
CHESWICK ASH DISPOSAL SITE
STORMWATER BENCH
DRAINAGE AREA DELINEATION

DRAWN	9/2/2015	DRAFT		DRAWING NUMBER
CHECKED	DMD	CHK		DRAWING NO.
APPROVED	RJB	APP		SHEET: SHEET
SIZE:	24X36			REV: REVNO
DISCIPLINE:	CIVIL	SCALE:	NTS	FILE:

P:\2014\144-063\-0400\Dwg\SW03 - FINAL GRADING\144063-SW03-001-PROPOSED FINAL GRADING PLAN.dwg[FINAL GRADES] LS:4/1/2016 - (bgkes) - LP: 4/6/2016 9:18 AM

ATTACHMENT 2

ROUTING OF 25-YEAR 24-HOUR STORM



Routing Diagram for Stormwater Bench
Prepared by CEC, Inc., Printed 9/26/2016
HydroCAD® 10.00-14 s/n 01006 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.620	74	>75% Grass cover, Good, HSG C (1S)
0.620	**74**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.620	HSG C	1S
0.000	HSG D	
0.000	Other	
0.620		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.620	0.000	0.000	0.620	>75% Grass cover, Good	1S
0.000	**0.000**	**0.620**	**0.000**	**0.000**	**0.620**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Drainage Area 1 Runoff Area=0.620 ac 0.00% Impervious Runoff Depth>1.59"
Flow Length=600' Tc=15.2 min CN=74 Runoff=1.24 cfs 0.082 af

Reach 2R: Stormwater Bench Avg. Flow Depth=0.20' Max Vel=1.56 fps Inflow=1.24 cfs 0.082 af
n=0.035 L=600.0' S=0.0300 '/' Capacity=9.59 cfs Outflow=1.05 cfs 0.081 af

Total Runoff Area = 0.620 ac Runoff Volume = 0.082 af Average Runoff Depth = 1.59"
100.00% Pervious = 0.620 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Drainage Area 1

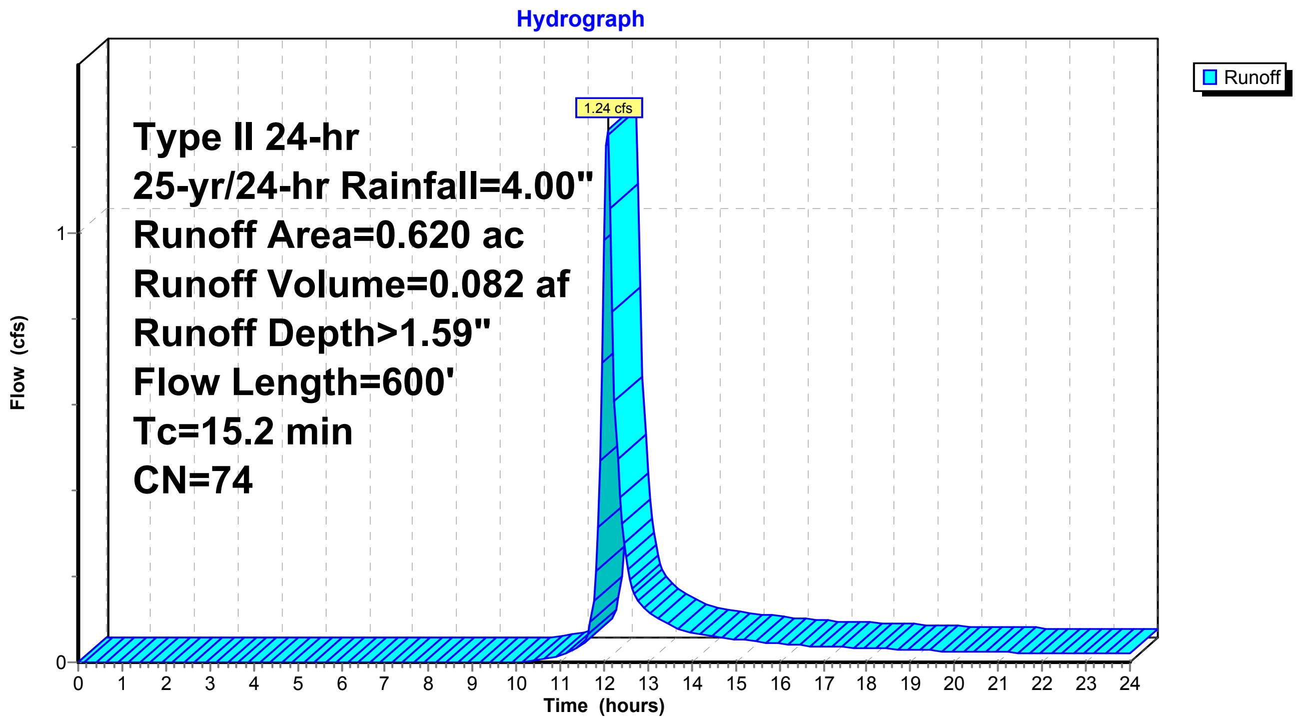
Runoff = 1.24 cfs @ 12.08 hrs, Volume= 0.082 af, Depth> 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr/24-hr Rainfall=4.00"

Area (ac)	CN	Description
0.620	74	>75% Grass cover, Good, HSG C
0.620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	30	0.5000	0.29		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.41"
10.5	70	0.0300	0.11		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.41"
3.0	500	0.0300	2.79		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
15.2	600	Total			

Subcatchment 1S: Drainage Area 1



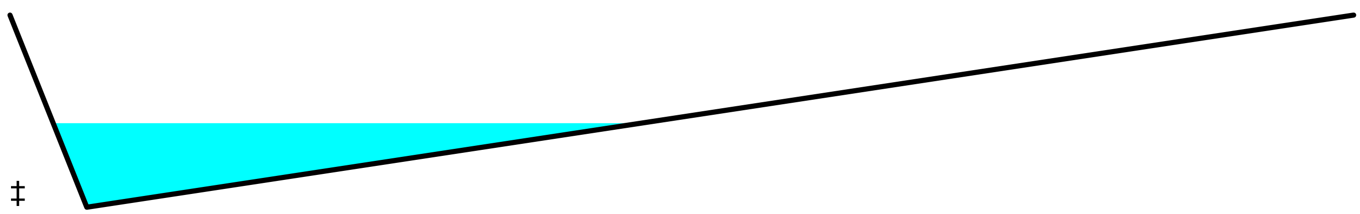
Summary for Reach 2R: Stormwater Bench

Inflow Area = 0.620 ac, 0.00% Impervious, Inflow Depth > 1.59" for 25-yr/24-hr event
Inflow = 1.24 cfs @ 12.08 hrs, Volume= 0.082 af
Outflow = 1.05 cfs @ 12.26 hrs, Volume= 0.081 af, Atten= 15%, Lag= 10.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.56 fps, Min. Travel Time= 6.4 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 14.6 min

Peak Storage= 408 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 0.45' Flow Area= 3.5 sf, Capacity= 9.59 cfs

0.00' x 0.45' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 33.0 '/' Top Width= 15.75'
Length= 600.0' Slope= 0.0300 '/'
Inlet Invert= 1,166.00', Outlet Invert= 1,148.00'



Reach 2R: Stormwater Bench