



Inver Grove Heights Planning Commission
Tuesday, November 19, 2024 at 7:00 PM
8150 Barbara Avenue, Inver Grove Heights, MN 55077

AGENDA

NOTICE TO RESIDENTS: Individuals may submit written public comments in advance of the meeting by emailing comments to Stacy Bodsberg (sbodsberg@ighmn.gov). Comments received prior to 4:00 p.m. on Tuesday, November 19, 2024, will be provided to the Council at or before the November 19, 2024 meeting.

1. **Call to Order**
2. **Roll Call**
3. **Consent Agenda**
 - A. Minutes of the November 6, 2024, Planning Commission Meeting
4. **Public Hearing**
 - A. Zoning Code Amendment, Conditional Use Permit and Non-Conforming Use Certificate Amendment to allow the proposed vertical expansion of the Pine Bend Sanitary Landfill located at 2495 117th Street East. (BFI Waste Systems of North America, LLC. - Case No. 24-21NCUC)
5. **Regular Business**
6. **Adjourn**

This document is available upon a three (3) business day request in alternate formats such as braille, large print, audio recording, etc. Please contact Stacy Bodsberg, Community Development Support Specialist, at 651.450.2545 or sbodsberg@ighmn.gov.

PLANNING COMMISSION MINUTES – CITY OF INVER GROVE HEIGHTS

Wednesday, November 6, 2024 – 7:00 p.m.
City Council Chambers – 8150 Barbara Avenue

1. CALL TO ORDER

Chair Weber called the Planning Commission Meeting to order at 7:00 p.m.

The Pledge of Allegiance was recited.

2. ROLL CALL

Commissioner's Present: Jonathan Weber (*Chair*)
Scott Clancy (*Vice-Chair*)
Jason Teiken
Lance Twedt
Amy Hunting
Robert Heidenreich
Aida Schaefer
Dennis Wippermann

Commissioner's Absent: Trisha Presley (*Secretary*) – *excused*

Staff Present: Jason Ziemer, Community Development Director
Heather Botten, Associate Planner
Stacy Bodsberg, Community Development Support Specialist

3. CONSENT AGENDA

A. Minutes of October 15, 2024, Planning Commission Meeting.

Motion by Hunting, Second by Clancy, to approve the minutes as submitted.

Ayes: 8

Nays: 0 Motion Carried.

4. PUBLIC HEARING

A. Zoning Code Amendment to Create the Use *Palliative Care Home* in the E-1, Estate District. (The Bardo – Case No. 24-38ZA)

Reading of Public Notice

Vice-Chair Clancy read the Public Hearing Notice.

Presentation of Request

Associate Planner Botten presented a summary of the staff report.

The applicant wishes to convert a single-family home to an end-of-life care facility that would provide 24-hour residential and supportive services for dying people.

If the code amendment is approved, Palliative Care Home use would be added to the City Code and allowed in all E-1, Estate District zoned properties.

The second decision for the Commission involves the type of use: permitted, conditional, or interim.

- Permitted use may be difficult to administer.
 - Staff would not be able to review the site for parking, access, or number of patients allowed.
- Conditional use would allow for the addition of conditions.
 - Would stay with the property even if the owner changed.
- Interim use is for temporary uses or newer uses that do not fit into the Zoning Code.

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- Allows for a timeline for re-evaluation and the setting of performance standards and conditions.

Staff have drafted suggested Performance Standards, which can be edited if the use is approved:

- Up to 3 dying people residing in the property at one time
- No remains stored on the property
- No support/accessory services for people other than the patients residing in the home and their families
- No funeral services on the property
- Parking will be provided on the property (not on public/private streets)
- Interim use would expire in 5 years, or when the ownership of the property changes

Staff believe that the Department of Health may require a license for this type of use. However, staff recommend continuing with the public hearing. (If a license is required, there may be some impact on Building and Fire Code requirements and/or performance standards.)

Planning Commission Discussion

Commissioner Schaefer questioned how neighboring cities handle this type of use. Associate Planner Botten stated that Palliative Care Home is a newer use type. Cities broadly do not yet have policies for palliative care homes. Some have policies for hospice homes, but those are different as they are licensed. Schaefer inquired if there was any other difference between palliative care homes and hospice homes, besides lack of licensing. Botten stated that may be a question for that applicant. Schaefer inquired if it would be a non-profit or for-profit business. Botten stated that either way would not affect the code amendment/use type decision.

Commissioner Schaefer inquired about requirements for operating a business in a residence. Community Development Director Ziemer clarified that there are requirements for home-occupation businesses, but that this use is different. The State of Minnesota is still determining specifics.

Commissioner Clancy inquired about a map of all the land currently zoned E-1, Estate District. Associate Planner Botten stated one isn't readily available at this meeting but could be prepared for the next meeting. Clancy questioned whether the licensing would be for the building itself or for the workers. Botten stated that it would be the for the building; the State similarly requires licensing for group homes and hospice homes.

Opening of Public Hearing

Christin Ament, 6985 Babcock Trail, Applicant, stated that she has read and understood the staff report. She shared that she is a nurse practitioner who has been working in hospice/palliative care for 15 years, and the owner of a property approached her about starting a palliative care home, as opposed to a hospice home. (Hospice homes must follow Medicare determinations about what is hospice-appropriate, which did not fit with their residential rather than clinical vision for the space.) The property is also close to nature, which allows for nature-based practices. The model for this use type is the Omega Home Network (e.g., the Center for Conscious Living and Dying in Asheville), which allows 3 or fewer people to die in a residential home (unlicensed) with staff, volunteers, and hospice professionals. Once a patient is deemed terminal, an outside hospice agency provides medical care, and staff and volunteers provide comfort care. Each patient completes an intake form with their Advance Care Directive, Do Not Resuscitate/Do Not Intubate orders, the results of their most recent physical, and the hospice agency of their choice.

Commissioner Clancy inquired if there would be a staff member present 24/7. Ms. Ament stated that a staff member would be present during business hours. Family and/or volunteers (background-checked with references, similar to a home health aide) would be there overnight. Volunteers who have expressed interest so far include backgrounds as medical professionals or death doulas.

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Commissioner Hunting inquired about how the patient referral process would work. Ms. Ament stated that most patients would likely come from hospitals. Once patients receive a terminal diagnosis and are assigned to a hospice agency, discharge coordinators connect patients to in-home care, a long-term care facility, a nursing home, or one of the few hospice facilities in the metro. However, referrals could also come from nursing homes or transitional care units. Hunting inquired if potential clients could be homeless. Ms. Ament stated that she hoped so. Hunting inquired how staff would be paid. Ms. Ament stated that the model they are interested in (Omega Home Network) is donation-based. However, that model focuses on providing people with a place to be in their final days. The goal for this care home will be to provide support services to the patient and family before death and to the family after death.

Commissioner Hunting stated that long-term care insurance would deny coverage to insured people due to the lack of a license and asked whether similar facilities in other states are licensed. Ms. Ament stated that they are not. And summarized some responses to questions from the State Department of Health: Family, hospice agencies (RNs, MDs, aides, chaplains, social workers), Bardo staff (2 medically trained, 2 trained in providing comfort), and volunteers would provide care. There would be no facility affiliation with a particular hospice agency. Volunteers would be selected based on interest, trained, and there would be monthly check-ins. There would not be an admittance contract, but each patient would fill out an extensive application. Hospice agencies would monitor each patient's medical state and care. Upon death, hospice agency staff/volunteer/Bardo staff would contact a funeral home to get the death certificate. Hunting inquired whether, if the State decides the home needs to be licensed, if the Applicant would continue in establishing this business. Ms. Ament stated that she would.

Commissioner Twedt questioned whether this home would be open to anyone. Ms. Ament stated that it would; she has been connected with different hospitals and hopes that they will consider the home for referrals. Twedt inquired about the potential length of a patient's stay. Ms. Ament stated that imposing limits on a stay would be unethical, but currently the average length of a stay in hospice is about seven days. The hope would be to not have people there longer than two weeks in order to maximize available space. However, no one would be kicked out at the two-week mark.

Commissioner Twedt questioned whether there would be relationships with particular funeral homes. Ms. Ament stated that the goal would be to have a list of resources to connect the families with, but not a pipeline to a certain funeral home.

Commissioner Twedt inquired about patient payment. Ms. Ament stated that there are eight hospice facilities in the Twin Cities. Our Lady of Peace is the only one that does not charge. They have 20 beds. The others charge \$550 to \$775 per day, which is usually paid out-of-pocket. The plan for this facility is to offer it free of charge, by donation. If there is a charge, the estimated overhead would be \$200 per day. The plan would be to ask those who can pay more to pay more to cover those who cannot.

Chair Weber asked the Commission to focus on land use/land designation questions.

Commissioner Schaefer inquired as to how much space in each bedroom would be required for 3 people in this type of facility. Ms. Ament stated that the majority of people in hospice are bed-bound in a twin-size hospital bed. The hope is to also provide a daybed in each bedroom to accommodate family members. Schaefer stated that she would prefer to limit the space rather than the number of people per facility. She asked for a square footage estimate. Ms. Ament stated that a 16x16-foot room would allow for a twin bed and a daybed.

Commissioner Wippermann inquired about the reason for the added parking lot accommodating 15 to 16 vehicles. Ms. Ament stated that 15-16 spaces is what the location allows for. If all rooms were full, with each patient having family members present and hospice staff coming and going, the

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estimate of 10 to 12 people arriving throughout the day (not all at once). The Fire Chief is consulting about emergency vehicles arriving at the scene.

Commissioner Clancy stated that he is open to approving an Interim Use Permit (IUP) with the performance standards that staff have suggested.

Chair Weber agreed.

Commissioner Schaefer asked for language on minimum square footage per dying person.

Commissioner Wippermann stated that many families would appreciate this type of facility in the community. He brought up neighborhood compatibility -- he said that he drove past the property, and it is set back from the street in a wooded area, but on a flat lot, the number of vehicles coming and going could change the character of the neighborhood.

Commissioner Twedt stated that he is in favor of the concept but would like more information about oversight.

Commissioner Hunting stated that she agreed with Commissioner Twedt. She has concerns as the City is not set up to do inspections, monitor training, or respond to complaints. She asserted that there should be a pause until the State of Minnesota makes its decision on licensing. Could see this type of facility working, but there are more details that need to be worked out.

Chair Weber asked if a condition could be added to approval say that the State would have to determine that this type of facility does not need a license. Associate Planner Botten said that this was possible.

Commissioner Clancy asked whether there was a timeline for that decision from the State.

Chair Weber stated that there is not.

Associate Planner Botten stated that approval could be postponed until an answer from the State is resolved.

Chair Weber stated that by approving this use as an Interim Use Permit would increase the pressure on the State to answer the licensing question.

Commissioner Clancy suggested lowering the Interim Use Permit timeline to one or two years.

Chair Weber stated that going through the Interim Use Permit process every year would be a burden on the City.

Associate Planner Botten clarified that the specifics about the Interim Use Permit would be handled at a later time.

Community Development Director Ziemer stated that the goal for the staff's suggested performance standards was to provide pre-determined standards; there could be additional standards considered in individual applications.

Commissioner Hunting asked whether Interim Use Permit's stay with a property. Botten stated that Conditional Use Permits stay with a property; IUPs are a temporary use on a property.

Veronica Barnes, 3596 72nd Street East, stated that she had good experiences with The Bardo. She discussed personal and professional experiences with death that have led her to support the

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type of space where people can die with ease and reverence. She expressed support for this business in Inver Grove Heights as an example for the country.

Chair Weber closed the Public Hearing.

Planning Commission Discussion

Commissioner Hunting requested to add language about the licensing and felt five years was too long for an IUP of this type, one or two years sounded about right.

Chair Weber inquired with Associate Planner Botten to provide an overview of the IUP process. Botten stated that the Applicant would have to make a site-specific Interim Use Permit application. The interval can be decided at the time of the IUP application. There is also the option to put the interval at change of ownership. There could be a one-time extension, and they could then ask for permanent use.

Commissioner Twedt stated that limiting the permit to a year or two could negatively impact the business's ability to retain staff.

Chair Weber suggested leaving out the time interval.

Associate Planner Botten stated that there would be set performance standards to ensure that people in E-1 zoning would know the minimum requirements, but there could be additional site-specific conditions. She recommended including the standards, but said Performance Standard f. could be removed.

Commissioner Hunting stated that she was in favor of removing Performance Standard f. She asked for wording about needing to follow state licensing guidelines be added.

Planning Commission Recommendation

Motion by Weber, Second by Twedt, to Approve a Zoning Code Amendment in the E-1, Estate zoning district for *Palliative Care Home* with the conditions a, b, c, d, e, and replacing f with "the property must follow State of Minnesota guidelines on whether it needs to be a licensed facility or unlicensed facility".

Ayes: 8

Nays: 0

Motion Carried.

The item is tentatively scheduled to go before the City Council on November 25, 2024.

B. Comprehensive Plan Amendment to Change the Land Use from RDR, Rural Density Residential to LI, Light Industrial; Rezoning from A, Agricultural to I-1, Limited Industry District; and Zoning Code Amendment to Create the Use Commercial Yard Waste Recycling and Composting Facility in I-1, Limited Industry District for the property located at 10645 Rich Valley Boulevard. (Jack Hartigan – Case No. 24-12Z)

Reading of Public Notice

Vice-Chair Clancy read the Public Hearing Notice.

Presentation of Request

Associate Planner Botten presented a summary of the staff report.

The Applicant is requesting to open a commercial yard waste recycling/composting facility for reprocessing of yard waste into topsoil.

The applicant requests:

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- Change land use from Rural Density Residential to Light Industrial (Comprehensive Plan Amendment).
- Rezone property from A, Agricultural to I-1, Limited Industry District – this would be spot-zoning, given that the area is Rural Density Residential.
- Add Commercial Yard Waste Recycling and Composting Facility as Conditional Use in the I-1, Limited Industry District (Zoning Code Amendment).

The surrounding properties to the south and west are owned by Flint Hills, meaning no further residential development is planned. Yard waste recycling is deemed a low traffic generator. However, if the property is rezoned, any type of I-1, Limited Industry would be supported on this site in the future – this could represent a major change in land use direction and pattern from what is in the Comprehensive Plan. In addition, there could be odor problems due to compost turning. Moreover, there would not be much tax generated due to lack of structures/employees on site.

Associate Planner Botten stated that even if the rezoning and comp plan amendment are denied, this land use (Commercial Yard Waste Recycling and Composting Facility) could be allowed in I-1, Limited Industry Districts broadly.

This use is allowed in the nearby Integrated Resource Management Overlay District, which was created to keep landfills and other waste management facilities in one area of the City. Another option might be to expand the Overlay District, but staff are not recommending that at this time.

Staff recommend denial of the land use change, denial of the rezoning, and denial of the zoning code amendment.

Planning Commission Discussion

Chair Weber inquired as to what the zoning is for Gerten's. Botten stated that it is zoned Commercial PUD. Weber inquired about the owners of the properties to the south and west. Botten stated that Pine Bend Refinery/Flint Hills owns them.

Chair Weber clarified that the current zoning is Agricultural and future land use guidance was Rural Density Residential. Associate Planner Botten confirmed in the affirmative.

Commissioner Hunting inquired about a recent application for a mini-storage business nearby that was denied.

Commissioner Wippermann asked whether that was this same property.

Associate Planner Botten stated that it is not, and the mini-storage business was proposed for property to the north of this one.

Opening of Public Hearing

Jack Hartigan, 9852 Adam Ave, Applicant, said that he runs a landscaping company and has lived in Inver Grove Heights for 20 years. He said that currently, his business uses Gerten's to dump leaves, brush, and dirt, but disposal costs are rising. He said that the Republic Services dump site is adjacent.

Commissioner Heidenreich inquired about the area for collecting leaves and debris and who would be able to utilize. Mr. Hartigan stated that the plan was to focus on local residents and local businesses (Rosemount/Inver Grove/Eagan), as there's a lack of facilities in the south metro. Heidenreich inquired as to how jumping worms would be handled. Mr. Hartigan stated that there would be regular inspections from DNR, as well as regulations and best practices for mitigation. Heidenreich inquired as to what those regulations and best practices were. Mr. Hartigan stated that the City of Eagan has already come up with recommendations and that they plan to follow those.

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Paul Saver, 7845 Boyd Court, stated that he is the owner of Johnson Excavating, 10805 Rich Valley Boulevard, located directly north of the applicant's property. He is in support of the applicant and thinks this is an excellent use and opportunity for the applicant's property.

John Larson, 1938 105th Street East, stated that he is opposed to changing the land use from RDR. He is also opposed to changing the zoning from Agricultural to I-1, Light Industrial, as this would change the long-term plan for the area.

Motion by Clancy, Second by Teiken, to include two emails from residents into the record.

Ayes: 8

Nays: 0 Motion Carried.

Scott Lindell, 10895 Barnes Ave, stated that he lives in the area and is concerned about spot zoning and allowing more industrial businesses in the area in the future. He also has concerns about odor management.

Susan Tschida, 2360 108th Street East, expressed opposition to more industrial businesses generally and to this business due to concerns about odor.

William Gillet, 2295 108th Street, stated that Gerten's exists nearby and is a well-run facility. He is opposed due to the short distance of the proposed business from his home.

Jack Hartigan, 9852 Adam Ave, stated that Gerten's facility in Eagan will drop their capacity soon due to part of their lease ending. At that point, their prices will increase significantly. Mr. Hartigan explained that when a pile is turned, there's a 24-hour period of time where there is a light odor. However, they plan on following all the recommendations that Gerten's uses, and they welcome community input as well.

Chair Weber closed the Public Hearing.

Planning Commission Discussion

Community Development Director Ziemer reminded the Commission that the matter on the table is not the specific use, but the change in land use and zoning, which would broaden the type of uses allowed in all Light Industrial properties.

Commissioner Schaefer inquired about whether a Commercial Yard Waste Recycling and Composting Facility would be allowed in an Agricultural district. Associate Planner Botten stated that a Commercial Yard Waste Recycling and Composting Facility is currently only allowed in the Integrated Resource Management Overlay District.

Commissioner Clancy questioned if it could be allowed within the Agricultural district. Botten stated that the Commission could make that recommendation.

Commissioner Clancy questioned if the Integrated Resource Management Overlay District could be extended to include this area. Botten stated that it could be requested but would require a new planning application to be submitted and would include new public hearing notice sent to surrounding property owners.

Chair Weber stated that a nearby business is zoned Agricultural, and they operate with a Conditional Use Permit. Inquired as to why this application was submitted as a Rezoning request rather than a Conditional Use Permit under its current Agricultural zoning. Botten stated that changing the zoning code to allow it in Agricultural would open up Commercial Yard Waste Recycling and Composting Facility as a Conditional Use for all Agricultural lots.

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Commissioner Twedt inquired to keep the current zoning and proposed a Conditional Use Permit. Community Development Director Ziemer stated that changing the Agricultural zoning was not currently an item before the Commission, but that could be direction given to staff.

Commissioner Clancy recommended denial of all three requests and stated that he would support a request for a Conditional Use Permit.

Chair Weber inquired if the Applicant could simply amend his current application. Botten stated that the Applicant would have to decide whether to move forward with the current request to Council or withdraw his request and submit a new request to amend the Zoning Code to allow this use in the Agricultural-zoned areas as a Conditional Use. Weber stated that he did not want to create bureaucratic hurdles for applicants. Botten stated that changing the request from an industrial/commercial use to a residential use would represent a significant change affecting more properties in the City, and this process would need to be published in the paper..

Commissioner Wippermann stated that he would open up this use to any Agricultural property. He expressed opposition to that and is also opposed to the current request due to the spot zoning issue. But would support extending the Integrated Resource Management Overlay District to include this site.

Chair Weber inquired whether Gerten's operates under an IRM. Botten stated that they are not.

