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July 24, 2024

Mr. Tony Peterson
Waste and Materials Management Program
Wisconsin Department of Natural Resources
Eau Claire Service Center
1300 W. Clairemont Avenue
Eau Claire, WI 54701

Subject: Dairyland Power Cooperative – Alma Off-Site Disposal Facility Phase IV Landfill Plan of Operation Modification for Initial Permitting of Coal Combustion Residuals (CCR) Landfills – Addendum 2, Town of Belvidere, Buffalo County, Wisconsin (License #4126)

Dear Mr. Peterson:

On behalf of Dairyland Power Cooperative (DPC), this letter provides responses to the Wisconsin Department of Natural Resources (WDNR)'s April 15, 2024 Incompleteness Determination (Incompleteness Letter) for the Plan of Operation Approval Modification for Initial Permitting of CCR Landfills at the DPC Alma Off-Site Disposal Facility, Phase IV Landfill (Phase IV Landfill). This is Addendum 2 to the January 30, 2023 Plan of Operation Modification for the Phase IV Landfill (January 2023 Plan Mod).

This addendum is presented in the form of a letter such that each item requiring additional information is shown in bold text followed by DPC's response. If additional materials are needed to supplement the textual response, these supplemental materials are provided within attachments to this Addendum 2.

Attachment 1 contains the certification statement for this Addendum. **Attachment 2** provides the Incompleteness Letter and communication from the WDNR following the May 2, 2024 meeting between WDNR, TRC, and DPC.

1. ***Section NR 504.04(5)(j), Wis. Adm Code: Provide a revised leachate removal system for Cell 4 which includes a sump and side slope riser design.***

   Response: DPC previously obtained an exemption from this requirement in the May 2001 Conditional Plan of Operation Approval. Based on the May 2, 2024 meeting conducted between WDNR, DPC, and TRC it is our understanding that WDNR is re-evaluating this granted exemption due to changes to chs. NR 500-538 resulting from the promulgation of the federal CCR rules. It should be noted that the Federal CCR Rule does not include specific design requirements for the leachate collection and removal system other than the following: (1) designed and operated to maintain less than 30-centimeters depth of leachate over the composite liner, (2) constructed of materials that are chemically resistant to CCR….and of sufficient strength and thickness to prevent collapse under the pressures exerted by the overlying waste, and (3) designed and operated to minimize clogging during the active life and post-closure care period. Therefore, the promulgation of the Federal CCR rule should not impact the existing status of the previously approved exemption request.

   However, as requested by the WDNR, DPC is re-requesting an exemption from s. NR 504.04(5)(j) to allow for the required horizontal liner penetration to accommodate the existing design of the gravity drained system for Cells 4A and 4B of the Alma Off-Site Phase IV Landfill. To justify this request, the following information has been provided below: discussion of the existing gravity leachate collection system design including its pipe penetration, evaluation of the existing system, components of the future system that are currently installed for Cell 4, discussion of the benefits and preferred use of the system, and quality control that is conducted during construction.

As noted above, DPC currently utilizes a gravity drain leachate collection system for the conveyance of generated leachate to the existing leachate collection tank in all of the constructed cells of the Landfill, Cells 1 through 3. This accounts for approximately 63 percent of the total permitted landfill acreage. In the existing cells, this accounts for four existing penetrations through the base liner of the landfill. In the future Cell 4, two additional pipe penetrations would be constructed as proposed in the 2000 Plan of Operation.

The gravity drain leachate collection system consists of the 6-inch perforated SDR 11 HDPE leachate collection pipe located within the limits of waste. The 6-inch perforated pipe generally runs north to south along the base of the landfill. Near the southern toe of slope, the perforated pipe transitions to a non-perforated 6-inch diameter SDR 11 HDPE pipe while remaining within the limits of waste, north of the liner penetration location. Following the liner penetrations, the piping transitions to a dual encased pipe (non-perforated 6-inch diameter SDR 17 within a non-perforated 10-inch diameter SDR 11). This dual encased pipe is routed into currently constructed manholes and gravity drains to the leachate collection tank south of the Phase IV Landfill.

The liner penetrations are designed to contain leachate within the lined landfill and the dual encased transfer pipes. A double HDPE pipe boot is installed at the location where the transfer piping exits the liner system. The double HDPE boot consists of two pipe boots that are welded to the non-perforated pipe and are offset from each other. At each liner penetration, the inner pipe boot was installed first and welded to the pipe and then the secondary boot was placed over the initial boot and welded in a way that the second pipe boot covers the initial pipe boot welds. A detail of the double pipe boot and liner penetration components that were installed during the construction of Cell 3A is included in **Attachment 3**. The double pipe boot provides additional protection against migration of leachate into the environment.

Outside the base grades (top of soil barrier layer) the transfer piping is wrapped in a geosynthetic clay liner (GCL) wrap. The GCL wrap was installed along the length of the non-perforated pipe outside the limits of waste to where the pipe transitions from the single pipe to a dual encased pipe, approximately 24 feet from the base of the landfill. The GCL wrap provides a low permeability layer that acts as a secondary containment around the pipe in case of potential leaks. In addition, a minimum 2-foot-thick low-permeability soil (soil barrier layer) that is used to construct the base of the composite liner system is also placed in all directions around the pipe from the liner penetration to beyond the termination of the GCL wrap. Approximately 21 feet from the base of the landfill the GCL wrapped 6-inch non-perforated pipe passes through a 4-foot by 4-foot HDPE anti-seep collar that is installed within the southern berm of the of the Phase IV Landfill. The anti-seep collar provides additional protection from potential leakage. These features provide multiple layers of safety measures to minimize the potential for migration of leachate from the liner penetration.

The existing gravity drain system has operated as designed and intended. No significant problems have been noted. DPC regularly jets the leachate collection lines and if indications of clogging arise, additional jetting occurs at the site.

Groundwater monitoring has been conducted at the Phase IV Landfill during its active life. When reviewing the previous 6 years of groundwater monitoring reports, the Phase IV Landfill has not seen any statistically significant increases (SSIs) within the wells of the monitoring network and the site has continued to remain within detection monitoring. During the regular inspection of the existing leachate conveyance system, evidence of leaks of have not been noted. Groundwater results from downgradient wells have not shown evidence of leaks through the liner system, and liquids have not been identified within the dual encased piping located beyond the anti-seep collar.

Because the non-perforated piping associated with Cell 4, Module A and B is routed within a portion of the Cell 3 build-out, a portion of Cell 4, Module A's gravity conveyance system was installed during liner construction of Cell 3A in 2012. This installed infrastructure consists of manhole MH7 along with the dual encased piping located between manholes MH6 and MH7, and two lines of piping from future Cells 4A and 4B to manhole MH7. Select low permeability soil (soil barrier layer) was placed around the northern 10 feet of the pipes and extended 2 feet in all directions. The installed pipes were capped for the future connections to occur during the construction of Cell 4A. Therefore, the only connections that need to occur are the connections that will occur at the liner penetration and within the limits of waste for the Cell 4A and 4B leachate collection piping if no changes are made to the design. The installed infrastructure is shown on Sheet 6 in **Attachment 3**.

Revising the design of the of the leachate collection system for Cell 4 would require several changes in operation and construction for future buildout of the landfill. As noted above, construction of a portion of the Cell 4A and 4B system was required during Cell 3A construction due to the location of piping with the Cell 3A perimeter berm. This includes piping and the manhole that the piping is connected to. Changes to the design to incorporate a sump and pump system would require removal of this piping within the perimeter berm of Cell 3A and changes to the installed manhole to allow a forcemain to be connected to the existing gravity drain transfer system. Electrical infrastructure required for a pump system is not currently available at the landfill. This would require an electrical conductor to be routed up to the landfill to service one cell of the landfill and would require the addition of a pump and electrical controls and communication between electrically actuated valves near the leachate collection tank and the pump in Cell 4. The electricity would need to be routed to avoid existing landfills and infrastructure on the property, and would result in significant construction cost and complexity.

In addition, the gravity system provides simpler operation for DPC. There is generally reduced operational and maintenance requirements for a gravity drain system. Due to the lack of pumps, there are no pumps to fail that would need to be replaced and/or repaired. Floats and valves do not need to be maintained to allow for proper pump operation. If a pumped system is added to Cell 4, this would result in differing operation and maintenance requirements across the landfill, adding complexity to the current simple system.

The current design's performance meets the requirements of the site. If leachate volume drastically increases, DPC has protocols in place to allow for direct leachate removal from the landfill via temporary pump systems that can directly load leachate into tanker trucks. Though a pump system may be able to move more liquid in a shorter time, DPC does not necessarily have the infrastructure in place to manage that on a consistent basis. At the Phase IV landfill, the limiting factors for the leachate collection and transfer system are the size of the transfer pipes, the storage capacity of the tank and the hauling limitations of the transfer tankers. For these reasons, there is not a significant advantage to having a permanent pumped system installed to service Cell 4.

As part of the general inspection and monitoring associated with the Landfill, DPC will continue to monitor for potential leaks from the proposed liner penetration within Cell 4. During routine landfill operations, inspections of the manholes, televising of pipes, and inspection of the exterior slopes and vegetation will provide indicators in the unlikely event of potential leakage from the landfill. In addition, groundwater monitoring will continue at the wells located across the site, and if statistically significant increases are observed, an investigation into the cause will be conducted.

During construction, thorough quality control testing will be completed on the pipe penetration location similar to the testing that has been completed in the other constructed cells. This includes electrical resistivity testing of the liner and completing spark testing along welds of the pipe boot. Observation and testing on the subbase of the piping will be completed to confirm that the pipe is being placed on a stable and unyielding subgrade to minimize settlement and damage to the piping due to movement.

Based on the information presented, a gravity drained system as currently designed and partially installed for Cell 4 is expected to operate in a similar manner as the systems currently in-place at the landfill. No significant complications or releases due to the gravity drain system and its corresponding liner penetration have been noted at the site. The system is designed and installed with safety measures in place to minimize the potential of leakage through the liner system. Therefore, DPC requests that the WDNR re-approve the use of the existing gravity drain system and the penetration through the liner for the remaining cell (Cell 4) of the Phase IV Landfill.

2. Section NR 514.07(10), Wis. Adm. Code: Provide additional information for the operational plans required for the CCR landfill.

a. Section NR 514.07(10)(b)(3), Wis. Adm. Code: Provide an estimated schedule for construction of the storm water control structures. This can be an estimate based on an assumed CCR filling rate.

Response: An estimated schedule for the remaining run-on and runoff control structures is provided in Appendix D of the Run-on and Run-off Control System Plan (**Attachment 4**). This schedule is based on an estimated filling rate of approximately 49,000 cubic yards per year. It should be noted that construction may be conducted differently than the schedule presented as filling rates will fluctuate on a yearly basis. Construction and closure of cells will be dependent on the projected disposal requirements at the time and when final waste grades are obtained.

No other changes to the plan were made.

b. Section NR 514.01(10)(c)(6), Wis. Adm. Code: Provide an estimated schedule of final cover construction activities including the year and number of acres of each construction event. This can be an estimate based on an assumed CCR filling rate.

Response: An estimated schedule containing the estimated acres to be closed in each event and the year that the event will begin is provided as Table 1 in the attached Closure Plan (**Attached 5**). Table 2 shows compliance with the schedule requirement in s. NR 506.083(3)(a), which is associated with the timeline following initiation of closure (e.g. date of final receipt of CCR waste and any non-CCR waste stream or final removal of CCR from the CCR landfill for the purpose of beneficial use of CCR). This breaks out the steps of the final closure activity for the site to show that it can be accomplished within 6 months as required by s. NR 506.083(3)(a).

The estimated schedule is based on an annual filling rate of approximately 49,000 cubic yards per year. It should be noted that actual closures may be conducted differently than the schedule presented as filling rates will fluctuate on a yearly basis and closure will be dependent on when final waste grades are obtained.

3. Section NR 520.07(1), Wis. Adm. Code: Provide an updated long-term care cost estimate table that includes the estimated cost for video inspection of the leachate collection system every five years.

Response: **Attachment 6** provides an updated long-term care cost estimate table, which includes leachate line televising.

4. Provide a chronological listing of all previous department issued plan of operation and modification approvals, including expedited plan modifications, along with a listing of their approval conditions, indicating the status (active, completed or superseded) of each condition. This will assist the department with potentially rescinding or superseding outdated conditions of past approvals.

Response: DPC and TRC conducted a virtual meeting with Tony Peterson and Matthew Bachman of the WDNR on May 2, 2024. During this meeting, each of the comments of the April 15 Incompleteness letter were discussed. During this discussion, WDNR noted that this request was not required but would generally be appreciated.

DPC and TRC provided WDNR, for their convenience, copies of previous approval letters for the Plan of Operation and modifications that were approved in the January 2023 Modification to the Plan of Operation. It is the opinion of DPC that these should be sufficient in WDNR's determination of the active statuses of previous site approval conditions. No other documentation will be provided, as this request is not required for this submittal.

DPC is requesting that the WDNR review and provide an approval for the Phase IV Landfill. Please feel free to contact Leif Tolokken at (608) 386-2675 or me at (608) 622-9382 with questions regarding this document.

Sincerely,

TRC

Todd W. Martin

Todd Martin
Principal Project Manager

cc: See attached Distribution List

List of Enclosures

Attachment 1: Addendum Certification Statement
Attachment 2: WDNR Communication
Attachment 3: Supporting Documentation for Item 1
Attachment 4: Updated Run-on and Run-off Control System Plan
Attachment 5: Updated Closure Plan
Attachment 6: Long-term Care Costs

Distribution List

Recipient	Hard Copy	Electronic Copy[1]
Anthony Peterson Wisconsin Department of Natural Resources 141 NW Barstow Street #180 Waukesha, WI 53188	1	Yes
Matthew Bachman Wisconsin Department of Natural Resources 1300 W Clairemont Ave Eau Claire, WI 54701	1	Yes
Leif Tolokken Dairyland Power Cooperative 3200 East Avenue South La Crosse, WI 54601		Yes
Don Loock Dairyland Power Cooperative S2180 State Hwy 35 Alma, WI 54610		Yes
BreAnne Kahnk TRC 999 Fourier Drive, Suite 101 Madison, WI 53717		Yes

Footnotes:

(1) Electronic copies to be sent via an e-mail link.

Attachment 1

Addendum Certification Statement

Certification Statement

"I, ______________________________, hereby certify that I am a licensed professional engineer in the
Douglas R. Genthe, P.E.

State of Wisconsin in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 500 to 538, Wis. Adm. Code."

I, ______________________________, hereby certify that I am a licensed professional geologist
Stephen Sellwood, P.G.

in the State of Wisconsin in accordance with the requirements of Chapter GHSS 2, Wisconsin Administrative Code; that the preparation of this document has not involved any unprofessional conduct as detailed in Chapter GHSS 5, Wisconsin Administrative Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in Chapters NR 500 to NR 538, Wisconsin Administrative Code.

Attachment 2

WDNR Communication

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
1300 W. Clairemont Ave.
Eau Claire, WI 54701-6127

Tony Evers, Governor

Telephone 608-266-2621
Toll Free 1-888-936-7463
TTY Access via relay - 711

WISCONSIN
DEPT. OF NATURAL RESOURCES

April 15, 2024

FID #606043900
Buffalo County
SW/Correspondence

Mr. Leif Tolokken
Dairyland Power Cooperative
JPM Station
500 Old State Highway 35
Alma, WI 54610

Subject: Incompleteness Determination for the Plan of Operation Approval Modification for Initial Permitting of Coal Combustion Residuals (CCR) Landfill for the Dairyland Power Cooperative Alma Off-Site Disposal Facility, Phase IV Landfill (License #4126)

Dear Mr. Tolokken:

The Department of Natural Resources (department) has reviewed for completeness the plan of operation modification for initial permitting of a CCR Landfill ("the plan"), dated January 30, 2023, along with the addendum to the plan dated January 17, 2024, both submitted on behalf of Dairyland Power Cooperative (DPC), by TRC Companies for the Dairyland Power Cooperative Alma Off-Site Disposal Facility, Phase IV Landfill.

The department has determined the plan is not complete since the minimum requirements of chs. NR 500 to 520, Wis. Adm. Code, have not been met in accordance with s. NR 514.045, Wis. Adm. Code. The department understands the complexity of the new CCR rules and its implementation and will be available to discuss the following items while you work to prepare the addenda to your initial submittal.

The following information must be provided in order for the department to issue a determination that the plan is complete:

1. **Section NR 504.06(5)(j), Wis. Adm. Code:** Provide a revised leachate removal system for Cell 4 which includes a sump and side slope riser design.

2. **Section NR 514.07(10), Wis. Adm. Code:** Provide additional information for the operational plans required for the CCR landfill.

    a. Section NR 514. 07(10)(b)3, Wis. Adm. Code: Provide an estimated schedule for construction of the storm water control structures. This can be an estimate based on an assumed CCR filling rate.

    b. Section NR 514. 07(10)(c)6, Wis. Adm. Code: Provide an estimated schedule of final cover construction activities including the year and number of acres of each construction event. This can be an estimate based on an assumed CCR filling rate.

3. **Sections NR 520.07(1), Wis. Adm. Code:** Provide an updated long-term care cost estimate table that includes the estimated cost for video inspection of the leachate collection system every five years.

4. Please provide a chronological listing of all previous department issued plan of operation and modification approvals, including expedited plan modifications, along with a listing of their approval conditions, indicating the status (active, completed or superseded) of each condition. This will assist the department with potentially rescinding or superseding outdated conditions of past approvals.

This incompleteness determination is not a denial of the plan, but merely indicates that additional information is needed for the department to determine the plan is complete. Submittal of this information does not ensure approval, nor does it preclude the department from requiring additional information if continued review indicates it is needed.

If you have any questions regarding this letter, please contact Tony Peterson at (715) 491-8546 or anthony.peterson@wisconsin.gov, or Matthew Bachman at (608) 512-3233 or matthew.bachman@wisconsin.gov.

Sincerely,

John Morris, Professional Soil Scientist, Regional Supervisor
Northern and West Central Regions
Waste and Materials Management Program

cc: Brian Kalvelage – Dairyland Power Cooperative (brian.kalvelage@dairylandpower.com)
BreAnne Kahnk – TRC Companies (bkahnk@trccompanies.com)
Todd Martin – TRC Companies (twmartin@trccompanies.com)
Tony Peterson – DNR/WA (anthony.peterson@wisconsin.gov)
Matthew Bachman – DNR/WA (matthew.bachman@wisconsin.gov)
Joseph Lourigan – DNR/WA (joseph.lourigan@wisconsin.gov)
Malena Grimm – DNR/WA (malena.grimm@wisconsin.gov)

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
141 NW Barstow St. Room 180
Waukesha, WI 53188

Tony Evers, Governor

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TTY Access via relay - 711

May 9, 2024

FID: 606043900
Buffalo County
SW/Correspondence

Mr. Leif Tolokken
Dairyland Power Cooperative
JPM Station
500 Old State Highway 35
Alma, WI 54610

Subject: Follow-Up Letter from Department's Meeting with Dairyland Power Cooperative (Co-Op) on May 2, 2024, Regarding the Plan of Operation Approval Modification for Initial Permitting of Coal Combustion Residuals (CCR) Landfill for the Dairyland Power Co-Op Alma Off-Site Disposal Facility, Phase IV Landfill (License #4126)

Dear Mr. Tolokken:

The Department of Natural Resources (department) met with Dairyland Power Co-Op and TRC Companies to discuss the department's second incompleteness determination letter dated April 15, 2024 (incompleteness letter) for the plan of operation approval modification (plan modification) for initial permitting for a CCR landfill for the Dairyland Power Cooperative Alma Off-Site Disposal Facility, Phase IV Landfill (landfill).

During the meeting Dairyland Power Co-Op expressed interest in continuing the discussion on item number 1 of the incompleteness letter, which requested that the leachate collection system of Cell 4 of the landfill be revised to include a sump and sideslope riser system to avoid penetrations through the landfill liner system as required by s. NR 504.06(5)(j), Wis. Adm. Code.

The department may grant an exemption to the requirements of chs. NR 500 to 538, Wis. Adm. Code, in special cases where the proposal will not cause environmental pollution as defined under s. 299.01 (4), Wis. Stats. In considering a proposal for an exemption under s. NR 500.08 (4), Wis. Adm. Code, the department shall take into account such factors as the population of the area being served, the amount of waste being generated, the geologic and hydrogeologic conditions at the facility, the design of the facility, the operational history of the facility, the physical and chemical characteristics of the waste, and any other information that may be appropriate.

If Dairyland Power wishes to request an exemption, please include the relevant information to show how the proposed landfill is a special case, how the exemption will not cause environmental pollution and the supporting factors that the department should consider in reviewing the request that shows why the exemption is warranted.

Suggested information that may be relevant to an exemption request includes the following:

- An evaluation of the performance of the current gravity drain leachate collection and removal system operating within Cells 1 through 3 of the landfill.
- An explanation of the existing leachate collection and removal system infrastructure already constructed for Cell 4.
- An explanation of why the gravity drain leachate collection and removal system would be preferential to a sump and sideslope riser leachate collection and removal system for Cell 4 of the landfill with regards to operations, maintenance, and performance.

- An explanation of how potential leaks through the penetrations of landfill liner would be identified.

Please note that the department does not guarantee that if an exemption to s. NR 504.06(5)(j), Wis. Adm. Code, is requested as part of the plan modification that it would be approved. The department would need to review the exemption request in its entirety before making a decision.

If you have any questions regarding this letter, please contact Tony Peterson at (715) 491-8546 or anthony.peterson@wisconsin.gov, or Matthew Bachman at (608) 512-3233 or matthew.bachman@wisconsin.gov.

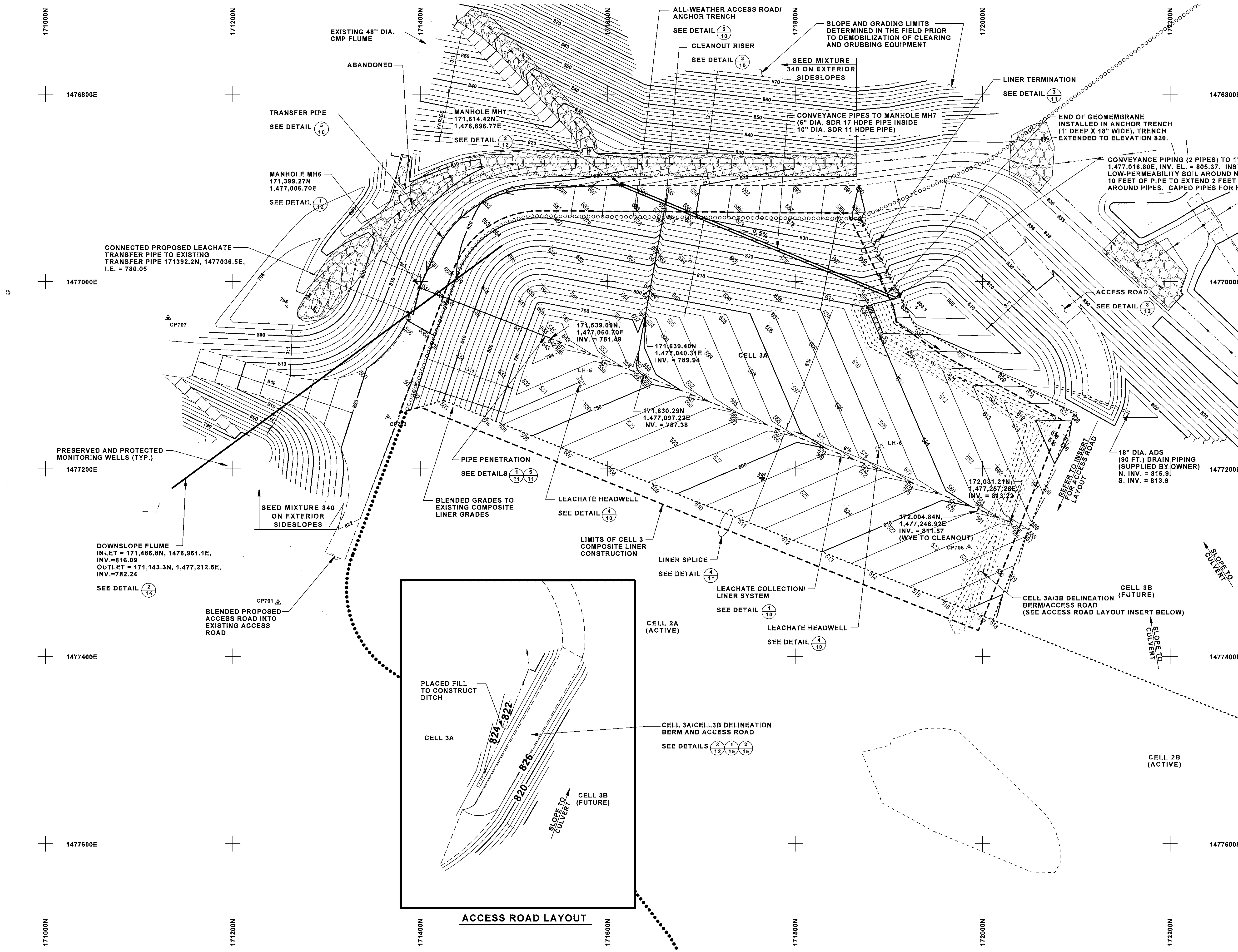
Sincerely,

Tony Peterson
Waste Management Engineer
Southeast Region

cc: Brian Kalvelage – Dairyland Power Cooperative (brian.kalvelage@dairylandpower.com)
BreAnne Kahnk – TRC Companies (bkahnk@trccompanies.com)
Todd Martin – TRC Companies (twmartin@trccompanies.com)
Tony Peterson – DNR/WA (anthony.peterson@wisconsin.gov)
Matthew Bachman – DNR/WA (matthew.bachman@wisconsin.gov)
Joseph Lourigan – DNR/WA (joseph.lourigan@wisconsin.gov)
Tess Brester – DNR/WA (tess.brester@wisconsin.gov)
John Morris – DNR/WA (john.morris@wisconsin.gov)