Planning Commission Recommendation

Motion by Wippermann, Second by Hunting, to Deny the request for a Comprehensive Plan Amendment from RDR, Rural Density Residential to LI, Light Industrial subject to the conditions listed in the staff report; and Approve the Rezoning of the property from A, Agricultural to I-1, Limited Industry District; and Approve the Zoning Code Amendment to allow Commercial Yard Waste and Composting Facilities as a Conditional Use in the I-1 District with the reason that it would be spot zoning, and also the reasons listed in the staff report.

Ayes: 8

Nays: 0 Motion Carried.

The item is tentatively scheduled to go before the City Council on November 25, 2024.

C. Zoning Code Amendment to Title 10 of the City Code (Zoning Regulations), Chapter 2, Section 10-2-2 and Chapter 6, Section 10-6-2 relating to Cannabis, Medical Cannabis and Low-Potency Hemp uses. (City of IGH/Cannabis Ordinance – Case 24-39X)

Reading of Public Notice

Vice-Chair Clancy read the Public Hearing Notice.

Presentation of Request

Community Development Director Ziemer presented a summary of the staff report.

New regulations from the State law legalizing commercial and recreational cannabis go into effect on January 1, 2025.

Low-potency hemp edibles and medical-use cannabis were already legal.

All businesses must be licensed through the new Office of Cannabis Management through the State of Minnesota.

Retailers must also register with the City. The retail registration will be handled by City Council, but there is also a zoning certification component, which the Planning Commission will interact with.

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There are buffer setbacks, which the Planning Commission will not need to consider.

The actions requested are:

- Create definitions for uses
 - Adding definitions to the code instead of including references to State statutes is preferable from a staff and customer service standpoint, as it makes it easier to find relevant information
- Determine types of uses and zoning
 - Permitted, conditional, accessory
 - Staff recommends considering delivery services an Accessory Use
 - Agriculture districts:
 - Staff recommend permitting use, with a footnote specifying that this excludes indoor and outdoor cultivation beyond that allowed for personal use
 - No commercial operations permitted
 - Commercial districts:
 - Staff recommend only permitting retail in B-2, B-3, and B-4, and aligning General Retail use categories based on size of store (under 1,000 square feet in B-2, B-3, or B-4; over 1,000 square feet, B-4 only)
 - Limited Business, B-1
 - Neighborhood Business, B-2
 - General Business, B-3
 - Shopping Center, B-4
 - Office Park districts:
 - Staff recommends permitting no uses
 - Industrial districts:
 - Staff recommends permitting cultivation, manufacturing, wholesale, and limited retail.
 - Relevant business definitions/regulations:
 - Microbusinesses and mezzobusinesses can both be 3-in-1 (cultivator, manufacturer, and retailer)
 - On-site consumption is allowed in microbusinesses (similar to a taproom), but disallowed in mezzobusinesses
 - Microbusinesses can have one retail location; mezzobusinesses can have up to three
 - No retail-only in industrial districts; businesses will need to also do cultivation and/or manufacturing on-site
- Suggested Performance Standards
 - Cultivation only indoors
 - Retail in industrial areas only if cultivation and manufacturing are on the same premises
 - Outdoor storage of raw/finished product(s) or waste materials prohibited
 - On-site storage of raw/finished product(s) prohibited with Delivery Services and Transporters
 - Transport vehicles for raw/finished product(s) must be parked in secured, fenced site
 - No raw/finished product may be stored in vehicles
 - Security systems, lighting, etc.
 - Additional conditions for CUPS, if necessary or required
 - Odor will be managed similar to noise/light concerns (requiring air handling systems, etc.)

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Community Development Director Ziemer stated that cannabis use would be allowed in one Planned Unit Development, Argenta Hills, due to its commercial properties being zoned B-4. Permitting cannabis use in other Planned Unit Developments (Bishop Heights, Arbor Point, Office Park PUDs) would require an amendment.

Existing lower-potency hemp and medical cannabis locations will be grandfathered in as Legal Non-Conforming (regardless of buffer areas/zoning decisions). There are continuing legal questions about existing uses, e.g., once a property changes ownership.

Staff recommend approval of the zoning amendment related to cannabis uses.

Questions for discussion:

- What use(s) to permit for each zoning district? Office Park district?
- Permitted versus conditional versus accessory uses?
- How much additional regulation for non-retail use?
- Other Performance Standards not listed to consider?

Planning Commission Discussion

Chair Weber inquired about the micro/mezzobusiness definitions. Community Development Director Ziemer stated that those were established in State statute.

Commissioner Schaefer questioned why outdoor growing is not allowed in Agricultural districts. Community Development Director Ziemer stated that there were concerns about securing and monitoring the outdoor growing. Schaefer clarified that greenhouses would not be allowed in Agricultural districts, but they would be allowed in Industrial districts. Ziemer confirmed that. The intention was to give the City more control over where these uses occur. There are still some licensing questions being determined (e.g., does retail include selling seeds/plants?)

Chair Weber clarified that each person is allowed up to 8 plants and that these could be grown outside. Community Development Director Ziemer confirmed that.

Chair Weber questioned whether the Cannabis Testing use category refers to testing people or testing of the product. Ziemer stated that it was the latter, testing of the product. Chair Weber suggested adding the word Product to the "Cannabis Testing" use for clarity. Ziemer stated that he would verify adding that word was legally acceptable.

Commissioner Twedt questioned whether cities broadly will be establishing their own definitions. Ziemer stated that they would be, though some are quite short. Staff provided more definition to make uses clearer. Twedt inquired as to what happens if the City establishes a definition that conflicts with State statute. Ziemer stated that the State statute would take precedence. Twedt inquired as to whether this would increase the regulatory burden on the City. Ziemer stated that it would not. Every cannabis business type would be licensed with the State. The City will not be responsible for the license. If a business is registered with the City, the City could revoke registration for lack of compliance, and it would then go to the State for review. Twedt stated that the City can then establish additional requirements. Ziemer stated yes, but in compliance with State statute.

Commissioner Clancy inquired if there will be involvement at the County level. Ziemer stated that the City had the option of deferring registration to the County and the City's preference was to retain control of registration.

Commissioner Clancy inquired as to whether other cities would respect buffer zones that cross City boundaries. Ziemer stated that he did not know.

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Commissioner Teiken inquired as to whether the suggested definitions had been legally reviewed for conformance with State statute. Ziemer stated that they had.

Commissioner Schaefer stated that City-specific definitions would make it more difficult to monitor changes to State statute and recommended adhering to State definitions to reduce staff workload. Ziemer stated that the suggested definitions are in line with those of other cities. With less definition, there is the potential for responding reactively rather than proactively to issues that may arise.

Commissioner Twedt inquired about the reasoning for City-specific definitions.

Chair Weber pointed out that the retail registration definitions align closely with State statute.

Community Development Director Ziemer stated that was because there are State licensing standards on the retail side. However, there is less guidance from the State on the zoning side. The City's suggested definitions do not conflict with any State statutes.

Chair Weber brought up the example of Sunday liquor sales and agreed with the approach of over- rather than under-defining at first, as definitions could always be removed later.

Commissioner Twedt stated that he doubted whether removal of regulations would actually occur.

Commissioner Teiken inquired as to whether the City has heard from interested cannabis businesses yet. Ziemer stated that they had not. Existing low-potency and medical businesses could be grandfathered in or be required to get the Conditional Use Permit.

Commissioner Wippermann inquired as to whether state law requires allowing cannabis businesses in the City. Chair Weber confirmed that it does.

Planning Commission Recommendation

Motion by Weber, Second by Teiken, to Approve a Zoning Code Amendment to Title 10 of the City Code (Zoning Regulations), Chapter 2, Section 10-2-2 and Chapter 6, Section 10-6-2 relating to Cannabis, Medical Cannabis and Low-Potency Hemp uses.

Ayes: 8

Nays: 0

Motion Carried.

The item is tentatively scheduled to go before the City Council on November 25, 2024.

5. REGULAR BUSINESS

None.

6. ADJOURN

Motion to adjourn the meeting at 9:13 p.m.

Respectfully submitted by Will Clashe, Recording Secretary.



Planning Commission Report

MEETING DATE:	November 19, 2024
CASE NO:	24-21NCUC
APPLICANT:	BFI Waste Systems of North America, LLC
PROPERTY OWNER:	Same.
REQUEST:	Hold a public hearing on the applications for a Zoning Ordinance Amendment to allow a vertical expansion of an existing sanitary landfill; Conditional Use Permit for vertical expansion of the Pine Bend Sanitary Landfill; and the Non-Conforming Use Certificate Amendment to permit the landfill expansion.
LOCATION:	2495 117th Street East
COMPREHENSIVE PLAN:	General Industrial
ZONING:	I-2, General Industry; IRM-Integrated Resource Management Overlay Zoning District
STAFF CONTACT:	Kris Wilson, 651.450.2511

ACTION REQUESTED

The Planning Commission is asked to hold a public hearing on the applications for a Zoning Ordinance Amendment, Conditional Use Permit, and a Non-Conforming Use Certificate Amendment to permit a vertical expansion of Pine Bed Landfill.

BACKGROUND OVERVIEW

Since initially being permitted by the MPCA in 1971, Pine Bend Landfill has operated a sanitary landfill on property comprised of approximately 323 acres located at 2495 117th Street, between Highways 52/55 and Rich Valley Boulevard. The Landfill is a sanitary landfill that accepts solid waste for disposal, including mixed municipal solid waste, non-hazardous industrial solid waste, construction debris and demolition debris, non-infectious waste, and asbestos. The landfill currently has a permitted airspace design capacity of 33,937,400 million cubic yards, including final cover. As of August 2023, the landfill had a remaining permitted airspace design capacity of approximately 2,986,936 cubic yards, including final cover. The landfill currently estimates an annual fill rate of approximately 600,000 cubic yards. This amount, however, can vary significantly depending on various factors.

The landfill is proposing a vertical capacity expansion of 8,185,800 cubic yards, including 7,888,250 cubic yards of waste and 297,550 cubic yards of final cover material. This vertical capacity expansion is referred to as Phase 7. The Phase 7 design proposes to vertically extend the currently permitted 3:1 final cover slopes around the perimeter of the landfill. The design provides for increased capacity vertically without increasing the landfill footprint horizontally. The expansion would extend the life of the landfill about 13.6 years and increase the landfill's elevation by approximately 86.8 feet at the

highest point. Pine Bend Landfill's application to the City is attached.

CITY APPROVALS REQUESTED BY LANDFILL

Pine Bend Landfill's proposed vertical expansion requires the City's approval of the following:

- A Zoning Ordinance Amendment to allow a vertical capacity expansion of the existing sanitary landfill as a conditional use in the IRM overlay district, providing that landfills have a non-conforming use certificate, are in compliance with that certificate, and meet other conditions regarding final cover, liners, leachate collection, gas extraction, height, property boundaries, capacity, and acceptable wastes.
- A Conditional Use Permit to allow a vertical capacity expansion of the landfill to a maximum capacity of 8,185,800 cubic yards, including 7,888,250 cubic yards of waste.
- A Non-Conforming Use Certificate Amendment to allow the capacity expansion and maximum elevation increase.

PINE BEND LANDFILL BACKGROUND

Pine Bend Landfill initially received a Conditional Use Permit (CUP) for its operation in 1975. The landfill became a legal non-conforming use in 1991 when the City adopted a Zoning Ordinance Amendment that prohibited final disposal facilities for mixed municipal waste within the I-2 zoning district. That amendment prohibited sanitary landfills, such as Pine Bend's, created the Integrated Resource Management Overlay Zoning District, and placed that overlay zoning district on the Pine Bend Landfill and other properties in the area. The overlay zoning district prohibits certain waste industries, restricts and regulates other waste industries, and requires waste industries to be concentrated in the southeast industrial area of the City.

Since there were numerous questions regarding how the City zoning ordinance's non-conforming regulations applied to the landfill, the City and the landfill entered into a Non-Conforming Use Certificate (NCUC) in 1995. The NCUC resolved uncertainties for both the City and the landfill. It clarified the zoning status of the landfill, specified the rights and responsibilities of the landfill, and provided the City with more specific controls which had not been clearly defined in the previous Conditional Use Permit.

Since issuance of the Non-Conforming Use Certificate (NCUC) in 1995, the City has approved several additional requests by Pine Bend for modifications to the NCUC and changes to the landfill. Most of these requests were for accessory uses or minor revisions, such as the establishment of an energy recovery facility for the generation of electricity, open storage of trucks and trailers, a revised landscaping plan, a modified elevation and grading plan, a compost facility, and stockpiling of soils. In 2004, the City approved a landfill capacity expansion of 5.6 million cubic yards. This expansion was primarily a vertical expansion over previously filled areas and a small horizontal expansion where the landfill offices are located.

In 2018, the City approved a side slope capacity expansion of 3.53 million cubic yards. This required a change to the City's zoning ordinance to allow the expansion of an existing sanitary landfill, and resulted in the approval of a new CUP and NCUC Amendment. The landfill continues to operate today, subject to the terms of the existing NCUC, as amended, and the existing Conditional Use Permits and Host Community Agreement.

Based on existing airspace capacity, at current filling rates, it is anticipated that the landfill would run out of existing Certificate of Need (CON), which is the permitted tons of solid waste the MPCA has

authorized the landfill to receive, by January of 2028. Additionally, the terms of the existing Host Community Agreement require the landfill to permanently stop accepting waste for disposal and to close the landfill to the public no later than December 31, 2030, or when the permitted airspace capacity of 32.13 million cubic yards (not including final cover) is reached, whichever occurs first. If the zoning ordinance amendment is approved, the landfill will have additional waste disposal capacity and will continue to operate for a longer period of time.

EVALUATION OF REQUEST

2024 PINE BEND LANDFILL REQUEST AND CITY REVIEW

In June 2022, Pine Bend Landfill made application to the State of Minnesota Pollution Control Agency (MPCA) for the proposed vertical capacity expansion currently under review by the City. The MPCA then prepared an Environmental Assessment Worksheet (EAW) for the expansion. In November 2023, the EAC and City Council reviewed the EAW and submitted comments to the MPCA. The MPCA completed the EAW process by making a finding of a negative declaration, meaning that a more involved Environmental Impact Statement (EIS) was not necessary.

The City, with Barr Engineering's assistance, performed four rounds of technical review of the June 2022 Application and September 2022 Addendum that focused on 12 technical topics: waste acceptance, ground water monitoring system, leachate recirculation, solid waste composting, ground water quality, surface water management, waste capacity, liner and leachate collection system design, gas monitoring and gas extraction/treatment systems, final cover design, closure, post-closure, contingency action, operation and maintenance plans, and final assurance cost estimates. In October and November of 2023, the EAC and City Council approved the City's technical review memo that included all recommendations submitted to Pine Bend Landfill and the MPCA. Pine Bend Landfill subsequently modified its June 2022 Application and September 2022 Addendum to the MPCA, based on comments provided by the City during this process. The May 22, 2024, final technical review that summarizes all correspondence between the City/Barr and Pine Bend Landfill is attached to this packet for reference.

Before the MPCA can act on Pine Bend Landfill's application to the state, the City of Inver Grove Heights and Dakota County must receive, review and act on expansion applications submitted by Pine Bend Landfill. Pine Bend Landfill submitted an application to the City of Inver Grove Heights on June 17, 2024, to initiate this process with the City.

Barr Engineering's Final Letter Report (dated November 8, 2024), reviews Pine Bend Landfill's City application. During this review, Barr Engineering paid particular attention to waste capacity, groundwater quality and trends, surface water, and gas migration and trends. Barr's review states the key environmental-related considerations related to the Phase 7 expansion are:

- Potential negative impacts would be increased visibility from nearby properties, and a potential increase in litter and odor due to the proposed increased landfill height.
- Landfill gas is currently collected, cleaned, and conveyed into a nearby natural gas pipeline. Additional landfill gas generated by the increased waste disposal would increase the quantity of gas supplied to the natural gas pipeline and therefore would be an environmental benefit, assuming the existing operation has the capacity to process additional gas.
- It is not expected that offsite subsurface migration of landfill gas would increase with the proposed Phase 7 expansion because it is believed that the source of the subsurface gas is waste in the old unlined area. However the issue of how to reduce or mitigate the existing subsurface gas migration remains.

- There is a potential negative environmental impact to surface water because the proposed Phase 7 expansion includes an increase in the amount of 3:1 (horizontal:vertical) sideslopes that will increase the rate of surface water runoff and potentially increase the amount of erosion on the sideslopes. However, these potential negative environmental impacts are mitigated with the proposed final cover and stormwater management systems that are designed to accommodate the steeper sideslopes.

Expansion-Related Documents

1. Zoning Ordinance Amendment.

The City's zoning ordinance prohibits the establishment of new sanitary landfills accepting mixed municipal solid waste, although it permits the expansion of existing sanitary landfills in certain circumstances. Pine Bend's current application for a vertical expansion is not permitted under the existing zoning ordinance. In order for the landfill to expand vertically as requested, the City's zoning ordinance would need to be amended to allow both the increase in height of the landfill, as well as the requested increase in airspace of the landfill. The attached zoning ordinance amendment would permit the requested vertical expansion of the landfill to a maximum elevation of 1,105.8 feet, as measured from mean sea level, National Geodetic Vertical Datum of 1929, and would allow the expanded design capacity of the sanitary landfill to a total capacity of 42,123,200 cubic yards, including final cover soils.

2. Non-Conforming Use Certificate Amendment.

Pine Bend Landfill operates under a Non-Conforming Use Certificate (NCUC), which has been amended several times. The NCUC is a lengthy document that lays out in great detail how the landfill is permitted to operate, establishes the maximum height of the landfill, and approves various site plan-related documents. The proposed NCUC amendment increases the allowed the height of the landfill, and includes the proposed Phase 7 expansion plans as part of the approved site plan documents.

3. Conditional Use Permit.

If the zoning ordinance amendment discussed above is approved, in order for Pine Bend Landfill to move forward with its vertical expansion, a CUP must be issued for that expansion. The proposed CUP would allow the landfill the ability to expand its height and volume as requested in its current application. The CUP contains a number of conditions, many of which are identical to the conditions included in the CUP issued in 2018 for the horizontal expansion of the landfill. It also contains a number of new and revised conditions, in particular conditions related to addressing subsurface gas migration.

Approval of the CUP is contingent upon the execution by the City and BFI Waste Systems of North America, LLC, of a new Host Community Agreement. Negotiations between the City and BFI are ongoing, and the Planning Commission is not asked to review a draft amended and restated Host Community Agreement.

Requested Planning Commission Action

The Planning Commission is asked to conduct a public hearing and then consider the attached draft Zoning Ordinance Amendment, CUP, and NCUC Amendment, and to provide a recommendation regarding the same to the City Council.

ALTERNATIVES

N/A

RECOMMENDATION

Staff requests the Planning Commission open a public hearing on the applications for a zoning ordinance text amendment, NCUC amendment, and conditional use permit, and then continue the hearing to the December 3, 2024, Planning Commission meeting. At the December 3 meeting, the Planning Commission will be asked to conclude the public hearing and then provide a recommendation regarding these applications to the City Council.

ATTACHMENTS

1. Zoning Ordinance Amendment
2. Non-Conforming Use Certificate Amendment
3. Conditional Use Permit
4. Pine Bend Landfill Application (revised July 2024)
5. Plan Set
6. 2018 Conditional Use Permit
7. City of Inver Grove Heights Memo (dated May 22, 2024)
8. Response to City of Inver Grove Heights' October 16, 2024 Review Letter (dated October 29, 2024)
9. Response to City of Inver Grove Heights' September 10, 2024 Review Letter (dated September 23, 2024)
10. Final Barr Pine Bend Landfill Letter Report (dated November 8, 2024)

**Item 4.A, Attachment 1 - Zoning Ordinance
Amendment**

**CITY OF INVER GROVE HEIGHTS
DAKOTA COUNTY, MINNESOTA
ORDINANCE NO. _____**

**AN ORDINANCE AMENDING INVER GROVE HEIGHTS CITY CODE
SECTION 10-13E-6 RELATED TO EXPANSION OF THE AIR SPACE OF AN
EXISTING SANITARY LANDFILL**

Section One. Amendment. Section 10-13E-6 of the Inver Grove Heights City Code related to expansion of the air space of an existing sanitary landfill is hereby amended to read as follows. The deleted language is shown with strikethrough and the added language is shown underlined:

Expansion of the air space of an existing sanitary landfill, provided all the following conditions are met:

- A. The existing sanitary landfill must have a nonconforming use certificate.
- B. The existing sanitary landfill must be in compliance with and must remain in compliance with the nonconforming use certificate, as amended.
- C. The layer of expanded air space on the existing sanitary landfill where disposal will occur must have a liner, leachate extraction system and landfill gas extraction system. The liner and these extraction systems must be approved by the MPCA, the County and the City before disposal can occur in the expanded air space.
- D. The landfill must also have in place an existing leachate extraction system and a leachate removal and management plan. The leachate removal and management plan must be approved by the MPCA.
- E. The landfill must also have in place an existing landfill gas extraction system and a landfill gas management plan. The landfill gas management plan must be approved by the MPCA.
- F. The final contour height of the sanitary landfill, as expanded (including the final cover system), must not exceed 1,105.8 feet ~~be more than one percent (1%) higher than the final contour (including the final cover system) as previously approved in the nonconforming use certificate, as amended.~~ Measurements shall be taken from mean sea level, National Geodetic Vertical Datum of 1929.
- G. The expanded air space must not increase the parcel boundaries of the existing sanitary landfill as previously approved in the nonconforming use certificate, as amended.
- H. The design capacity of the sanitary landfill, including the expansion area, shall not exceed a total capacity of 42,123,200 cubic yards, including final cover system. ~~volume of the expanded air space for disposal (not including the final cover system) must not be more than forty percent~~

~~(40%) of the cubic yards of air space for disposal (not including the final cover system) that were allowed in the previously approved nonconforming use certificate, as amended.~~

I. The types of waste to be disposed in the expanded air space may only include the following:

1. Construction debris and demolition debris;
2. Infectious waste which has been processed so as to become noninfectious;
3. Mixed Municipal solid waste from whatever source including, but not limited to, mixed Municipal solid waste material from composting, energy recovery facilities, and recycling facilities and processes;
4. Nonhazardous industrial solid waste including, but not limited to, industrial incinerator ash, all in accord with the industrial waste management plan; and
5. Solid wastes approved by the MPCA for use as cover material including, but not limited to, foundry sands and certain sludges.

~~J. The surface square footage of the final cover system for the entire sanitary landfill, as expanded, must not be more than 8.5 acres greater than the surface square footage of the final cover system that would have been placed if the air space of the sanitary landfill had not been expanded.~~

Section Two. Effective Date. This ordinance amendment shall be effective from and after its passage and publication according to law.

Passed this ____ day of _____, 2024.

CITY OF INVER GROVE HEIGHTS

By: _____
Brenda Dietrich, Mayor

ATTEST:

Rebecca Kiernan, City Clerk

**Item 4.A, Attachment 2 - Non-Conforming Use
Certificate Amendment**

**CITY OF INVER GROVE HEIGHTS
DAKOTA COUNTY, MINNESOTA**

RESOLUTION NO. _____

**A RESOLUTION AMENDING RESOLUTION NO. 6465 GRANTING A NON-
CONFORMING USE CERTIFICATE FOR PINE BEND SANITARY LANDFILL FOR A
SANITARY LANDFILL**

The City Council of the City of Inver Grove Heights does hereby resolve as follows:

WHEREAS, BFI Waste Systems of North America, LLC (BFI) owns and operates the Pine Bend Sanitary Landfill (Landfill) located on the north side of 117th Street and legally described on the attached Exhibit A.

WHEREAS, on November 27, 1995, the City Council of the City of Inver Grove Heights approved Resolution No. 6465 Granting a Non-Conforming Use Certificate for Pine Bend Sanitary Landfill for a Compost Facility and Sanitary Landfill (hereinafter referred to as the Non-Conforming Use Certificate).

WHEREAS, on March 11, 2002, by Resolution No. 02-32 the City Council amended the Non-Conforming Use Certificate to allow the maximum elevation limitation of the landfill to change from 1020 feet above sea level to 1,010 feet above mean sea level, to allow for steeper landfill side slopes without inadvertently increasing the airspace capacity of the Landfill.

WHEREAS, on March 22, 2004, by Resolution No. 04-49, the City amended the Non-Conforming Use Certificate to allow a greater airspace capacity for the disposal of solid waste by a CUP, increase the permitted final height of the landfill by nine feet, and revised the list of approved site plan documents by amending Section 3.3, Section 3.5, and Exhibit D to the Non-Conforming Use Certificate.

WHEREAS, on April 9, 2018, by Resolution No. 18-70, the City Council amended the Non-Conforming Use Certificate to allow a side slope expansion of the Landfill, amending Section 5.6.1, Section 5.8.3, and Exhibit D of the Non-Conforming Use Certificate.

WHEREAS, BFI in writing has accepted and agreed to the existing Non-Conforming Use Certificate, as amended by the resolutions noted above.

WHEREAS, the City and BFI desire to amend the Non-Conforming Use Certificate in the manner set forth hereafter.

NOW THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF INVER GROVE HEIGHTS AS FOLLOWS:

- A. Section 3.5 of the Non-Conforming Use Certificate is amended in its entirety to read as follows:

3.5 **Sanitary Landfill – Maximum Elevation Limitation.** No part of the final landfill contour shall exceed an elevation of 1,105.8 feet above mean sea level, National Geodetic Vertical Datum of 1929. That elevation includes the final cover system.

- B. Section 5.4 of the Non-Conforming Use Certificate is amended in its entirety to read as follows:

5.4 **Final Cover System Timing for Lined Areas.** The final cover system shall be placed on areas of Pine Bend Sanitary Landfill as described in the Solid Waste Permit (SW-45) issued by the MPCA in 2015, except that if a Conditional Use Permit (CUP) for a Vertical Expansion of the Landfill allowing a final height of the landfill to a height of not more than 1,105.08 feet above mean sea level, National Geodetic Vertical Datum of 1929, is approved, then the final cover system shall be placed as shown on the Plans approved as part of that CUP and on Exhibit D of this NCUC.

- C. Exhibit D of the Non-Conforming Use Certificate is amended to read as follows:

EXHIBIT D
SITE PLAN FOR PINE BEND SANITARY LANDFILL

The Site Plan includes six sheets as found in the Non-Conforming Use Certificate, as approved by the City Council on November 27, 1995, as follows:

Sheet 1 - Monitoring Systems, Gas Extraction System, Leachate Collection System and Lined/Unlined Areas

Sheet 2 - Entrances from 117th Street, Fence (Permanent), Buildings and Landscape Areas

Sheet 3 - Composting Areas, Fire Lanes, Fences (Permanent) and Temporary Open Storage Areas

Sheet 4 - Final Closure Grading and Stormwater Management

Sheet 5 - Landscape Plan

Sheet 6 -Landscape Details

Together with the amendments as shown in the following documents:

- a. Landscape Plan, dated May 2001
- b. “Proposed Final Grades”, “Final Grade Comparison”, and “Final Grade Isopach Map, dated April, 2001
- c. Narrative and Plans of “Application to the City of Inver Grove Heights for the Pine Bend Landfill”, dated August 2003
- d. Twenty-six plan sheets, titled “Permit Application, Pine Bend Landfill – SW 45, Prepared for BFI Waste Systems of North America, Inc.”, dated February 2002, January 2003, and August 2003.
- e. “Response to comments for BFI Pine Bend Landfill,” as prepared by Wenck Associates Inc., dated November 11, 2003.

Together with the amendments as shown in the following additional documents:

- 1. The following appendices found in the “Application Submittal to the City of Inver Grove Heights for the Pine Bend Landfill – Phase 2 Development” prepare by WENCK Associates, Inc., dated and revised February 2018 (Revised February 2018 City Application)
- 2. Appendix C – Plan Sheets – Including 28 permit design plan sheets
- 3. Appendix E – Stormwater Management Model and Calibrations

To the extent Appendix C and Appendix E of the Revised February 2018 City Application are inconsistent with the previous documents comprising the Site Plan, Appendix C and Appendix E of the Revised February 2018 City Application shall control and prevail.

Together with the amendments as shown in the following additional documents:

- 1. Narrative and Plans of “Application Submittal to the City of Inver Grove Heights for the Pine Bend Landfill Phase 7 Development, MPCA Permit #SW-45,” dated June 2024, Revised July 2024 including the comment responses a and b below (the “2024 Revised City Application”).
 - a. Comment response memorandum prepared by Stantec data September 23, 2024.
 - b. Comment response letter from Republic Services dated October 29, 2024.
- 2. Appendix C – Plan Sheets, consisting of a 19-page Plan Set titled “BFI Waste Systems of North America, LLC Pine Bend Landfill Inver Grove Heights, Minnesota 2022 Major Permit Modification” prepared by Stantec and dated 2022.02.21, which are included with the 2024 Revised City Application.
- 3. Appendix E – Stormwater Management Model and Calibrations, which is included with the 2024 Revised City Application.

To the extent that Appendix C and Appendix E of the 2024 Revised City Application are inconsistent with the previous documents comprising the Site Plan, Appendix C and Appendix E of the 2024 Revised City Application shall control.

D. All other sections, terms, provisions, and conditions of the Non-Conforming Use Certificate shall remain in full force and effect.

E. This Non-Conforming Use Certificate Amendment shall become effective only upon the approval and execution of the Fourth Amended and Restated Host Community Agreement by the City of Inver Grove Heights and BFI.

F. This Resolution and the following Acceptance shall be recorded with the Dakota County Recorder against the land constituting the Landfill, which land is described on the attached Exhibit A.

Passed this ____ day of _____, 2024.

CITY OF INVER GROVE HEIGHTS

By: _____
Brenda Dietrich, Mayor

ATTEST:

Rebecca Kiernan, City Clerk

(CITY SEAL)

STATE OF MINNESOTA)
)
COUNTY OF DAKOTA) ss.

On this ____ day of _____, 2024, before me a Notary Public within and for said County, personally appeared Brenda Dietrich and Rebecca Kiernan to me personally known, who being each by me duly sworn, each did say that they are respectively the Mayor and City Clerk of the City of Inver Grove Heights, the municipality named in the foregoing instrument, and that the seal affixed to said instrument was signed and sealed on behalf of said municipality by authority of its City Council and said City Clerk acknowledged said instrument to be the free act and deed of said municipality.

Notary Public

ACCEPTANCE AND ACKNOWLEDGEMENT

BFI Waste Systems of North America, LLC, hereby accepts and agrees to the terms, conditions, and provisions as set forth in the foregoing resolution.

BFI WASTE SYSTEMS OF NORTH AMERICA, LLC

By: _____
NAME HERE

Its: _____

STATE OF _____)
)
COUNTY OF _____) SS.

On this ____ day of _____, 2024 before me a Notary Public within and for said County, personally appeared _____ to me personally known, who being by me duly sworn, did say that _____ is the _____ of BFI Waste Systems of North America, LLC, the limited liability company named in the foregoing instrument, and that the foregoing instrument was executed on behalf of the limited liability company by authority of the _____ of said entity and that _____ acknowledged said instrument to be the free act and deed of BFI Waste Systems of North America, LLC.

Notary Public

This instrument was drafted by and after recording return to:

Bridget McCauley Nason, # 0347322
Kennedy & Graven, Chartered
150 South 5th Street, Suite 700
Minneapolis, MN 55402 (612) 337-9245

EXHIBIT A

Real property located in Dakota County, Minnesota and legally described as follows:

Lot 1, Block 1, Lot 1, Block 2, and Outlot A, Pine Bend Sanitary Landfill, according to the plat thereof on file and of record with the Dakota County Registrar of Titles.

Item 4.A, Attachment 3 - Conditional Use Permit

**CITY OF INVER GROVE HEIGHTS
DAKOTA COUNTY, MINNESOTA**

RESOLUTION NO. _____

**RESOLUTION APPROVING A CONDITIONAL USE PERMIT
TO ALLOW A VERTICAL EXPANSION OF PINE BEND LANDFILL**

CASE NO. _____

PROPERTY LOCATED AT 2495 EAST 117TH STREET

WHEREAS, an application for a Conditional Use Permit for an airspace capacity vertical expansion ("Vertical Expansion") of Pine Bend Sanitary Landfill ("Pine Bend Landfill" or "Landfill") has been submitted by BFI Waste Systems of North America, LLC for property located at 2495 East 117th Street ("Property") and legally described in **Exhibit A** and depicted in **Exhibit B**, attached hereto; and

WHEREAS, the Property is currently zoned 1-2, General Industry and IRM, Integrated Resource Management Overlay Zoning District; and

WHEREAS, the proposed Vertical Expansion of Pine Bend Landfill is a conditional use in the IRM, Integrated Resource Management Overlay Zoning District; and

WHEREAS, in accordance with Minnesota Statutes, Section 462.357, subd. 3, a public hearing concerning the proposed Conditional Use Permit was held before the Inver Grove Heights Planning Commission on _____, 2024; and

WHEREAS, this is the third application for a conditional use permit for an airspace capacity expansion of Pine Bend Sanitary Landfill since 1995.

NOW, THEREFORE, BE IT RESOLVED, by the City Council of the City of Inver Grove Heights, that a Conditional Use Permit for the Vertical Expansion of the Pine Bend Landfill on the Property to allow: 1) an increase in height of the Landfill of an additional 86.8 feet to a maximum elevation of 1,105.8 feet (National Geodetic Vertical Datum of 1929); and 2) to increase the permitted design capacity of the landfill by 8,185,800 cubic yards, inclusive of final cover soils, (7,888,250 cubic yards excluding final cover) to a total permitted airspace capacity of 42,123,200 cubic yards is **APPROVED** subject to the following **CONDITIONS**:

1. The City and Pine Bend Landfill agree that prior to the vertical expansion allowed by this Conditional Use Permit, the total permitted/ultimate airspace capacity of Pine Bend Landfill was 33,937,400 cubic yards, inclusive of final cover materials, and the maximum permitted height of the Landfill was 1,019 feet (National Geodetic Vertical Datum of 1929).

2. The terms and conditions of the conditional use permit for an airspace capacity expansion for Pine Bend Landfill, dated March 22, 2004 (Resolution 04-48), as well as the terms and conditions of the conditional use permit for a side slope expansion for Pine Bend Landfill, dated April 9, 2018, (Resolution 18-69), to the extent the same are contradicted by any of the terms and conditions of this Resolution are hereby superseded by this Resolution.
3. The vertical expansion approved by this Conditional Use Permit shall be constructed and operated in substantial conformity with the following Approved Plans:
 - a. The "Application Submittal to the City of Inver Grove Heights for the Pine Bend Landfill," prepared by Stantec dated June 2023, Revised July 2024, including the Plan Sheets found in Appendix C.
 - b. Comment response memorandum prepared by Stantec dated September 23, 2024.
 - c. Comment response letter from Republic Services dated October 29, 2024.
4. The area of the 2004 capacity expansion shall be limited to the area defined as Phase 5 on the Approval Plans, the area of the 2018 side slope capacity expansion shall be limited to the area defined as Phase 6 on the Approved Plans, and this Vertical Expansion shall be limited to the area defined and shown as Phase 7 on the Approved Plans.
5. Pine Bend Landfill shall comply with all applicable terms and conditions found in:
 - a. Resolution No. 6330 Approving a Conditional Use Permit for an Energy Recovery Facility for the Generation of Electricity, dated May 30, 1995
 - b. Resolution No. 6465 Granting a Non-Conforming Use Certificate for Pine Bend Landfill for a Sanitary Landfill, dated November 27, 1995
 - c. Resolution No. 2001-86 Approving a Conditional Use Permit for Open Storage for Truck and Trailer Storage/Parking, dated July 9, 2001
 - d. Resolution 01-117 Adopting a Revised Landscaping Plan, dated September 10, 2001
 - e. Resolution No. 02-32 Amending the Non-Conforming Use Certificate by Modifying the Phasing Plan, Maximum Elevation, and Final Grading and Storm Water Plans, dated March 11, 2002
 - f. Resolution No. 02-127 Approving a Conditional Use Permit for the Stockpiling of Clean Soil Material as an Accessory Use to an Existing Landfill to a Maximum of 335,100 Cubic Yards, dated August 26, 2002

- g. Resolution No. 04-48 Approving a Conditional Use Permit to Allow an Airspace Capacity Expansion of Pine Bend Landfill, dated March 22, 2004; as modified by this resolution.
- h. Resolution No. 04-49 Amending Resolution No. 6465 Granting a Non-Conforming Use Certificate for Pine Bend Landfill for a Sanitary Landfill, dated March 22, 2004
- i. Resolution No. 04-51 Declaring Lapse of Nonconforming Use Rights for Pine Bend Sanitary Landfill to Operate a Compost Facility, dated March 22, 2004
- j. Resolution No. 04-50 Approving A Conditional Use Permit for the Stockpiling of . Clean Soil Material as an Accessory Use to an Existing Landfill to a Maximum of 355,100 Cubic Yards, dated March 22, 2004
- k. Resolution No. 18-69 Approving a Conditional Use Permit to Allow a Side Slope Capacity Expansion of Pine Bend Landfill, dated April 9, 2018
- l. Resolution No. 18-70. Amending Resolution No. 6465 Granting a Non-Conforming Use Certificate for Pine Bend Sanitary Landfill for a Sanitary Landfill, dated April 9, 2018.
- m. Resolution No. 24-___ Amending Resolution No. 6465 Granting a Non-Conforming Use Certificate for Pine Bend Landfill for a Sanitary Landfill, dated November 27, 1995, as subsequently amended

With the exception of the conditions found in Section 13 herein, to the extent any of the conditions in the above documents are in conflict, except to the extent specifically noted otherwise, the most restrictive conditions found in the documents listed above shall apply.

- 6. Section 5 through 10 of the Nonconforming Use Certificate (NCUC), as amended, shall also apply to this Vertical Expansion and the terms and conditions of those sections are made part of this Conditional Use Permit and incorporated by reference.
- 7. Notwithstanding anything to the contrary contained in Pine Bend Landfill's Solid Waste Management Plan, the types of waste to be disposed in the 2004 airspace capacity expansion, the 2018 side slope capacity expansion, and this Vertical Expansion, shall only include the following:
 - a. Construction debris and demolition debris.
 - b. Infectious waste which has been processed so as to become non-infectious.