Attachment 3

Supporting Documentation for Item 1



NOTES

1. REFER TO PLAN SHEET 2 OF THIS PLAN SET FOR LEGEND, BASE MAP NOTES AND BENCHMARK LOCATIONS.

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

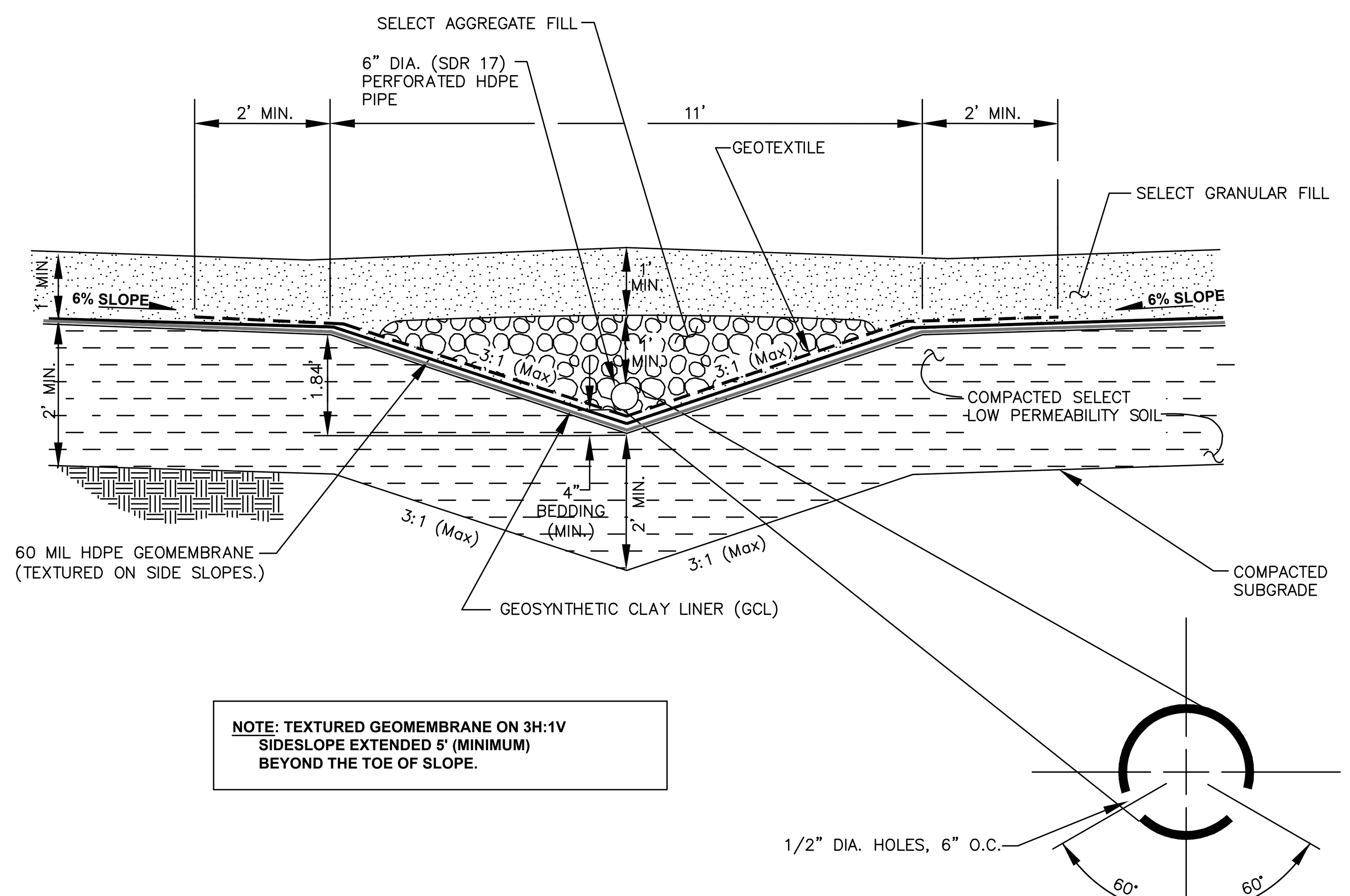
NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: DAIRYLAND POWER COOPERATIVE PHASE IV, CELL 3A LINER CONSTRUCTION DOCUMENTATION

SHEET TITLE: BASE GRADES

DRAWN BY: dreyzek	SCALE: 1" = 50'	PROJ. NO.	187576.0000.000006
CHECKED BY: TWM		FILE NO.	187576.06.SHT06-BG.PLT
APPROVED BY: KDP	DATE PRINTED:	SHEET 6 OF 16	
DATE: JANUARY 2013			

TRC
708 Heartland Trail
Suite 3000
Madison, WI 53717
Phone: 608.826.3600



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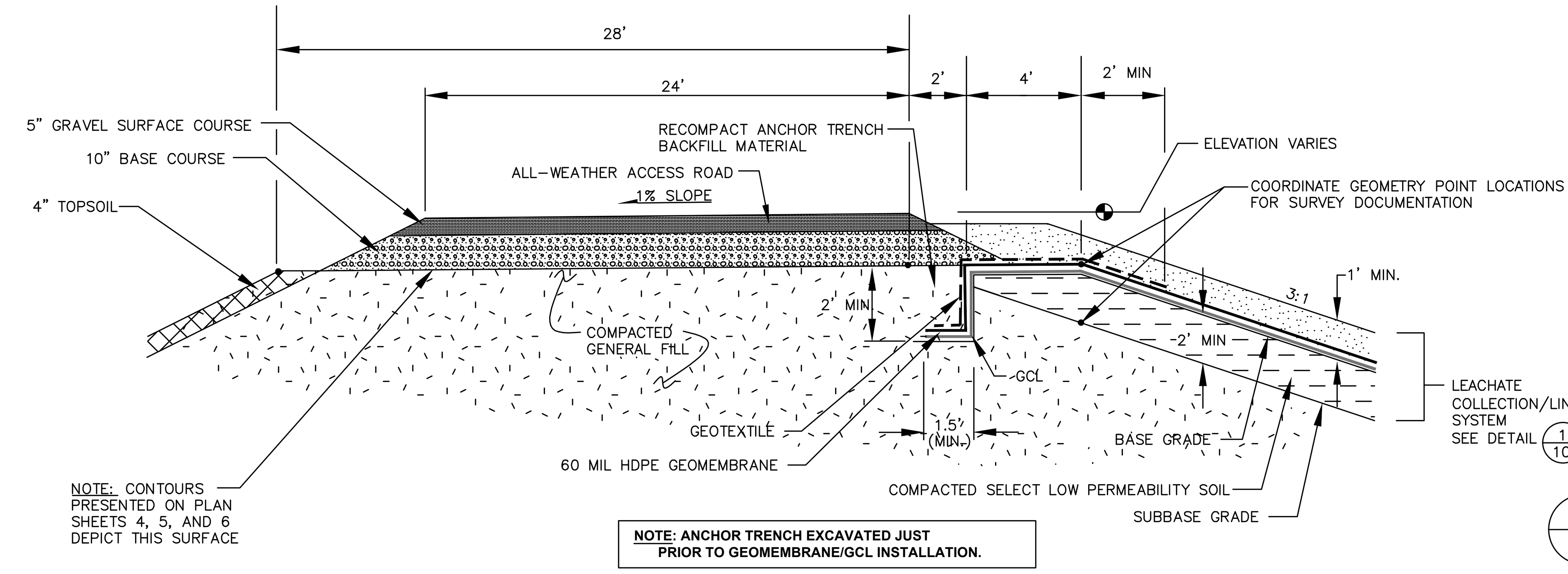
LEACHATE COLLECTION/LINER SYSTEM

(NOT TO SCALE)



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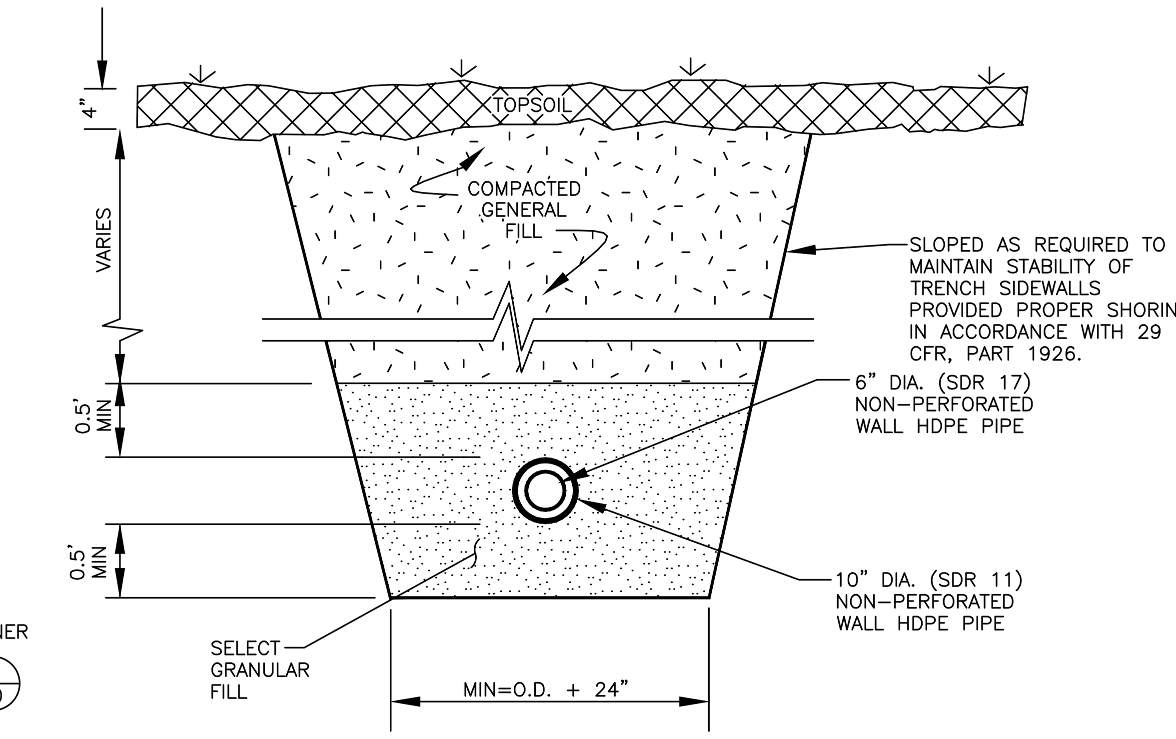
ALL-WEATHER ACCESS ROAD/ ANCHOR TRENCH

(NOT TO SCALE)



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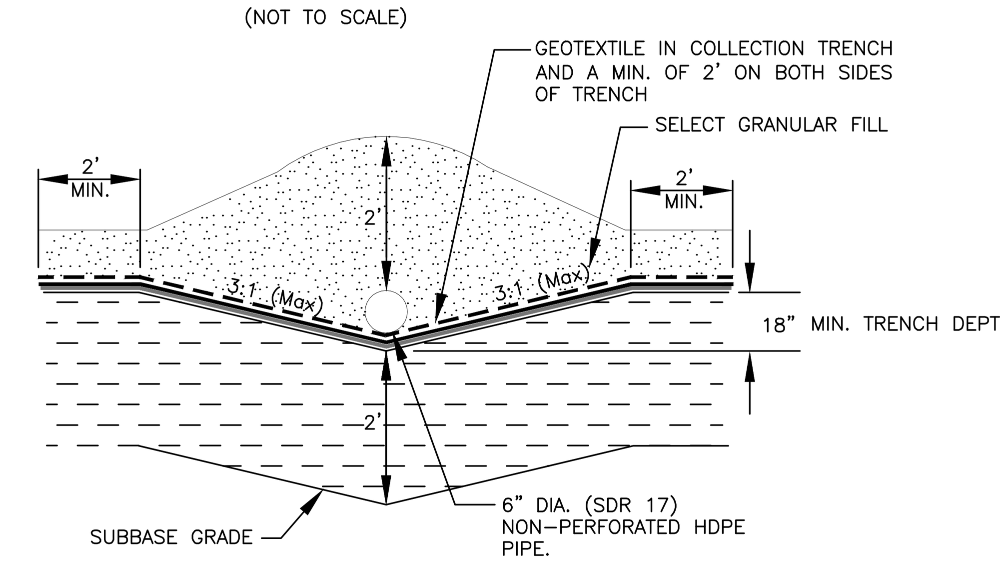
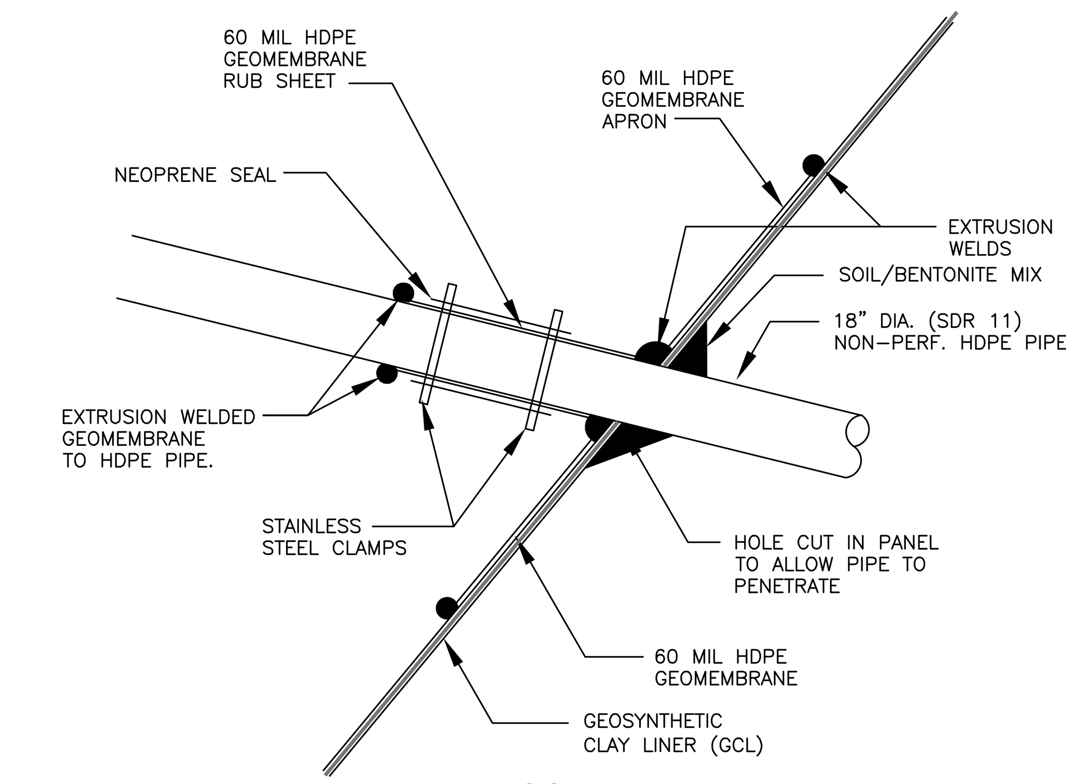


SECTION A-A'

RISER PIPE



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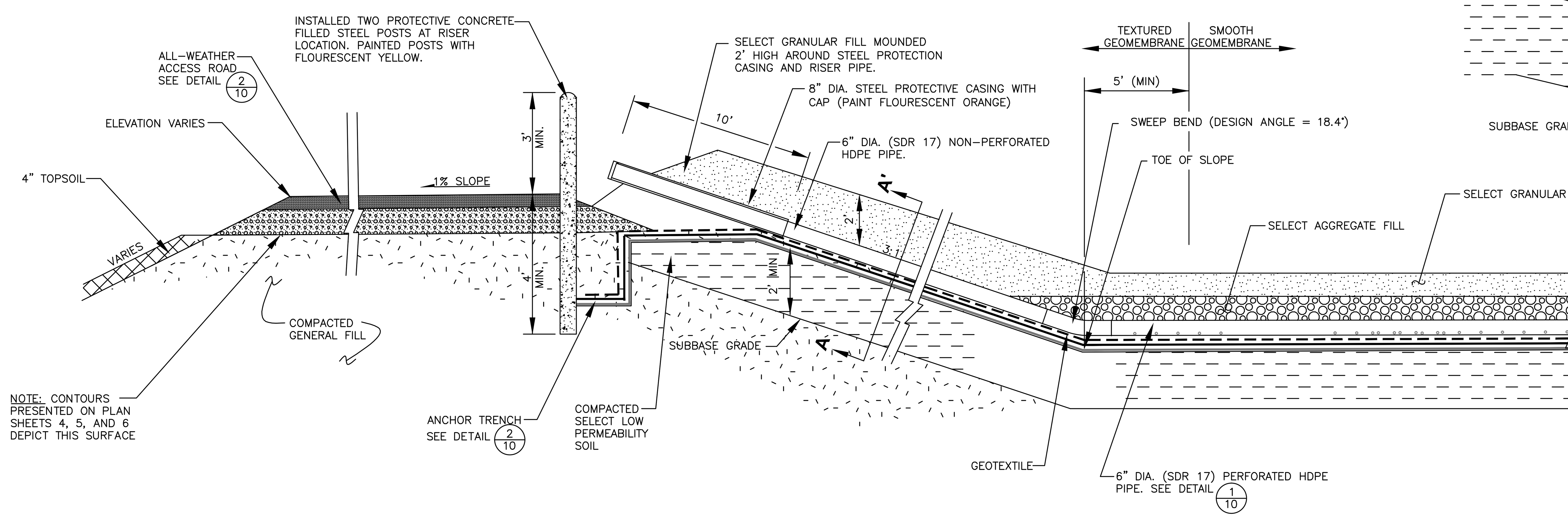
PIPE BOOT

(NOT TO SCALE)



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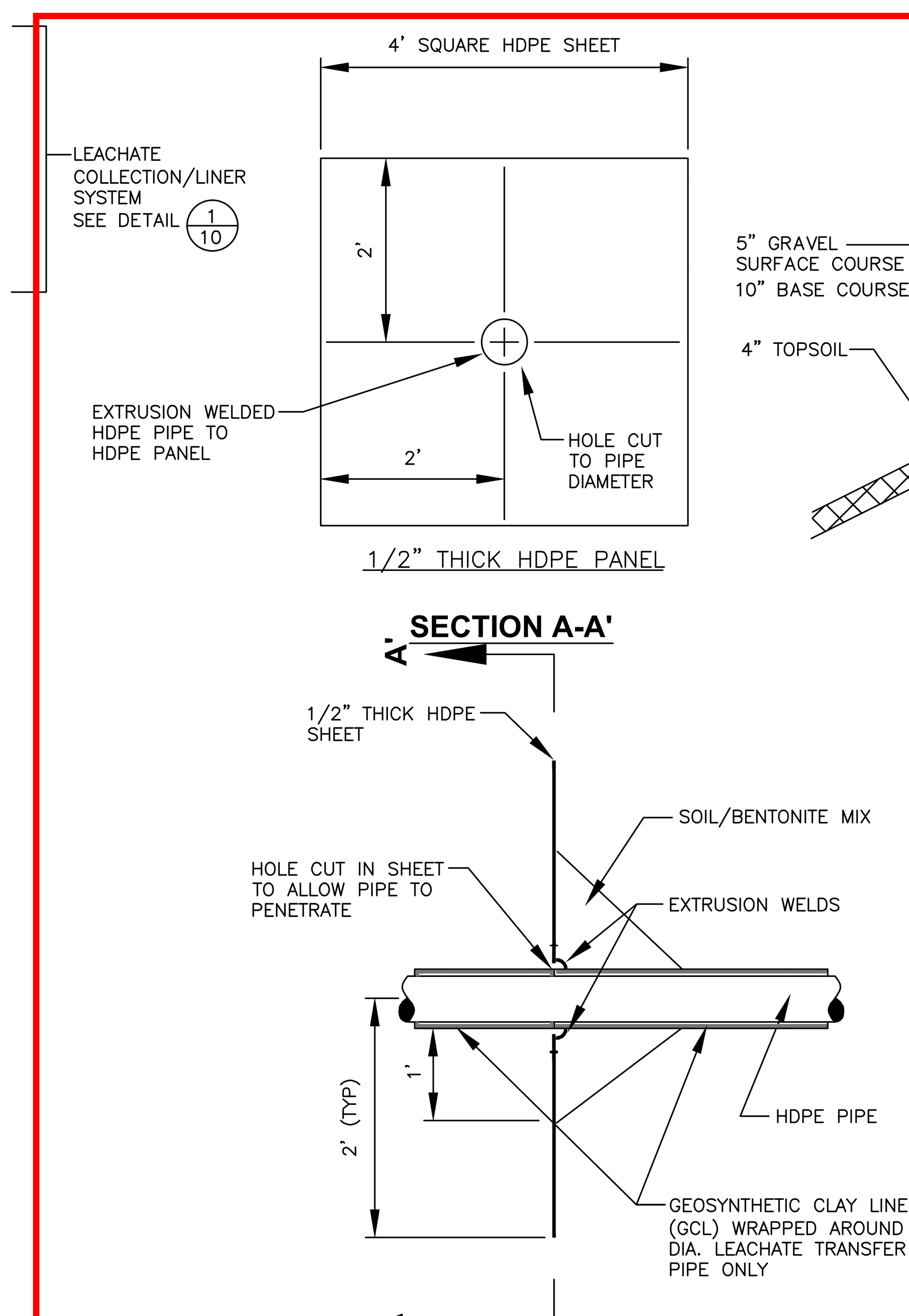
CLEANOUT RISER

(NOT TO SCALE)



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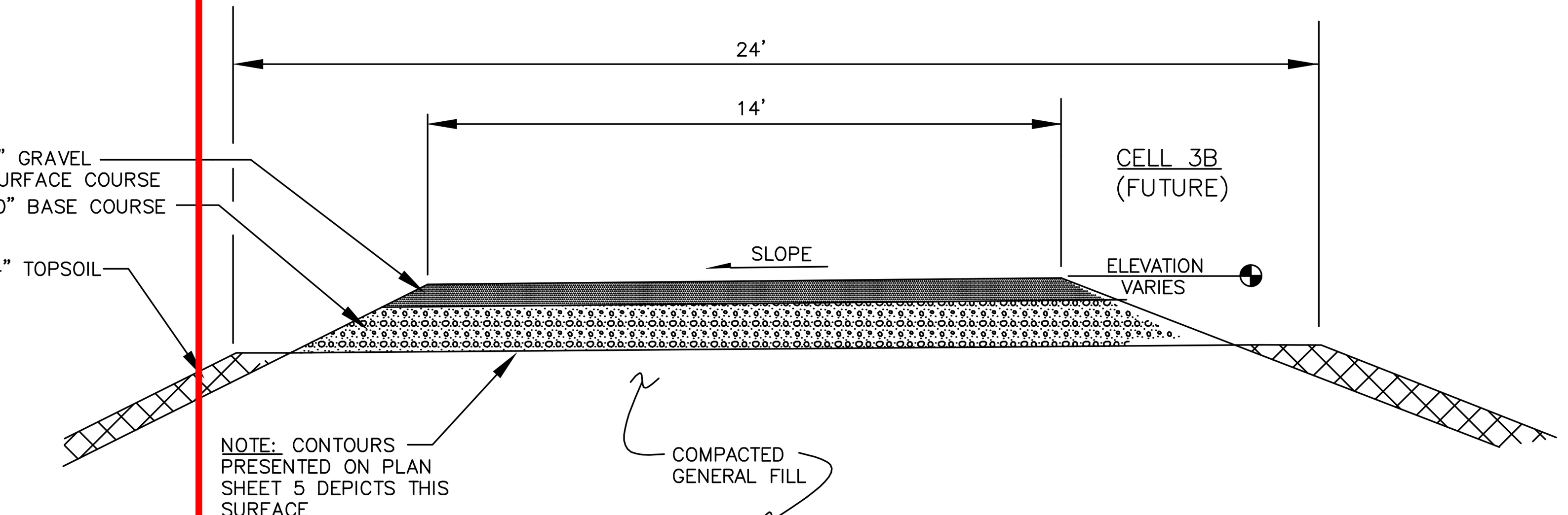
ANTI-SEEP COLLAR

(NOT TO SCALE)



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ALL-WEATHER ACCESS ROAD (NORTH)

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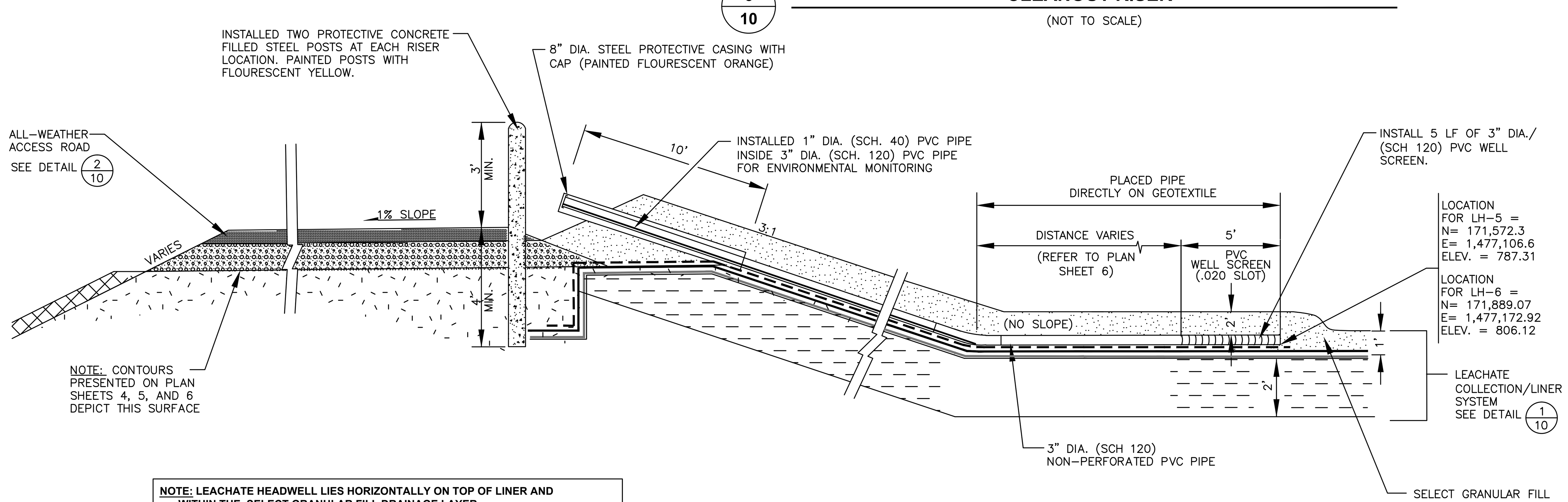

4
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LEACHATE HEADWELL LH-5 & LH-6

(NOT TO SCALE)

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: **DAIRYLAND POWER COOPERATIVE PHASE IV, CELL 3A LINER CONSTRUCTION DOCUMENTATION**

SHEET TITLE: **DETAILS**

DRAWN BY: DREYZEK	SCALE: AS SHOWN	PROJ. NO. 187576.0000.000006	
CHECKED BY: TWM		FILE NO. 187576.0000.06.SHT 10.dwg	
APPROVED BY: KDP	DATE PRINTED:	SHEET 10 OF 16	
DATE: JANUARY 2013			