- c. Mixed municipal solid waste from whatever source including, but not limited to, mixed municipal solid waste material from composting, energy recovery facilities, and recycling facilities and processes. The term mixed municipal solid waste shall be as defined in Section 1.29 of the "Non-Conforming Use Certificate for Pine Bend Sanitary Landfill for a Compost Facility and Sanitary Landfill," issued on November 27, 1995.
 - d. Non-hazardous industrial solid waste including, but not limited to, industrial incinerator ash, all in accord with the Industrial Waste Management Plan. The term industrial solid waste shall be as defined in Section 1.24 of the "Non-Conforming Use Certificate for Pine Bend Sanitary Landfill for a Compost Facility and Sanitary Landfill," issued on November 27, 1995.
 - e. Solid wastes approved by the MPCA for use as cover material including, but not limited to, foundry sands and certain sludges.
8. If sanitary sewer is extended to Pine Bend Landfill, Pine Bend Landfill shall connect the leachate collection/storage systems to the sanitary sewer, pay its pro rata share of special assessments (in conjunction with other lands served by the sanitary sewer extension) immediately or over a term determined by the City Council but not less than five years and not more than ten years, and pay connection and hook up charges, as soon as the sanitary sewer is accepted for use by the City.
9. Hours for the construction of the 2004 airspace capacity expansion, the 2018 side slope capacity expansion, and this Vertical Expansion shall be:
- | | |
|-----------------------|--------------------|
| Monday through Friday | 6:00 AM to 8:00 PM |
| Saturday | 6:00 AM to 4:00 PM |
- Upon the request of Pine Bend Landfill, temporary extensions of hours or days of construction may be approved by the City Administrator.
- The hours of operation of the landfill shall be as stated in Pine Bend Landfill's Non-Conforming Use Certificate.
10. Pine Bend Landfill shall comply with all applicable Federal laws and regulations, Minnesota State Statutes, Minnesota Rules, Dakota County Regulations, and the terms of MPCA Solid Waste Permit SW-45 as it may be amended.
11. In addition to compliance with all applicable Minnesota Statutes, Minnesota Rules and the terms of MPCA Solid Waste Permit SW-45 as it may be amended, Pine Bend Landfill shall comply with the following additional special conditions regarding surface water and groundwater monitoring and groundwater compliance boundary requirements:

- a. As part of its annual report to the MPCA, Pine Bend Landfill may use alternative methods for the groundwater trend analysis, if approved in advance by the City.
 - b. Pine Bend Landfill shall conduct additional investigations, if required by the City Council, when hydrogeologic changes occur or continued release of contaminants to groundwater warrant, as determined by the City Council. Pine Bend Landfill shall start the investigation within 60 days after determined by the City Council, complete the investigation within 360 days including design for additional groundwater remedial measures, and implement remedial measures within 180 days of City Council's approval of remedial measures design.
 - c. Required water sampling may be waived by the City Administrator in conjunction with either the Community Development Director or Public Works Director, in the case of extenuating circumstances, such as inaccessibility caused by deep snow or wet soils. If such a waiver is granted, the City Council will be notified at its next regular meeting and the waiver shall be discussed at the next quarterly meeting with the City and Pine Bend Landfill and documented in the meeting minutes.
12. In addition to compliance with all applicable Minnesota Statutes, Minnesota Rules and the terms of MPCA Solid Waste Permit SW-45 as it may be amended, Pine Bend Landfill must comply with the following special conditions relating to the dual gas/leachate extraction system:
- a. As part of the annual report, Pine Bend Landfill shall describe the system operations and maintenance, including quality and quantity of leachate collected, and provide recommendations for system modifications.
 - b. Pine Bend Landfill shall perform the following and discuss efforts as part of the annual report, which is due March 1st each year, to:
 - i. Operate, maintain, and update the dual gas/leachate extraction system to maximize leachate extraction to the greatest extent practicable.
 - ii. Lower pump intakes or provide an explanation of why pumps could not, or should not, be lowered.
 - iii. Allow one full year of "dry" operations before removing pumps or provide explanation regarding why the pumps need to be removed and why they cannot be reinstalled.
 - iv. Monitor leachate head level in wells after pumps are removed.

- v. Evaluate the market availability of new pumps that could be installed in the dual gas/leachate extraction wells.
 - vi. Reinstall pumps in wells currently in the dual gas/leachate extraction system and continually operate the pumps.
 - vii. Install pumps in existing wells and pumping stations and add them to the dual gas/leachate extraction system or provide an explanation of why the pumps could not, or should not, be installed.
 - c. Requirements for the dual gas/leachate extraction system may be waived by the City Administrator in conjunction with either the Community Development Director or Public Works Director, in the case of extenuating circumstances, such as inability to reinstall pumps or if it is technically unfeasible to operate or maintain the dual gas/leachate extraction system. If such a waiver is granted, the City Council will be notified at its next regular meeting and the waiver shall be discussed at the next quarterly meeting with the City and Pine Bend Landfill and documented in the meeting minutes.
13. Pine Bend Landfill must achieve compliance with Minnesota Rule 7035.2815, Subpart 11 regarding landfill gas management, including future similarly applicable Minnesota Rule revisions, for six consecutive months as certified by a professional engineer prior to the following, whichever occurs first:
- a. Filling of waste beyond 35.00 million cubic yards (excluding final cover); or
 - b. January 1, 2027

The City Council may, but is not required, to waive this requirement, if the City Council determines that adequate progress is being made to mitigate subsurface gas migration.

If this requirement is not waived, and if the City formally determines, after giving Pine Bend Landfill and BFI Waste Systems notice and an opportunity to be heard, that compliance with this condition is not achieved, then before a deadline to be set by the City at the time of such a determination, Pine Bend Landfill and BFI Waste Systems must temporarily cease accepting waste for disposal at the Pine Bend Landfill until this condition is met; after such a determination by the City, when Pine Bend Landfill and BFI Waste Systems demonstrate to the City's satisfaction that the condition is met, waste may once again be accepted for disposal at the Pine Bend Landfill.

Until compliance is achieved for six consecutive months as required above, BFI Waste Systems of North America, LLC must present progress on its efforts to achieve

compliance to the City of Inver Grove Heights Environmental Commission in the first quarter of every year and report progress in the annual report to the MPCA.

All ongoing gas migration related work plans and reports must be submitted to the City for review and comment.

The requirement contained above is not an election of remedies by the City and is not a waiver of the City's right and remedies under the conditional use permits or under the nonconforming use certificate or under any host community agreement.

The City specifically reserves the right to take action to enforce Minnesota Rule 7035.2815, Subpart 11 and to exercise its rights and remedies under the conditional use permits and under the non-conforming use certificate or under any host community agreement with respect to any past, existing or future violations of Minnesota Rule 7035.2815, Subpart 11, including future similarly applicable Minnesota Rule revisions.

No remedy conferred upon or reserved to the City in this or any other conditional use permit or in the non-conforming use certificate or in any host community agreement shall be exclusive of any other available remedy or remedies, but each and every such remedy shall be cumulative and shall be in addition to every other remedy given under the conditional use permits or the non^e conforming use certificate or in the host community agreement or now or hereafter existing at law or in equity or by statute. No delay or omission to exercise any right or power shall impair any such right or power or shall be construed to be a waiver thereof, but any such right and power may be exercised from time to time and as often as may be deemed expedient.

During the time that the Pine Bend Landfill must temporarily cease to accept waste for disposal in the event that the City has made a formal determination that the above condition is not met, Pine Bend Landfill and BFI Waste Systems of North America, LLC must nonetheless continue to pay the City the fees and payments stated in Section 8 of the Fourth Restated and Amended Host Community Agreement dated _____, 2024, by and among BFI Waste Systems of North America, LLC, Browning-Ferris Industries, Inc. and the City of Inver Grove Heights (as amended from time to time); and Pine Bend Sanitary Landfill and BFI Waste Systems of North America, LLC must meet and comply with the other obligations stated in the Fourth Restated and Amended Host Community Agreement (as amended from time to time) including, but not limited to, the Host Community Fee, the Minimum Monthly Payment, the Annual Payment, the Per Ton Payment, and any and all other payments required under the Fourth Restated and Amended Host Community Agreement.

14. Pine Bend Landfill shall perform a subsurface gas concentration trend analysis at least once per year, and shall include the same in future annual reports.

15. Pine Bend Landfill shall provide documentation showing the horizontal and vertical extent of the subsurface gas plume both on the Property and beyond the Property, including on adjacent properties; this shall be updated at least once per year and shall be included with future annual reports to the City.
16. Pine Bend Landfill shall maintain a Minnesota Pollution Control Agency air emission permit for the Renewable Natural Gas facility.
17. The owner and operator of Pine Bend Landfill are both responsible for complying with the obligations and conditions contained in this Conditional Use Permit.
18. Breach of any Host Community Agreement between the City and BFI Waste Systems is deemed to be violation of this Conditional Use Permit.
19. This Conditional Use Permit shall become effective only upon the execution of the Fourth Restated and Amended Host Community Agreement by the City and Pine Bend Landfill and only upon the Fourth Restated and Amended Host Community Agreement becoming effective.
20. This Conditional Use Permit shall only remain effective if there is a Host Community Agreement in effect between the City and Pine Bend Landfill. The City and Pine Bend Landfill have approved the Fourth Restated and Amended Host Community Agreement which by its terms expires on December 31, 2032. Pine Bend Landfill acknowledges and agrees that if that Fourth Restated and Amended Host Community Agreement is not extended or a new Fifth Restated and Amended Host Community Agreement is not executed by both the City and Pine Bend Landfill on or before December 31, 2032, Pine Bend Landfill shall cease acceptance of waste on the Property on January 1, 2033, and no further waste shall be disposed on the Property until such time as the expiration date of the Fourth Restated and Amended Host Community Agreement is extended in writing by the parties, or a new Fifth Restated and Amended Host Community Agreement is executed.

BE IT FURTHER RESOLVED that the City Clerk is hereby authorized and directed to record a certified copy of this resolution at the Dakota County Recorder's Office.

Adopted by the City Council of the City of Inver Grove Heights this ____ day of _____, 2024.

AYES:

NAYS:

CITY OF INVER GROVE HEIGHTS

By: _____
Brenda Dietrich
Its: Mayor

ATTEST:

Rebecca Kiernan, City Clerk

(CITY SEAL)

STATE OF MINNESOTA)
) ss.
COUNTY OF DAKOTA)

On this ____ day of _____, 2024, before me a Notary Public within and for said County, personally appeared Brenda Dietrich and Rebecca Kiernan to me personally known, who being each by me duly sworn, each did say that they are respectively the Mayor and City Clerk of the City of Inver Grove Heights, the municipality named in the foregoing instrument, and that the seal affixed to said instrument was signed and sealed on behalf of said municipality by authority of its City Council and said City Clerk acknowledged said instrument to be the free act and deed of said municipality.

Notary Public

ACCEPTANCE AND ACKNOWLEDGEMENT

BFI Waste Systems of North America, LLC, hereby accepts and agrees to the terms, conditions, and provisions as set forth in the foregoing resolution.

BFI WASTE SYSTEMS OF NORTH AMERICA, LLC

By: _____
NAME HERE

Its: _____

STATE OF _____)
)
COUNTY OF _____) ss.

On this ____ day of _____, 2024 before me a Notary Public within and for said County, personally appeared _____ to me personally known, who being by me duly sworn, did say that _____ is the _____ of BFI Waste Systems of North America, LLC, the limited liability company named in the foregoing instrument, and that the foregoing instrument was executed on behalf of the limited liability company by authority of the _____ of said entity and that _____ acknowledged said instrument to be the free act and deed of BFI Waste Systems of North America, LLC.

Notary Public

This instrument was drafted by and after recording return to:

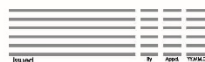
Bridget McCauley Nason, # 0347322
Kennedy & Graven, Chartered
150 South 5th Street, Suite 700
Minneapolis, MN 55402 (612) 337-9245

EXHIBIT A
LEGAL DESCRIPTION OF LANDFILL PROPERTY

Real property located in Dakota County, Minnesota legally described as follows:

Lot 1 Block 1, Lot 2, Block 1, and Outlot A, Pine Bend Sanitary Landfill

Parcel ID: 20-57575-01-010

[illegible]

**Item 4.A, Attachment 4 - Pine Bend Landfill
Application (revised July 2024)**



**APPLICATION SUBMITTAL TO THE CITY
OF INVER GROVE HEIGHTS FOR THE
PINE BEND LANDFILL**

Phase 7 Development
MPCA Permit #SW-45

June 2024

Revised July 2024

Prepared for:
BFI Waste Systems of North America, LLC
Pine Bend Landfill 2495
East 117th Street
Inver Grove Heights, MN 55077

Prepared by:
Stantec
One Carlson Parkway Suite 100
Plymouth, MN 55447

Project Number:
227706442

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1 Introduction

1.1 General Project Description

BFI Waste Systems of North America, LLC (BFI) respectfully submits to the City of Inver Grove Heights (City) an application for an airspace expansion and continued development of the Pine Bend Landfill (PBL) to be identified as Phase 7. This application was prepared based upon the applicable City requirements.

With this application, BFI is requesting amendments and approvals from the City for the following:

- ▲ Zoning Ordinance amendment
- ▲ Conditional Use Permit (CUP)
- ▲ Non-Conforming Use Certificate (NCUC) amendment
- ▲ Host Community Agreement amendment

1.2 City Approval Requirements

The Pine Bend Landfill is a mixed municipal solid waste (MSW) landfill, located in Inver Grove Heights, Minnesota, which has been in operation since 1971 under the Minnesota Pollution Control Agency (MPCA) Solid Waste Permit SW-45. The landfill is owned and operated by BFI Waste Systems of North America, Inc. (BFI).

BFI submitted an application for a major modification to the Minnesota Pollution Control Agency (MPCA) for Solid Waste Permit #SW-45 in June 2022. The request for a major modification detailed a proposed Phase 7 airspace capacity expansion over the existing landfill footprint by vertical expansion, extending the 3:1 cover slopes approximately 85 feet higher than the currently permitted Phase 5 and Phase 6 final cover grades. It is important to note that no horizontal footprint increase was proposed as part of the major modification request. This application to the City of Inver Grove Heights is the next step in the governmental approval process with an application to Dakota County to follow.

1.3 Project Benefits

The landfill is located in an area consistent with nearby industrial uses including a construction and demolition landfill as well as a large refinery. In addition, the project provides many environmental benefits including:

- ▲ Continued surface water control efficiency. The surface water management system has been designed to manage a 100-year, 24-hour MSE 24 hr. 3 storm event of 7.43 inches. The existing surface water management system is inspected and maintained by PBL.
- ▲ Efficient landfill gas collection and management. As part of the expansion, the existing gas collection system at the landfill will be expanded to capture landfill gas generated from the future waste to be placed. The landfill currently generates approximately 3,000 cfm of landfill gas which results in 2,140 dekatherms of Renewable Natural Gas (RNG) per day processed by the RNG plant located on-site and operated by Opal, a landfill gas developer. The RNG eliminates 43,900 metric tons of carbon and offsets emissions from more than 400 heavy-duty trucks every year.



Application Submittal to the City of Inver Grove Heights for the Pine Bend Landfill

1 Introduction

The landfill and proposed expansion also provide many socio - economic and financial benefits to the City including:

- ▲ The landfill provides an important service to the community for the disposal of municipal solid waste generated. The landfill is host to an annual City-wide cleanup event. BFI is also a member of the River Heights Chamber of Commerce and donates to the B.E.S.T. Foundation.
- ▲ Property tax revenue. PBL currently pays \$162,000.00 in property taxes. If the Recyclery and Hauling company, both of which are also located in Inver Grove Heights, are included this number increases to \$419,000.00.
- ▲ Host fee revenue. In 2023, PBL contributed \$2,303,000.00 host fees to the City.
- ▲ Local employment. Including the Landfill, Recyclery, and Hauling Company, approximately 145 people are employed by BFI.



2 Facility Information and Design

2.1 Ownership and History

As previously stated, BFI owns and operates the landfill. With regards to ownership history, MPCA permit SW-45 was originally issued to Pine Bend Development Company on September 7, 1971. Phoenix, Inc. operated the facility until 1976 when they purchased it. Browning Ferris Industries purchased the stock of Phoenix, Inc. on August 1, 1980 and Browning Ferris Industries then established Pine Bend Landfill, Inc. as a wholly owned subsidiary. Through additional mergers and acquisitions with Allied Waste in 1999 and Republic Services in 2008, the facility ownership has ultimately changed to its current status, BFI Waste Systems of North America, LLC a subsidiary of Republic Services, Inc.

BFI is ultimately responsible for all operations at the landfill, including the active gas management system and gas to energy plant. It should be noted that Opal Fuels, LLC (Opal) currently operates the active gas system at the landfill. Browning Ferris Gas Services, Inc. which was purchased by Gas Recovery Systems, Inc. previously operated the gas system.

A timeline for important historical environmental permitting, monitoring and response actions is provided as follows:

- ▲ **April 23, 1985** – The Proposer and the MPCA entered into a Response Order by Consent (“Order”) under Section 17 and 18 of the Minnesota Environmental Response and Liability Act of 1983. Minn. Stat. ch. 115B. The Order required the Proposer to perform a Remedial Investigation and Feasibility Study to investigate the source or sources of groundwater contamination at and near the Facility; to assess actual and potential impacts of the releases or threatened releases of hazardous substances, pollutants and contaminants from the Facility on public health, welfare and the environment; and to identify, assess, design, develop and implement response action alternatives.
- ▲ **October 23, 1990** – The Proposer and the MPCA entered into an Amended Response Order by Consent (“Amended Order”). The scope of the Amended Order required the Proposer to redesign and complete the remedial investigation agreed to in the 1985 Order, conduct a feasibility study; develop a plan to provide an alternative drinking water source for certain residential wells adversely affected by the release(s) from the Facility and the neighboring Crosby American Demolition Landfill; and to develop a response action plan and implement the approved response actions.
- ▲ **September 23, 1991** – The MPCA approved the Updated Remedial Investigation Report for the Facility. In regard to the alternative drinking water source, the Proposer developed a plan and the MPCA issued a Record of Decision in September 1991, which required the residences with affected wells to connect to the city’s water supply system. The city of Inver Grove Heights completed the connections supplying municipal water to the residences in December 1994.
- ▲ **November 21, 1994** – The MPCA approved No Action Alternatives under the Superfund process for the source control and the remediation of groundwater contamination as recommended in the Updated Detailed Remedial Analysis Report. The Minnesota solid waste management rules require more stringent levels for cleanup and remediation than the Superfund Program, therefore, the source control



Application Submittal to the City of Inver Grove Heights for the Pine Bend Landfill
2 Facility Information and Design

and the remediation of groundwater contamination was previously and currently managed in accordance with this Permit.

- ▲ **March 4, 2003** – The MPCA granted the Proposer a CON capacity as part of the Phase 5 vertical expansion of the Facility. The CON capacity granted was six (6) million cy and brought the total Facility disposal capacity to 29,800,000 cy.
- ▲ **July 2008 and November 2013** – The Proposer submitted Applications for Permit Renewal with a new SW-45 Permit being reissued.
- ▲ **August 2015** – The Proposer submitted a Request for a Major Modification to Permit SW-45 for the Phase 6 Development.
- ▲ **November 10, 2016** – The MPCA issued an approved Findings of Fact and Order for a Negative Declaration on the Need for an Environmental Impact Statement (EIS) on the Environmental Assessment Worksheet (EAW) proposed for the proposed Pine Bend Landfill Phase 6 Development.
- ▲ **October 25, 2016, March 6, 2017, and July 17, 2017** – The proposer provided responses to City comments on the Major Modification Application submitted to the MPCA.
- ▲ **June 2022** – The Proposer submitted a Request for a Major Modification to Permit SW-45 for the Phase 7 Development.
- ▲ **August 2022** – Newly constructed Opal RNG facility is on-line and operational.
- ▲ **March 1, 2024** – The MPCA issued an approved Findings of Fact and Order for a Negative Declaration on the Need for an Environmental Impact Statement (EIS) on the Environmental Assessment Worksheet (EAW) proposed for the proposed Pine Bend Landfill Phase 7 Expansion.
- ▲ **February 12, 2024, April 12, 2024, and April 29, 2024** – The proposer provided responses to City comments on the Major Modification Application submitted to the MPCA.

The Permittee has constructed and the MPCA has approved the following major features Construction Summary:

Feature	Year Constructed
Methane Gas Extraction System	1995, 1996
Liner Base	
Phase 1	1987
Phase2	1988
Phase 3	1992
Phase 3B	1995



Application Submittal to the City of Inver Grove Heights for the Pine Bend Landfill
2 Facility Information and Design

Feature	Year Constructed
Phase 4 Cell A	1999
Phase 4 Cell B	2001
Phase 5 Cell A	2005
Phase 5 Cell B	2006
Phase 5 Cell C	2009
Phase 5 Cell D	2010
Phase 5 Cell E	2013
Phase 5 Cell F-1	2018
Phase 5 Cell F-2	Future Construction
Phase 6 Cell C-1	2019
Phase 6 Cell C-2	2020
Phase 6 Cells D and B-1	2021
Phase 6 Cell B-2	2022
Phase 6 Cell A	2023
Final Cover of Unlined Fill Area	
Phase 1	1993
Phases 2 and 3	1995, 1996



Feature	Year Constructed
Phase 3 (SE corner)	2001
Phase 4 (lower portion of Phase 4)	2011
Liner Sidewall Extension	1995, 1996

2.2 Types of Waste Received

The Pine Bend Landfill accepted approximately 350,124 tons of solid waste in 2023. This includes the following:

- ▲ MSW
- ▲ Processing residuals
- ▲ Industrial waste including processing residual and alternative daily cover material. The July 2014 Solid Waste Management Plan was incorporated into the June 2022 MPCA Permit Application and is provided as Appendix A.