TRC

708 Heartland Trail
Suite 3000
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Phone: 608.826.3600

File Location: J:\Dairyland Power\Alma\187576\0000\000006 File Name: 187576.0000.06.SHT 10 Layout Name: SHEET 10
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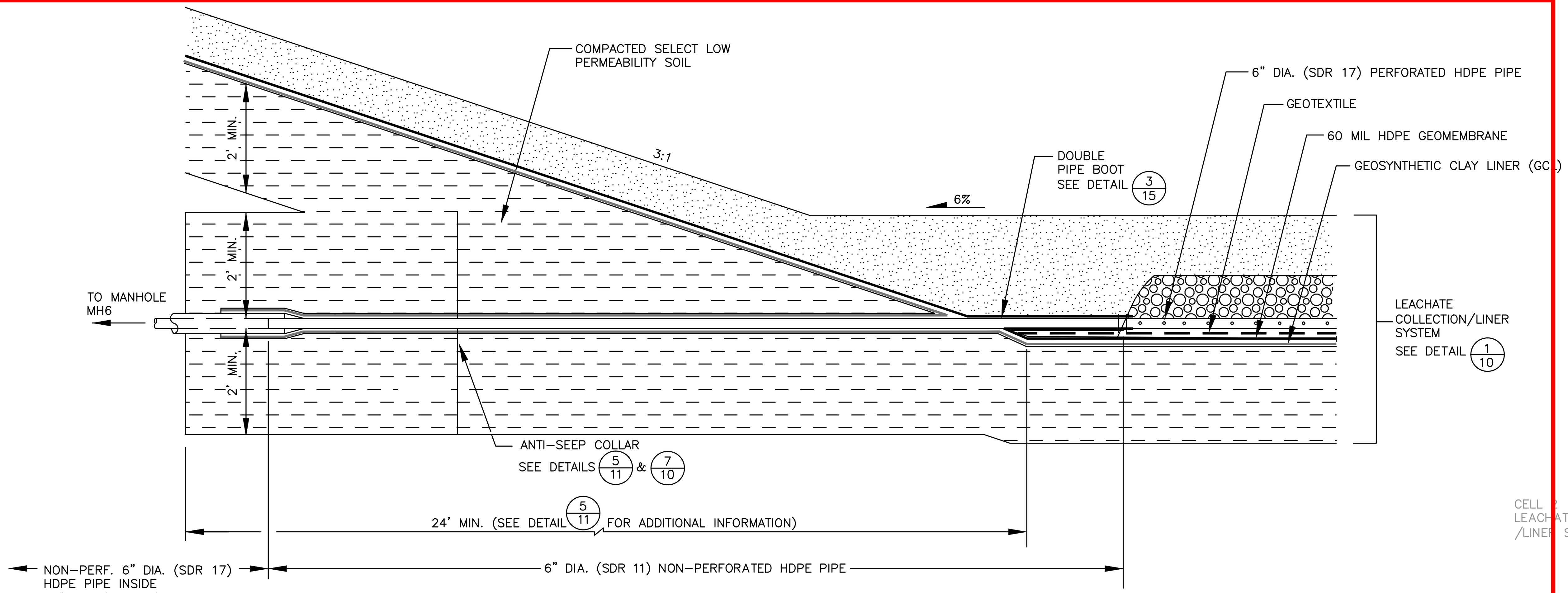
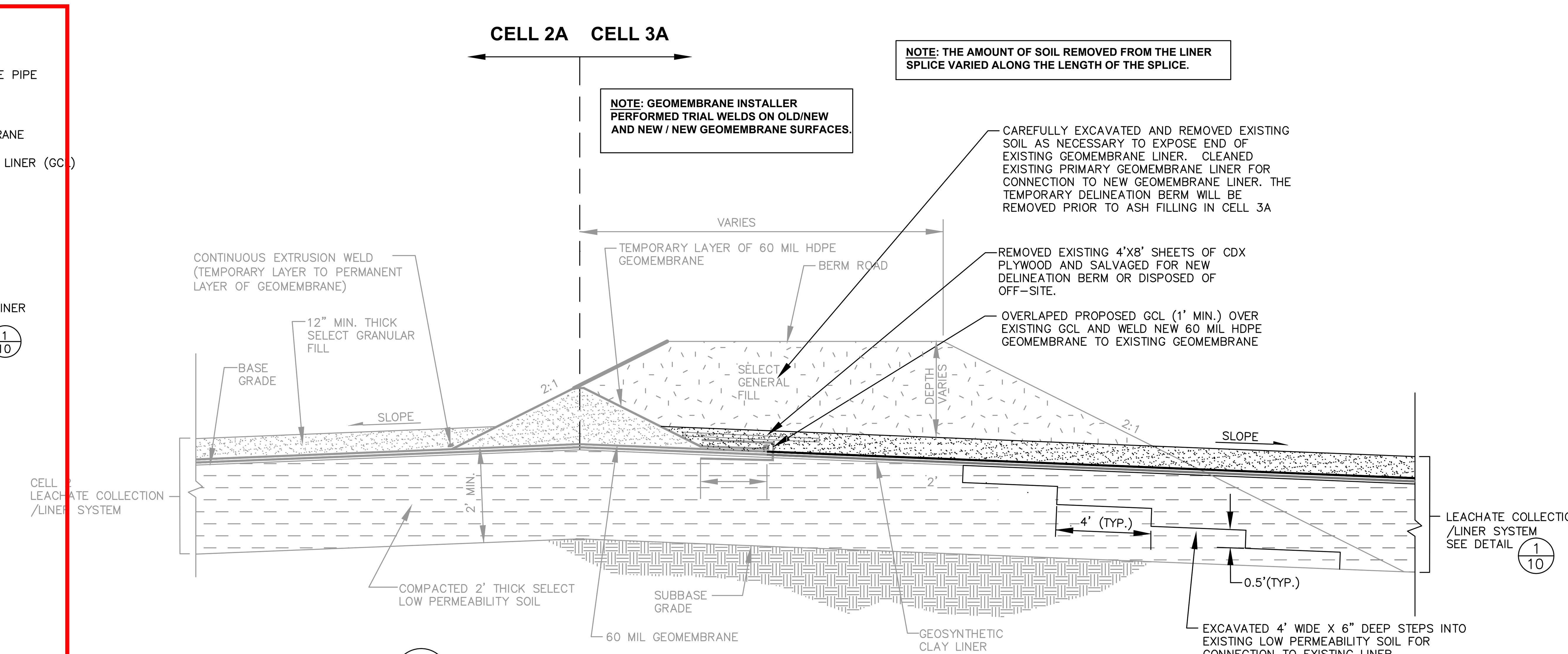


PIPE PENETRATION THROUGH LANDFILL PERIMETER BERM (PROFILE LOOKING WEST)

1/11

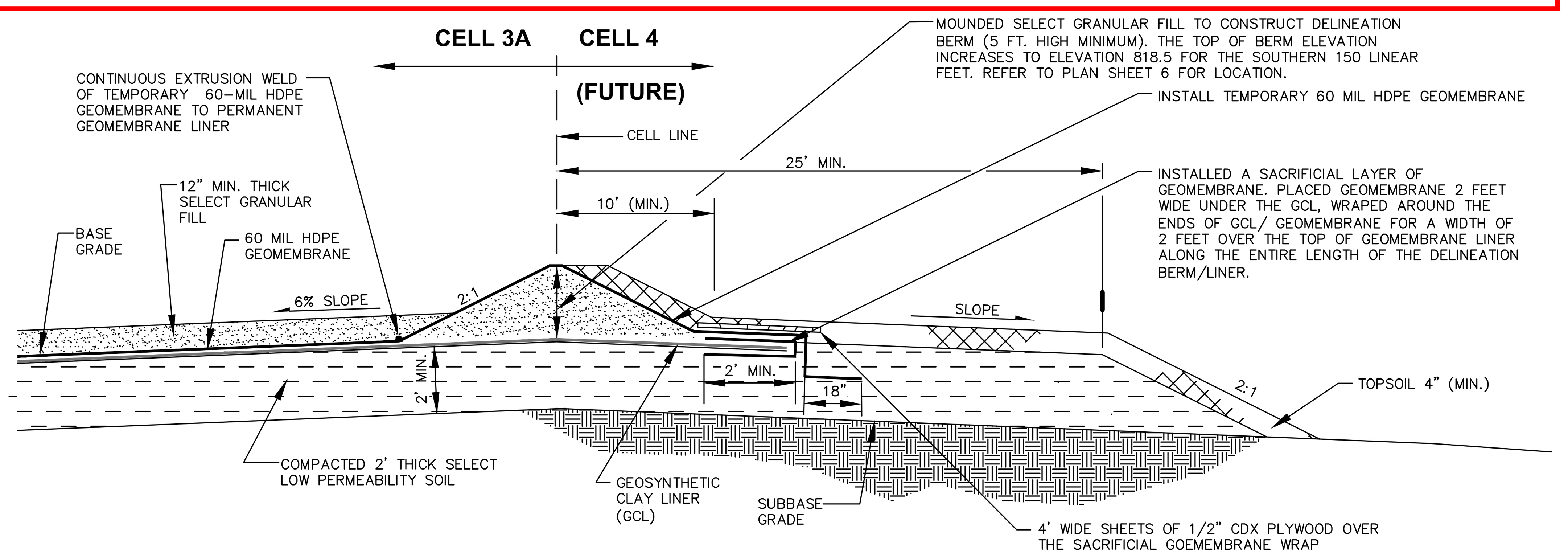
(NOT TO SCALE)



4/11

LINER SPLICE

(NOT TO SCALE)



2/11

DELINEATION BERM

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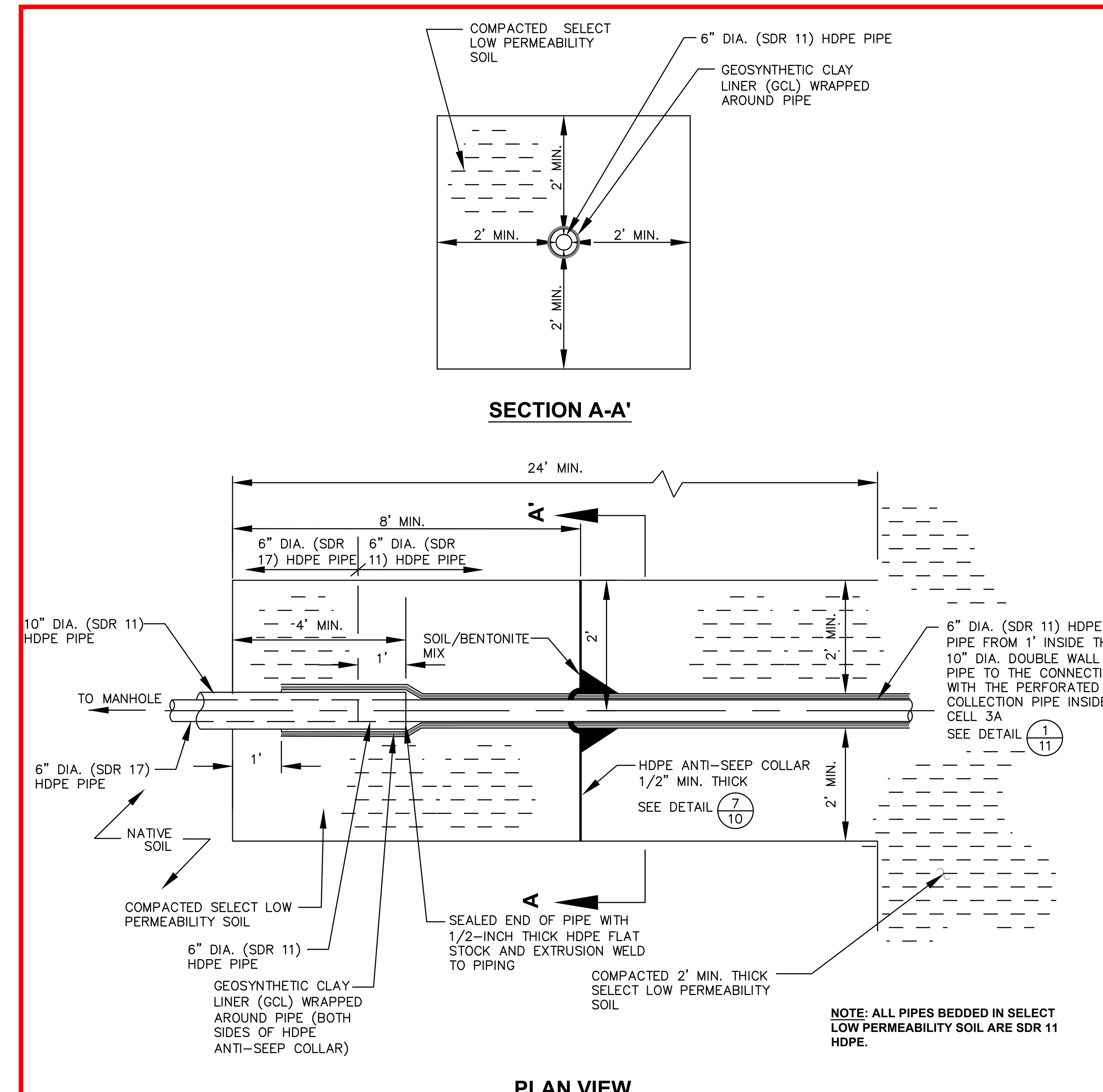

5/11

PIPE PENETRATION THROUGH COMPACTED SELECT LOW PERMEABILITY SOIL

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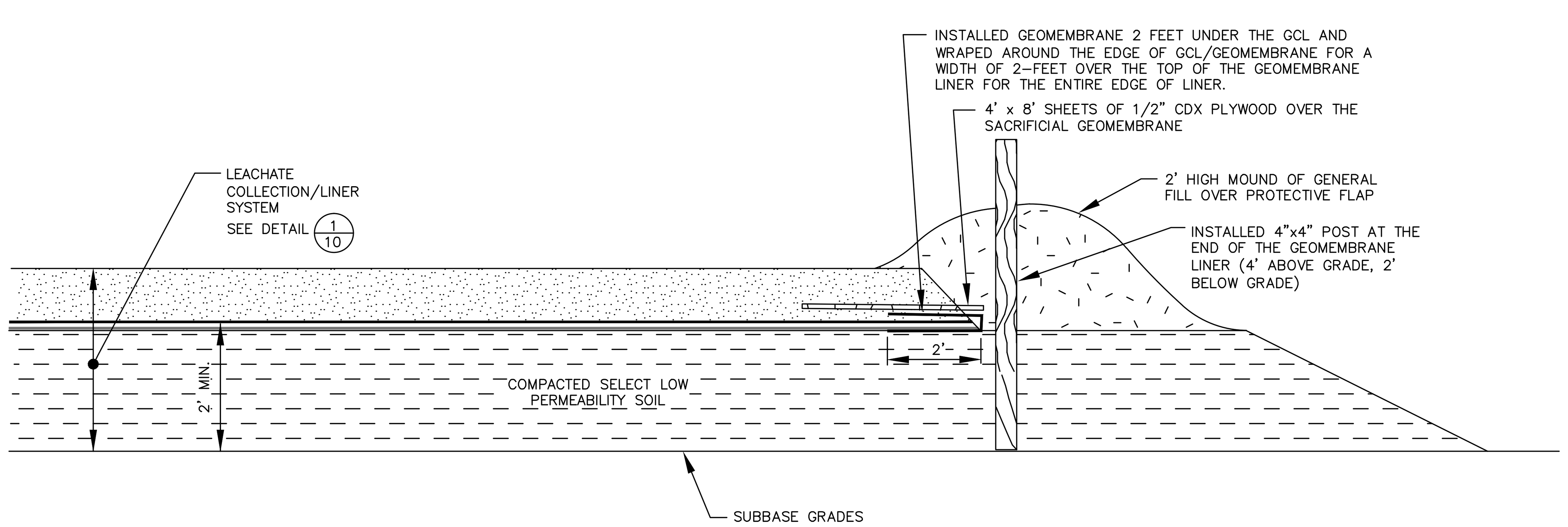

NOTE: APPLIES ABOVE ELEV. 820' ON 3:1 SIDESLOPES.

3/11

LINER TERMINATION

(NOT TO SCALE)

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: **DAIRYLAND POWER COOPERATIVE PHASE IV, CELL 3A LINER CONSTRUCTION DOCUMENTATION**

SHEET TITLE: **DETAILS**

DRAWN BY: DREYZEK	SCALE:	PROJ. NO. 187576.0000.000006
CHECKED BY: TWM	AS SHOWN	FILE NO. 187576.0000.06.SHT 11.dwg
APPROVED BY: KDP	DATE PRINTED:	SHEET 11 OF 16
DATE: JANUARY 2013		

TRC

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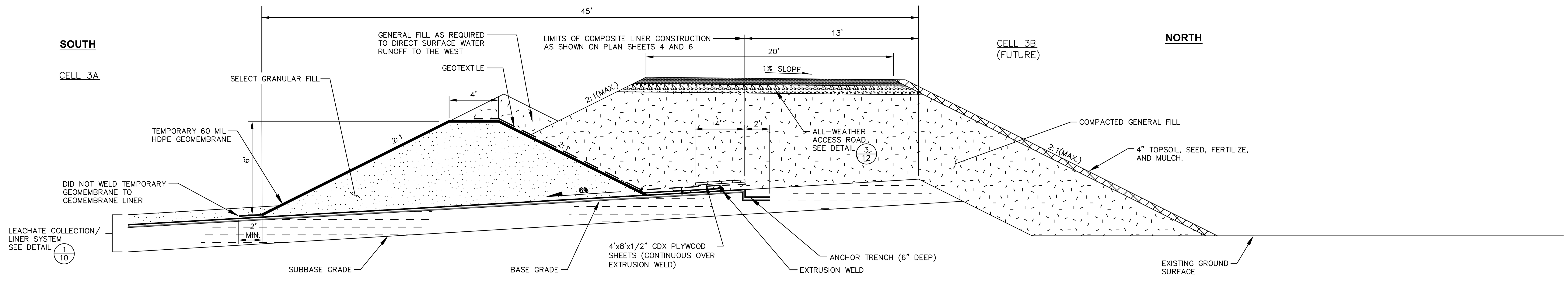
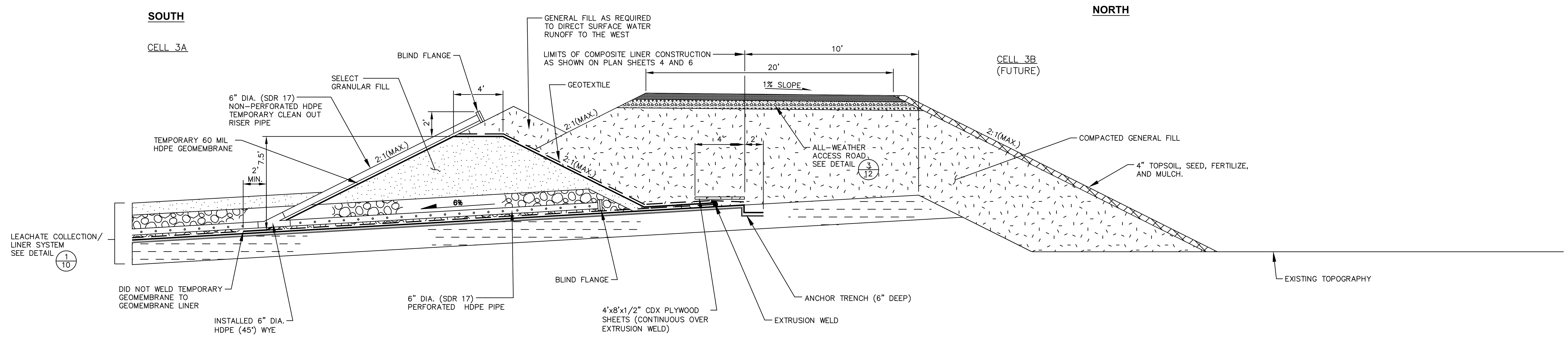


1/15 **CELL 3A/CELL 3B DELINEATION BERM**

(NOT TO SCALE)



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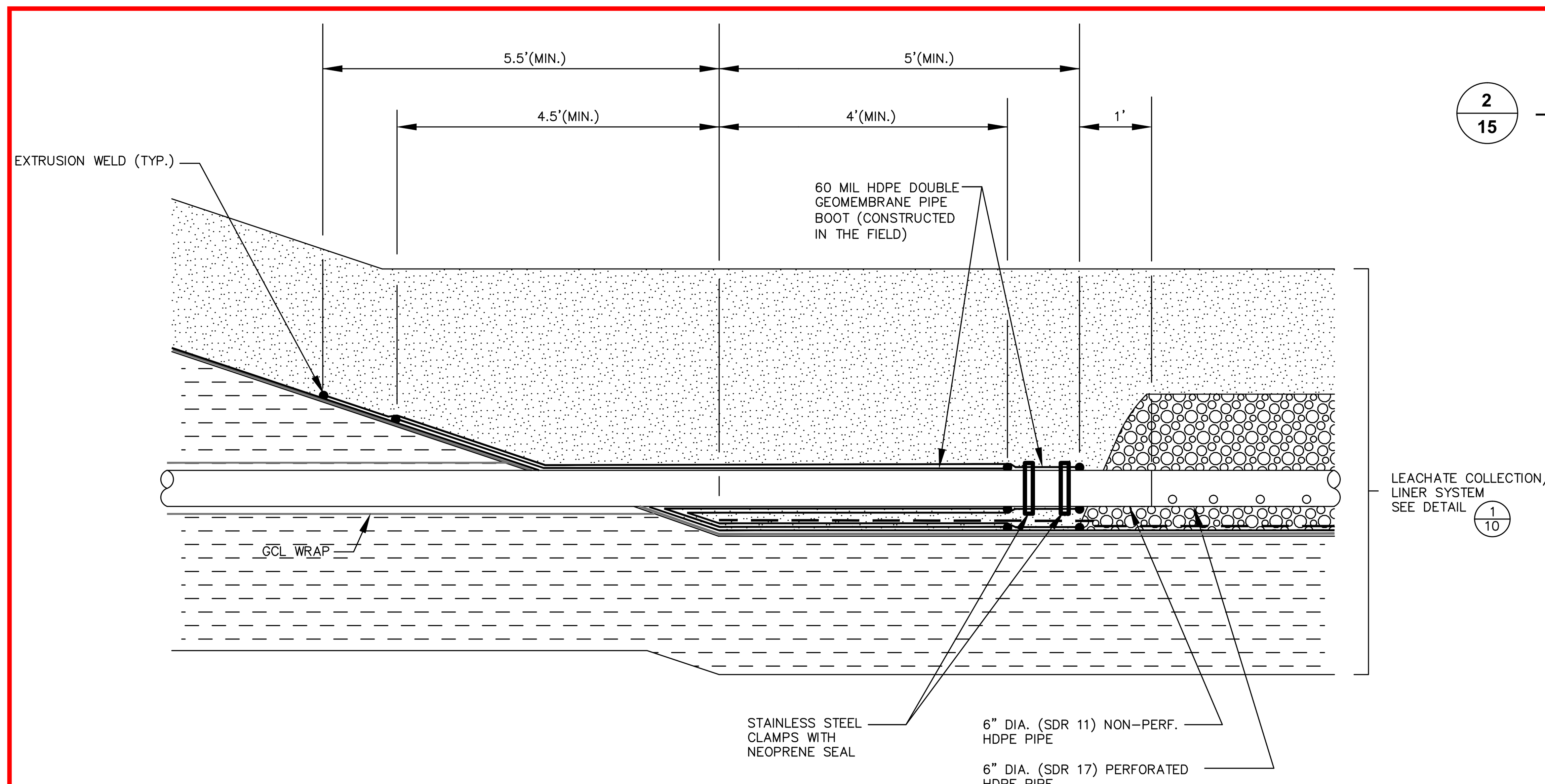
(NOT TO SCALE)



3/15 **DOUBLE PIPE BOOT- PIPES PENETRATING THROUGH COMPACTED SELECT LOW PERMEABILITY SOIL (TYPICAL)**

(NOT TO SCALE)

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

NO.	BY	DATE	REVISION	APP'D.
3.				
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1.				

PROJECT: **DAIRYLAND POWER COOPERATIVE PHASE IV, CELL 3A LINER CONSTRUCTION DOCUMENTATION**

SHEET TITLE: **DETAILS**

DRAWN BY: DREYZEK	SCALE: AS SHOWN	PROJ. NO. 187576.0000.000006	
CHECKED BY: TWM		FILE NO. 187576.0000.06.SHT 15.dwg	
APPROVED BY: KDP	DATE PRINTED:	SHEET 15 OF 16	
DATE: JANUARY 2013			

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Attachment 4

Updated Run-on and Run-off Control System Plan

Run-On and Run-Off Control System Plan

Alma Offsite Disposal Facility
Phase IV Landfill
Alma, Wisconsin

October 2016
Revised October 2021
Revised January 2024
Revised July 2024

Prepared For:

Dairyland Power Cooperative
3200 East Avenue South
La Crosse, Wisconsin 54601

Prepared By:

TRC
999 Fourier Drive, Suite 101
Madison, Wisconsin 53717

BreAnne Kahnk, P.E.
Senior Project Engineer

Todd Martin
Principal Project Manager

TABLE OF CONTENTS

APPENDICES

REVISION HISTORY

Revision Number	Revision Date	Section Revised	Summary of Revisions
1	10/6/2021	1.2, 2.2, 2.3, 3.0, App. B	5-year periodic revision, revised text and Appendix B
2	10/11/2023	Inserted Section 3	Requirements to meet WDNR standards
3	7/24/2024	App. D	Estimated Construction Schedule

1.0 Introduction

1.1 Purpose and Scope

This Run-On and Run-Off Control System Plan (Plan) was prepared by TRC Environmental Corporation (TRC) on behalf of Dairyland Power Cooperative (DPC) for the Alma Offsite Disposal Facility, Phase IV Landfill (Landfill) where coal combustion residuals (CCR) are disposed. The approximately 32.1 acre Landfill is located in Sections 18 and 19, T21N, R12W, Town of Belvidere, Buffalo County, Wisconsin.

This Plan meets the run-on and run-off control system requirements of the United States Environmental Protection Agency's (USEPA) CCR Rule (Title 40 Code of Federal Regulations (CFR) parts 257 Subpart D – "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments"). This text and its accompanying appendices and plan sheets present the plans and specifications of the run-off and run-on control systems of the Landfill. The plan sheets and the text, with its appendices, complement each other and should be reviewed and used as one document.

2.0 Engineering Design Concepts for Controlling Run-On and Run-Off

2.1 General

The Landfill design has been developed to provide environmentally sound CCR disposal. The storm water run-on and run-off control systems for the Landfill have been designed and meet the requirements of 40 CFR 257.81.

The supporting calculations for the run-on and run-off design are referenced throughout the text and are included in the appendices. Details and drawings illustrating design layout and specifications are referenced as applicable and presented on the plan sheets and figures. The majority of the calculations provided in the appendices were prepared during the initial permitting of the Phase IV Disposal Area and included in the October 2000 Plan of Operation (POO) in accordance with Wisconsin Administrative Code, Chapters 500 through 520, and conversations with the Wisconsin Department of Natural Resources (WDNR). Plan sheets included in Appendix C are the relevant plan sheets from the October 2000 POO drawing plan set. For the purposes of this Plan, the terms surface water and storm water have been used interchangeably and reflect precipitation routed over land or temporarily stored to manage run-on and run-off. No streams, wetlands, or bodies of water are located in areas that would impact run-on and run-off at the Landfill.

2.2 Run-On Control System

2.2.1 General

The run-on control system for the Landfill consists of perimeter berms, diversion berms, downslope flumes, ditching, sedimentation basins, and culverts, designed and constructed to control surface water during both the operational and post-closure periods of the Landfill. The design of the surface water controls have been performed for the operational periods when the combination of surface conditions and contributing acreage would result in the greatest run-off volume, and for the post-closure period. Given the location of the site, the surface water management system was designed utilizing the 100-year, 24-hour storm event at the time of the design, which exceeds the current 25-year, 24-hour storm event required by 40 CFR 257.81(a)(1). Calculations for the surface water run-on control designs are included in Appendix A.

The surface water control system design has been performed to meet the following requirements:

- Run-off curve numbers (RCNs) used in the analysis provide a conservative analysis of the potential land uses of the upland areas. Upland areas within the watershed primarily include wooded areas and agricultural lands. The wooded areas are located on the steeper-sloped areas of the valley and are unlikely to be affected by future land uses. High RCNs for the agricultural lands were selected to represent a conservative fallow condition with exposed bare soil. The RCNs selected for these areas were 86.
- Surface water run-on controls have been designed to divert off-site surface water away from the active fill areas. On-site surface water is routed to sedimentation basins, except surface water in contact with active fill areas, which is treated as leachate.

2.2.2 Control of Surrounding Run-On

Surface water from areas west, north, and east of the Landfill currently drain to existing drainage channels that have formed in the valleys near the Landfill. These drainage channels converge at the location of the Landfill, are conveyed around the Landfill by perimeter diversion ditches, and continue to the south in a single drainage ditch. The main drainage ditch then routes the water to the south for approximately 1.5 miles before discharging into the Mississippi River (see Plan Sheet 5 in Appendix C).

Diversion ditches are designed to route off-site surface water around the Landfill in a controlled manner. These ditches are constructed in phases as the Landfill is developed.

During previous construction events, the perimeter drainage ditch along the eastern, western, and northern sides of the Landfill were constructed to route storm water from the east, west, and north around the Landfill. Cells 1, 2, and 3 of the Landfill have been constructed (see Plan Sheet 9 in Appendix C). A temporary drainage ditch/diversion berm was constructed on the northwestern side of the Landfill to route surface water from areas northwest of the Landfill around the Landfill. During Cell 4, Module B development, the remaining surface water controls will be completed (see Plan Sheets 11 and 12 in Appendix C).

Temporary and permanent ditching and diversion berms were designed and constructed to manage the peak flows associated with the 100-year, 24-hour storm event.

2.2.3 Diversion Berms

Diversion berms are designed along the final cover system to collect and transfer surface water to the receiving downslope flume or sedimentation basin (see Detail 2 on Plan Sheet 19 in Appendix C). These diversion berms concentrate and control flow, and discharge the non-contact surface water (water that has not come into contact with the CCR) from the Landfill away from the final cover. The swales created by the diversion berms are designed at 2 percent typical slopes along the flow lines. The locations of the surface water diversion berms are shown on Plan Sheet 12 in Appendix C.

Drainage areas for the Landfill are defined by the proposed surface water diversion berms at the site. Run-off computations were performed for the site with the proposed diversion berms in-place and are contained in Appendix A. Figure K-2 in Appendix A shows the post-closure drainage areas for the Landfill.

2.2.4 Downslope Flumes

Downslope flumes are included in the design to collect and transfer surface water from the diversion berms on the final cover to the sedimentation basins. Plan Sheet 12 shows the location of the downslope flumes. The downslope flumes have been designed as enclosed pipe flumes to limit erosion and to control the flow as it crosses roads. Downslope flume calculations are included in the culvert design subsection of Appendix A.

2.2.5 Ditching

Surface water ditching has been designed to minimize velocities and depths of flow. Velocities for the grass-lined ditching have been limited to 4 feet per second (fps). In areas where velocities exceed 4 fps, permanent erosion matting, or grouted riprap are used to limit erosion and reduce velocities. Ditch sizing calculations are contained in Appendix A. Designed ditch locations are shown on Figure K-3 in Appendix A. The ditching to route surface water around the Landfill and away from the active areas of the Landfill are designed at a minimum 2-foot depth as shown on Detail 8 on Plan Sheet 23 in Appendix A. Ditch sizing calculations for operational and post-closure conditions show that a minimum freeboard of 0.4 feet occurs as the worst case condition in the ditches for the 100-year 24-hour storm event. Therefore, the calculations indicate that run-on to the active areas of the Landfill should not occur for the 25-year 24-hour storm event as required by 40 CFR 257.81(a)(1).

2.2.6 Sedimentation Basins

Two permanent sedimentation basins are designed to capture and treat non-contact run-off from the Landfill final cover system. The locations of the permanent sedimentation basins are shown on Plan Sheet 5 in Appendix C. The basins have been designed with a minimum surface area that exceeds the surface area required to settle 0.015 mm particles. The sedimentation basins are designed to accommodate the surface water run-off from a 100-year, 24-hour storm event. The emergency spillways are designed to control the run-off from a storm greater than the 100-year, 24-hour storm event.

2.2.7 Culverts

Several culverts are designed to transport non-contact run-off from the Landfill final cover and surrounding areas. The locations of the permanent culverts are shown on Plan Sheet 12 in Appendix C. The culverts have been designed to allow the peak run-off associated with a 100-year, 24-hour storm to pass through it without creating surface water breaching (i.e., berm overflow and run-on into active areas of the Landfill) or excessive backwater levels. Culvert sizing was performed using design charts developed by the U.S. Department of Transportation Federal Highway Administration. Culvert sizing calculations are provided in Appendix A.

2.2.8 Temporary Surface Water Controls

In addition to the permanent surface water management features discussed above, temporary surface water controls are also implemented during operation of the Landfill to control surface water from entering the active disposal area and to limit erosion of the final cover. These temporary control features include diversion berms, downslope discharge structure, and culverts. Temporary diversion berms will be constructed as needed along the transition from an active area to an area that has reached final grade, or that has intermediate cover, in order to control surface water from entering the active area. Temporary downslope discharge structures will be used to route non-contact run-off from diversion berms (either temporary or permanent) to the perimeter ditches.

2.3 Run-Off Control System

2.3.1 General

The leachate collection and handling system in conjunction with cell delineation berms (see detail 5 on Plan Sheet 17 in Appendix C) and perimeter berms comprise the control system for preventing contact surface water run-off from the active portions of the Landfill. Contact surface water is managed as leachate. The leachate collection system for the Landfill has been designed to provide effective drainage, collection, and removal of leachate from the Landfill.

2.3.2 Leachate Collection System

The primary components of the leachate collection system consist of a drainage layer, leachate collection and transfer piping, cleanouts, manholes, a storage tank, and a load-out facility. The leachate collection system layout is shown on Plan Sheet 5 in Appendix C. The drainage layer is placed over the geomembrane on the base and sidewalls. The drainage layer promotes the efficient transmission of leachate to the leachate collection trenches and pipes. The drainage layer is a minimum of 12 inches thick and has a minimum hydraulic conductivity of 1.0×10^{-2} centimeters per second (cm/s).

The leachate collection piping is placed in vee-shaped trenches and consists of 6-inch–diameter perforated high density polyethylene (HDPE) pipe. Pipe bedding material is placed around the perforated pipe and mounded as shown on Plan Sheet 17 in Appendix C.

Leachate collection pipes in each cell are placed parallel to each other in valleys over the herringbone design across the base. These lines drain at a 4 to 6 percent slope to the leachate removal and transfer system.

Temporary cell delineation berms are used along the cell boundaries to control surface water run-off from exiting the active areas of the Landfill. Refer to Detail 5 on Plan Sheet 17 for further details on the temporary cell delineation berm design.

2.3.3 Leachate Removal and Transfer System

The perforated leachate collection piping will transition to 6-inch–diameter nonperforated leachate transfer piping within the Landfill just prior to where the transfer piping penetrates the liner system at the southern toe-of-slope of each cell. The horizontal pipe penetration has been designed to prevent leachate from leaving the Landfill liner system through the liner penetration.

Outside of the limits of CCR, concrete manholes provide a location for transfer piping to manifold into a single perimeter transfer pipe around the southern end of the Landfill, and to provide a location for cleanout access piping.

The combined transfer piping then extends to the leachate storage tank located near the ash processing facility. Leachate collected in the tank is pumped into tanker trucks and transported to a nearby wastewater treatment plan for treatment which complies with 40 CFR 257.81(b). Plan Sheet 5 illustrates the location of the transfer piping, manholes, and the storage tank.

2.3.4 Leachate Storage Capacity From a 25-Year 24-Hour Storm Event

The proposed phasing plans and existing conditions were reviewed to determine the worst-case scenario for leachate generation. This worst-case scenario was used to show that run-off from the active area of the Landfill would not occur from a 25-year 24-hour storm event. Calculations contained in Appendix B show that there is approximately 14,700 cubic feet of leachate storage capacity remaining in the leachate collection system after a 25-year 24-hour storm event. Therefore, sufficient infrastructure is provided to prevent run-off from the active area of the Landfill as required by 40 CFR 257.81(a)(2).

2.3.5 Conclusions

This Plan has demonstrated that the Landfill has a run-on control system and a run-off control system sufficient to prevent flow onto or off of the active portion during a 24-hour 25-year storm event. The Landfill is in compliance with the requirements of 40 CFR 257.81.

3.0 Construction of Run-on and Run-off Control System

3.1 Run-on Control Systems

As noted in Section 2.2, the run-on control system consists of perimeter berms, diversion berms, downslope flumes, ditching, sedimentation basins, and culverts. Run-on controls have been designed to divert off-site surface water away from the active fill areas. On-site water is routed to sedimentation basins, except surface water in contact with active fill areas which is treated as leachate.

As summarized in Section 2.2.2, the run-on features are constructed incrementally during both the liner construction and final cover construction events. The previously constructed features were constructed per the site specifications with construction oversight directed by a professional engineer licensed in the State of Wisconsin. Documentation reports for construction events at the Landfill were prepared, submitted to the WDNR, and approved by the WDNR.

Temporary systems are used at the limits of the construction event to assist in the run-on control system until the remainder of the components are completed. The remainder of the run-on control system components will be completed during development of Cell 4B and following its closure. Specific schedules of exactly when features will be developed is not practicable, as the development and closure of the Landfill is dependent on filling activities, which are highly variable. Future construction will meet the previously approved design and specifications as noted in the October 2000 Plan of Operation, and construction oversight will be directed by a professional engineer licensed in the State of Wisconsin.

An estimated schedule for these systems, based on an assumed CCR filling rate is included as Appendix D.

3.2 Run-off Control Systems

As noted in Section 2.3, the run-off control system consists of the leachate collection system in conjunction with cell delineation berms and perimeter berms. The previously constructed features for the active area were constructed during the liner installation of the associated module/cell. The remaining portions of the run-off control system will be constructed during the construction events for Cells 4A and 4B. The general placement of the leachate collection system is summarized in Section 2.3.2 and is detailed in the approved October 2000 Plan of Operation.

Previous and future construction have been/will be completed in accordance with the site specifications and design, as shown in Appendix C. Construction oversight has/will be directed by a professional engineer licensed in the State of Wisconsin. Documentation reports for previous construction events have been prepared, submitted to the WDNR, and previously approved by the WDNR. Following construction of future landfill cells/modules, reports documenting construction will be prepared and submitted to the WDNR as required by ch. NR 516.

An estimated schedule for these systems, based on an assumed CCR filling rate is included as Appendix D.

4.0 Amendment of the Plan and Notification

This Plan was completed in compliance with the requirements set forth in 40 CFR 257.81. This document has been placed in the operating record, posted to the publicly accessible website, and government notifications have been provided.

A Run-On and Run-Off Control System Plan must be prepared every 5 years from the completion date of this Plan.

The Plan must be amended whenever the periodic review period is reached or if changes in site conditions, either intentionally or unintentionally, occur that will sustainably impact the current written plan in effect.

5.0 Engineer's Certification

Pursuant to 40 CFR 257.81 and by means of this certification I attest that:

(i) I am familiar with the requirements of the federal CCR rule (40 CFR 257);

(ii) this Run-On and Run-Off Control System Plan has been prepared in accordance with good engineering practice; and

(iii) this Run-On and Run-Off Control System Plan meets the requirements of 40 CFR 257.81(c).

For the purpose of this document, "certify" and "certification" shall be interpreted and construed to be a "statement of professional opinion." The certification is understood and intended to be an expression of my professional opinion as a Wisconsin licensed professional engineer, based upon knowledge, information, and belief. The statement(s) of professional opinion are not and shall not be interpreted or construed to be a guarantee or a warranty of the analysis herein.

Breanne Kahnk

Signature of Registered Professional Engineer

Registration No. E-46825 State: Wisconsin

WISCONSIN BREANNE N. KAHNK E-46825 MIDDLETON, WI 7-24-24 PROFESSIONAL ENGINEER

Appendix A: Surface Water Run-On Control System Calculations

Note: For clarification purposes, these run-on calculations estimate "run-off" quantities from areas in and surrounding the Landfill that develop non-contact surface water that is managed to prevent run-on to the active Landfill areas.

- Surface Water Run-off Calculations
  - Purpose/Methodology/Assumptions/Results/References
  - Post-closure Run-off Calculations
  - Operational Run-off Calculations
  - Reference Information
- Diversion Berm, Perimeter Ditch, and Spillway Design Calculations
  - Purpose/Methodology/Assumptions/Results/References
  - Calculations – Post-closure Landfill Conditions
  - Calculations – Operational Landfill Conditions
  - Reference Information
- Culvert/Downslope Flume Design Calculations
  - Purpose/Methodology/Assumptions/Results/References
  - Calculations – Post-closure Landfill Conditions
  - Calculations – Temporary Culverts, Operational Conditions
- Vegetation Information

Surface Water Run-off Calculations

Purpose/Methodology/Assumptions/Results/References

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
Dairyland Power Cooperative	BJK	5/97	BLP	6/97	3081.40

SURFACE WATER RUNOFF CALCULATIONS

Purpose

The purpose of the surface water runoff calculations was to estimate the amount of surface water runoff and the peak discharge for the 25-year, 24-hour and 100-year, 24-hour storms at the proposed Dairyland Power Landfill. Calculations were performed for the pre- and post-development conditions. Calculations were also performed for operational conditions for the 25-year, 24-hour storm. Once determined, the surface water runoff quantities were compared to determine the effect of the proposed landfill on the existing drainage patterns. The runoff calculations were also used to size diversion ditches, sedimentation basins, culverts, and downslope flumes.

Methodologies

Surface water runoff calculations consist of delineating drainage areas (watersheds), as shown on the attached figures, estimating runoff characteristics, and calculating the peak and total runoff rate and volume for each drainage area. The methods for computing surface water runoff were based on the methodologies presented in the Technical Release No. 55 - "Urban Hydrology for Small Watersheds" by the United States Soil Conservation Service.

The calculations were performed using the QUICK TR-55 computer program developed by Haestad Methods (Haestad 1989). The program incorporates rainfall quantities, storm distributions, surface runoff characteristics, drainage areas, times of concentration, and travel times to generate a hydrograph from which the volume of surface water runoff and the peak discharge are obtained.

It is noted that the storm water control structures have been designed using a 100-year, 24-hour storm event and a TR-55 Type II storm distribution to determine peak flow rates. Rainfall distributions for the Type II storm event include "nested" higher intensity storm events within those needed for longer durations at the same probability. The resulting peak flows using this design method meet or exceed the peak flows obtained using a 25-year, time of concentration storm event (required by NR 504.09).

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Dairyland Power Cooperative	BJK	5/97	BLP	6/97	3081.40

Assumptions

The following assumptions were made in developing the hydrographs (Note: The figures and values referenced in these assumptions have been included in the references portion of this appendix):

- A 2-year, 24-hour storm event in the vicinity of the landfill is 2.8 inches based on rainfall maps prepared by the U.S. Weather Bureau.
- A 25-year, 24-hour storm event in the vicinity of the landfill equates to 4.9 inches based on rainfall maps prepared by the U.S. Weather Bureau.
- A 100-year, 24-hour storm event in the vicinity of the landfill equates to 6.1 inches based on rainfall maps prepared by the U.S. Weather Bureau.
- A Type II rainfall distribution was used, based on SCS storm distribution maps provided in the TR-55 manual.
- Cover types for the pre-development conditions, from which runoff curve numbers were determined, were based on USGS topographic maps and an aerial photograph.
- For the post-development landfill conditions, a runoff curve number of 74 was assumed, based on values provided in the TR-55 manual.
- Based on the USDA-SCS General Soil Map for Buffalo County, Wisconsin, the primary soil formations present include the Dubuque silt loam and the Fayette silt loam. These soils are a Type B soil, based on tables provided in the TR-55 manual.
- Runoff curve numbers for the non-landfill areas ranged from 55 to 86, based on values provided in the TR-55 manual. Refer to the attached calculations for the breakdown and description of each of the curve numbers used for the various drainage areas.

Results

The table below summarizes the results of the surface water runoff analyses and provides a comparison of the pre- and post-development conditions:

STORM	TOTAL RUNOFF (acre-ft)			PEAK DISCHARGE (cfs)		
	PRE-	POST-	Δ	PRE-	POST-	Δ
25-year	153	148	(5)	1,170	1,028	(142)
100-year	232	225	(7)	1,895	1,622	(273)

Based on the results of the surface water runoff calculations, the proposed landfill is not anticipated to have an adverse impact on the existing surface water at the site. Total runoff volumes to the existing drainageways are not anticipated to change in the pre- and post-development conditions. Peak runoff volumes to the existing drainageways for post-

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	By:	Date:	By:	Date:	
Dairyland Power Cooperative	BJK	5/97	BLP	6/97	3081.40

development conditions are slightly lower than the pre-development conditions. This is primarily due to the use of sedimentation basins to dissipate peak flows from the landfill to the surrounding areas. The reduced peak flows will result in reduced sediment transport from the site.

The results of these surface water runoff calculations have also been used in the attached diversion berm, perimeter ditch, spillway, and sedimentation basin calculations. These structures have been designed to handle the peak runoff from the 100-year, 24-hour storm event.

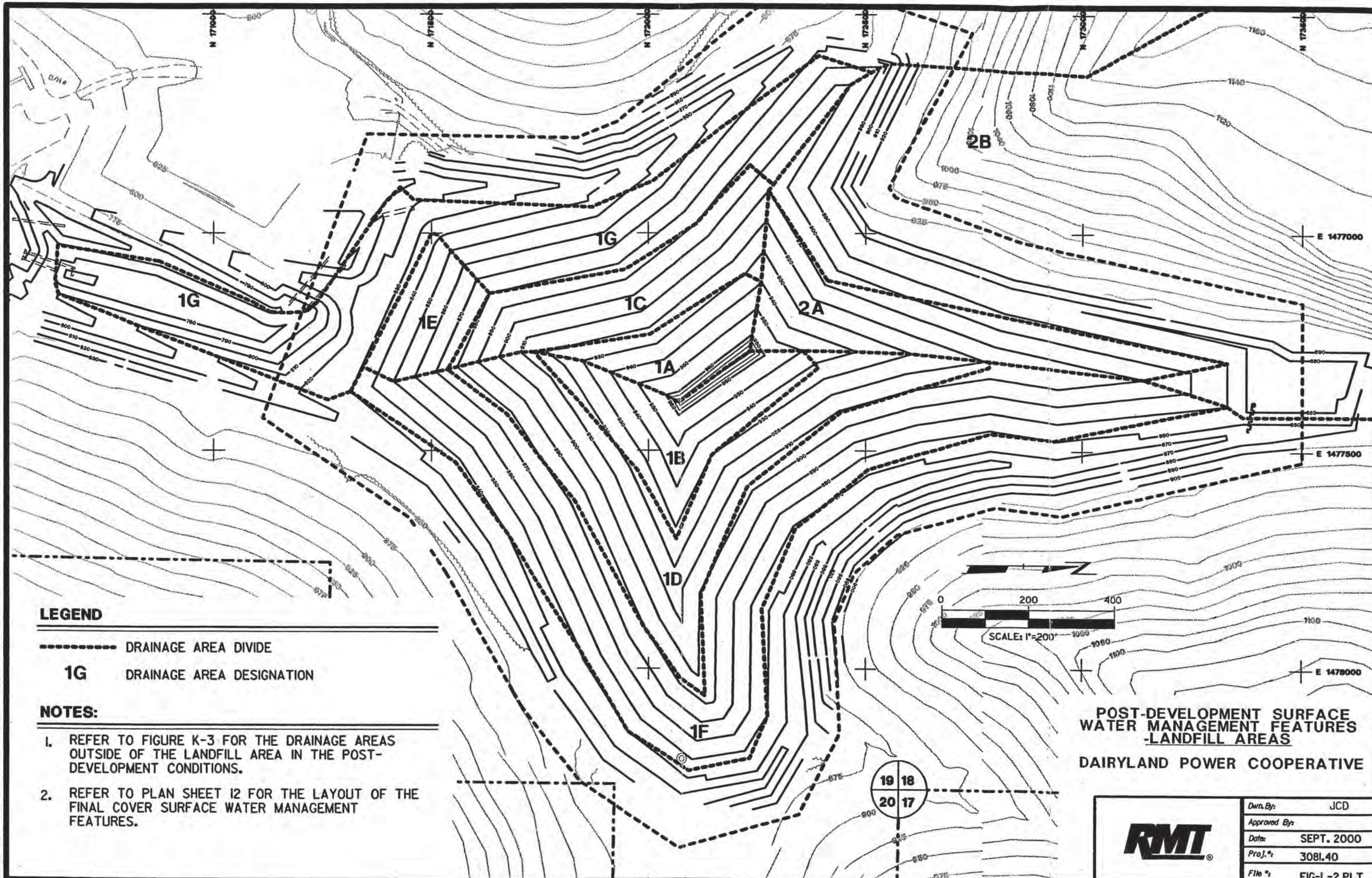
References

US Department of Agriculture, Soil Conservation Service. Urban Hydrology for Small Watersheds. Technical Release No. 55. 2nd Edition. June 1986.

US Department of Agriculture, Soil Conservation Service. 1986. Engineering Field Manual for Conservation Practices. November 1986.

Haestad Methods. Pond Pack, QUICK TR-55. Hydrology for Small Watersheds. December 1989.

Post-closure Run-off Calculations



(1) 4-6,9,10,12,21,23,24,26-28,32,34,40,43,45,54,55,57,61
(2) 1-16
(3) 33,45-50
(4) 2,3,14-16

Ref. File 1 = bmclient.dgn
Ref. File 2 = bmrmt.dgn
Ref. File 3 = proposed.dgn
Ref. File 4 = surface.dgn

Design File = ...081\40\FIG-L-2.PLT
Plot Date = Tue Sep 19 11:21:06 2000
Plot File = ...081\40\FIG-L-2.prf
Pen Table = ...DNET\TBL\default.tbl
Levels On = 1-63

RMT COMPUTER AIDED DESIGN & DRAFTING

FIGURE K-2

Quick TR-55 Ver.5.46 S/N:
Executed: 09:52:46 04-09-1997

Dairyland Power Coop.
Feasibility Report
Landfill Runoff
BJK 3/97

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
1A	1.40	74
1B	2.20	74
1C	2.90	74
1D	5.30	74
1E	1.20	74
1F	9.50	74
1G	7.40	84

Quick TR-55 Ver.5.46 S/N:
Executed: 09:52:46 04-09-1997

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Dairyland Power Coop.
Feasibility Report
Landfill Runoff
BJK 3/97

RUNOFF CURVE NUMBER DATA

Composite Area: 1A

SURFACE DESCRIPTION	AREA (acres)	CN	
Landfill Cover	1.40	74 ✓	
COMPOSITE AREA --->	1.40	74.0	(74)

Composite Area: 1B

SURFACE DESCRIPTION	AREA (acres)	CN	
Landfill Cover	2.20	74 ✓	
COMPOSITE AREA --->	2.20	74.0	(74)

Composite Area: 1C

SURFACE DESCRIPTION	AREA (acres)	CN	
Landfill Cover	2.90	74 ✓	
COMPOSITE AREA --->	2.90	74.0	(74)

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Executed: 09:52:46 04-09-1997

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Composite Area: 1D

SURFACE DESCRIPTION	AREA (acres)	CN	
Landfill Cover	5.30	74 ✓	
COMPOSITE AREA --->	5.30	74.0	(74)

Composite Area: 1E

SURFACE DESCRIPTION	AREA (acres)	CN	
Landfill Cover	1.20	74 ✓	
COMPOSITE AREA --->	1.20	74.0	(74)

Composite Area: 1F

SURFACE DESCRIPTION	AREA (acres)	CN	
Landfill Cover	9.50	74 ✓	
COMPOSITE AREA --->	9.50	74.0	(74)

Composite Area: 1G

SURFACE DESCRIPTION	AREA (acres)	CN	
Landfill Cover	4.40	74 ✓	
Sedimentation Basin	3.00	98 ✓	
COMPOSITE AREA --->	7.40	83.7	(84)

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Executed: 09:53:01 04-09-1997

Dairyland Power Coop.
Feasibility Report
Landfill Runoff
BJK 3/97

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
2A	2.70	74
2B	21.50	69

Quick TR-55 Ver.5.46 S/N:
Executed: 09:53:01 04-09-1997

/BLG
6/13/97

Dairyland Power Coop.
Feasibility Report
Landfill Runoff
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RUNOFF CURVE NUMBER DATA

::

Composite Area: 2A

SURFACE DESCRIPTION	AREA (acres)	CN	
Landfill Cover	2.70	74	
COMPOSITE AREA --->	2.70	74.0	(74)

Composite Area: 2B

SURFACE DESCRIPTION	AREA (acres)	CN	
Landfill Cover	2.70	74	
Graded/Grassed Area	2.00	61	
Woods/Brush	15.80	67	
Sedimentation Basin	1.00	98	
COMPOSITE AREA --->	21.50	68.8	(69)

Quick TR-55 Ver.5.46 S/N:
Executed: 08:55:25 06-18-1997 a:COVER1.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.
Feasibility Report
Landfill Final Cover
BJK 3/97

Subarea descr.	Tc or Tt	Time (hrs)
1A	Tc	0.18
1B	Tc	0.23
1C	Tc	0.23
1D	Tc	0.35
1E	Tc	0.18
1F	Tc	0.45
1G	Tc	0.22

Quick TR-55 Ver.5.46 S/N:
Executed: 09:48:41 04-09-1997 a:COVER1.TCT

✓ BAG 6/13/97

Dairyland Power Coop.
Feasibility Report
Landfill Final Cover
BJK 3/97

Tc COMPUTATIONS FOR: 1A

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Dense Grass	
Manning's roughness coeff., n		0.2400	
Flow length, L (total < or = 300)	ft	150.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2500	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.13	= 0.13

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	420.0	
Watercourse slope, s	ft/ft	0.0200	
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.2818	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.05	= 0.05

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.18

Quick TR-55 Ver.5.46 S/N:
Executed: 09:48:41 04-09-1997 a:COVER1.TCT

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Dairyland Power Coop.
Feasibility Report
Landfill Final Cover
BJK 3/97

Tc COMPUTATIONS FOR: 1B

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Dense Grass	
Manning's roughness coeff., n		0.2400	
Flow length, L (total < or = 300)	ft	125.0 ✓	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2500 ✓	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.11	= 0.11

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	960.0 ✓	
Watercourse slope, s	ft/ft	0.0200 ✓	
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.2818	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.12	= 0.12

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.23

Quick TR-55 Ver.5.46 S/N:
Executed: 09:48:41 04-09-1997 a:COVER1.TCT

✓ [handwritten initials] 6/13/97

Dairyland Power Coop.
Feasibility Report
Landfill Final Cover
BJK 3/97

Tc COMPUTATIONS FOR: 1C

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Dense Grass	
Manning's roughness coeff., n		0.2400	
Flow length, L (total < or = 300)	ft	165.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2500	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.14	= 0.14

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	720.0	
Watercourse slope, s	ft/ft	0.0200	
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.2818	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.09	= 0.09