A yard waste compost facility located on the west 100 acres was closed in 2010 due to ash borer disease. The MPCA permit for this facility has been kept up to date.

2.3 Facility Users

At present, all materials at the Pine Bend Landfill are deposited by licensed haulers of municipal solid waste, demolition materials and approved industrial waste haulers, as well as the general public.

2.4 Waste Flow/Site Capacity/Phasing

For the purposes of cell phasing, an annual fill rate of approximately 600,000 cubic yards per year will be used. The 600,000 cubic yard annual fill rate is based upon approximately 420,000 tons per year received and assumes an in-place density of approximately 1,400 pounds per cubic yard, as well as PBL's knowledge and experience in the solid waste collection marketplace.

An addendum to the MPCA solid waste permit application was prepared in September 2022 to analyze remaining Certificate of Need (CON) consumption (see Appendix B). As of May 2022, PBL had 2,237,508 tons of remaining CON, with an estimated consumption rate of 400,000 tons per year of MSW. At that rate the CON PBL had remaining as of 2022 would be used by January 2028.

As of June 2024, PBL has 1,555,842 tons of remaining CON. At the estimated rate of 400,000 tons of MSW per year, PBL will run out of CON in May 2028. CON updates are included in PBL's annual operating report each year.

PBL is currently filling in the Phase 6 area of the landfill. The Phase 4 development, which consists of Phases 4A, 4B, and 4C is approximately 36.8 acres in size, and was designed and permitted to allow for approximately 4 million cubic yards of capacity. Phase 5 is the vertical expansion over previously filled areas and is to be developed with a total of 6 cells designated Phase 5A through 5F of which Phases 5A through 5E have been constructed. As of January 2021, the remaining permitted/ultimate landfill capacity



Application Submittal to the City of Inver Grove Heights for the Pine Bend Landfill

2 Facility Information and Design

is approximately 2,643,316 cubic yards (which includes final cover requirements). The Phase 6 major permit modification application requested an additional 4,137,400 cubic yards of airspace capacity for the Phase 6 development. The total permitted capacity of the site was increased from 29,800,000 cubic yards to 33,937,400 cubic yards (including final cover materials).

The Phase 7 development for which this major modification application is being submitted will allow for the vertical expansion of airspace capacity over the existing Facility footprint. No horizontal footprint increase is included as part of this proposed vertical expansion. The Project will increase the permitted design capacity by 8,185,800 cubic yards (cy), for a total capacity of 42,123,200 cy and extend the life of the Facility by approximately thirteen (13) years. Of the proposed increase in design capacity it is anticipated that approximately 7,888,250 cy will be operational volume, and approximately 297,550 cy will be final cover soils.

A summary of the design volumes as provided in the August 2015 Application for Major Modification submittal to the MPCA is provided in Table 2-1: Landfill Design Volumes. As shown, the landfill will be constructed and closed in phases.

Table 2-1: Landfill Design Volumes

Phase	Remaining Airspace (cy) ⁽¹⁾⁽²⁾	Estimated Final Cover (cy)	Remaining Operational Airspace (cy)	Status	Site Life (year) ⁽³⁾	Site Life (months)	Open Date
5F-2	826,300	37,682	788,618	Future - Permitted	1.4	16.5	Future
6	1,134,334	100,972	1,033,362	Constructed	1.9	22.7	2019-2023
7	8,185,800	297,550	7,888,250	Future – Vertical Expansion	13.6	163.7	Future
Total	10,146,434	436,204	9,710,230		16.9	202.9	

(1) Based on December 2023 drone survey completed by Firmatek.

(2) Includes Final Cover requirements.

(3) Based on Annual waste flow of 600,000 cubic yards.

2.5 Phase 7 Landfill Expansion Engineering Design

The Phase 7 design proposes to extend the currently permitted 3:1 final cover slopes around the perimeter of the landfill vertically. The design provides for increased capacity without increasing the landfill footprint. The 3:1 final cover slope design already in place on the west side of the landfill has been shown to be stable and efficient at surface water management. The proposed and current landfill design includes environmental controls that meet or exceed regulatory requirements for this type of facility. Plan sheets from the June 2022 Major Modification Application (updated in response to City comments) detailing the design for Phase 7 are provided in Appendix C. The 2022 Geotechnical Evaluation,



response to geotechnical comments raised by the City, and additional geotechnical evaluation are included in Appendix D.

2.6 Base Grades

2.6.1 DESIGN

Base grade is defined as the top of the liner surface. The base grades for the currently permitted MSW facility have been designed to maximize site life, and yet minimize environmental impacts. The grades range from 33 percent on the internal sideslopes (3 horizontal to 1 vertical) to a minimum of 3 percent on the base, with leachate flow being directed to collection sumps within each phase.

Phase 7 is a vertical expansion with no new base grades, the base grades for the existing Phase 6 cells were set by the current grade on the overfill areas at the time of construction, but were no less than 3 percent and no greater than 33%, the maximum allowed by MPCA Rules. Leachate from the Phase 7 waste will percolate to the Phase 6 base grades and will be collected by the existing Phase 6 leachate collection system.

2.7 Liner Design

The liner system for MSW disposal areas, according to MPCA solid waste rules, must be designed to have a minimum collection efficiency of 95 percent. In addition, the liner system in combination with the final cover must have a minimum collection efficiency of 98.5 percent.

The approved liner system designs for the existing and remaining landfill development vary for the different areas of the site depending upon the existing liner system in-place below the vertical expansion. The proposed liner designs are as follows:

1. The western fill area or what basically constitutes Phase 4 development has been constructed with a composite liner consisting of one 60-mil (0.060 inch) high density polyethylene (HDPE) liner, overlying a 2-foot compacted clay liner. The clay liner has a maximum permeability of 1×10^{-7} cm/sec, and was compacted to a minimum of 95 percent Standard Proctor Dry Density, with a moisture content 0 to 5 percent wet of optimum moisture content.
2. The Central Fill Area or the valley between Phases 1, 2, and 3 and Phase 4 development is generally on virgin ground and a composite liner is currently permitted for this area. The composite liner is the same design as presented above and what is currently being utilized in Phase 4, & Phases 5A through 5F-1, and is permitted for 5F-2.
3. The southeast fill area is the portion of Phase 3 landfill development which has received final cover with a 40-mil flexible membrane liner. The permitted liner design for overfill in this area is one 60- mil HDPE liner, overlying a geosynthetic clay liner (GCL).
4. The majority of the Phase 6 expansion area is over Phases 1 and 2 which were constructed without an engineered liner. The constructed liner in this area is one 60-mil HDPE liner, overlying a GCL and the existing 2-foot clay cap meeting base liner quality standards.

The HELP Model calculations for the above liner designs were prepared as part of the previous MPCA permit application process and verify that these liner designs have an efficiency approaching 100 percent, which is exceeding MPCA rule requirements.

Geotechnical calculations presented in Appendix D demonstrate that the liner system will not be adversely affected by settlement of the underlying waste due to the combined effects of biodegradation and physical creep. The post settlement grade on the slopes analyzed will be greater than or equal to 3%,



at the end of the site life and subsequent post closure care period, which is consistent with the previous HELP modeling predictions of leachate head buildup.

2.8 Leachate Collection System

2.8.1 INTRODUCTION

As mentioned above leachate from within the Phase 7 waste will be collected and managed by the existing Phase 6 leachate collection system. The leachate collection system for Phase 6 is designed to collect and convey leachate from the overfill area to one of 6 leachate collection sumps located around the perimeter of the landfill. The leachate collection sumps were created by excavating low points in the designated areas between the perimeter berm and the existing landfill to serve as containment for the Phase 6 cells. The containment berm was constructed so that the alignment creates a trench slope along the inside toe that directs leachate to the respective sumps. The trench area was then filled with coarse aggregate and a perforated leachate collection pipe directs leachate to the sumps. Each sump holds approximately 4,000 gallons of leachate.

Leachate collected in the sumps is then pumped via a submersible sideslope riser pump to the existing forcemain that encircles the perimeter of the landfill. Each sump incorporates a sideslope riser to eliminate penetration of the liner. Submersible pumps capable of pumping approximately 80 to 120 gpm of leachate were then installed at the bottom of each sideslope riser. The leachate pumps maintain less than 12-inches of head over the liner during regular operations. Leachate from the sumps will continue to be pumped to the leachate tanks through the existing double-wall, HDPE forcemain, which has been buried at a minimum 5-foot depth to prevent freezing.

Currently, the site is served by two above ground steel leachate storage tanks as follows:

- ▲ One 101,000-gallon tank in southern portion of site near office building;
- ▲ One 80,000-gallon tank in southern portion of site near office building.

From the storage tanks, tanker trucks transport the leachate to the MCES wastewater treatment plant in St. Paul. The storage tanks have provided adequate storage capacity in the past and are anticipated to serve the site's needs moving forward.

Historical leachate collection data is presented below.

Year	Leachate Collection Volumes (Gallons)
2017	7,848,040
2018	8,087,766
2019	9,235,088
2020	10,453,293
2021	9,188,290
2022	11,052,540



Based on the data, it is reasonable to estimate that the leachate generation will continue to be about 8 to 11 million gallons per year in upcoming years as PBL plans to final close portions of the landfill as soon as final grade is reached and open areas should remain approximately the same as current. The real variability is a function of seasonal precipitation and the amount of open landfill surface area, rather than total landfill area.

2.8.2 DRAINAGE LAYER SYSTEM

The HDPE liner is overlain by 12 inches of granular drainage layer material. In compliance with the MPCA Solid Waste Rules, the permeability of the drainage layer is specified to be 1×10^{-3} cm/sec, or greater. On all sideslopes steeper than 10 percent, a textured HDPE membrane was utilized to improve stability of the geomembrane/clay interface, geomembrane/drainage layer interface and the geomembrane/GCL interface.

The granular drainage layer collects leachate and provides drainage along the liner to the leachate collection trench. Coarse aggregate (5/8 inch to 1.5 inch) is embedded around the collection pipes to protect them from damage and provide increased flow performance. An intermediate filter aggregate overlies the coarse aggregate. The granular drainage layer also functions as a protective layer to prevent equipment from damaging the HDPE liner. The potential for the HDPE membrane to be punctured by a particle from the pipe bedding material was evaluated. These calculations were previously completed and updated to account for additional waste mass and weight, and the factor of safety from puncture by this mechanism (coarse aggregate) was shown to be 1.5.

2.8.3 COLLECTION PIPES

Construction of the leachate collection trench begins with the placement of a geotextile in the pipe trenches above the HDPE liner. A layer of coarse aggregate 3 inches thick was placed in the trench, and the pipe was placed and aligned. The remaining coarse aggregate was placed after the pipe was fully installed. Graded filter aggregate 12 inches thick was placed over the coarse aggregate to provide a filter from the overlying granular drainage layer. This filter helps stop migration of particles that might otherwise clog the collection pipe. The granular drainage layer material was then placed over the trench. Special care was taken to properly align the pipes, according to the invert elevations and locations. The perforations were oriented to be on bottom.

The collection pipes are 6-inch diameter, perforated, Standard Dimension Ratio (SDR) 11, HDPE pipe. Pipe strength calculations were previously completed for the Phase 5 vertical expansion and the pipe deflection due to maximum loading by waste was determined to be less than 5 percent. Failure due to buckling or wall crushing was also evaluated and safety factors were shown to be 11.6 and 6.8, respectively. The Phase 7 expansion area will not have any fill depths and maximum loading conditions in the vicinity of the collection pipes greater than those used in the above calculations.

2.8.4 LEACHATE SUMP, HEAD BUILD-UP, AND REMOVAL

As previously described, there is a significant amount of historical leachate collection data for this site. This historical data shows that, approximately 8 to 11 million gallons of leachate will likely be generated and collected per year while this site is in operation.

For the Phase 6 area, leachate sumps were created by the intersection of the proposed perimeter berm and the existing final cover. Approximately 4,000 gallons of leachate can be contained in the leachate sumps, which were designed to be 2 feet deep and assuming the porosity of coarse aggregate to be 0.4. During regular operations, leachate head is maintained at 12 inches or less over the sump area by setting



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the start/stop limits of the leachate pump to reflect these elevations. The pumps will pump the leachate to one of the two existing leachate tanks via the existing forcemain.

Leachate can be controlled during initial filling of the vertical expansion area by limiting the active fill area and by diverting surface water, prior to contact with the waste, to the surface water downslope structures if possible or directly off the waste footprint.

2.8.5 LEACHATE LEAK DETECTION

With regards to a leak detection system (lysimeter) installed beneath the low point of the Phase 6 fill area, MPCA Solid Waste Rules part 7035.2815, subp. 9 states:

A. The owner or operator must install the detection system at the lowest elevation of the fill area and throughout the fill area, as necessary, to monitor leachate build-up and for use as a part of the collection system. The detection system must be capable of monitoring leachate build-up in the fill area and consist of collection lysimeters and standpipes capable of monitoring, detecting, and collecting leachate movement through the liner. The detection system must consist of materials compatible with the leachate. The commissioner may approve a detection system without collection lysimeters or standpipes provided the owner or operator shows either to be unnecessary based on the liner system, subsurface soil conditions, ground and surface water flow patterns, depth to ground water, and the amount of leachate generated. The detection system must be designed and constructed to monitor the effectiveness of the leachate storage area.

For the Phase 6 development, which included an enhanced liner system in the sump areas (60 mil, GCL, 2 feet of clay), PBL conducted liner leak location testing following each phase of liner system construction in lieu of lysimeters. Historically, PBL sees little to no liquid and no detection of leachate indicator parameters in their current lysimeters. PBL is committing to providing enhanced design and construction activities for this overfill development; above and beyond what has been performed in the past for their liner system that is showing no indication of loss of integrity. PBL is aware that the MPCA has approved the elimination of lysimeters in other composite lined facilities. As noted above all leachate from the waste in Phase 7 will be collected using the existing leachate collection system in Phase 6.

2.8.6 DUAL EXTRACTION SYSTEM

The leachate extraction system at the Pine Bend Landfill (PBL) in Inver Grove Heights, Minnesota was installed in 2002 to collect leachate from the unlined portion of the landfill. Fifty (50) gas extraction wells were reconfigured to allow for dual use for landfill gas and leachate recovery. Because this portion is unlined, successful leachate extraction is vital in source control of the groundwater and in reducing leachate from the closed portion of the landfill mound. An evaluation of the system shows an overall reduction in leachate head levels from 2002 to the present during the time the system has been operational. The number of dual extraction wells has decreased due to extraction wells being removed from the system because of the Phase 5 and 6 expansions, as well as miscellaneous pump issues (silted in or unremovable from well). It should be noted that all dual extraction pumps have been temporarily removed as needed between 2019 and 2023 (for the Phase 6 expansion), allowing for active waste filling activities in the vicinity of those wells. The dual extraction system is being redesigned to use a pneumatic system for dual extraction activities.

The Grundfos SQE pumps installed in the dual extraction wells were equipped with an onboard electronic motor that records pump starts and stops, hours of operation, and speed of the pump along with a number of other operating features. The pump supplier for the site has indicated that the SQE pumps are the top-of-the-line pumps to be used in this application and are the only constant pressure pumps on the



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market fully equipped with built-in electronic controls which allow for advanced computer-controlled performance and state of the art protection features including sophisticated diagnostics. This information is stored in the pump motor and collected via a CU300; a motor-controlled equipment monitors at each individual well. Each well is also equipped with a bubbler tube and reference port for liquid level measurements.

In the past, pumps have been pulled from the wells for general maintenance and cleaning and in some cases, the pumps are not able to be returned to their original position. To address this concern, as well as the potential to add additional wells to the dual extraction system, PBL installed four pumping stations prior to Cell 5C construction in 2010. Another pumping station was installed prior to Cell 6C-1 construction in 2019, and two more prior to Cell 6D construction in 2021. The pumping stations are constructed with 10-inch riser pipes rather than the 6 to 8-inch wells typically installed at landfills. This was done to more easily allow for the removal and reinstallation of pumps over time. PBL installed pumps in two of the pumping stations, PS-1 and PS-2 in October of 2013. The two pumping stations were electrically connected to node 1 and the forcemain was connected to the existing forcemain installed adjacent to PS-1. New electrical was run to pumping stations PS-1, PS-2 and PS-3 in 2020, and new pumps and appurtenances were installed in PS-2 and PS-3.

Due to the above experience, PBL committed to install six (6) additional pumping stations throughout the Phase 6 3:1 build-out area. A total of 11 pumping stations were planned to be installed, all of which have since been installed. The pumping stations are installed in the same manner as those in the Phase 5 overfill area and help maintain access for removing leachate from the old unlined Phase 1 and 2 fill areas at the site. The locations and construction details for the proposed pumping stations are provided in the Plan Drawings.

The bottom of waste is shown on the cross-sections and this information was used to determine the depth of the pumping stations. The locations were based on evaluating the pumping volumes from existing dual extraction wells in the area. The proposed pumping stations are located near areas where relatively higher volumes of leachate are currently being removed.

2.9 Final Cover

2.9.1 DESIGN OVERVIEW

The final cover is designed to contain or divert precipitation from filled areas of the site. The efficiency of the cover system is defined as the amount of precipitation that is rejected or contained in the cover system and must be at least 90 percent (Minnesota Rules Part 7035.2815 Subp. 6.D.(2)). The previously completed HELP model calculations show the cover system design efficiency to be approximately 100 percent.

One of the design features of the proposed expansion is to continue the 3:1 benched final cover slope vertically by increasing the permitted elevations. This design provides for increased capacity without increasing site footprint or elevation. In addition, the design has been shown to be stable and very efficient at surface water management. The MPCA guidance document for 3:1 final cover systems was utilized in completing the design for PBL.

As shown on the plan sheets, benched sideslope final cover system is constructed on all areas that are covered at a 3:1 slope. A benched system will be stable, efficient, and maintainable. The benches are 12 feet wide to incorporate access roads and surface water management. The benches are sloped at 12.5 to 16.6 percent into the sideslopes with a long axis grade of 3 to 5 percent. The final cover sideslopes will be 33 percent for a maximum length of 40 vertical feet and a flow distance of 120 feet. The majority of the



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final cover will be at a three percent grade.

The final cover barrier layer will consist of a 40-mil LLDPE liner, or equivalent. For increased stability, all final cover slopes will utilize a textured liner material. A synthetic geonet drainage layer with geotextile bonded on both sides will overlie the liner. A cross-section of the final cover profile is described below.

The cover material will consist of 24 inches of cover soil and/or topsoil above the geosynthetics. The upper 6 inches will be topsoil capable of sustaining vegetation. The final cover topsoil layer will be mulched and seeded with shallow-rooted, drought-tolerant grasses.

A cross section of the final cover system is provided below.

- ▲ 6 inches Topsoil
- ▲ 18 inches Cover Soil
- ▲ Geonet geocomposite
- ▲ 40-mil LLDPE Geomembrane
- ▲ 6 inches Smoothing or Buffer Layer

Slopes on the final cover of the facility will be constructed at up to 33 percent grade. The final cover then peaks at a 3 percent grade at the top to a maximum proposed elevation of 1,105.8 feet (NGVD 29). The new peak elevation is 85.8 feet higher than the previous permitted peak elevation of 1,019 feet (NGVD 29).

2.9.2 FINAL COVER GRADES

2.9.2.1 Slope Stability

The stability of the landfill was evaluated for both a circular failure within the waste mass and for a block-slide type failure along the interfaces within the existing final cover system and the proposed base liner system.

Detailed explanation of the methodology and assumptions is presented in Appendix D and the results are summarized below.

Analysis	Factor of Safety
Overall System	1.81
Lower Liner	1.91

The global stability was re-analyzed in February 2024 with varying additional conditions such as considering the base liner system impenetrable and removing cohesion to be conservative. All analyses still showed appropriate factors of safety, meeting 1.5 or greater for long-term conditions and 1.2 or greater for short-term conditions.

Veneer Cover Stability

Benches will be incorporated at intervals of 40 vertical feet or 120 feet flow distance. The benches are 12 feet wide and are designed for use as access roads with surface water control on the inboard side. Benching provides for a buttressing effect at the toe for each 40 vertical feet of slope. This buttressing effect contributes greatly to the stability of the veneered cover system. Each bench will also serve as an anchor for the geosynthetic materials. This anchoring effect was neglected (conservative) in slope analysis. The final cover design includes the use of textured LLDPE geomembrane and a synthetic



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geonet drainage layer. This combination of features greatly enhances removal of infiltrated surface water while providing a high friction angle and resulting stability in the final cover components.

Overlying the drainage media is a 24-inch layer of cover soils/topsoil. This layer, once vegetated, provides significant moisture holding and evapotranspiration capability, which also enhances overall final cover performance.

An analysis of the veneer stability of the final cover system was previously performed during the phase 5 expansion permitting and demonstrated that the stability of the final cover design will meet the design safety factor criteria of 1.5. The proposed final cover profile is consistent with what was proposed in that permitting document, so no additional analysis is warranted.

Final Cover Access

The proposed benches provide for more designed access than typically provided on landfill covers. The larger amount of final cover access results in better access to the final cover, surface water control features, and many of the landfill gas well heads for operation, maintenance, and inspection. Landfill gas wellheads are placed for easy access from the benches where possible.

2.9.3 SURFACE WATER MANAGEMENT

The surface water system has been designed to manage a 100-year, 24-hour MSE 24-hr 3 storm event of 7.43 inches. The system consists of benches, catch basins, drainage piping, downslope structures, junction vaults, diversion structures, and sedimentation ponds. The components of the surface water system are described below. The results of the stormwater model are included in Appendix E. Note that the surface water model results included in Appendix E, dated 5/24/2024, were updated per City comments (see Appendix D for comment response) from the prior surface water model results, dated 2/12/2024, to more accurately account for soil types, provide more conservative flow (i.e. shallow concentrated flow instead of sheet flow), correct a pipe size at Node 7P, and to more accurately reflect storage conditions of Node 9P. To prevent confusion of the model results only the more recently updated version is included, however the previous results are archived and available upon request.

2.9.3.1 Peak Run-off

HydroCAD 10.10 – 6a was the model used to determine the maximum discharge from the final cover system to each of the stormwater management ponds. Peak runoff was estimated using calculated runoff CN's for each subcatchment. Curve Numbers were calculated using the C soil group for both sloped and flat areas (the same cover soils would be used for both areas). The slope area composite was calculated by assigning 30% to the newly graded condition (CN 91) and 70% to a fair, 50%-70% grass cover condition (CN 79). Similarly, the flat area composite was calculated by assigning 30% to the newly graded condition (CN 86) and 70% to a fair, 50%-70% grass cover condition (CN 69). These percentages are representative of the proposed construction phasing since the entire final cover area will not be in the newly graded condition at the same time. The percent of each sub catchment in a sloped vs flat region was multiplied by the respective composite curve number to get the final CN for that sub catchment.

All subcatchments were renamed with the same letter on which pond its directed to and numbering down from top to bottom with odd numbers to the left of downslopes and even numbers to the right. Double letters used for area's not directly adjacent to the main downslope.

Atlas 14 Rainfall values for Dakota county were used in setting the storm events. Time of concentrations were calculated using sheet flow and shallow concentrated flow for the longest flow path for each subwatersheds. To be conservative in the analysis, no infiltration is modeled in swales or downslopes.



The 100-yr high water level was also set by modeling no infiltration in the swales and downslopes.

2.9.3.2 Bench and Drainage Swale Design

Benches are placed on all 3:1 slopes. They are sloped into final cover and V shaped with right and left side slopes 3:1 and 8:1, respectively. The benches are placed in order to intercept and direct flow, as well as minimize erosion. The drainage channel at the interior of the bench was designed with the following characteristics:

Height= 22" (typical)
Slope= 3% to 5% (typical)
Manning "n" value= 0.035

The drainage benches were designed to handle the 100yr flow for each subarea and are spaced 40' vertically around the perimeter of the landfill. The peak flow depth will not exceed the depth of the bench. Benches will have category 4 erosion control matting installed to protect against erosion until vegetation is established.

2.9.3.3 Downslope Structures

Each bench discharges into one of seven cable concrete lined downslope structures located around the perimeter of the site. Each downslope structure is a trapezoidal channel with design characteristics summarized below:

Depth = 2.0' (typical)
Bottom width = 9 feet
Manning "n" value= 0.040

Runoff is contained during the 100-year rainfall event.

2.9.3.4 Junction Vaults

The downslope piping systems in the southwest and northeast corners of the currently permitted design discharge to concrete junction vaults. In the junction vaults, flow is combined to a single pipe that outlets to the existing railroad crossing culverts, a 48-inch RCP on the southwest and a 96-inch RCP on the northwest.

2.9.3.5 Sedimentation Ponds

Surface water from the proposed vertical expansion final cover area is also directed to existing sedimentation ponds.

Routing

Discharge to the southwest pond (8P) is directed from the downslope through an existing concrete diversion structure to a 48" pipe which discharges to the final outfall.

Discharge to the existing east pond (6P) is directed through an existing low area into a set of culverts beneath the railroad tracks prior to final outfall. There is currently one 36-inch culvert in place beneath the tracks. To accommodate additional stormwater flows per the design, two additional 36-inch culverts will be installed in this area. It should be noted that this will require installation by horizontal drilling methods due to the adjacent railroad tracks.



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Discharge to the northeast pond (4P) is directed through existing low areas directly into the pond.

Discharge to the northwest pond (3P) is directed through existing low areas to a 60' downslope into the final outfall.

Discharge to the west pond (1P) is directed through an existing concrete diversion structure to a 60" pipe, to an existing 96" pipe which discharges to the final outfall.

Infiltration

By City requirement all ponds must be able to infiltrate 1" runoff over new impervious surfaces. No new impervious surfaces are created as part of this expansion.

Inspection and Cleaning

The sedimentation basins, as well as the drainageways and culverts, are inspected monthly to determine if cleaning is required. Below is a table of sedimentation levels that shows how much sediment would need to build up across the bottom of the basin to impact the ability to manage a 100-year, 24-hour storm without overflow.

Pond	Pond Overflow Elevation	Pond Bottom Elevation	Sediment Elevation Impacting 100-Yr Storm Management	Cleaning Action Elevation
1P (West Pond)	859	843	856	854
3P (Northwest Pond)	876	858	871	869
4P (Northeast Pond)	900	878	894	892
6P (East Pond)	896	882	892	890
8P (Southwest Pond)	846	837	841.5	839.5

2.10 Landfill Gas Management

2.10.1 BACKGROUND

The EPA and MPCA require that landfill gas (LFG) generated at MSW landfills be controlled. This control requirement is to achieve two objectives. First, the methane component of LFG is combustible in the concentration range of 5 to 15 percent by volume in air. Five percent is considered the lower explosive limit or LEL and 15 percent is considered the upper explosive limit or UEL. Consequently, migration and concentration of methane into enclosed spaces could result in an explosive atmosphere. Therefore, Minnesota Rule 7035.2815 Subp. II requires that the concentration of any explosive gas not exceed the LEL at the property boundary or 25 percent of the LEL in or around facility structures. PBL has an MPCA-approved gas collection and monitoring system to address concerns with migration of combustible gas.

The second objective in controlling LFG is for maintenance of air quality standards. In March of 1996, the EPA promulgated air emissions regulations for large new and existing MSW landfills. These are the New Source Performance Standards and Emission Guidelines (NSPS). Under these regulations, affected facilities that emit more than 50 megagrams per year (Mg/yr) of non-methane organic compounds (NMOC) must install controls. The installed controls must be capable of reducing the NMOC in the



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collected LFG by at least 98 percent by weight. PBL has been proactive in the installation of landfill gas control equipment.

PBL employs a comprehensive monitoring program for early detection of landfill gas (LFG) in on-site structures and at adjacent properties, as well as gas collection and a landfill gas to energy plant. Occupied buildings and structures located at the facility are continuously monitored using electronic monitoring devices. These devices allow for detection of concentrations of LFG well below the concentrations at which the gas reaches an explosive range.

Landfill gas migration from the landfill is monitored with permanent landfill gas monitoring probes around the perimeter of the facility. There have been readings at the probes at concentrations above the LEL, suggesting subsurface gas migration. Mitigation and analysis efforts include multiple geoprobe investigations, installation of passive gas vents, installation of wind turbines on the passive gas vents, radon fan installation on gas vents, and a skid blower pilot study to apply more vacuum to the vents.

2.10.2 GAS PROBE MANAGEMENT

As stated above, PBL employs a comprehensive monitoring program for early detection of landfill gas (LFG) in on-site structures and at adjacent properties, as well as gas collection and a landfill gas to energy plant. Minnesota Rule 7035.2815 Subp.11 also requires that occupied buildings and structures located at the facility are continuously monitored using electronic monitoring devices. These devices allow for detection of concentrations of LFG well below the concentrations at which the gas reaches an explosive range. Landfill gas migration from the landfill is monitored with permanent landfill gas monitoring probes around the perimeter of the facility. These probes are monitored in accordance with the Gas Management and Monitoring Plan which is included in the Facility Operations and Maintenance Plan.

2.10.3 GAS MIGRATION MITIGATION

Currently, PBL has been actively working with the MPCA and the City of Inver Grove Heights to address gas migration concerns. A Gas Migration Remedial Action Report, dated February 2024, was most recently submitted under separate cover to the MPCA, City of Inver Grove Heights and Dakota County as part of the 2023 Annual Report.

In 2023, methane readings continued to linger above 25% LEL in monitoring probes MMP-14 and -16 along the northern perimeter of the landfill, however methane concentrations displayed a decreasing trend in the second half of the year. The remainder of the monitoring probes along the northern perimeter continue to follow the historical trend below 25% LEL (MMP-11, -12A, -12B, -12C, -12D, -15). Along the eastern perimeter of the landfill, methane concentrations varied above and below 25% LEL among the soil gas monitoring probes. MMP-17, -18A, -18B, -21, -22A, -22B and -22C all had readings exceeding 100% methane LEL at some point during the year. The majority of these probes also show an overall decreasing trend in the second half of the year. MMP-18 is comprised of a triplet cluster where A, B, and C correspond to shallow, intermediate, and deep screened sections, respectively. At this location, methane concentrations were most frequently elevated at MMP-18B and MMP-18A. MMP-18C did not exceed 25% LEL. Along the western perimeter, methane was below 25% methane LEL at MMP-10, GMP-3, and GMP-4. However, methane was frequently detected at concentrations above 100% LEL at GMP-5 and MMP-25B along the western perimeter. MMP-25B was replaced with MMP-25C at the perimeter of the landfill in 2023, and it should be noted that MMP-25C has not had any concentrations detected above 25% LEL. MMP-23 and -24 consist of triplet clusters that monitor methane migration to the south. Methane was also consistently measured above 100% LEL at MMP-24 during 2023, with decreasing trends late in the year. It should be noted that in the last three (3) calendar months of 2023 a



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total of 59 readings were collected with a total of seven (7) exceedances of the LEL in four (4) probes, with no exceedances in the other 36 probes.

As described in a memorandum dated June 6, 2022, radon fans were installed on passive gas vents GV-1 through GV-5 in lieu of a temporary active gas collection system when it was determined that the fans could potentially provide an equal or better flow and vacuum on the vent with less construction effort compared to providing a conventional active LFG extraction system (blower system). The fans on vents near MMP-17 (GV-1 through GV-5) were installed in April 2022 and were powered by a nearby electrical panel for the fans to run continuously. Fans were later installed on GV-6 through -11 in July 2022. Ten passive gas vents, identified as GV-12 through GV-21, were installed in a separate construction event in July 2022 between various gas probes and the waste mass with the intent to vent potentially migrating LFG to the atmosphere. GV-12 and -13 were installed near MMP-17D, GV-14 through -16 were installed near MMP-18A, B, and C, GV-17 and -18 were installed near MMP-19, and GV-19 through -21 were installed near MMP-23A, B, and C. In December 2023 two additional vents were installed near GMP-55. See Figures 2 through 4 for the locations of all existing passive gas vents. Each new vent was installed with the same radon fans, initially running on generator power. Permanent electrical power was installed to radon fans near MMP-22, -23 and -24 in September 2023 as part of the Phase 6A construction project. PBL would like to install permanent electrical power at the rest of the fans that are still on generator power in 2024. They are also currently evaluating solar power as an option at the two newest vents.

A Rotron EN454 regenerative blower mounted on a skid was temporarily installed near MMP-17, and three (3) two-inch PVC pipes were connected to gas vents GV-1 through GV-5, the vents between MMP-17 and the waste mass. One pipe is connected to GV-1, the next is connected to GV-2 and GV-3, and the third is connected to GV-4 and GV-5. Each of the three inlets has a control valve to tune the flow as needed, and each of the three has a vacuum of approximately 30-50 inches. The blower is powered via an adjacent control panel that the skid panel is directly wired to, and it has an internal knockout tank with a valve to release any collected condensate. Since methane concentrations have greatly reduced at MMP-17 since the installation of the temporary blower system, PBL intends to continue running the blower for the foreseeable future.

Long-term effects of the installation of additional passive gas vents, radon fans and temporary blower system are not yet apparent but in the short term it appears methane concentrations are decreasing at probes that have nearby vents. The effects of the vents, radon fans and the temporary blower system will continue to be monitored for trends.

At this time, PBL is proposing to connect radon fans currently running on temporary power to a permanent power source for more continuous operation of the existing fans. Opal has also committed to more tuning of wells in the area now that overliner has been installed over much of the unlined area and the risk of oxygen intrusion in those wells is less. This could continue to reduce gas migration potential in the vicinity of the probes.

The proposed schedule for work items related to gas migration in 2024 included the following:

	<u>Task to be Completed</u>	<u>Anticipated Completion Date</u>
1.	Establish permanent electrical power to installed radon fans that are currently on temporary power.	Summer 2024



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2.	Continue to evaluate temporary blower system impact to probe readings at MMP-17.		Ongoing
3.	Continue monitoring gas probe and gas vent methane concentrations to track impact of the installation of radon fans and the temporary blower system. Continue to evaluate additional gas mitigation alternatives.		Ongoing
4.	Continue to optimize tuning of gas wells near the perimeter of the landfill.		Ongoing
5.	Monthly visual inspection of cover for distressed vegetation near EW-320 and EW-10.		Ongoing
6.	Submit 2024 Annual Gas Migration Remedial Action report to MPCA, City, and County including a summary of work performed, and an evaluation of data, and recommendation for additional remedial measures.		Winter of 2024/2025

An updated Gas Migration Remedial Action Report is anticipated to be included in the facility's Annual Operating Report by March 1, 2025. The updated report will detail progress on proposed remedial action items and propose continued remedial action items for 2025.

2.10.4 FUTURE GAS SYSTEM INSTALLATION

The Pine Bend Landfill gas extraction system is currently being augmented in the Phase 6 area to include a horizontal gas collector system as well as the installation of six (6) new pumping stations. Although the pumping station's primary purpose is to remove leachate from the unlined landfill area, they may also be retrofitted to serve as dual extraction wells and also provide for landfill gas collection. Lateral subheader piping (8-inch HDPE) are connected to the existing header piping system to provide vacuum to the new horizontal gas collection system. Horizontal collector piping (6-inch HDPE) is installed as shown on the Drawings. The proposed system has been designed to provide effective control of landfill gases in the Phase 6 expansion, and vertical expansion areas upon completion of filling. Horizontal collectors are identified as HC-1. All new wells/horizontal collectors are given an identification number when installed. The system is installed in phases as filling progresses with the use of temporary controls to keep the existing system active during the construction of the proposed vertical expansion.

In addition, new vertical gas extraction wells are proposed to be installed in the Phase 7 vertical expansion area once final waste grades are reached. A plan for the vertical gas wells is shown on Plan Sheets No. 8 and 9.

2.10.5 EXISTING EXTRACTION WELLS

The existing gas wells are extended as filling progresses during Phase 6 development and vertical expansion. This means that periodically the well head assembly will require repositioning as development



dictates. This may include remotely locating the wellhead away from the filling area. It is also possible that certain wells may be extended, but temporarily taken out of service. The existing gas wells in areas where overfilling occurs are extended vertically by fusing piping to the existing well pipe and also to the subheader connection to maintain the wellheads at 48 inches above the landfill surface during operations. The existing wellhead assembly are removed prior to fusing the well and subheader extensions and are reinstalled after the extension is made. A bentonite mixture is used to seal the annular space between the outer pipe and well casing, if applicable.

It is anticipated that gas well extension process will take approximately two (2) hours per well to complete. The existing gas system is set up such that individual gas wells can be isolated from the active gas system by valves. Therefore, the entire active gas system does not need to be shut down during the extension process. Only a portion of the system is isolated as a preventive measure against excessive oxygen intrusion during the extension work.

2.10.6 HORIZONTAL COLLECTORS

As previously discussed, horizontal collectors are currently planned to be installed in the areas of the Phase 6 expansion where the overfill waste thickness will be too shallow for practical installation of vertical extraction wells. The horizontal collectors will consist of 6-inch HDPE piping and the proposed layout is shown on the Drawings. Coarse aggregate is installed below, above, and on each side of the perforated horizontal collector piping and geotextile is placed over the coarse aggregate. The solid piping portion of the collectors is covered with sand. Condensate from the horizontal gas collection piping drain to existing condensate pumps. The minimum pipe slope will be 3% to promote condensate drainage. Each horizontal gas collector is connected to the gas lateral subheader piping via a wellhead. Valves to regulate vacuum and gas flow are installed. A detail is provided on the Drawings.



3 Operations

3.1 General Operations and Site Security

A bound copy of a recently updated operations and maintenance plan along with the latest site evaluation reports as amended and approved and a complete set of plans will be kept in the operations office at the landfill for reference. A certified operator will be present to observe proper operation and monitoring of the facility.

The site will be maintained to provide a safe operating environment. The perimeter fencing and entrance gate will be maintained to provide security for the facility and discourage unauthorized access. The operator will lock the gates at the end of each working day and maintain the security systems on the facility buildings.

3.2 Hours of Operation

Normal operating hours for the facility are from 5:30 a.m. to 6:00 p.m. Monday through Friday, with waste received from 6:00 a.m. to 4:00 p.m, and placement of daily cover until 6:00 p.m. Saturday operations may occur during the same weekly hours listed above, but Saturday operations are not a regular occurrence. A certified operator is on-site during the normal operating hours and during extended hours when waste is being delivered. Outside of normal operating hours, all site hours will be in accordance with the NCUC, and if any change in hours are needed in the future the City will be notified.

3.3 Employees

As of 2024, the facility has three (3) MPCA-certified operators, allowing one certified operator to be present at the facility during all hours of site operation. New site personnel who will be charged with operating responsibilities generally receive formal training within the first six months of employment. All employee-training records are maintained at the facility office. Facility operators are encouraged to update their training on a biannual basis, or as necessary, to maintain MPCA certification.

The facility strives to maintain a safe work environment for the employees and customers. The Pine Bend Landfill has a mandatory safety and/or training program. Typical on-site training includes the following topics:

- ▲ Personal Protective Equipment
- ▲ Electrical Safety
- ▲ BFI Special Waste/Hazardous Waste Identification
- ▲ Random Inspection Program
- ▲ Working Face Safety
- ▲ Waste Screening/Evaluation
- ▲ Lock-out/Tag-out Program
- ▲ Hazard Communication
- ▲ Fire Extinguisher Training - Fire Prevention
- ▲ Drug and Alcohol Policy
- ▲ Storm Water Pollution Prevention Program
- ▲ Unacceptable Waste Procedures



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3 Operations

- ▲ Exempt Industrial Waste Identification
- ▲ Bloodborne Pathogen
- ▲ Seat Belt Policy
- ▲ Safe Lifting/Back Safety
- ▲ Eye Protection
- ▲ Storm Water Management Plan
- ▲ Respirator Program/Fit Testing
- ▲ Hearing Conservation
- ▲ Winter Safety Slips-Trips-Falls
- ▲ Confined Space Entry
- ▲ Compaction Techniques
- ▲ Railroad Crossing Safety
- ▲ Heat Stress

The meetings are held monthly, or more often, to review and update current operating procedures.