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.23

Quick TR-55 Ver.5.46 S/N:
Executed: 08:55:25 06-18-1997 a:COVER1.TCT

✓ BZG
6/13/97

Dairyland Power Coop.
Feasibility Report
Landfill Final Cover
BJK 3/97

Tc COMPUTATIONS FOR: 1D

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Dense Grass	
Manning's roughness coeff., n		0.2400	
Flow length, L (total < or = 300)	ft	160.0 ✓	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2500 ✓	

$$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$$ hrs 0.13 = 0.13

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	1770.0 ✓	
Watercourse slope, s	ft/ft	0.0200 ✓	

$$Avg.V = Csf * (s)^{0.5}$$ ft/s 2.2818

where: Unpaved Csf = 16.1345
Paved Csf = 20.3282

T = L / (3600*V) hrs 0.22 = 0.22

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	

$$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$$ ft/s 0.0000

Flow length, L ft 0

T = L / (3600*V) hrs 0.00 = 0.00

::

TOTAL TIME (hrs) 0.35

Quick TR-55 Ver.5.46 S/N:
Executed: 08:55:25 06-18-1997 a:COVER1.TCT

✓BJB 6/13/97

Dairyland Power Coop.
Feasibility Report
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BJK 3/97

Tc COMPUTATIONS FOR: 1E

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Dense Grass	
Manning's roughness coeff., n		0.2400	
Flow length, L (total < or = 300)	ft	175.0 ✓	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2500 ✓	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.14	= 0.14

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	250.0 ✓	
Watercourse slope, s	ft/ft	0.0200 ✓	
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.2818	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.03	= 0.03

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.18

Quick TR-55 Ver.5.46 S/N:
Executed: 09:48:41 04-09-1997 a:COVER1.TCT

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Feasibility Report
Landfill Final Cover
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√BJG 6/13/97

Tc COMPUTATIONS FOR: 1F

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Dense Grass	
Manning's roughness coeff., n		0.2400	
Flow length, L (total < or = 300)	ft	150.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2500	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.13	= 0.13

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	2650.0	
Watercourse slope, s	ft/ft	0.0200	
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.2818	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.32	= 0.32

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.45

Quick TR-55 Ver.5.46 S/N:
Executed: 09:48:41 04-09-1997 a:COVER1.TCT

✓BLG 6/13/97

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Feasibility Report
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Tc COMPUTATIONS FOR: 1G

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Dense Grass	
Manning's roughness coeff., n		0.2400	
Flow length, L (total < or = 300)	ft	170.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2500	
$T = \dfrac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.14	= 0.14

SHALLOW CONCENTRATED FLOW

Segment ID		2	3	
Surface (paved or unpaved)?		Unpaved	Unpaved	
Flow length, L	ft	780.0	370.0	
Watercourse slope, s	ft/ft	0.0600	0.0800	
$Avg.V = Csf * (s)^{0.5}$	ft/s	3.9521	4.5635	
where: Unpaved Csf = 16.1345				
Paved Csf = 20.3282				
T = L / (3600*V)	hrs	0.05 +	0.02	= 0.08

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \dfrac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.22

Quick TR-55 Ver.5.46 S/N:
Executed: 08:57:44 06-18-1997 a:COVER2.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.
Feasibility Report
Landfill Final Cover
BJK 3/97

Subarea descr.	Tc or Tt	Time (hrs)
2A	Tc	0.28
2B	Tc	0.18

Quick TR-55 Ver.5.46 S/N:
Executed: 08:57:44 06-18-1997 a:COVER2.TCT

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Feasibility Report
Landfill Final Cover
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✓BJG 6/13/97

Tc COMPUTATIONS FOR: 2A

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Dense Grass	
Manning's roughness coeff., n		0.2400	
Flow length, L (total < or = 300)	ft	200.0 ✓	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2500 ✓	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.16	= 0.16

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	940.0 ✓	
Watercourse slope, s	ft/ft	0.0200 ✓	
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.2818	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.11	= 0.11

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.28

Quick TR-55 Ver.5.46 S/N:
Executed: 08:57:44 06-18-1997 a:COVER2.TCT

Dairyland Power Coop.
Feasibility Report
Landfill Final Cover
BJK 3/97

Tc COMPUTATIONS FOR: 2B

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Brush	
Manning's roughness coeff., n		0.1300	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2000	
$T = \dfrac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.15	= 0.15

SHALLOW CONCENTRATED FLOW

Segment ID		2	3	
Surface (paved or unpaved)?		Unpaved	Unpaved	
Flow length, L	ft	560.0	300.0	
Watercourse slope, s	ft/ft	0.4400	0.0800	
$Avg.V = Csf * (s)^{0.5}$	ft/s	%10.7024	4.5635	
where: Unpaved Csf = 16.1345				
Paved Csf = 20.3282				
T = L / (3600*V)	hrs	0.01 +	0.02	= 0.03

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \dfrac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.18

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
BJK 3/97

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
1A	1.40	74.0	0.20	0.00	4.90	2.28	I.14	.14
1B	2.20	74.0	0.20	0.00	4.90	2.28	I.14	.14
1C	2.90	74.0	0.20	0.00	4.90	2.28	I.14	.14
1D	5.30	74.0	0.40	0.00	4.90	2.28	I.14	.14
1E	1.20	74.0	0.20	0.00	4.90	2.28	I.14	.14
1F	9.50	74.0	0.50	0.00	4.90	2.28	I.14	.14
1G	7.40	84.0	0.20	0.00	4.90	3.18	I.08	.10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 29.90 acres or 0.04672 sq.mi
Peak discharge = 67 cfs

WARNING: Drainage areas of two or more subareas differ by a factor of 5 or greater.

Total Runoff =

$$\frac{22.5\text{ ac}(2.28") + 7.4\text{ ac}(3.18\text{ in})}{12}$$

= 6.2 ac-FT

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
1A	0.18	0.00	0.20	0.00	Yes	--
1B	0.23	0.00	0.20	0.00	Yes	--
1C	0.23	0.00	0.20	0.00	Yes	--
1D	0.35	0.00	0.40	0.00	Yes	--
1E	0.18	0.00	0.20	0.00	Yes	--
1F	0.45	0.00	0.50	0.00	Yes	--
1G	0.22	0.00	0.20	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
BJK 3/97

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
1A	4	12.2
1B	6	12.2
1C	8	12.2
1D	11	12.3
1E	3	12.1
1F	17	12.4
1G	29	12.2
Composite Watershed	67	12.2

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

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Fesibility Study
Landfill Cover
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Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
1A	0	0	0	1	2	3	4	2	1
1B	0	0	0	1	3	5	6	4	2
1C	0	0	0	2	4	7	8	5	3
1D	0	0	1	1	2	5	8	11	11
1E	0	0	0	1	2	3	3	2	1
1F	0	1	1	2	3	5	9	15	17
1G	1	1	2	8	15	27	29	18	9
Total (cfs)	1	2	4	16	31	55	67	57	44

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
1A	1	1	1	0	0	0	0	0	0
1B	1	1	1	1	1	1	0	0	0
1C	2	1	1	1	1	1	1	1	0
1D	8	6	4	3	2	2	1	1	1
1E	1	1	0	0	0	0	0	0	0
1F	17	13	10	8	5	3	3	2	2
1G	6	5	4	3	3	2	2	2	2
Total (cfs)	36	28	21	16	12	9	7	6	5

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
BJK 3/97

Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
1A	0	0	0	0	0	0	0	0	0
1B	0	0	0	0	0	0	0	0	0
1C	0	0	0	0	0	0	0	0	0
1D	1	1	1	1	1	1	0	0	0
1E	0	0	0	0	0	0	0	0	0
1F	2	1	1	1	1	1	1	1	1
1G	1	1	1	1	1	1	1	1	1
Total (cfs)	4	3	3	3	3	3	2	2	2

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
1A	0	0	0	0	0
1B	0	0	0	0	0
1C	0	0	0	0	0
1D	0	0	0	0	0
1E	0	0	0	0	0
1F	1	1	1	0	0
1G	1	1	0	0	0
Total (cfs)	2	2	1	0	0

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55
Watershed file: --> A:COVER1 .MOP
Hydrograph file: --> A:COVER100.HYD

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8/20/98

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
1A	1.40	74.0	0.20	0.00	6.10	3.27	I.12	.12
1B	2.20	74.0	0.20	0.00	6.10	3.27	I.12	.12
1C	2.90	74.0	0.20	0.00	6.10	3.27	I.12	.12
1D	5.30	74.0	0.40	0.00	6.10	3.27	I.12	.12
1E	1.20	74.0	0.20	0.00	6.10	3.27	I.12	.12
1F	9.50	74.0	0.50	0.00	6.10	3.27	I.12	.12
1G	7.40	84.0	0.20	0.00	6.10	4.29	I.06	.10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 29.90 acres or 0.04672 sq.mi
Peak discharge = 98 cfs

WARNING: Drainage areas of two or more subareas differ by a factor of 5 or greater.

Total Runoff =

$$\frac{22.5 \text{ ac } (3.27") + 7.4 \text{ ac } (4.29")}{12}$$

= 3.8 ac-FT

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
1A	0.18	0.00	0.20	0.00	Yes	--
1B	0.23	0.00	0.20	0.00	Yes	--
1C	0.23	0.00	0.20	0.00	Yes	--
1D	0.35	0.00	0.40	0.00	Yes	--
1E	0.18	0.00	0.20	0.00	Yes	--
1F	0.45	0.00	0.50	0.00	Yes	--
1G	0.22	0.00	0.20	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55
Watershed file: --> A:COVER1 .MOP
Hydrograph file: --> A:COVER100.HYD

Dairyland Power Coop.
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>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
1A	6	12.2
1B	9	12.2
1C	12	12.2
1D	16	12.3
1E	5	12.2
1F	25	12.4
1G	40	12.2
Composite Watershed	98	12.2

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55
Watershed file: --> A:COVER1 .MOP
Hydrograph file: --> A:COVER100.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
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Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
1A	0	0	0	1	3	5	6	3	2
1B	0	0	0	2	4	8	9	5	3
1C	0	0	1	3	6	11	12	7	4
1D	0	1	1	2	4	7	12	16	15
1E	0	0	0	1	2	4	5	3	2
1F	1	1	1	2	4	8	14	22	25
1G	1	2	2	10	20	37	40	24	12
Total (cfs)	2	4	5	21	43	80	98	80	63

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
1A	1	1	1	1	1	0	0	0	0
1B	2	1	1	1	1	1	1	1	1
1C	3	2	2	1	1	1	1	1	1
1D	12	8	6	4	3	2	2	2	1
1E	1	1	1	1	0	0	0	0	0
1F	24	19	14	11	7	5	4	3	3
1G	8	6	5	4	3	3	3	2	2
Total (cfs)	51	38	30	23	16	12	11	9	8

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55
Watershed file: --> A:COVER1 .MOP
Hydrograph file: --> A:COVER100.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
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Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
1A	0	0	0	0	0	0	0	0	0
1B	0	0	0	0	0	0	0	0	0
1C	1	1	1	0	0	0	0	0	0
1D	1	1	1	1	1	1	1	1	1
1E	0	0	0	0	0	0	0	0	0
1F	2	2	2	2	1	1	1	1	1
1G	2	2	2	1	1	1	1	1	1
Total (cfs)	6	6	6	4	3	3	3	3	3

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
1A	0	0	0	0	0
1B	0	0	0	0	0
1C	0	0	0	0	0
1D	1	0	0	0	0
1E	0	0	0	0	0
1F	1	1	1	1	0
1G	1	1	1	1	0
Total (cfs)	3	2	2	2	0

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:16
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER225.HYD

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Fesibility Study
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>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
2A	2.70	74.0	0.30	0.00	4.90	2.28	I.14 .14
2B	21.50	69.0	0.20	0.00	4.90	1.89	I.18 .18

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 24.20 acres or 0.03781 sq.mi
Peak discharge = 54 cfs

WARNING: Drainage areas of two or more subareas differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
2A	0.28	0.00	0.30	0.00	Yes	--
2B	0.18	0.00	0.20	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:16
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER225.HYD

Dairyland Power Coop.
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>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
2A	6	12.2
2B	48	12.2
Composite Watershed	54	12.2

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:16
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER225.HYD

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Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
2A	0	0	0	1	2	4	6	6	4
2B	1	1	2	9	20	42	48	31	17
Total (cfs)	1	1	2	10	22	46	54	37	21

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
2A	3	2	1	1	1	1	1	1	0
2B	11	9	7	6	5	4	4	4	3
Total (cfs)	14	11	8	7	6	5	5	5	3

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
2A	0	0	0	0	0	0	0	0	0
2B	3	3	2	2	2	2	2	2	1
Total (cfs)	3	3	2	2	2	2	2	2	1

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
2A	0	0	0	0	0
2B	1	1	1	1	0

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 15:19:47
Watershed file: --> A:\COVER2 .MOP
Hydrograph file: --> A:\COVER200.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
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>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
2A	2.70	74.0	0.30	0.00	6.10	3.27	I.12	.12
2B	21.50	69.0	0.20	0.00	6.10	2.79	I.15	.15

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 24.20 acres or 0.03781 sq.mi
Peak discharge = 82 cfs

WARNING: Drainage areas of two or more subareas differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
2A	0.28	0.00	0.30	0.00	Yes	--
2B	0.18	0.00	0.20	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 15:19:47
Watershed file: --> A:\COVER2 .MOP
Hydrograph file: --> A:\COVER200.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
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>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
2A	9	12.2
2B	73	12.2
Composite Watershed	82	12.2

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 15:19:47
Watershed file: --> A:\COVER2 .MOP
Hydrograph file: --> A:\COVER200.HYD

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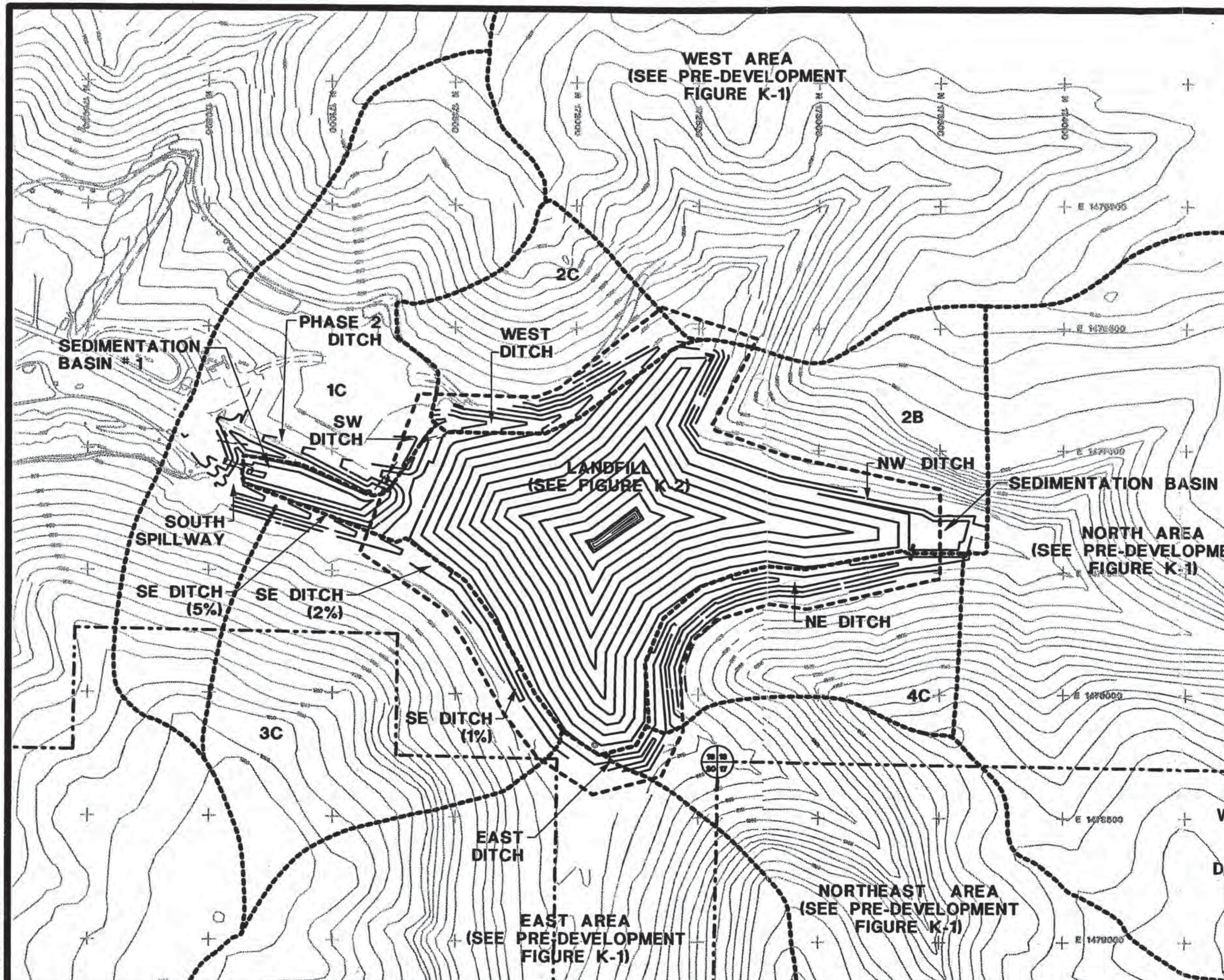
Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
2A	0	0	1	1	3	6	9	9	6
2B	2	2	3	16	33	65	73	45	24
Total (cfs)	2	2	4	17	36	71	82	54	30

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
2A	4	3	2	2	1	1	1	1	1
2B	16	13	10	9	7	6	6	5	5
Total (cfs)	20	16	12	11	8	7	7	6	6

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
2A	1	1	0	0	0	0	0	0	0
2B	4	4	3	3	3	3	2	2	2
Total (cfs)	5	5	3	3	3	3	2	2	2

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
2A	0	0	0	0	0
2B	2	2	1	1	0



LEGEND

DRAINAGE AREA DIVIDE

3C WEST AREA DRAINAGE AREA DESIGNATION

NOTES:

1. REFER TO FIGURE K-2 FOR DRAINAGE AREAS ALONG THE LANDFILL FINAL COVER.

0 400 800

SCALE: 1"=400'

POST-DEVELOPMENT SURFACE WATER MANAGEMENT FEATURES -EXTERIOR AREAS

DAIRYLAND POWER COOPERATIVE

RMT

Dwn. By:	JCD
Approved By:	
Date:	SEPT. 2000
Proj.#:	3081.40
File #:	FIG-L-3.PLT

RMT COMPUTER AIDED DESIGN & DRAFTING

FIGURE K-3

Quick TR-55 Ver.5.46 S/N:
Executed: 11:43:33 07-30-1998

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 rev 7/98

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
1C	42.00	67
2C	15.00	56
3C	33.00	58
4C	16.00	57
East	520.00	67
Northeast	80.00	63
North	236.00	63
West	100.00	71

Quick TR-55 Ver.5.46 S/N:
Executed: 11:43:33 07-30-1998

√BLG
8/20/98

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 rev 7/98

RUNOFF CURVE NUMBER DATA

Composite Area: 1C

SURFACE DESCRIPTION	AREA (acres)	CN	
Woods (35%)	15.00	55	
Existing Landfill (50%)	21.00	74	
Graded Areas (10%)	4.00	61	
Fallow - Bare Soil (5%)	2.00	86	
COMPOSITE AREA --->	42.00	66.5	(67)

Composite Area: 2C

SURFACE DESCRIPTION	AREA (acres)	CN	
Woods (85%)	12.80	55	
Graded Areas (15%)	2.20	61	
COMPOSITE AREA --->	15.00	55.9	(56)

Composite Area: 3C

SURFACE DESCRIPTION	AREA (acres)	CN	
Woods (80%)	27.00	55	
Graded Areas (10%)	3.00	61	
Fallow - Bare Soil (10%)	3.00	86	
COMPOSITE AREA --->	33.00	58.4	(58)

Quick TR-55 Ver.5.46 S/N:
Executed: 11:43:33 07-30-1998

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Composite Area: 4C

SURFACE DESCRIPTION	AREA (acres)	CN	
Woods (75%)	12.00	55	
Graded Areas (25%)	4.00	61	
COMPOSITE AREA --->	16.00	56.5	(57)

Composite Area: East

SURFACE DESCRIPTION	AREA (acres)	CN	
Woods (60%)	312.00	55	
Fallow - Bare Soil (40%)	208.00	86	
COMPOSITE AREA --->	520.00	67.4	(67)

Composite Area: Northeast

SURFACE DESCRIPTION	AREA (acres)	CN	
Woods (75%)	60.00	55	
Fallow - Bare Soil (25%)	20.00	86	
COMPOSITE AREA --->	80.00	62.8	(63)

Composite Area: North

SURFACE DESCRIPTION	AREA (acres)	CN	
Woods (75%)	177.00	55	
Fallow - Bare Soil (25%)	59.00	86	
COMPOSITE AREA --->	236.00	62.8	(63)

Quick TR-55 Ver.5.46 S/N:
Executed: 11:43:33 07-30-1998

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8/20/98

Composite Area: West

SURFACE DESCRIPTION	AREA (acres)	CN	
Woods (50%)	50.00	55	
Fallow - Bare Soil (50%)	50.00	86	
COMPOSITE AREA --->	100.00	70.5	(71)

Quick TR-55 Ver.5.46 S/N:
Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97

Subarea descr.	Tc or Tt	Time (hrs)
1C	Tc	0.35
2C	Tc	0.32
3C	Tc	0.41
4C	Tc	0.38
East	Tc	0.68
Northeast	Tc	0.37
North	Tc	0.53
West	Tc	0.52

Quick TR-55 Ver.5.46 S/N:
Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97

√BAG 6/17/97

Tc COMPUTATIONS FOR: 1C

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Woods	
Manning's roughness coeff., n		0.4000	
Flow length, L (total < or = 300)	ft	300.0 ✓	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2700 ✓	
$T = \dfrac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.33	= 0.33

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	650.0 ✓	
Watercourse slope, s	ft/ft	0.5000 ✓	
$Avg.V = Csf * (s)^{0.5}$	ft/s	%11.4088	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.02	= 0.02

CHANNEL FLOW

Segment ID		3	
Cross Sectional Flow Area, a	sq.ft	42.00	
Wetted perimeter, Pw	ft	28.00	
Hydraulic radius, r = a/Pw	ft	1.500	
Channel slope, s	ft/ft	0.1500 ✓	
Manning's roughness coeff., n		0.0450	
$V = \dfrac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	%16.8040	
Flow length, L	ft	500 ✓	
T = L / (3600*V)	hrs	0.01	= 0.01

::

TOTAL TIME (hrs) 0.35

Quick TR-55 Ver.5.46 S/N:
Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

√BAG 6/17/97

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97

Tc COMPUTATIONS FOR: 2C

```
SHEET FLOW (Applicable to Tc only)
    Segment ID                                    1
    Surface description                       Woods
    Manning's roughness coeff., n                0.4000
    Flow length, L (total < or = 300)    ft     300.0
    Two-yr 24-hr rainfall, P2            in     2.800
    Land slope, s                        ft/ft  0.4200
                       0.8
           .007 * (n*L)
    T =  --------------                  hrs     0.27            = 0.27
               0.5   0.4
             P2   *  s

SHALLOW CONCENTRATED FLOW
    Segment ID                                   2
    Surface (paved or unpaved)?                  Unpaved
    Flow length, L                       ft     370.0
    Watercourse slope, s                 ft/ft  0.4200

                        0.5
    Avg.V =  Csf *  (s)                  ft/s   %10.4564
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                     hrs     0.01            = 0.01


CHANNEL FLOW
    Segment ID                                   3
    Cross Sectional Flow Area, a         sq.ft   17.00
    Wetted perimeter, Pw                 ft      17.00
    Hydraulic radius, r = a/Pw           ft      1.000
    Channel slope, s                     ft/ft   0.0600
    Manning's roughness coeff., n                0.0450

                   2/3   1/2
         1.49  *  r   *  s
    V =  --------------------            ft/s    8.1105
                  n

    Flow length, L                       ft      1050

    T = L / (3600*V)                     hrs     0.04            = 0.04

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                          TOTAL TIME (hrs)        0.32
```

Quick TR-55 Ver.5.46 S/N:
Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

✓ [handwritten initials] 6/17/97

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97

Tc COMPUTATIONS FOR: 3C

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Row Crops	
Manning's roughness coeff., n		0.1700	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.0500	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.32	= 0.32

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	1020.0	
Watercourse slope, s	ft/ft	0.3600	
$Avg.V = Csf * (s)^{0.5}$	ft/s	9.6807	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.03	= 0.03

CHANNEL FLOW

Segment ID		3	
Cross Sectional Flow Area, a	sq.ft	150.00	
Wetted perimeter, Pw	ft	45.00	
Hydraulic radius, r = a/Pw	ft	3.333	
Channel slope, s	ft/ft	0.0150	
Manning's roughness coeff., n		0.0600	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	6.7868	
Flow length, L	ft	1450	
T = L / (3600*V)	hrs	0.06	= 0.06

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TOTAL TIME (hrs) 0.41

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                     Tc COMPUTATIONS FOR: 4C

 SHEET FLOW (Applicable to Tc only)
    Segment ID                                     1
    Surface description                     Woods
    Manning's roughness coeff., n                0.4000
    Flow length, L (total < or = 300)    ft     300.0
    Two-yr 24-hr rainfall, P2            in     2.800
    Land slope, s                     ft/ft     0.3700
                     0.8
       .007 * (n*L)
    T = --------------                  hrs      0.29              = 0.29
             0.5    0.4
          P2   *  s

 SHALLOW CONCENTRATED FLOW
    Segment ID                                     2
    Surface (paved or unpaved)?                 Unpaved
    Flow length, L                        ft      390.0
    Watercourse slope, s               ft/ft     0.5000

                       0.5
    Avg.V =  Csf *  (s)               ft/s    X11.4088
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                    hrs      0.01              = 0.01


 CHANNEL FLOW
    Segment ID                                     3
    Cross Sectional Flow Area, a      sq.ft     28.00
    Wetted perimeter, Pw                 ft     20.00
    Hydraulic radius, r = a/Pw           ft     1.400
    Channel slope, s                  ft/ft     0.0200
    Manning's roughness coeff., n               0.0500

                  2/3    1/2
        1.49  *  r   *  s
    V = --------------------           ft/s    5.2741
                   n

    Flow length, L                       ft      1670

    T = L / (3600*V)                    hrs      0.09              = 0.09

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                                          TOTAL TIME (hrs)        0.38
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                    Tc COMPUTATIONS FOR: East

SHEET FLOW (Applicable to Tc only)
   Segment ID                                   1
   Surface description                      Row Crops
   Manning's roughness coeff., n             0.1700
   Flow length, L (total < or = 300)   ft    300.0
   Two-yr 24-hr rainfall, P2           in    2.800
   Land slope, s                      ft/ft  0.0500
                       0.8
       .007 * (n*L)
   T = --------------                 hrs     0.32              = 0.32
           0.5   0.4
        P2   *  s

SHALLOW CONCENTRATED FLOW
   Segment ID                                   2
   Surface (paved or unpaved)?               Unpaved
   Flow length, L                      ft    2000.0
   Watercourse slope, s               ft/ft  0.0700

                        0.5
   Avg.V =  Csf *  (s)                ft/s   4.2688
   where:   Unpaved Csf = 16.1345
            Paved   Csf = 20.3282

   T = L / (3600*V)                   hrs     0.13              = 0.13


CHANNEL FLOW
   Segment ID                                   3        4
   Cross Sectional Flow Area, a     sq.ft    27.00     27.00
   Wetted perimeter, Pw                ft    16.40     16.40
   Hydraulic radius, r = a/Pw          ft    1.646     1.646
   Channel slope, s                 ft/ft   0.0700    0.0400
   Manning's roughness coeff., n            0.0700    0.0700