3.4 Equipment

The following equipment is available on-site and is adequate for daily landfill operations.

- ▲ Two 836H landfill compactors
- ▲ 836K landfill compactor
- ▲ D-8T dozer
- ▲ D-6T dozer
- ▲ D-6R dozer
- ▲ Two 740B Haul Trucks
- ▲ Motor Grader
- ▲ Wheel loader 930
- ▲ Skid Steer
- ▲ Farm Tractor with mower deck
- ▲ Water Truck

This equipment list may change at any time depending upon updated technology and the requirements of the site. All equipment is maintained on a routine basis. Equipment maintenance records are kept on-site at the landfill.

Facility equipment is adequately maintained to ensure safe operation and the ability to handle the waste as they are received. Each piece of equipment has its own maintenance schedule, depending on its level of usage. General maintenance operations are performed at the site. In-depth maintenance and repair is performed in the facility equipment building. Maintenance manuals for all equipment at the site are kept in a file in the equipment building.

A daily maintenance program includes removing waste from radiators and checking for worn cooling system hoses and fan belts, checking hydraulic systems for worn hoses and fluid leaks, checking for fuel leaks, worn tracks or tires, etc.

Prior to operating the equipment at the beginning of each day, all water, hydraulic fluid, oil, and fuel levels are checked. An inspection of the area around the equipment is made to ensure the area is clear. The backup warning system is checked before leaving the startup area.



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3 Operations

While equipment is operating, the machine is checked periodically for hanging or attached debris. The fuel and hydraulic systems are checked for leaks. Waste is handled in a manner, which protects the operator, as well as those at the working face.

At shutdown, the engine is allowed to cool evenly prior to shutting off. A 3-to-5 minute idle period is typical. All blades and other moveable parts are lowered to the ground, and the brakes and transmission locks set.

Records are kept of all maintenance work performed on the facility equipment. These records are kept with the equipment manuals in the maintenance building.

3.5 Processing

There is no processing or open storage of MSW at the Pine Bend Landfill. However, Pine Bend Landfill does provide appliance recycling, electronics recovery, and household hazardous waste removal.

3.6 Post-Closure, Contingency Action Plan and Financial Assurances

Refer to the attached Appendix F for the modified closure, post-closure, and contingency action cost estimates. These cost estimates have been modified based upon comments received from the City in review of the MPCA permit application.

3.7 Total Facility Operating Permit

The landfill is governed by a Total Facility Operating Permit (SW-45) through the MPCA with a Part 70 Air Permit Facility ID No. 037000138.



4 Potential Environmental Impacts

4.1 Leachate

The leachate generated from the proposed Phase 7 expansion will be collected and conveyed from the composite liner to collection sumps in the Phase 6 area. Leachate is removed from the sumps by pumps capable of handling the expected leachate quantities and treated off-site at the MCES St. Paul (Pigs Eye) wastewater treatment facility, which stipulates its own leachate monitoring requirements with which PBL must comply.

4.2 Methane

The owner and operator of PBL, BFI Waste Systems of North America, LLC (BFI), operates an active gas collection and monitoring system at the site. The monitoring system consists of gas probes around the perimeter of the site. Per MPCA requirements, all facility gas probes are monitored; Minnesota Rule 7035.2815 Supp. 11 requires that the concentration of any explosive gas not exceed the lower explosive limit (LEL) of five percent methane at the property boundary or 25 percent of the LEL (1.25 percent methane) in or around facility structures. The gas probes that have historically shown exceedances of the LEL are monitored monthly, while other probes are monitored quarterly. Gas probe measurements are acquired using a landfill gas monitoring device and are performed by Opal, the gas developer for the landfill.

PBL employs a comprehensive monitoring program for early detection of landfill gas (LFG) in on-site structures and at adjacent properties, as well as an active gas collection and a landfill gas to energy plant. Minnesota Rule 7035.2815 Supp. 11 also requires that occupied buildings and structures located at the facility are continuously monitored using electronic monitoring devices. These devices allow for detection of LFG concentrations well below the LEL. Landfill gas migration from the landfill is monitored with permanent landfill gas monitoring probes around the perimeter of the facility. Gas level readings at the gas probes on the east, south, and west sides of the PBL have historically indicated LFG concentrations above the LEL. As part of on-going landfill operations and to address comments from the MPCA and the City of Inver Grove Heights, PBL has performed various gas probe investigations to help identify the off-site migration of methane around the perimeter of the site; PBL has been actively working to address gas migration issues. The most recent investigations and actions completed at the site were provided under separate cover in a Gas Migration Remedial Action Report dated February 2024.

4.3 Noise

Noise control is handled on-site by limiting hours of operation and by providing acceptable muffler systems on the vehicle traffic. The following information regarding noise is as follows:

4.3.1 LANDFILL EQUIPMENT/MACHINERY RELATED TO WASTE DISPOSAL

Noise presently generated at the site is the result of equipment used for hauling, compacting, and covering the refuse. The following machines or vehicles are operated at the site:



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4 Potential Environmental Impacts

4.3.1.1 Landfill Machinery

Decibel (dBA) Range		Hrs/ week
Dozer	80-115	36hrs/week
Compactor 1	82-92	72hrs/week
Compactor 2	82-92	14hrs/week
Soil hauling truck	85-95	42hrs/week
Backhoe	73-80	42hrs/week

4.3.1.2 Haul Trucks

Refuse trucks hauling refuse to the site generate other noise. Approximately 160 refuse hauling trucks enter the site every day. 80 percent of these trucks are semi-trailer trucks and 20 percent are dump trucks. Such trucks are likely to generate from 85 to 95 dBA at the truck according to data furnished by the Hennepin County Department of Public Works. Traffic from these haul trucks take place from Highway 52 onto 117th Street into the south entrance of the site. All land within this reach of 117th Street is zoned industrial and no private homes or residences are presently in that area.

4.3.1.3 Nearby Sensitive Receptors

The closest resident is approximately 2,100 feet west of the landfill (east side of Rich Valley Blvd.) and 1,500 feet from the stockpile or borrow area located within the 100-acre adjacent site. This home is owned by BFI and rented out to a local resident. Topography presents a buffer between the work areas and private dwellings.

4.3.1.4 Operating Hours

Waste is received at the landfill between 6AM and 8PM, Monday through Friday, and 6AM to 4PM on Saturdays. No heavy equipment operates outside of these times unless opened on Sunday for special circumstances.

4.3.2 LANDFILL EQUIPMENT/MACHINERY RELATED TO CONSTRUCTION

The proposed expansion will not alter the existing noise generation typical of a construction project. Since Phase 7 is a vertical expansion no new cells will be constructed, and construction will typically consist of final cover or gas infrastructure construction projects.

4.4 Litter, Vectors, and Odor

Unloading of all wastes will be confined to as small an area as practical, and surrounded with appropriate facilities to confine wind-blown material within the area. The litter is picked up daily as generated.

During periods of windy weather, the operators employ an appropriate variety of tactics to prevent littering. These tactics are described as follows:

- ▲ Maintain disposal area in well-screened areas.



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4 Potential Environmental Impacts

- ▲ Place the waste at the lowest level of the fill area possible.
- ▲ Apply liberal quantities of cover soil as the cell is filled.
- ▲ Reject waste that is highly susceptible to becoming windblown.
- ▲ Police the site fences and tree lines and return all litter to the working face.

In certain extreme conditions, operations will cease. The decision for operations to cease is made at the discretion of the facility manager. Historically, the site has closed and ceased accepting waste for disposal on days of high winds that prohibit landfill personnel from controlling litter within the boundaries of the site.

Vector control is achieved through the use of daily, intermediate, and final cover. Highly putrescible wastes are covered immediately upon placement at the working face. PBL also has a contract with Plunkett's Pest Control Company to provide inspection of the buildings on a monthly basis. Plunkett's Pest Control also completes a site walkover to identify rodent harborage and baits any active areas to eliminate problems.

Odors at the site are currently controlled by the operation of the active gas extraction system. The proposed expansion will not alter the existing odor conditions or generation at the site.

4.5 Fugitive Dust

Fugitive dust control during landfilling operations of the expansion will be controlled as is currently being done with the following landfill practices:

- ▲ The approach road to the landfill, 117th Street, is paved.
- ▲ The main on-site road to the active fill area is partially paved.
- ▲ An on-site water tank truck applies water to areas subjected to dust creation.
- ▲ If dust becomes a problem, sand is spread on the unpaved roads to control dust.

4.6 Site Geology and Groundwater

Site geology and hydrogeology has been extensively evaluated since the facility began operations in 1971. A groundwater monitoring network has been in-place since 1972 and more than 35 years of groundwater monitoring data has been collected.

The 2023 Annual Water Quality and Natural Attenuation Monitoring Report prepared by Groundwater and Environmental Services, Inc. (GES) represents the most recent compilation of site hydrogeologic information available. The above 2021 Annual Report should be referred to for a more detailed discussion. A brief overview of the site hydrogeology is presented below.

The uppermost aquifer underneath the site consists of the glacial deposits that are hydraulically connected to the Prairie du Chien Group and the Jordan bedrock formations. In the bedrock valley, the glacial deposits are also hydraulically connected with the Franconia Formation. Prairie du Chien and Jordan collectively comprise the major aquifer in the Twin Cities metropolitan area. The Franconia Formation can provide small amounts of water, but is usually considered to be, along with the St. Lawrence Formation, a confining unit (Schoenberg, 1990). The Ironston and Galesville Sandstones serve as a regional aquifer above the Eau Claire formation, which acts as a major aquitard. The deepest aquifer in the area is generally considered to be the Mt. Simon Sandstone.



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4 Potential Environmental Impacts

An extensive monitoring well network is used for water-level measurements and water-quality sampling at PBL. The water table in glacial deposits is encountered between 725 to 800 feet (NGVD 29). Groundwater flow direction is to the northeast with the northeast flow becoming more easterly as it approaches the bedrock valley along the northern boundary of PBL.

The average horizontal hydraulic gradient in the uppermost aquifer has been calculated to be 0.010 feet per foot. Historically, the gradient has been steeper along the eastern boundary of PBL. Adjacent to and east of PBL, the hydraulic gradient becomes more gradual until about U.S. Highway 52/Minnesota Highway 55 where the hydraulic gradient increases once again due to the proximity of the Mississippi River Valley.

There are no changes being proposed as part of the Phase 7 development relating to the groundwater monitoring system at the landfill.

The Project will not appropriate or consume groundwater and therefore not contribute to groundwater supply issues in the area. The Facility has an existing groundwater monitoring network in place and would continue to monitor groundwater quality. The groundwater monitoring network and program would ensure early detection of groundwater quality impacts. If the Proposer observes groundwater quality impacts during monitoring, they will work with the MPCA to develop appropriate actions to address and improve groundwater quality under the terms of their solid waste permit. The Proposer would secure all required permits prior to implementing actions targeted at improving groundwater quality.

Additionally, the proposed vertical expansion will include appropriate leachate collection and management within the landfill. These practices will minimize the potential for groundwater contamination. The existing groundwater monitoring network and sampling program will detect if leachate or other landfill constituents have entered the groundwater prior to reaching sensitive waterbodies such as the Mississippi River.



5 Land Use Impacts

5.1 Land Use

The site is situated in a zoned industrial area with largely industrial neighbors; Koch Refining Company, Excel Energy, Inc., Mid-America Pipeline Company, Rich Valley (SKB Demo Landfill), etc. In addition, the closed Crosby American Demolition Landfill is located immediately north of the Pine Bend Landfill. Since the landfill has seemingly operated compatibly with neighboring sites and nearby land uses, this is not anticipated to change as a result of the proposed expansion. There are no anticipated conflicts involving environmental matters associated with the proposed expansion.

The Inver Grove Heights zoning ordinance allows for the airspace expansion of current landfills (10-13E-6) as a conditional use. Therefore, the Project is allowable on the site with a CUP. The Facility currently operates under an existing CUP and a NCUC from the City of Inver Grove Heights. The Facility also operates under a Solid Waste Facility License from Dakota County. The Proposer will need to amend their existing CUP, NCUC and Dakota County Solid Waste License for the Project.

The Project would not change the nature of the Facility. The Project will not expand the footprint of the Facility and it would continue to operation as a municipal waste landfill. Existing conditions associated with traffic, noise, dust, odor, and other issues related to Facility operations would continue, but would not change from current operations.

5.2 Traffic and Haul Routes

No construction of new cells is required for the vertical expansion of Phase 7. Existing landfill traffic, such as enclosed semi-trailers and garbage trucks would continue to be used for hauling MSW into the site. It should be noted that Dakota County is planning an expansion of the existing 117th Street used for access to the landfill. This may result in adjusted traffic or haul routes during road construction.

5.3 Stormwater/Erosion Control

No adverse impacts to the receiving waters from the site's surface water runoff are anticipated. There are no immediate receiving waters at or near the landfill. Surface water discharges are, and will continue to be directed to existing sedimentation ponds. The proposed expansion is not anticipated to increase the surface run-off volume, all of which is directed to the two existing sedimentation ponds. The storm water control facilities at the landfill have been conservatively designed to handle the 100-year, 24-hour storm event of 7.43 inches.

Erosion control on the landfill cover will be controlled by the installation of benches and permanent turf reinforcement mat that will intercept the run-off and direct it to downslope piping systems. Vegetation will be established as soon as possible on the intermediate and final covered areas of the landfill.

The proposal incorporates structural and/or non-structural control measures to reduce pollutants in storm water from soil erosion. The structural control measures include the following:

- ▲ Benches
- ▲ Downslope piping system
- ▲ Junction vaults
- ▲ Sedimentation ponds



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5 Land Use Impacts

- ▲ Curbs, berms, and earthen dikes
- ▲ Velocity dissipation devices
- ▲ Rock outlet protection
- ▲ Silt fencing
- ▲ Straw bale dikes
- ▲ Subsurface drains

The non-structural control measures include the following:

- ▲ Best management practices (spill prevention, neat and orderly material storage)
- ▲ The Spill & Emergency Response Plan
- ▲ Security
- ▲ Routine visual inspections

5.4 Utilities

The proposed Phase 7 development will require minimal revisions to the utilities at the site. Some utilities will be removed in the final development of Phase 5 (in the vicinity of the existing office building).

5.5 Landscaping

The Pine Bend Landfill has already constructed a network of landscaping berms and uses as much of the natural tree barriers as possible for screening around their current facility. Since the proposed expansion does not increase the boundaries of the current landfiling operations, the existing landscaping is considered adequate. Viewshed maps and 3D modeling of views of the existing landfill and proposed maximum elevation of the expansion are included in Appendix G. The viewshed maps were developed and evaluated using lidar data for Dakota County. The first figure shows the areas the existing landfill is visible from, the second shows the areas the landfill at proposed final grades would be visible from, and the third figure overlays both layers for comparison. Note that some areas shown as visible or not visible may be impacted by nearby trees and buildings. Some areas shown as visible may be visible from the top of a tree or structure rather than at ground level. The 3D modeling of projected views from various points in the City of Inver Grove Heights are also included, comparing current view of the existing landfill to expected view of the proposed expanded landfill at final grades. Industrial properties surround the Facility with limited visibility from residential or scenic areas.

5.6 Fire Protection

Arrangements and coordination with the City of Inver Grove Heights police and fire services is a condition of Pine Bend Landfill's NCUC with the City. The fire department has keys for the landfill gate.

Fire extinguishers are located on all large earth moving and waste handling equipment. They are also available in the shop and office. The vendor checks them annually. Testing verification is maintained with the facility records. The landfill has a water truck, normally used for dust control that can be used for fires. It can draw water from a water supply tank or a surface water source.



6 Additional Items

6.1 Statement of Compliance

Pine Bend Landfill's groundwater monitoring system, leachate recirculation, solid waste composting, and surface water management will take place in accordance with the MPCA solid waste permit application including subsequent modifications based on the responses to City review recommendations.

6.2 Host Community Fee

The City and Pine Bend Landfill are in negotiation for a renewal of the Host Community Agreement, which will include provisions for the proposed expansion.

Pine Bend Landfill has also entered into a new Host Fee Agreement with Dakota County on January 1, 2023. The term of the new Dakota County Host Agreement runs through December 31, 2037.

6.3 Compliance History

6.3.1 MPCA

6.3.1.1 Groundwater Contamination

BFI implemented a long-term groundwater monitoring program in accordance with the Minnesota Solid Waste Landfill Compliance Program to assess trends in water quality downgradient of the PBL. On April 23, 1985, BFI and the MPCA entered into an agreement for BFI to perform a Remedial Investigation and Feasibility Study that would: a) investigate the source, or sources, of groundwater contamination at, and near, the facility; b) assess actual and potential impacts of the releases, or threatened releases, of hazardous substances, pollutants, and contaminants from the facility on public health, welfare, and the environment; and c) identify, assess, design, develop, and implement response action alternatives. On October 23, 1990, BFI and the MPCA entered into an agreement for BFI to conduct a feasibility study; develop a plan to provide an alternative drinking water source for certain residential wells adversely affected by the release(s) from the landfill and the neighboring Crosby American Demolition Landfill; and to develop a response action plan and implement the approved response actions.

The actual and potential impacts of the releases, or threatened releases, of hazardous substances, pollutants, and contaminants from the facility on public health, welfare, and the environment were determined to be primarily Volatile Organic Compounds (VOCs) and particularly chlorinated hydrocarbons that were encountered within the landfill's groundwater monitoring network. BFI developed response action alternatives for remediation. On September 23, 1991, the MPCA approved the Updated Remedial Investigation Report for the PBL. In regard to the alternative drinking water source, PBL developed a plan, and the MPCA issued a Record of Decision in September 1991, which required the residences with affected wells to be connected to the city of Inver Grove Heights (City) water supply system. The City completed the connections supplying municipal water to the residences in December 1994. On November 21, 1994, the MPCA approved No Action Alternatives under the Superfund process for the source control and the remediation of groundwater contamination as recommended in the Updated Detailed Remedial Analysis Report.



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6 Additional Items

In 2001, BFI completed a pilot study to evaluate the applicability of utilizing enhanced in-situ bioremediation as a remedial approach for mitigating VOCs in the groundwater beneath the site. The in-situ bioremediation system stimulates the growth of biological organisms in a saturated subsurface environment by introducing a supplemental food source of high fructose corn syrup that is injected into the unlined portion of the landfill through three injection wells. The bioremediation system increases the breakdown of groundwater contaminants, which in turn decreases contaminants in the groundwater. The conclusions drawn from the twelve-quarter study revealed that the introduction of high fructose corn syrup into the groundwater has resulted in marked changes in groundwater inorganic chemistry and in a statistical reduction in the concentration of chlorinated alkenes in the groundwater. In general, VOC concentrations have decreased and continue to decrease in all wells located in the pilot study area.

To mitigate the existing groundwater contamination further, BFI proposed, in July 2002, to enhance the existing source control measures at the PBL through the installation of additional leachate collection pumps within existing landfill gas collection wells. This dual extraction well system, which was installed in October 2002, is expected to reduce leachate levels in Phase I and II and subsequently reduce the concentrations of contaminants in the groundwater.

There are no changes being proposed as part of the Phase 7 development relating to the groundwater monitoring system at the landfill. For a detailed discussion on groundwater conditions at the Pine Bend Landfill, please refer to the 2023 Annual Groundwater Monitoring Report as well as a report entitled "Update on the Effects of Natural Attenuation and Source Control Measures with Respect to Groundwater Quality at the Pine Bend Landfill" which was submitted by BFI on May 15, 2003. The City of Inver Grove Heights received a copy of this report.