                  2/3   1/2
      1.49  *  r   *  s
   V = --------------------           ft/s  7.8521    5.9356
                 n

   Flow length, L                      ft     2500      3000

   T = L / (3600*V)                   hrs     0.09  +   0.14    = 0.23

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                                          TOTAL TIME (hrs)        0.68
```

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Tc COMPUTATIONS FOR: Northeast

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Row Crops	
Manning's roughness coeff., n		0.1700	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.0800	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.27	= 0.27

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	600.0	
Watercourse slope, s	ft/ft	0.0700	
$Avg.V = Csf * (s)^{0.5}$	ft/s	4.2688	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.04	= 0.04

CHANNEL FLOW

Segment ID		3	
Cross Sectional Flow Area, a	sq.ft	27.00	
Wetted perimeter, Pw	ft	16.40	
Hydraulic radius, r = a/Pw	ft	1.646	
Channel slope, s	ft/ft	0.1400	
Manning's roughness coeff., n		0.0700	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	%11.1045	
Flow length, L	ft	2400	
T = L / (3600*V)	hrs	0.06	= 0.06

::

TOTAL TIME (hrs) 0.37

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Tc COMPUTATIONS FOR: North

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		Row Crops	
Manning's roughness coeff., n		0.1700	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.0500	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.32	= 0.32

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	1000.0	
Watercourse slope, s	ft/ft	0.0600	
$Avg.V = Csf * (s)^{0.5}$	ft/s	3.9521	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.07	= 0.07

CHANNEL FLOW

Segment ID		3	
Cross Sectional Flow Area, a	sq.ft	27.00	
Wetted perimeter, Pw	ft	16.40	
Hydraulic radius, r = a/Pw	ft	1.646	
Channel slope, s	ft/ft	0.0830	
Manning's roughness coeff., n		0.0700	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	8.5502	
Flow length, L	ft	4200	
T = L / (3600*V)	hrs	0.14	= 0.14

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TOTAL TIME (hrs) 0.53

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                      Tc COMPUTATIONS FOR: West

 SHEET FLOW (Applicable to Tc only)
    Segment ID                                    1
    Surface description                       Row Crops
    Manning's roughness coeff., n               0.1700
    Flow length, L (total < or = 300)    ft     300.0
    Two-yr 24-hr rainfall, P2            in     2.800
    Land slope, s                        ft/ft  0.0500
                      0.8
       .007 * (n*L)
    T = --------------                   hrs     0.32            = 0.32
           0.5   0.4
         P2  *  s

SHALLOW CONCENTRATED FLOW
    Segment ID                                    2
    Surface (paved or unpaved)?                 Unpaved
    Flow length, L                       ft     1600.0
    Watercourse slope, s                 ft/ft  0.0850

                     0.5
    Avg.V =  Csf *  (s)                  ft/s   4.7040
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                     hrs     0.09            = 0.09


CHANNEL FLOW
    Segment ID                                    3
    Cross Sectional Flow Area, a        sq.ft   17.00
    Wetted perimeter, Pw                  ft    16.40
    Hydraulic radius, r = a/Pw            ft    1.037
    Channel slope, s                    ft/ft   0.1000
    Manning's roughness coeff., n               0.0700

                 2/3   1/2
        1.49  *  r  *  s
    V = --------------------            ft/s   6.8943
                 n

    Flow length, L                        ft     2600

    T = L / (3600*V)                     hrs     0.10            = 0.10

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                                         TOTAL TIME (hrs)          0.52
```

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Quick TR-55 Ver.5.46 S/N:
Executed: 11:30:57 06-18-1997 a:POSTDVTT.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

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Subarea descr.	Tc or Tt	Time (hrs)
1C	Tt	0.00
2C	Tt	0.05
3C	Tt	0.01
4C	Tt	0.09
East	Tt	0.07
Northeast	Tt	0.09
North	Tt	0.18
West	Tt	0.08

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Tt COMPUTATIONS FOR: 2C

SHEET FLOW (Applicable to Tc only)

Segment ID			
Surface description			
Manning's roughness coeff., n		0.0000	
Flow length, L (total < or = 300)	ft	0.0	
Two-yr 24-hr rainfall, P2	in	0.000	
Land slope, s	ft/ft	0.0000	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.00	= 0.00

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.0000	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.00	= 0.00

CHANNEL FLOW

Segment ID		1	
Cross Sectional Flow Area, a	sq.ft	17.00	
Wetted perimeter, Pw	ft	17.00	
Hydraulic radius, r = a/Pw	ft	1.000	
Channel slope, s	ft/ft	0.0500 ✓	
Manning's roughness coeff., n		0.0450	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	7.4039	
Flow length, L	ft	1200 ✓	
T = L / (3600*V)	hrs	0.05	= 0.05

::

TOTAL TIME (hrs) 0.05

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Tt COMPUTATIONS FOR: 3C

SHEET FLOW (Applicable to Tc only)

Segment ID			
Surface description			
Manning's roughness coeff., n		0.0000	
Flow length, L (total < or = 300)	ft	0.0	
Two-yr 24-hr rainfall, P2	in	0.000	
Land slope, s	ft/ft	0.0000	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.00	= 0.00

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.0000	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.00	= 0.00

CHANNEL FLOW

Segment ID		1	
Cross Sectional Flow Area, a	sq.ft	42.00	
Wetted perimeter, Pw	ft	28.00	
Hydraulic radius, r = a/Pw	ft	1.500	
Channel slope, s	ft/ft	0.1500	
Manning's roughness coeff., n		0.0450	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	%16.8040	
Flow length, L	ft	550	
T = L / (3600*V)	hrs	0.01	= 0.01

::

TOTAL TIME (hrs) 0.01

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Tt COMPUTATIONS FOR: 4C

SHEET FLOW (Applicable to Tc only)

Segment ID			
Surface description			
Manning's roughness coeff., n		0.0000	
Flow length, L (total < or = 300)	ft	0.0	
Two-yr 24-hr rainfall, P2	in	0.000	
Land slope, s	ft/ft	0.0000	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.00	= 0.00

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
Avg.V = $Csf * (s)^{0.5}$	ft/s	0.0000	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.00	= 0.00

CHANNEL FLOW

Segment ID		1	2	
Cross Sectional Flow Area, a	sq.ft	150.00	42.00	
Wetted perimeter, Pw	ft	45.00	28.00	
Hydraulic radius, r = a/Pw	ft	3.333	1.500	
Channel slope, s	ft/ft	0.0150	0.1500	
Manning's roughness coeff., n		0.0600	0.0450	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	6.7868	%16.8040	
Flow length, L	ft	1950	550	
T = L / (3600*V)	hrs	0.08 +	0.01	= 0.09

::

TOTAL TIME (hrs) 0.09

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Tt COMPUTATIONS FOR: East

SHEET FLOW (Applicable to Tc only)

Segment ID			
Surface description			
Manning's roughness coeff., n		0.0000	
Flow length, L (total < or = 300)	ft	0.0	
Two-yr 24-hr rainfall, P2	in	0.000	
Land slope, s	ft/ft	0.0000	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.00	= 0.00

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.0000	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.00	= 0.00

CHANNEL FLOW

Segment ID		1	2	
Cross Sectional Flow Area, a	sq.ft	150.00	42.00	
Wetted perimeter, Pw	ft	45.00	28.00	
Hydraulic radius, r = a/Pw	ft	3.333	1.500	
Channel slope, s	ft/ft	0.0150 ✓	0.1500 ✓	
Manning's roughness coeff., n		0.0600	0.0450	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	6.7868	X16.8040	
Flow length, L	ft	1600 ✓	550 ✓	
T = L / (3600*V)	hrs	0.07 +	0.01	= 0.07

::

TOTAL TIME (hrs) 0.07

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Tt COMPUTATIONS FOR: Northeast

SHEET FLOW (Applicable to Tc only)

Segment ID			
Surface description			
Manning's roughness coeff., n		0.0000	
Flow length, L (total < or = 300)	ft	0.0	
Two-yr 24-hr rainfall, P2	in	0.000	
Land slope, s	ft/ft	0.0000	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.00	= 0.00

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.0000	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.00	= 0.00

CHANNEL FLOW

Segment ID		1	2	
Cross Sectional Flow Area, a	sq.ft	150.00	42.00	
Wetted perimeter, Pw	ft	45.00	28.00	
Hydraulic radius, r = a/Pw	ft	3.333	1.500	
Channel slope, s	ft/ft	0.0150 ✓	0.1500 ✓	
Manning's roughness coeff., n		0.0600	0.0450	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	6.7868	%16.8040	
Flow length, L	ft	1870 ✓	550 ✓	
T = L / (3600*V)	hrs	0.08 +	0.01	= 0.09

::

TOTAL TIME (hrs) 0.09

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Tt COMPUTATIONS FOR: North

SHEET FLOW (Applicable to Tc only)

Segment ID			
Surface description			
Manning's roughness coeff., n		0.0000	
Flow length, L (total < or = 300)	ft	0.0	
Two-yr 24-hr rainfall, P2	in	0.000	
Land slope, s	ft/ft	0.0000	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.00	= 0.00

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.0000	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.00	= 0.00

CHANNEL FLOW

Segment ID		1	2	
Cross Sectional Flow Area, a	sq.ft	28.00	150.00	
Wetted perimeter, Pw	ft	20.00	45.00	
Hydraulic radius, r = a/Pw	ft	1.400	3.333	
Channel slope, s	ft/ft	0.0200 ✓	0.0150 ✓	
Manning's roughness coeff., n		0.0500	0.0600	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	5.2741	6.7868	
Flow length, L	ft	1670 ✓	2250 ✓	
T = L / (3600*V)	hrs	0.09 +	0.09	= 0.18

::

TOTAL TIME (hrs) 0.18

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Tt COMPUTATIONS FOR: West

SHEET FLOW (Applicable to Tc only)

Segment ID			
Surface description			
Manning's roughness coeff., n		0.0000	
Flow length, L (total < or = 300)	ft	0.0	
Two-yr 24-hr rainfall, P2	in	0.000	
Land slope, s	ft/ft	0.0000	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.00	= 0.00

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
Avg.V = $Csf * (s)^{0.5}$	ft/s	0.0000	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.00	= 0.00

CHANNEL FLOW

Segment ID		1		2	
Cross Sectional Flow Area, a	sq.ft	17.00		17.00	
Wetted perimeter, Pw	ft	17.00		17.00	
Hydraulic radius, r = a/Pw	ft	1.000		1.000	
Channel slope, s	ft/ft	0.0600 ✓		0.0500 ✓	
Manning's roughness coeff., n		0.0450		0.0450	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	8.1105		7.4039	
Flow length, L	ft	1050 ✓		1200 ✓	
T = L / (3600*V)	hrs	0.04	+	0.05	= 0.08

::

TOTAL TIME (hrs) 0.08

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

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Feasibility Report
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>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
1C	42.00	67.0	0.40	0.00	4.90	1.73	I.2	.20
2C	15.00	56.0	0.30	0.10	4.90	0.99	I.32	.32
3C	33.00	58.0	0.40	0.00	4.90	1.11	I.3	.30
4C	16.00	57.0	0.40	0.10	4.90	1.05	I.31	.31
East	520.00	67.0	0.75	0.00	4.90	1.73	I.2	.20
Northeast	80.00	63.0	0.40	0.10	4.90	1.45	I.24	.24
North	236.00	63.0	0.50	0.20	4.90	1.45	I.24	.24
West	100.00	71.0	0.50	0.10	4.90	2.04	I.17	.17

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total Runoff
= 141.9 ac-ft

Total area = 1042.00 acres or 1.6281 sq.mi
Peak discharge = 1027 cfs

WARNING: Drainage areas of two or more subareas
differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
1C	0.35	0.00	0.40	0.00	Yes	--
2C	0.32	0.05	0.30	0.10	Yes	--
3C	0.41	0.01	0.40	0.00	Yes	--
4C	0.38	0.09	0.40	0.10	Yes	--
East	0.68	0.07	0.75	0.00	Yes	--
Northeast	0.37	0.09	0.40	0.10	Yes	--
North	0.53	0.18	0.50	0.20	Yes	--
West	0.52	0.08	0.50	0.10	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
1C	61	12.3
2C	11	12.4
3C	28	12.4
4C	12	12.5
East	533	12.7
Northeast	84	12.5
North	219	12.6
West	145	12.5
Composite Watershed	1027	12.6

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
1C	1	1	2	5	9	22	43	61	61
2C	0	0	0	0	0	1	4	9	11
3C	0	0	0	0	1	6	17	27	28
4C	0	0	0	0	0	0	2	6	10
East	9	13	17	25	33	52	102	197	329
Northeast	1	1	2	4	7	14	31	57	80
North	2	3	4	6	8	13	28	66	126
West	3	5	6	11	17	30	56	95	128
Total (cfs)	16	23	31	51	75	138	283	518	773

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
1C	48	34	26	20	13	10	8	7	7
2C	10	8	6	5	3	2	2	2	2
3C	24	18	13	11	7	6	5	4	4
4C	12	11	9	7	4	3	3	2	2
East	454	527	533	490	350	248	183	143	117
Northeast	84	74	58	45	28	20	16	14	12
North	187	219	217	191	130	86	62	49	41
West	145	136	115	92	58	39	29	24	20
Total (cfs)	964	1027	977	861	593	414	308	245	205

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
1C	6	5	5	4	4	4	3	3	3
2C	1	1	1	1	1	1	1	1	1
3C	3	3	3	3	2	2	2	2	2
4C	2	2	1	1	1	1	1	1	1
East	98	81	69	59	53	47	42	38	36
Northeast	11	9	8	8	7	6	6	5	5
North	35	30	26	23	21	19	17	16	14
West	18	15	13	12	11	10	9	8	7
Total (cfs)	174	146	126	111	100	90	81	74	69

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
1C	3	2	2	2	0
2C	1	1	1	0	0
3C	2	1	1	1	0
4C	1	1	1	1	0
East	34	30	27	22	0
Northeast	5	4	4	3	0
North	14	12	10	9	0
West	7	6	5	5	0
Total (cfs)	67	57	51	43	0

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28
Watershed file: --> A:\POSTDV2 .MOP
Hydrograph file: --> A:\POSTDV00.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
1C	42.00	67.0	0.40	0.00	6.10	2.61	I.16	.16
2C	15.00	56.0	0.30	0.10	6.10	1.66	I.26	.26
3C	33.00	58.0	0.40	0.00	6.10	1.82	I.24	.24
4C	16.00	57.0	0.40	0.10	6.10	1.74	I.25	.25
East	520.00	67.0	0.75	0.00	6.10	2.61	I.16	.16
Northeast	80.00	63.0	0.40	0.10	6.10	2.25	I.19	.19
North	236.00	63.0	0.50	0.20	6.10	2.25	I.19	.19
West	100.00	71.0	0.50	0.10	6.10	2.98	I.13	.13

Total Runoff
= 215.7 ac-ft

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 1042.00 acres or 1.6281 sq.mi
Peak discharge = 1618 cfs

WARNING: Drainage areas of two or more subareas differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
1C	0.35	0.00	0.40	0.00	Yes	--
2C	0.32	0.05	0.30	0.10	Yes	--
3C	0.41	0.01	0.40	0.00	Yes	--
4C	0.38	0.09	0.40	0.10	Yes	--
East	0.68	0.07	0.75	0.00	Yes	--
Northeast	0.37	0.09	0.40	0.10	Yes	--
North	0.53	0.18	0.50	0.20	Yes	--
West	0.52	0.08	0.50	0.10	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28
Watershed file: --> A:\POSTDV2 .MOP
Hydrograph file: --> A:\POSTDV00.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
1C	96	12.3
2C	20	12.4
3C	49	12.4
4C	20	12.5
East	837	12.6
Northeast	136	12.4
North	360	12.6
West	223	12.5
Composite Watershed	1618	12.6

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28
Watershed file: --> A:\POSTDV2 .MOP
Hydrograph file: --> A:\POSTDV00.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
1C	2	3	4	9	18	38	71	96	94
2C	0	0	0	1	2	4	10	18	20
3C	1	1	1	2	6	15	33	48	49
4C	0	0	0	1	1	3	7	13	19
East	19	27	36	53	69	105	190	343	547
Northeast	3	4	5	10	18	36	70	109	136
North	6	9	11	17	22	33	63	127	224
West	6	9	12	20	32	56	102	165	209
Total (cfs)	37	53	69	113	168	290	546	919	1298

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
1C	73	51	38	29	19	14	12	10	9
2C	18	13	10	7	5	4	3	3	3
3C	39	28	21	17	11	9	7	6	6
4C	20	18	14	11	7	5	4	3	3
East	733	837	830	756	531	370	270	208	168
Northeast	132	110	85	65	40	28	23	19	17
North	315	360	350	303	200	130	92	71	59
West	223	201	163	128	79	53	40	32	27
Total (cfs)	1553	1618	1511	1316	892	613	451	352	292

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28
Watershed file: --> A:\POSTDV2 .MOP
Hydrograph file: --> A:\POSTDV00.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
1C	8	7	7	6	5	5	4	4	4
2C	2	2	2	2	1	1	1	1	1
3C	5	5	4	4	3	3	3	3	2
4C	3	2	2	2	2	2	1	1	1
East	141	115	97	83	74	66	59	53	49
Northeast	15	13	12	11	10	9	8	7	7
North	51	44	38	33	30	27	24	22	20
West	24	21	18	16	14	13	12	11	10
Total (cfs)	249	209	180	157	139	126	112	102	94

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
1C	4	3	3	2	0
2C	1	1	1	1	0
3C	2	2	2	2	0
4C	1	1	1	1	0
East	47	42	37	30	0
Northeast	6	6	5	4	0
North	19	17	15	13	0
West	10	8	7	6	0
Total (cfs)	90	80	71	59	0

Executed 09-18-2000 13:11:11

Data directory: p:\data\projects\3081\40\sw*.HYD

File Summary for Composite Hydrograph

Time (hrs)	POSTDV25 (cfs)	BSN1OUT1 (cfs)	BSN2OUT1 (cfs)	TPTPST25 (Total)
11.00	16.0	0.0	0.0	16.0
11.10	18.0	0.2	0.2	18.4
11.20	21.0	0.2	0.2	21.4
11.30	23.0	0.3	0.2	23.5
11.40	26.0	0.3	0.2	26.5
11.50	28.0	0.3	0.2	28.5
11.60	31.0	0.4	0.2	31.6
11.70	38.0	0.4	0.3	38.7
11.80	44.0	0.4	0.3	44.7
11.90	51.0	0.5	0.3	51.8
12.00	75.0	0.5	0.4	75.9
12.10	138.0	0.6	0.4	139.0
12.20	283.0	0.6	0.5	284.1
12.30	518.0	0.7	0.5	519.2
12.40	773.0	0.7	0.5	774.2
12.50	964.0	0.7	0.6	965.3
12.60	1027.0	0.7	0.6	1028.3 ← Peak
12.70	977.0	0.7	0.6	978.3
12.80	861.0	0.7	0.6	862.3
12.90	727.0	0.7	0.6	728.3
13.00	593.0	0.8	0.6	594.3
13.10	503.0	0.8	0.6	504.4
13.20	414.0	0.8	0.6	415.4
13.30	361.0	0.8	0.6	362.4
13.40	308.0	0.8	0.6	309.4
13.50	277.0	0.8	0.6	278.4
13.60	245.0	0.8	0.6	246.4
13.70	225.0	0.8	0.6	226.4
13.80	205.0	0.8	0.6	206.4
13.90	190.0	0.8	0.6	191.4
14.00	174.0	0.8	0.6	175.4
14.10	165.0	0.8	0.6	166.4
14.20	155.0	0.8	0.6	156.4
14.30	146.0	0.9	0.6	147.5
14.40	139.0	1.2	0.6	140.8
14.50	133.0	1.5	0.6	135.1
14.60	126.0	1.8	0.6	128.4
14.70	122.0	2.0	0.6	124.6
14.80	118.0	2.2	0.6	120.8
14.90	115.0	2.3	0.6	117.9

Combined Post-Development Hydrograph 25yr storm

Basin 1 +
Basin 2 +
Surrounding watershed.

Executed 09-18-2000 13:11:11

Data directory: p:\data\projects\3081\40\sw*.HYD

File Summary for Composite Hydrograph

Time (hrs)	POSTDV25 (cfs)	BSN1OUT1 (cfs)	BSN2OUT1 (cfs)	TPTPST25 (Total)
15.00	111.0	2.4	0.6	114.0
15.10	109.0	2.5	0.6	112.1
15.20	107.0	2.6	0.6	110.2
15.30	104.0	2.7	0.6	107.3
15.40	102.0	2.7	0.6	105.3
15.50	100.0	2.8	0.6	103.4
15.60	98.0	2.8	0.6	101.4
15.70	96.0	2.8	0.6	99.4
15.80	94.0	2.9	0.6	97.5
15.90	92.0	2.9	0.6	95.5
16.00	90.0	2.9	0.6	93.5
16.10	88.0	2.9	0.6	91.5
16.20	86.0	2.9	0.6	89.5
16.30	85.0	2.9	0.6	88.5
16.40	83.0	2.7	0.6	86.3
16.50	81.0	2.6	0.6	84.2
16.60	80.0	2.5	0.6	83.1
16.70	78.0	2.4	0.6	81.0
16.80	77.0	2.3	0.6	79.9
16.90	75.0	2.3	0.6	77.9
17.00	74.0	2.2	0.6	76.8
17.10	73.0	2.2	0.6	75.8
17.20	72.0	2.2	0.6	74.8
17.30	71.0	2.1	0.6	73.7
17.40	70.0	2.1	0.6	72.7
17.50	69.0	2.1	0.6	71.7
17.60	69.0	2.1	0.6	71.7
17.70	68.0	2.1	0.6	70.7
17.80	68.0	2.0	0.6	70.7
17.90	67.0	2.0	0.6	69.6
18.00	67.0	2.0	0.6	69.6
18.10	66.0	2.0	0.6	68.6
18.20	65.0	2.0	0.6	67.6
18.30	64.0	2.0	0.6	66.6
18.40	63.0	2.0	0.6	65.6
18.50	62.0	2.0	0.6	64.6
18.60	61.0	2.0	0.6	63.6
18.70	60.0	2.0	0.6	62.6
18.80	59.0	2.0	0.7	61.7
18.90	58.0	2.0	0.7	60.8
19.00	57.0	2.0	0.8	59.8

Executed 09-18-2000 13:11:11

Data directory: p:\data\projects\3081\40\sw*.HYD

File Summary for Composite Hydrograph

Time (hrs)	POSTDV25 (cfs)	BSN1OUT1 (cfs)	BSN2OUT1 (cfs)	TPTPST25 (Total)
19.10	56.0	2.0	0.8	58.8
19.20	56.0	2.0	0.9	58.9
19.30	55.0	2.0	0.9	57.9
19.40	55.0	2.0	0.9	57.9
19.50	54.0	2.0	0.9	56.9
19.60	53.0	1.9	0.9	55.9
19.70	53.0	1.8	0.9	55.7
19.80	52.0	1.6	1.0	54.6
19.90	52.0	1.5	1.0	54.5
20.00	51.0	1.4	1.0	53.4
20.10	51.0	1.4	1.0	53.3
20.20	50.0	1.3	1.0	52.3
20.30	50.0	1.2	1.0	52.2
20.40	49.0	1.2	1.0	51.2
20.50	49.0	1.2	1.0	51.2
20.60	49.0	1.1	1.0	51.1
20.70	48.0	1.1	1.0	50.1
20.80	48.0	1.1	1.0	50.1
20.90	47.0	1.1	1.0	49.1
21.00	47.0	1.0	1.0	49.0
21.10	47.0	0.8	1.0	48.8
21.20	46.0	0.8	1.0	47.8
21.30	46.0	0.8	1.0	47.8
21.40	45.0	0.8	1.0	46.8
21.50	45.0	0.8	1.0	46.8
21.60	45.0	0.8	1.0	46.8
21.70	44.0	0.8	1.0	45.8
21.80	44.0	0.8	1.0	45.8
21.90	43.0	0.8	1.0	44.8
22.00	43.0	0.8	1.0	44.8
22.10	42.0	0.8	1.0	43.8
22.20	41.0	0.8	1.0	42.8
22.30	40.0	0.8	1.0	41.8
22.40	39.0	0.8	1.0	40.8
22.50	38.0	0.8	1.0	39.8
22.60	37.0	0.8	1.0	38.8
22.70	35.0	0.8	1.0	36.8
22.80	34.0	0.8	1.0	35.8
22.90	33.0	0.8	1.0	34.8
23.00	32.0	0.8	1.0	33.8
23.10	31.0	0.8	1.0	32.8

Executed 09-18-2000 13:11:11

Data directory: p:\data\projects\3081\40\sw*.HYD

File Summary for Composite Hydrograph

Time (hrs)	POSTDV25 (cfs)	BSN1OUT1 (cfs)	BSN2OUT1 (cfs)	TPTPST25 (Total)
23.20	30.0	0.8	1.0	31.8
23.30	29.0	0.8	1.0	30.8
23.40	28.0	0.8	1.0	29.8
23.50	27.0	0.8	1.0	28.8
23.60	26.0	0.8	1.0	27.8
23.70	25.0	0.8	1.0	26.8
23.80	24.0	0.8	1.0	25.8
23.90	23.0	0.8	1.0	24.8
24.00	22.0	0.8	0.9	23.7
24.10	20.0	0.8	0.7	21.5
24.20	19.0	0.8	0.6	20.4
24.30	18.0	0.8	0.6	19.4
24.40	17.0	0.8	0.6	18.4
24.50	16.0	0.8	0.6	17.4
24.60	15.0	0.8	0.6	16.4
24.70	14.0	0.8	0.6	15.4
24.80	13.0	0.8	0.6	14.4
24.90	12.0	0.8	0.6	13.4
25.00	11.0	0.8	0.6	12.4
25.10	10.0	0.8	0.6	11.4
25.20	9.0	0.8	0.6	10.4
25.30	8.0	0.8	0.6	9.4
25.40	6.0	0.8	0.6	7.4
25.50	5.0	0.8	0.6	6.4

Executed 09-18-2000 13:14:54

Data directory: p:\data\projects\3081\40\sw*.HYD

File Summary for Composite Hydrograph

Time (hrs)	POSTDV00 (cfs)	BSN1OUT2 (cfs)	BSN2OUT2 (cfs)	TOTPST00 (Total)
11.00	37.0	0.0	0.0	37.0
11.10	42.0	0.2	0.2	42.4
11.20	48.0	0.3	0.2	48.5
11.30	53.0	0.3	0.2	53.5
11.40	58.0	0.4	0.3	58.6
11.50	64.0	0.4	0.3	64.7
11.60	69.0	0.4	0.3	69.7
11.70	84.0	0.4	0.3	84.7
11.80	98.0	0.5	0.3	98.8
11.90	113.0	0.5	0.4	113.9
12.00	168.0	0.6	0.4	169.0
12.10	290.0	0.6	0.5	291.1
12.20	546.0	0.7	0.5	547.2
12.30	919.0	0.7	0.6	920.3
12.40	1298.0	0.7	0.6	1299.3
12.50	1553.0	0.8	0.6	1554.4
12.60	1618.0	2.8	1.2	1622.0 ← Peak
12.70	1511.0	8.2	3.7	1522.9
12.80	1316.0	12.2	5.2	1333.4
12.90	1104.0	14.8	6.1	1124.9
13.00	892.0	15.7	6.6	914.3
13.10	752.0	15.5	6.9	774.4
13.20	613.0	14.8	7.0	634.8
13.30	532.0	14.0	7.0	553.0
13.40	451.0	13.3	7.0	471.3
13.50	402.0	12.5	7.0	421.5
13.60	352.0	11.7	6.9	370.6
13.70	322.0	10.8	6.7	339.5
13.80	292.0	10.0	6.6	308.6
13.90	270.0	9.6	6.5	286.0
14.00	249.0	9.1	6.3	264.3
14.10	236.0	8.5	6.0	250.6
14.20	222.0	8.1	5.8	235.9
14.30	209.0	7.7	5.7	222.4
14.40	199.0	7.4	5.4	211.9
14.50	190.0	7.2	5.2	202.3
14.60	180.0	7.0	4.8	191.8
14.70	174.0	6.8	4.5	185.3
14.80	168.0	6.6	4.2	178.8
14.90	163.0	6.2	4.0	173.2

Combined Post-Development Hydrograph - 100 yr Storm

Basin 1 +
Basin 2 +
Surrounding Watershed.

Executed 09-18-2000 13:14:54

Data directory: p:\data\projects\3081\40\sw*.HYD

File Summary for Composite Hydrograph

Time (hrs)	POSTDV00 (cfs)	BSN1OUT2 (cfs)	BSN2OUT2 (cfs)	TOTPST00 (Total)
15.00	157.0	5.8	3.8	166.6
15.10	153.0	5.5	3.6	162.1
15.20	150.0	5.3	3.5	158.8
15.30	146.0	5.0	3.4	154.4
15.40	143.0	4.6	3.3	150.9
15.50	139.0	4.3	3.3	146.6
15.60	136.0	4.1	3.2	143.3
15.70	134.0	3.9	3.2	141.1
15.80	131.0	3.8	3.1	137.9
15.90	129.0	3.6	3.1	135.7
16.00	126.0	3.5	3.1	132.6
16.10	123.0	3.4	3.1	129.5
16.20	120.0	3.4	3.1	126.4
16.30	118.0	3.3	3.0	124.2
16.40	115.0	3.2	2.8	121.0
16.50	112.0	3.2	2.6	117.8
16.60	110.0	3.2	2.5	115.7
16.70	108.0	3.1	2.4	113.5
16.80	106.0	3.1	2.3	111.4
16.90	104.0	3.1	2.3	109.3
17.00	102.0	3.1	2.2	107.3
17.10	100.0	3.1	2.2	105.2
17.20	99.0	3.0	2.1	104.2
17.30	97.0	3.0	2.1	102.2
17.40	96.0	3.0	2.1	101.1
17.50	94.0	3.0	2.1	99.1
17.60	93.0	3.0	2.1	98.1
17.70	92.0	3.0	2.0	97.1
17.80	92.0	3.0	2.0	97.1
17.90	91.0	3.0	2.0	96.0
18.00	90.0	3.0	2.0	95.0
18.10	89.0	3.0	2.0	94.0
18.20	88.0	3.0	2.0	93.0
18.30	87.0	3.0	2.0	92.0
18.40	86.0	3.0	2.0	91.0
18.50	85.0	2.9	2.0	89.9
18.60	84.0	2.8	2.0	88.8
18.70	83.0	2.6	2.0	87.6
18.80	82.0	2.5	2.0	86.5
18.90	81.0	2.4	2.0	85.4
19.00	80.0	2.4	2.0	84.4

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Data directory: p:\data\projects\3081\40\sw*.HYD

File Summary for Composite Hydrograph

Time (hrs)	POSTDV00 (cfs)	BSN1OUT2 (cfs)	BSN2OUT2 (cfs)	TOTPST00 (Total)
19.10	79.0	2.3	2.0	83.3
19.20	78.0	2.2	2.0	82.2
19.30	77.0	2.2	2.0	81.2
19.40	76.0	2.2	2.0	80.2
19.50	76.0	2.1	2.0	80.1
19.60	75.0	2.1	1.9	79.0
19.70	74.0	2.1	1.7	77.8
19.80	73.0	2.1	1.6	76.7
19.90	72.0	2.1	1.5	75.5
20.00	71.0	2.0	1.4	74.4
20.10	70.0	2.0	1.3	73.3
20.20	70.0	2.0	1.3	73.3
20.30	69.0	2.0	1.2	72.2
20.40	69.0	2.0	1.2	72.2
20.50	68.0	2.0	1.1	71.1
20.60	67.0	2.0	1.1	70.1
20.70	67.0	2.0	1.1	70.1
20.80	66.0	2.0	1.1	69.1
20.90	66.0	2.0	1.0	69.1
21.00	65.0	2.0	1.0	68.1
21.10	64.0	2.0	1.0	67.0
21.20	64.0	2.0	1.0	67.0
21.30	63.0	2.0	1.0	66.0
21.40	63.0	2.0	1.0	66.0
21.50	62.0	2.0	1.0	65.0
21.60	61.0	2.0	1.0	64.0
21.70	61.0	2.0	1.0	64.0
21.80	60.0	2.0	1.0	63.0
21.90	60.0	2.0	1.0	63.0
22.00	59.0	2.0	1.0	62.0
22.10	58.0	2.0	1.0	61.0
22.20	56.0	2.0	1.0	59.0
22.30	55.0	2.0	1.0	58.0
22.40	53.0	2.0	1.0	56.0
22.50	52.0	2.0	1.0	55.0
22.60	50.0	2.0	1.0	53.0
22.70	49.0	2.0	1.0	52.0
22.80	47.0	2.0	1.0	50.0
22.90	46.0	2.0	1.0	49.0
23.00	44.0	2.0	1.0	47.0
23.10	43.0	1.9	1.0	45.9

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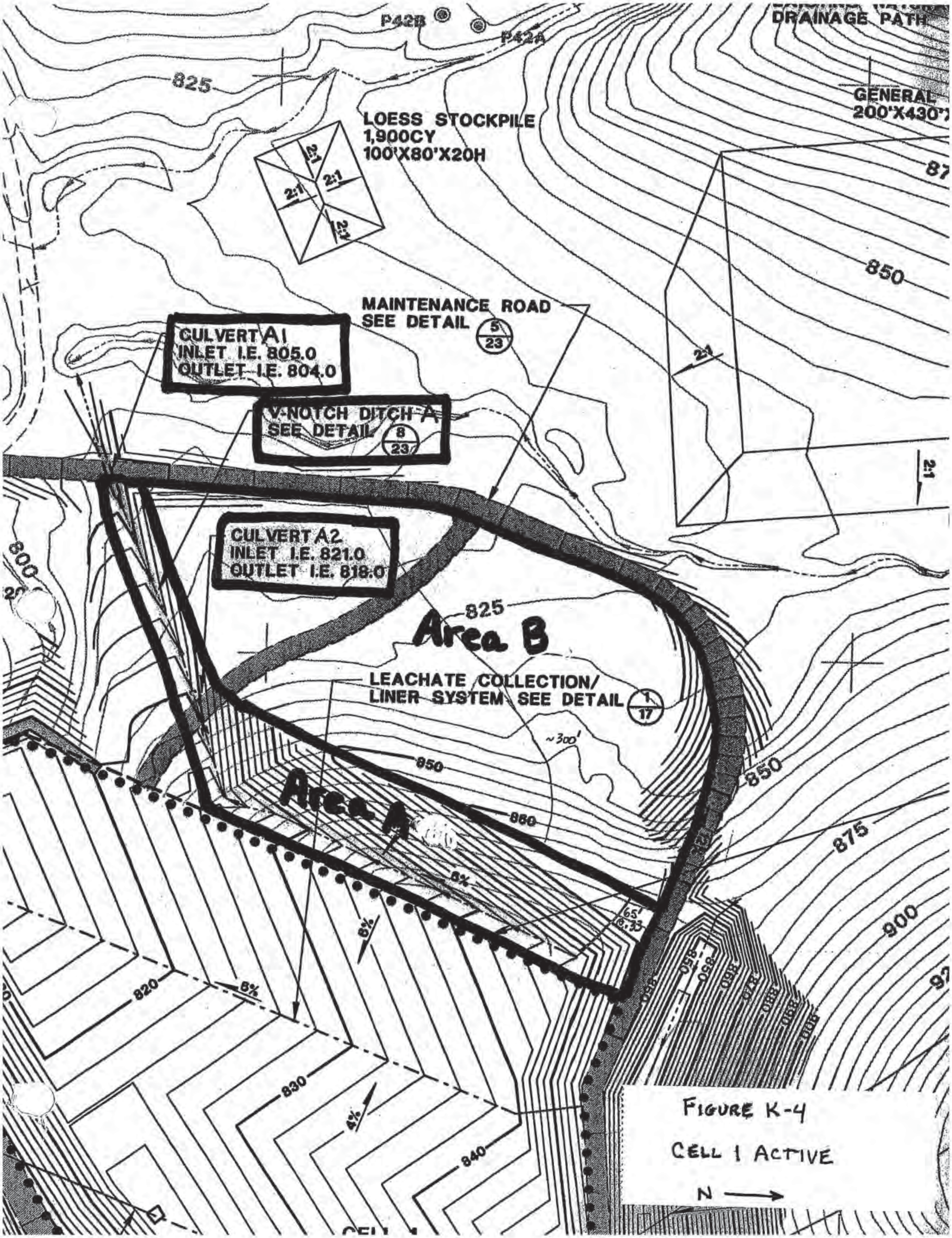
File Summary for Composite Hydrograph

Time (hrs)	POSTDV00 (cfs)	BSN1OUT2 (cfs)	BSN2OUT2 (cfs)	TOTPST00 (Total)
23.20	41.0	1.8	1.0	43.8
23.30	40.0	1.6	1.0	42.6
23.40	38.0	1.5	1.0	40.5
23.50	37.0	1.4	1.0	39.4
23.60	35.0	1.4	1.0	37.3
23.70	34.0	1.3	1.0	36.3
23.80	32.0	1.2	1.0	34.2
23.90	31.0	1.2	1.0	33.2
24.00	30.0	1.2	0.9	32.1
24.10	28.0	1.1	0.7	29.9
24.20	27.0	1.1	0.6	28.7
24.30	25.0	1.1	0.6	26.7
24.40	24.0	1.1	0.6	25.7
24.50	22.0	1.1	0.6	23.7
24.60	21.0	1.0	0.6	22.6
24.70	19.0	1.0	0.6	20.6
24.80	18.0	1.0	0.6	19.6
24.90	16.0	1.0	0.6	17.6
25.00	15.0	0.9	0.6	16.5
25.10	13.0	0.8	0.6	14.4
25.20	12.0	0.8	0.6	13.4
25.30	10.0	0.8	0.6	11.4
25.40	9.0	0.8	0.6	10.4
25.50	7.0	0.8	0.6	8.4

Operational Run-off Calculations


DRAINAGE PATH
P42B
P42A
825
LOESS STOCKPILE
1,900CY
100'X80'X20H
2:1
GENERAL
200'X430'
850
MAINTENANCE ROAD
SEE DETAIL 5/23
CULVERT A1
INLET I.E. 805.0
OUTLET I.E. 804.0
V-NOTCH DITCH A
SEE DETAIL 8/23
CULVERT A2
INLET I.E. 821.0
OUTLET I.E. 818.0
800
825
Area B
LEACHATE COLLECTION/
LINER SYSTEM SEE DETAIL 1/17
~300'
850
Area A
860
875
8%
900
820
830
840
4%
FIGURE K-4
CELL 1 ACTIVE
N

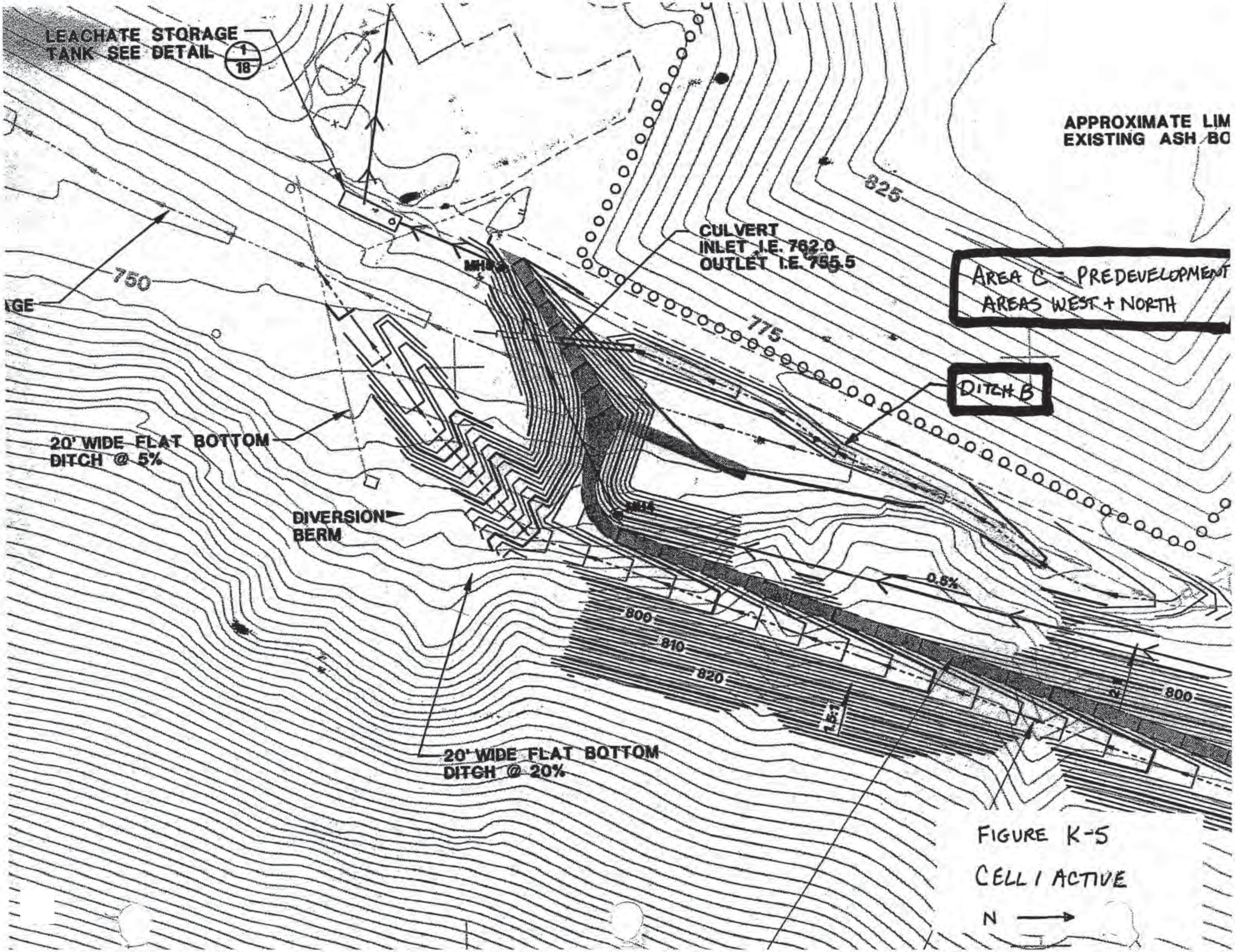


FIGURE K-5

CELL I ACTIVE

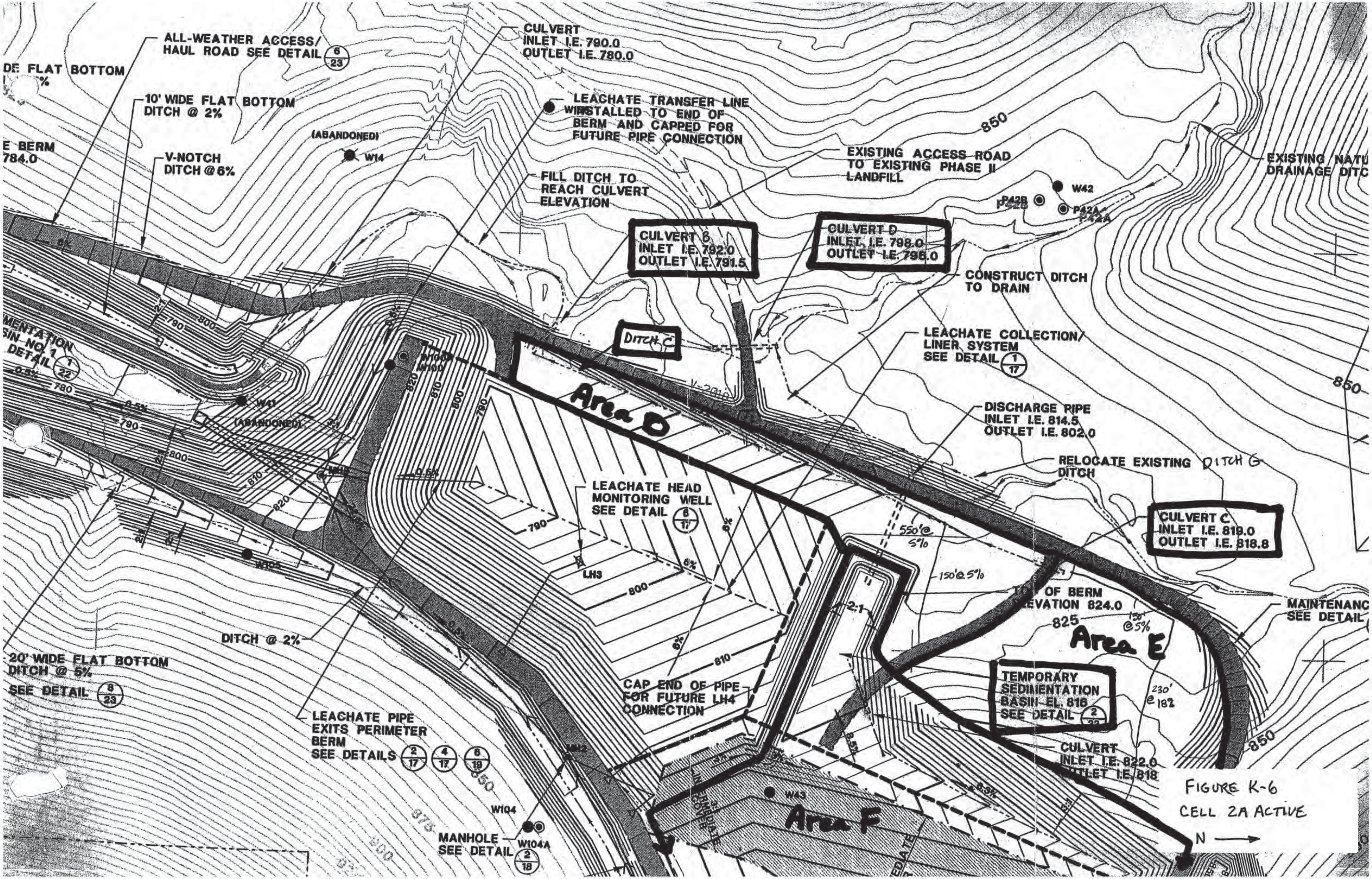


FIGURE K-6
CELL 2A ACTIVE

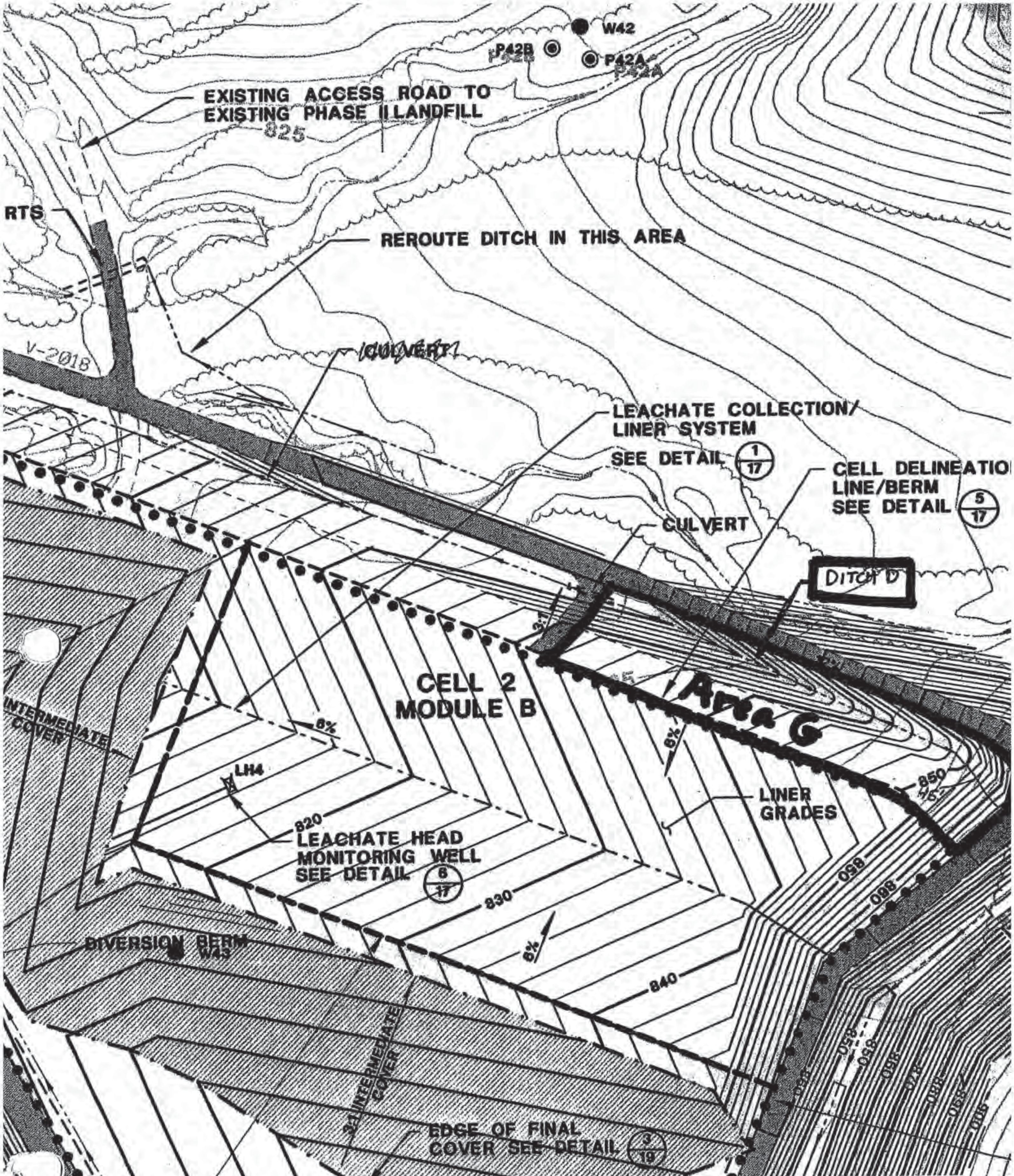


FIGURE K-7

CELL 2 B ACTIVE

N →

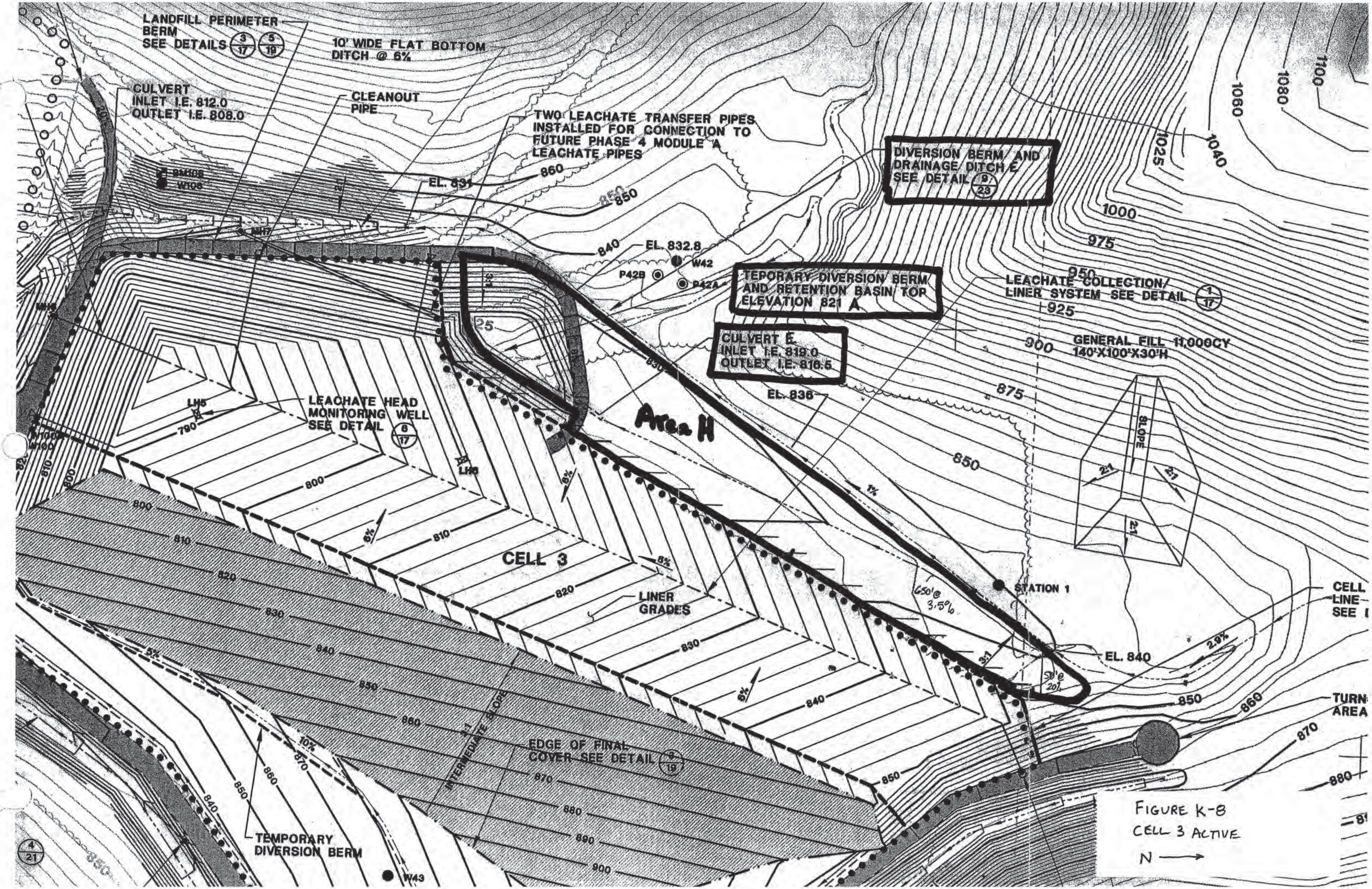


FIGURE K-8
CELL 3 ACTIVE
N →

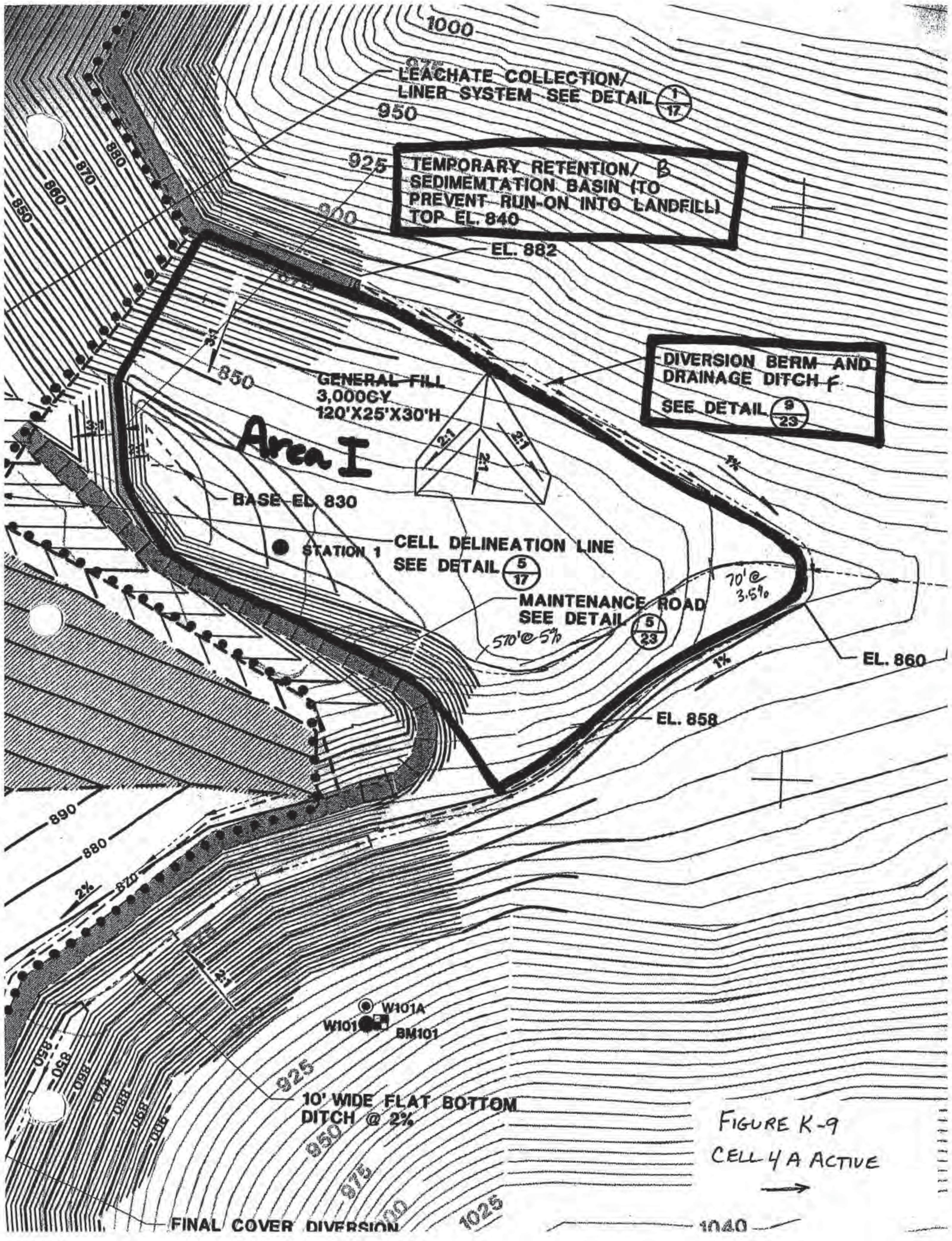


Figure K-9
Cell 4A Active

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SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.
Plan of Operation
Operational Conditions

Subarea descr.	Tc or Tt	Time (hrs)
Area A	Tc	0.08
Area B	Tc	0.21
Area D	Tc	0.06 – Round to 0.10
Area E	Tc	0.15
Area F	Tc	0.24
Area G	Tc	0.05 – Round to 0.10
Area H	Tc	0.10
Area I	Tc	0.15

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Dairyland Power Coop.
Plan of Operation
Operational Conditions

Tc COMPUTATIONS FOR: Area A

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description	grass		
Manning's roughness coeff., n		0.1500	
Flow length, L (total < or = 300)	ft	65.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.3330	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.04	= 0.04

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	625.0	
Watercourse slope, s	ft/ft	0.0600	
$Avg.V = Csf * (s)^{0.5}$	ft/s	3.9521	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.04	= 0.04

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.08

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                         Dairyland Power Coop.
                           Plan of Operation
                        Operational Conditions


                 Tc COMPUTATIONS FOR: Area B

SHEET FLOW (Applicable to Tc only)
   Segment ID                                  1
   Surface description                    grass
   Manning's roughness coeff., n               0.1500
   Flow length, L (total < or = 300)   ft      300.0
   Two-yr 24-hr rainfall, P2           in      2.800
   Land slope, s                     ft/ft     0.1700
                   0.8
       .007 * (n*L)
   T = --------------                  hrs      0.18              = 0.18
           0.5    0.4
         P2   *  s

SHALLOW CONCENTRATED FLOW
   Segment ID                                  2
   Surface (paved or unpaved)?                 Unpaved
   Flow length, L                      ft      220.0
   Watercourse slope, s              ft/ft     0.0200

                    0.5
   Avg.V =  Csf *  (s)                ft/s     2.2818
   where:   Unpaved Csf = 16.1345
            Paved   Csf = 20.3282

   T = L / (3600*V)                    hrs      0.03              = 0.03


CHANNEL FLOW
   Segment ID
   Cross Sectional Flow Area, a     sq.ft       0.00
   Wetted perimeter, Pw                ft       0.00
   Hydraulic radius, r = a/Pw          ft      0.000
   Channel slope, s                 ft/ft     0.0000
   Manning's roughness coeff., n              0.0000

                  2/3    1/2
       1.49  *  r   *  s
   V = --------------------           ft/s    0.0000
                n

   Flow length, L                      ft          0

   T = L / (3600*V)                    hrs      0.00              = 0.00

   ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                       TOTAL TIME (hrs)            0.21
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                            Dairyland Power Coop.
                              Plan of Operation
                           Operational Conditions


                      Tc COMPUTATIONS FOR: Area D

 SHEET FLOW (Applicable to Tc only)
    Segment ID                                   1
    Surface description                    soil
    Manning's roughness coeff., n                0.0110
    Flow length, L (total < or = 300)      ft    150.0
    Two-yr 24-hr rainfall, P2              in    2.800
    Land slope, s                        ft/ft   0.0500
                      0.8
        .007 * (n*L)
    T = --------------                     hrs    0.02              = 0.02
             0.5    0.4
          P2   *   s

 SHALLOW CONCENTRATED FLOW
    Segment ID                                   2
    Surface (paved or unpaved)?                  Unpaved
    Flow length, L                         ft    550.0
    Watercourse slope, s                 ft/ft   0.0500

                        0.5
    Avg.V =  Csf *  (s)                   ft/s   3.6078
    where:   Unpaved Csf = 16.1345
             Paved    Csf = 20.3282

    T = L / (3600*V)                       hrs    0.04              = 0.04


 CHANNEL FLOW
    Segment ID
    Cross Sectional Flow Area, a         sq.ft    0.00
    Wetted perimeter, Pw                   ft     0.00
    Hydraulic radius, r = a/Pw             ft    0.000
    Channel slope, s                     ft/ft   0.0000
    Manning's roughness coeff., n                0.0000

                    2/3    1/2
        1.49  *  r    *  s
    V = --------------------              ft/s   0.0000
                  n

    Flow length, L                         ft        0

    T = L / (3600*V)                       hrs    0.00              = 0.00

  ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                             TOTAL TIME (hrs)       0.06
```

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Quick TR-55 Ver.5.46   S/N:
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                         Dairyland Power Coop.
                          Plan of Operation
                        Operational Conditions


                  Tc COMPUTATIONS FOR: Area E

 SHEET FLOW (Applicable to Tc only)
    Segment ID                                     1
    Surface description                      grass
    Manning's roughness coeff., n                 0.1500
    Flow length, L (total < or = 300)    ft      230.0
    Two-yr 24-hr rainfall, P2            in      2.800
    Land slope, s                        ft/ft   0.1800
                        0.8
         .007 * (n*L)
    T =  --------------                  hrs      0.14               =  0.14
             0.5     0.4
           P2   *   s

 SHALLOW CONCENTRATED FLOW
    Segment ID                                     2
    Surface (paved or unpaved)?                  Unpaved
    Flow length, L                       ft      150.0
    Watercourse slope, s                 ft/ft   0.0500

                         0.5
    Avg.V =  Csf *  (s)                  ft/s    3.6078
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                     hrs      0.01               =  0.01


 CHANNEL FLOW
    Segment ID
    Cross Sectional Flow Area, a         sq.ft    0.00
    Wetted perimeter, Pw                 ft       0.00
    Hydraulic radius, r = a/Pw           ft       0.000
    Channel slope, s                     ft/ft    0.0000
    Manning's roughness coeff., n                 0.0000

                     2/3    1/2
         1.49  *  r   *  s
    V =  --------------------            ft/s     0.0000
                    n

    Flow length, L                       ft          0

    T = L / (3600*V)                     hrs      0.00               =  0.00

  ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                           TOTAL TIME (hrs)        0.15
```

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                      Dairyland Power Coop.
                        Plan of Operation
                      Operational Conditions


                 Tc COMPUTATIONS FOR: Area F

 SHEET FLOW (Applicable to Tc only)
    Segment ID                                  1
    Surface description                 grass
    Manning's roughness coeff., n              0.1500
    Flow length, L (total < or = 300)   ft     185.0
    Two-yr 24-hr rainfall, P2           in     2.800
    Land slope, s                       ft/ft  0.2500
                      0.8
         .007 * (n*L)
    T =  --------------                 hrs     0.10              = 0.10
            0.5    0.4
          P2   *  s

 SHALLOW CONCENTRATED FLOW
    Segment ID                                  2
    Surface (paved or unpaved)?                Unpaved
    Flow length, L                      ft     1370.0
    Watercourse slope, s                ft/ft  0.0300

                       0.5
    Avg.V =  Csf *  (s)                 ft/s   2.7946
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                    hrs     0.14              = 0.14


 CHANNEL FLOW
    Segment ID
    Cross Sectional Flow Area, a       sq.ft    0.00
    Wetted perimeter, Pw                ft      0.00
    Hydraulic radius, r = a/Pw          ft      0.000
    Channel slope, s                    ft/ft   0.0000
    Manning's roughness coeff., n               0.0000

                    2/3    1/2
         1.49  *  r   *  s
    V =  --------------------           ft/s    0.0000
                   n

    Flow length, L                      ft          0

    T = L / (3600*V)                    hrs     0.00              = 0.00

  ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                           TOTAL TIME (hrs)       0.24
```

```
Quick TR-55 Ver.5.46   S/N:
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                          Dairyland Power Coop.
                            Plan of Operation
                         Operational Conditions


                    Tc COMPUTATIONS FOR: Area G

 SHEET FLOW (Applicable to Tc only)
     Segment ID                                    1
     Surface description                      grass
     Manning's roughness coeff., n              0.1500
     Flow length, L (total < or = 300)   ft     45.0
     Two-yr 24-hr rainfall, P2           in     2.800
     Land slope, s                      ft/ft   0.3300
                    0.8
         .007 * (n*L)
     T = --------------                  hrs     0.03              =  0.03
             0.5   0.4
          P2   *  s

 SHALLOW CONCENTRATED FLOW
     Segment ID                                   2
     Surface (paved or unpaved)?                 Unpaved
     Flow length, L                      ft      320.0
     Watercourse slope, s               ft/ft   0.1200

                      0.5
     Avg.V =  Csf *  (s)                ft/s    5.5892
     where:   Unpaved Csf = 16.1345
              Paved   Csf = 20.3282

     T = L / (3600*V)                    hrs     0.02              =  0.02


 CHANNEL FLOW
     Segment ID
     Cross Sectional Flow Area, a     sq.ft      0.00
     Wetted perimeter, Pw                ft      0.00
     Hydraulic radius, r = a/Pw          ft     0.000
     Channel slope, s                  ft/ft    0.0000
     Manning's roughness coeff., n              0.0000

                     2/3    1/2
          1.49  *  r   *  s
     V = --------------------           ft/s    0.0000
                    n

     Flow length, L                      ft         0

     T = L / (3600*V)                    hrs     0.00              =  0.00

   ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                             TOTAL TIME (hrs)      0.05
```

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Quick TR-55 Ver.5.46   S/N:
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                        Dairyland Power Coop.
                         Plan of Operation
                       Operational Conditions


                  Tc COMPUTATIONS FOR: Area H

 SHEET FLOW (Applicable to Tc only)
    Segment ID                                1
    Surface description                   grass
    Manning's roughness coeff., n            0.1500
    Flow length, L (total < or = 300)   ft     50.0
    Two-yr 24-hr rainfall, P2           in    2.800
    Land slope, s                     ft/ft  0.2000
                     0.8
         .007 * (n*L)
    T =  --------------                  hrs    0.04           =  0.04
            0.5    0.4
          P2   *  s

 SHALLOW CONCENTRATED FLOW
    Segment ID                                2
    Surface (paved or unpaved)?             Unpaved
    Flow length, L                      ft    650.0
    Watercourse slope, s              ft/ft  0.0350

                      0.5
    Avg.V =  Csf *  (s)                ft/s   3.0185
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                    hrs    0.06           =  0.06


 CHANNEL FLOW
    Segment ID
    Cross Sectional Flow Area, a     sq.ft    0.00
    Wetted perimeter, Pw                ft    0.00
    Hydraulic radius, r = a/Pw          ft   0.000
    Channel slope, s                  ft/ft  0.0000
    Manning's roughness coeff., n            0.0000

                   2/3    1/2
         1.49  *  r   *  s
    V =  --------------------          ft/s   0.0000
                    n

    Flow length, L                      ft        0

    T = L / (3600*V)                    hrs    0.00           =  0.00

  ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                         TOTAL TIME (hrs)        0.10
```

```
Quick TR-55 Ver.5.46   S/N:
Executed: 19:42:40   10-12-2000     p:\data\projects\3081\40\sw\op\OPERAT.TCT

                         Dairyland Power Coop.
                           Plan of Operation
                         Operational Conditions


                    Tc COMPUTATIONS FOR: Area I

SHEET FLOW (Applicable to Tc only)
   Segment ID                                1
   Surface description                   grass
   Manning's roughness coeff., n             0.1500
   Flow length, L (total < or = 300)    ft     70.0
   Two-yr 24-hr rainfall, P2            in    2.800
   Land slope, s                     ft/ft   0.0350
                    0.8
       .007 * (n*L)
   T = --------------               hrs     0.10            =  0.10
          0.5    0.4
        P2   *  s

SHALLOW CONCENTRATED FLOW
   Segment ID                                2
   Surface (paved or unpaved)?               Unpaved
   Flow length, L                       ft    570.0
   Watercourse slope, s              ft/ft   0.0500

                      0.5
   Avg.V =  Csf *  (s)              ft/s   3.6078
   where:   Unpaved Csf = 16.1345
            Paved   Csf = 20.3282

   T = L / (3600*V)                  hrs     0.04            =  0.04


CHANNEL FLOW
   Segment ID
   Cross Sectional Flow Area, a    sq.ft     0.00
   Wetted perimeter, Pw               ft     0.00
   Hydraulic radius, r = a/Pw         ft    0.000
   Channel slope, s                ft/ft   0.0000
   Manning's roughness coeff., n           0.0000

                 2/3    1/2
        1.49  *  r   *  s
   V = --------------------         ft/s   0.0000
                  n

   Flow length, L                     ft        0

   T = L / (3600*V)                  hrs     0.00            =  0.00

   ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                        TOTAL TIME (hrs)        0.15
```

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:42
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL1 .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL1 .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 1

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
Area A	1.10	69.0	0.10	0.00	6.10	2.79	.15	.10
Area B	2.70	69.0	0.20	0.00	6.10	2.79	.15	.10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 3.80 acres or 0.00594 sq.mi
Peak discharge = 14 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Area A	0.10	0.00	**	**	No	--
Area B	0.21	0.00	0.20	0.00	No	--

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:42
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL1 .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL1 .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 1

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Area A	5	12.1
Area B	9	12.1
Composite Watershed	14	12.1

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:49
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL2A .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL2A .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2A

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Area D	1.30	69.0	0.10	0.00	6.10	2.79	.15 .10
Area E	1.60	69.0	0.20	0.00	6.10	2.79	.15 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 2.90 acres or 0.00453 sq.mi
Peak discharge = 11 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Area D	0.10	0.00	**	**	No	--
Area E	0.15	0.00	0.20	0.00	No	--

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:49
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL2A .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL2A .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2A

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Area D	6	12.1
Area E	6	12.2
Composite Watershed	11	12.1

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:57
Watershed file: --> p:\data\projects\3081\40\sw\op\TEMPBAS .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\TEMPBAS .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2A Temporary Basin

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Area F	7.60	69.0	0.20	0.00	6.10	2.79	.15 .10

* Travel time from subarea outfall to composite watershed outfall point.

Total area = 7.60 acres or 0.01187 sq.mi
Peak discharge = 27 cfs

>>>> Computer Modifications of Input Parameters <<<<<

	Input Values		Rounded Values		Ia/p	
Subarea Description	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
Area F	0.24	0.00	0.20	0.00	No	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:57
Watershed file: --> p:\data\projects\3081\40\sw\op\TEMPBAS .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\TEMPBAS .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2A Temporary Basin

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Area F	27	12.2
Composite Watershed	27	12.2

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:12:03
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL2B .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL2B .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2B

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Area G	0.60	69.0	0.10	0.00	6.10	2.79	.15 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 0.60 acres or 0.00094 sq.mi
Peak discharge = 3 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Area G	0.10	0.00	**	**	No	--

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:12:03
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL2B .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL2B .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2B

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Area G	3	12.1
Composite Watershed	3	12.1

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:12:08
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL3 .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL3 .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 3

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Area H	1.70	69.0	0.10	0.00	6.10	2.79	.15 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 1.70 acres or 0.00266 sq.mi
Peak discharge = 7 cfs

>>>> Computer Modifications of Input Parameters <<<<<

	Input Values		Rounded Values		Ia/p	
Subarea Description	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
Area H	0.10	0.00	**	**	No	--

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:12:08
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL3 .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL3 .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 3

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Area H	7	12.1
Composite Watershed	7	12.1

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:21:09
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL4A .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL4A .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 4A

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Area I	3.60	69.0	0.20	0.00	6.10	2.79	.15 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 3.60 acres or 0.00562 sq.mi
Peak discharge = 13 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Area I	0.15	0.00	0.20	0.00	No	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:21:09
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL4A .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL4A .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 4A

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Area I	13	12.2
Composite Watershed	13	12.2

Reference Information

Table 2-2a.—Runoff curve numbers for urban areas[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1]Average runoff condition, and $I_a = 0.2S$.
[2]The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
[3]CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4]Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5]Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b.—Runoff curve numbers for cultivated agricultural lands[1]

Cover description			Curve numbers for hydrologic soil group—			
Cover type	Treatment[2]	Hydrologic condition[3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T + CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T + CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

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

[2]*Crop residue cover* applies only if residue is on at least 5% of the surface throughout the year.

[3]Hydrologic condition is based on combination of factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes in rotations, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

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

[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.

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overton and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,s^{0.4}} \qquad \text{[Eq. 3-3]}$$

Table 3-1.—Roughness coefficients (Manning's n) for sheet flow

Surface description	n[1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1]The n values are a composite of information compiled by Engman (1986).
[2]Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
[3]When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

where

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1),
L = flow length (ft),
P_2 = 2-year, 24-hour rainfall (in), and
s = slope of hydraulic grade line (land slope, ft/ft).

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

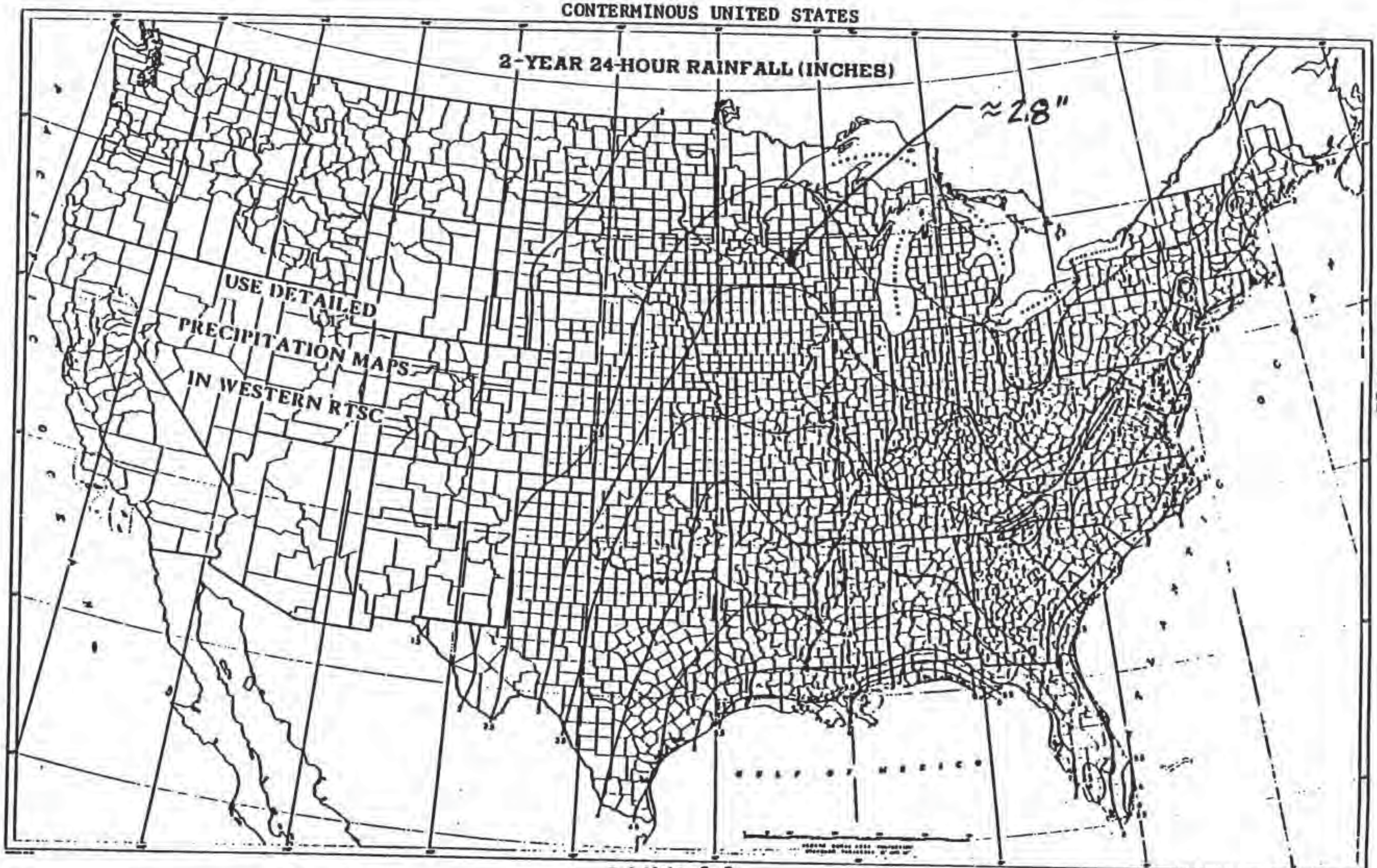

Exhibit 2-3
Sheet 1 of 5

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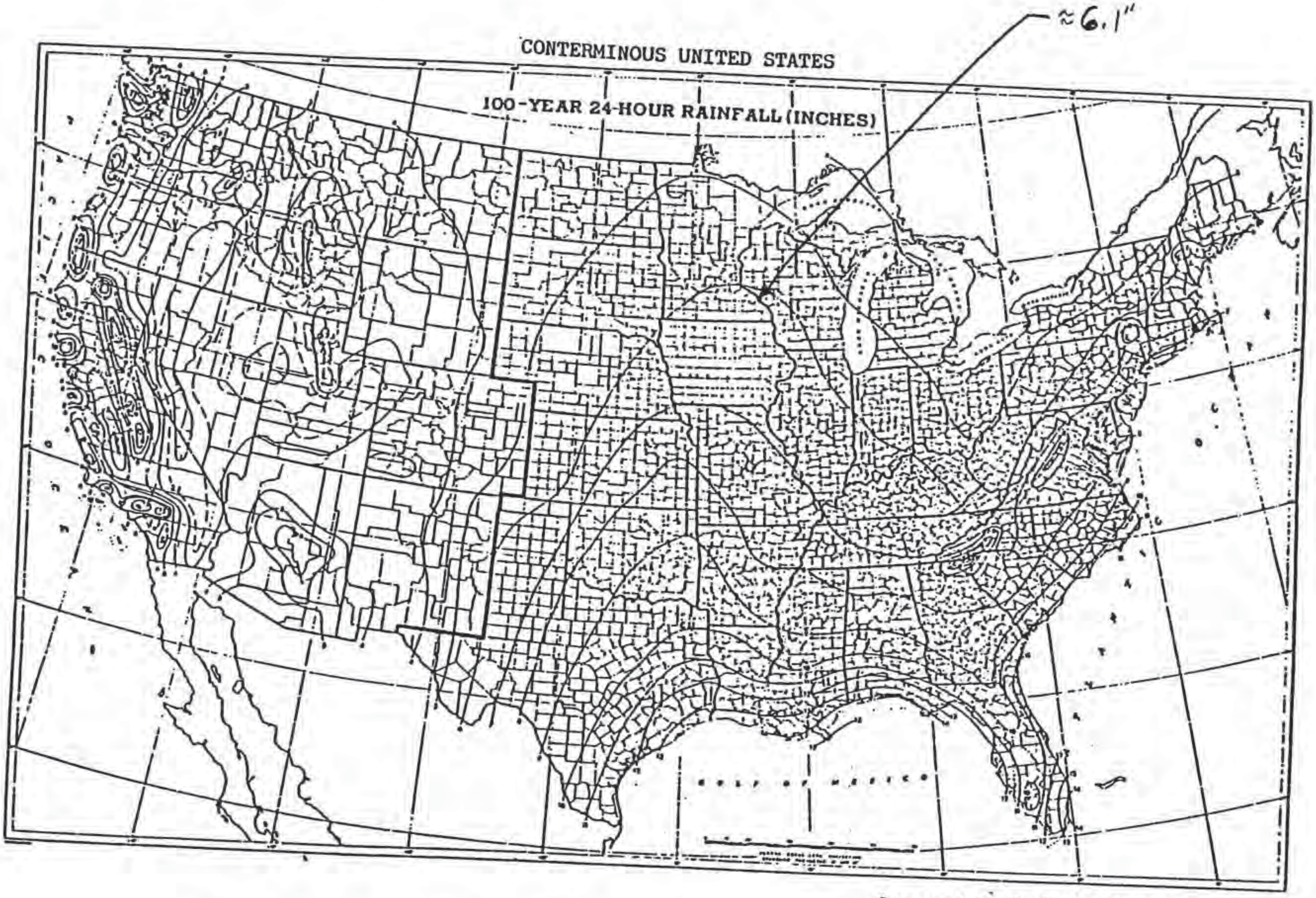

Prepared by U. S. Weather Bureau

FROM: Urban Hydrology for Small Watersheds. [n.p.]: U.S. Department of Agriculture. Soil Conservation Service Engineering Division, (Technical Release No. 55). 1975, as revised 1981.

—Approximate geographic boundaries for SCS rainfall distributions.