The MPCA MSW solid waste permit for the proposed landfill expansion will incorporate specific conditions to ensure that the permittee implements further remedial measures to address the existing groundwater contamination.

6.3.2 COUNTY

During the course of the past few years, Pine Bend Landfill has received notifications from Dakota County of minor operational deficiencies that have been immediately corrected to the satisfaction of Dakota County.

6.3.3 CITY

There have been no documented compliance issues with the City of Inver Grove Heights.

6.4 Status of Other Permits and Approvals

The following permits are required for the project. The status of the individual permits is also listed.

Unit of Government	Permit or Approval Required	Status
A. MPCA	Solid Waste Permit (SW-45)	Application Submitted and under review.
B. MPCA	NPDES General Storm Water Permit for Industrial Activity	In Compliance.
C. MPCA	NPDES General Storm Water Permit for Discharges During Construction Activity	Application to be Submitted for next construction project disturbing over 1 acre.



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6 Additional Items

D. MPCA	EAW	Findings of fact issued on March 1, 2024 and negative declaration ordered.
E. MPCA	Landfill Expansion Certificate of Need	Future application on as-needed basis.
F. MPCA	Consistency with Metropolitan Area Solid Waste Management Policy Plan	In Compliance.
G. Metropolitan Council	Industrial Discharge Permit	In Compliance.
H. Dakota County (County)	Solid Waste Facility License Modification	In Compliance.
I. County	Community Host Agreement	Negotiations.
J. City	Zoning Ordinance Amendment and Conditional Use Permit	To be amended.
K. City	Non-Conforming Conditional Use Permit (#2641)	To be amended.
L. City	Host Agreement	To be amended.



Appendix A Solid Waste Management Plan



Solid Waste Management Plan

Pine Bend Landfill, SW-45
BFI Waste Systems of North America, LLC

Revised 2014

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Note: All forms are examples and are subject to change as needed. Copies of modified forms will be sent to Dakota County Environmental Management Department and the MPCA.

I. INTRODUCTION

BFI Waste Systems of North America, LLC's (BFI) Pine Bend Landfill (PBL) accepts mixed municipal solid waste (MSW) and non-hazardous industrial solid waste (ISW). This Solid Waste Management Plan (Plan) was prepared in accordance with Minnesota Pollution Control Agency (MPCA) regulation 7035.2535 subp. 5 and addresses the management of MSW, and ISW delivered to PBL. For purposes of this Plan, the MPCA's definition of "Industrial Solid Waste" contained in regulation 7035.0300 applies. In accordance with MPCA regulations, ISW also includes construction waste and debris. PBL requires all ISW, except for construction waste and debris, to be evaluated and either approved or disapproved by PBL for disposal. The General Manager or designee will ensure that all test results are kept on file and that the evaluation procedures outlined in Section III are followed. The General Manager or designee shall review and approve each application for disposal of waste prior to disposal of the waste. The objective of this plan is to comply with all applicable requirements and to protect PBL employees, the public's health and safety, and the environment in and around the landfill.

Any amendments to this plan requiring regulatory review and approval prior to implementation will be submitted to the MPCA and Dakota County for such review and approval. In the event of a conflict between this Plan and Dakota County Ordinance 110, the Ordinance shall control.

For purposes of this Plan, a waste is unacceptable if it cannot be disposed at PBL in accordance with applicable laws, rules and regulations, county ordinance requirements, and Republic Services' Special Waste Management Plan.

II. CUSTOMER NOTIFICATION PROCEDURE

PBL has developed various methods of notifying waste generators, their service providers and haulers ("customers") of its procedures for review and acceptance of waste.

A. ISW

PBL meets with the potential customer and/or sends them an e-mail with the information required to complete a profile application. Further, PBL discusses with customers the policies and procedures concerning ISW as promulgated by the MPCA and Dakota County. PBL also notifies customers regarding the landfill's non-hazardous waste acceptance procedures (Appendix A). Lastly, PBL offers ISW training seminars and/or distributes written information to educate customers of current and proposed ISW policies as needed. When a waste is rejected, PBL will provide written notice to the customer explaining why the waste was rejected and advise the customer on what is acceptable and unacceptable.

B. MSW

PBL will provide a written description of acceptable and unacceptable waste to haulers that deliver MSW to PBL. When a waste is rejected, PBL will provide written notice to the hauler explaining why the waste was rejected and advise the hauler and/or customer of what is acceptable and unacceptable.

III. ISW GENERATOR WASTE EVALUATION PROCEDURE

A. Evaluating Waste Characteristics

PBL informs the ISW generator directly, if it is a collection company customer, or through the generator's waste service provider, if it is not a collection company customer, of the landfill's procedures for the review, acceptance and disposal of non-exempt ISW as defined below.

A Generator Waste Profile Sheet (Profile Sheet - Appendix B) must be completed in its entirety and signed by the generator's authorized representative for each non-exempt ISW. The Profile Sheet requests detailed information concerning the physical and chemical properties of the waste, the process producing the waste, as well as certification from the generator that the information provided is complete and accurate. Additional information, if required by federal, state or local regulations, will be obtained to fully characterize the waste.

It is the responsibility of the generator to fully and accurately characterize each waste stream and address all of the constituents appropriately in accordance with federal, state and local regulations. It is PBL's responsibility to properly review, and approve or disapprove ISW for disposal at Pine Bend Landfill.

PBL has developed a fact sheet (Appendix C) that is provided to generators to assist them with representative sampling. Dakota County will be provided a copy of any changes to the fact sheet. If the generator or its designee performs waste sampling, the Pre-Approval Sampling Form (Appendix D) must be completed.

B. Exempt Wastes

Certain ISW is exempt from certain requirements of Chapter 5 of Dakota County Ordinance 110, provided the generator does not mix or contaminate the waste with ISW that is not exempt. The list of exempt wastes is in Dakota County Ordinance 110 or is approved separately by Dakota County.

Records of exempt ISW accepted under Dakota County Ordinance 110, including the type of ISW and the name of the generator, are kept at PBL and made available to the County in accordance with the applicable requirements.

If a load containing exempt ISW mixed with MSW arrives at the landfill, PBL will inspect the waste for acceptability in accordance with federal, state and county regulations. If the waste can be disposed at PBL in compliance with applicable requirements, PBL will record the date, type of exempt waste, the hauler, and the generator (if it can be determined). This information will be submitted to Dakota County as required. The exempt ISW in the load will be scanned with the photo ionization detector (PID) and the data kept on file. If the waste passes the review as described in Section VII and the PID test, if the PID test is required, it will be disposed at the landfill. Certain exempt ISW types or specific ISW streams may qualify for exemptions from the PID scanning requirement. Dakota County must approve any such exemption.

IV. PBL's INITIAL EVALUATION PROCESS

A. ISW Evaluation Process

The ISW evaluation process begins when the generator submits all relevant information and analytical data on the subject waste to PBL for review. This evaluation process is outlined in the Industrial Solid Waste Evaluation Process flowchart attached as Appendix E.

A generator's request to dispose of ISW at PBL will undergo review prior to receiving approval for disposal. The General Manager or designee has the authority to deny the approval, or impose special procedures or requirements for testing and/or handling as a condition of acceptance. Approvals will be based on the regulations found in Dakota County Ordinance 110, MPCA rules, federal regulations, other applicable requirements, Republic Services' Special Waste Management Plan and this plan. If the waste meets federal, state, and county regulations and if Dakota County has approved the waste for disposal, if required, then PBL will send a Waste Approval Form to notify the generator or the generator's service provider, of each ISW approved for disposal at the landfill. This form includes a waste description, safety precautions (if any), and may recommend a method of management.

B. Test Results Above Dakota County Limits

If ISW test results indicate concentrations of any constituents above the County limits, but within the state and federal limits, a "request for deviation from acceptance levels" as provided by Ordinance 110 may be submitted by PBL to the County for review and approval.

V. USE OF SOLID WASTE AS DAILY COVER

Certain solid waste or other materials have physical characteristics that are appropriate for use as daily cover. Prior to accepting any material for use as daily cover, PBL will evaluate the material using the procedures outlined in the Acceptance Policy for Clean Fill and Alternative Cover Material as Daily Cover (Appendix E-1). These materials must be approved by Dakota County and meet MPCA requirements. These requirements will ensure that daily cover is capable of:

- minimizing infiltration of precipitation into the fill areas;
- preventing surface water from accumulating in fill areas;
- reducing wind erosion and windblown litter;
- minimizing the creation and movement of dust;
- reducing effects of freeze-thaw and other weather conditions;
- discouraging vector and burrowing animal intrusion into the site; and,
- minimizing fire potential.

Any materials that do not meet these requirements are not suitable for use as daily cover. Solid waste and other material will only be stockpiled and used in manner approved by Dakota County.

VI. PERIODIC RE-EVALUATION

Non-exempt ISW will be re-evaluated in accordance to Dakota County

Ordinance. The waste re-evaluation will be accomplished as follow:

Re-evaluation: At such time intervals as set forth by Dakota County, the generator's non-exempt ISW shall be re-evaluated. PBL will re-evaluate non-exempt ISW at time intervals set forth by Dakota County. The generator is required to complete a new Profile Sheet and submit updated analytical data of the waste, unless a Material Safety Data Sheet may adequately substitute for the analytical data. Additional information, if required by Dakota County, will be obtained to fully characterize the waste.

Analytical Exceedance Notification: If, during the re-evaluation process, the analytical results exceed county, state or federal standards, the generator will be notified immediately along with its waste service provider and Dakota County. The waste will not be disposed at the landfill unless the waste is within county, state and federal standards and the General Manager or designee approves the waste and Dakota County has approved the waste, if required.

VII. WASTE DELIVERY REVIEW AND REJECTION PROCEDURES

A. Inspection

1. Scale House Review

The scale attendant will receive from the waste hauler the Non-Hazardous Waste Manifest, if required, containing the name of the generator, type and volume of waste, point of generation, and the name of the transporter. The scale attendant will verify that a current PBL approval and a current Dakota County approval, if required, exist for this waste. If the information contained in the manifest does not match the approval, the waste will be rejected or an investigation into the discrepancy will be conducted and the discrepancy resolved prior to the waste being disposed with the resolution documented. The hauler will not be allowed to go to the working face until the discrepancy has been resolved. If the information on the manifest matches the approval, the scale attendant will initial the manifest and give it to the hauler. If the waste is ISW in an open-top container, the hauler will be directed to the inspection area. If the waste is ISW in a closed-top container or MSW, then the hauler will be told to go directly to the landfill working face. The landfill equipment operator and the General Manager or designee are notified when ISW is en route to the working face.

When waste arrives at the scale of the landfill, a radioactive material detection system screens the vehicle. The detection system is set at twice the background count rate. Appendix F details what actions will be taken if the alarm is triggered.

PBL has adopted an inspection program for MSW from non-residential sources delivered for disposal at Pine Bend Landfill. In addition to the routine inspection program described in this Plan, a site specific Random Inspection Program (Appendix G) has been implemented in accordance with federal and state standards. This program is designed to randomly screen waste delivery vehicles transporting MSW from non-residential sources and construction waste or debris for unacceptable wastes such as hazardous waste, PCB wastes, non-exempt ISW and waste not in compliance with Dakota County requirements.

MSW loads that arrive at the landfill are weighed, scanned for radioactivity, and directed to the working face for dumping. New and cash MSW customers are asked specific questions at the scale house regarding the contents of the load to identify unacceptable wastes as outlined in Dakota County Ordinance 110 (e.g. liquids, yard waste, lead acid batteries, etc.).

2. Inspection Area

When open-top vehicles containing ISW are directed to the inspection area, PBL will compare the manifested non-exempt ISW with the description on the Profile Sheet and any required PID testing will be done. For wastes that require onsite testing pursuant to applicable regulations, a representative sample of the waste will be taken and analyzed in the PBL onsite laboratory. For non-exempt ISW delivered in an open-top vehicle that is not received on a frequent basis, once approved, the landfill equipment operator will be notified and provided instructions on visually inspecting the load as it is being dumped and pushed for placement at the working face.

3. Working Face

Operators of landfill equipment look for unacceptable waste while the load is being dumped and while they are pushing the waste. If they see potentially unacceptable or suspicious waste in the load, it is reported to the General Manager or designee via radio or other means. The General Manager or designee will then review the suspicious material for acceptability in accordance with federal, state and county regulations. For example, the waste may be observed for identifying labels, noticeable odors, unusual colors or free liquids. If acceptable, the waste will be disposed. If deemed unacceptable, the waste will be rejected and the procedures identified in Section VII.B.I.a through e will be followed.

Once closed-top vehicles containing ISW have dumped their load at the working face, the General Manager or designee visually inspects and samples the waste for any necessary testing and conducts any required PID testing. Once test results have been approved, the General Manager or designee will inform the landfill equipment operator that the waste appears to be acceptable and will provide inspection instructions. Instructions for placing the waste may also be provided. Special handling procedures may be required for certain types of waste (Appendix H). However, if the test results are not approved, the waste will be rejected.

4. Manifest Completion

If the waste is disposed in part or in whole, the General Manager or designee will sign the manifest for non-exempt ISW and will document problems or discrepancies with the waste and their resolution.

B. Management of Unacceptable Waste

1. Except as provided below in paragraph 2, if unacceptable waste is observed and the General Manager or designee determines that it must be rejected, PBL will require the hauler to collect the waste and remove it from the landfill. PBL will also use its best effort to find out the source of the unacceptable waste. If an unacceptable waste is rejected, the following steps will be followed:

- a. The unacceptable waste will be segregated.
- b. The generator or its waste service provider, and the County will be contacted.
- c. The unacceptable waste will be removed from the landfill.
- d. A Rejected Load Form (Appendix I) will be completed for rejected ISW and a copy sent with the driver and a copy faxed to Dakota County.
- e. Rejected MSW will be reported in the Dakota County Quarterly Operations Report.

2. If exempt ISW that has not been previously approved is delivered to the landfill, PBL may immediately approve the waste if it meets Dakota County Ordinance 110 and MPCA requirements.

VIII. WASTE CATEGORIZATION

A. Management of Acceptable Wastes

The non-hazardous industrial solid wastes, as set forth in MPCA Section 7035.2535 Subpart 5 and the Dakota County Ordinance 110, and MSW are acceptable for disposal at PBL in accordance with applicable laws, rules and regulations.

B. Prohibited and Unacceptable Wastes

"Prohibited and Unacceptable Wastes" as provided by Dakota County Ordinance 110, Pollution Control Agency Solid Waste Management Rules and Minnesota Statutes are unacceptable for disposal at the Pine Bend Landfill.

C. Household Hazardous Waste Management

Household hazardous wastes will be managed in accordance with the Household Hazardous Waste Management Plan in Appendix J.

IX. TRAINING

PBL provides training for landfill employees on subjects related to landfill operations, including training on identifying and handling unacceptable waste that may be delivered to the landfill. Dakota County will be invited to participate from time to time. The operators are encouraged to become MPCA Type II landfill operators. A state-certified operator is always on-site during operating hours.

APPENDIX A
ACCEPTANCE PROCEDURES
FOR
NON-HAZARDOUS INDUSTRIAL SOLID WASTE

**ACCEPTANCE PROCEDURES
FOR
NON-HAZARDOUS INDUSTRIAL SOLID WASTE**

A. WASTE EVALUATION

Prior to acceptance of all non-exempt, non-hazardous industrial solid waste (ISW) at Pine Bend Landfill (PBL), the generator of the ISW must complete and submit the required information for review. This information includes the completion of various forms and analytical data, if required, to properly characterize the ISW stream.

Analytical data is essential. The generator must have the ISW analyzed, if required, at a laboratory and submit the results to PBL. In addition, the generator must submit to PBL any current analytical data they have on the ISW. PBL periodically reviews the QA/QC performed by the laboratory.

In addition to the analytical data, the generator must fill out several forms characterizing the ISW and the process generating the ISW. These forms include a Generator Waste Profile Sheet (Profile Sheet), a Pre-Approval Sampling Form, and any other required PBL or Dakota County approval forms. In addition, PBL may require the generator to submit any Material Safety Data Sheets (MSDS) on the ISW.

B. APPROVAL PROCEDURE

The generator takes a representative sample of the ISW and completes the Profile Sheet and the Pre-Approval Sampling Form. The sample is sent to the laboratory for the appropriate testing. Sampling may not be necessary if there is current analytical data available on the ISW.

The waste approval packet, consisting of the completed Profile Sheet, Pre-Approval Sampling Form, MSDS, any other required forms, the analytical test results, and any other pertinent information are sent to PBL. PBL reviews and verifies that the packet meets federal, state and county standards as well as other applicable requirements. Once PBL approves the packet, it is sent to Dakota County and Republic Services' Special Waste Department for their review and approval if required.

C. WASTE ACCEPTANCE REQUIREMENTS

Upon receipt of all approvals, the generator will be notified that they are now allowed to deliver the approved ISW. A completed Non-hazardous Waste Manifest must accompany every load of non-exempt ISW delivered to the landfill. **No non-exempt ISW will be accepted without this manifest properly completed.**

Once the load arrives at the landfill, landfill staff will check the manifest, conduct a visual inspection of the load, and perform the necessary testing to insure that the load matches the characteristics of the approved ISW. Haulers bringing in unapproved or unacceptable non-exempt ISW to the landfill will be required to remove the waste at their or the generator's expense.

APPENDIX B

GENERATOR WASTE PROFILE SHEET

DAKOTA COUNTY ENVIRONMENTAL MANAGEMENT DEPARTMENT

2014 Non-Hazardous Industrial Waste Codisposal Request Form

NEW

- ☐ Standard (\$200)
☐ Rush (\$285)

RENEWAL

- ☐ Standard (\$115)
☐ Rush (\$154)

- ☐ Amendment (\$65)
☐ Rush (\$89)
☐ Alternative Daily Cover (\$200)
☐ Rush (\$285)

FAX NUMBER: _____

CONTACT NAME: _____ TELEPHONE NO: _____

GENERATOR NAME: _____

MAILING ADDRESS: _____

CITY: _____ STATE: _____ ZIP: _____

This is an official request of _____ to dispose of non-hazardous
(Generator Name)

non-liquid industrial waste generated from _____
(Site Address)

located in _____ County to be disposed of at _____
(Landfill Name)

A. Waste Name/Description: _____

B. Dakota County waste # _____ (Leave blank for new applications)

C. Physical State: _____ Solid _____ Semi-Solid _____ Liquid

D. Quantity and frequency of disposal: _____

E. Color _____ Odor _____ (describe)

F. Process that produces waste (Please be complete and use additional pages if necessary):

G. For amendments, please indicate what changes are being sought _____

I. I would like my hauler notified of all communications regarding this waste. ☐ Yes ☐ No

If yes, name and address of hauler: _____

GENERATOR CERTIFICATION

I certify that this evaluation for codisposal review of non-hazardous, non-liquid industrial waste is complete and that to the best of my knowledge and belief the information contained herein is true and accurate. I understand that the Dakota County Environmental Management Department (Department) may request analytical tests to be performed on the described waste by an approved laboratory utilizing appropriate testing and sampling procedures. I understand that the Department must grant approval of this request prior to disposal, and if approved, the Department may impose certain conditions on the disposal that are not included in the request. I also certify that if Department approval is granted, only those wastes in the quantities, amounts and form identified on this request form will be sent to the landfill for disposal. I further certify that I have read and understand Dakota County Ordinance No. 110, Solid Waste Management, Chapter 5, and agree to comply with those Ordinance requirements.

Signature

Title

Date

If a waste is approved for continuous disposal, and if for any reason the generator becomes aware of a change in the chemical composition, properties or the process producing the waste, the generator agrees and is required to notify the Department of the change and to provide an updated waste analysis, if requested by the Department.

.....
LANDFILL REQUEST

This is an official request of the _____
(Landfill Name and Permit Number)

to accept and dispose of, if approved by the Department, non-hazardous, industrial waste as described on this form from _____
(Generator Name)

I am requesting approval to stockpile this waste: _____ (If yes, indicated where waste will be stockpiled & duration.) _____

The necessary requirements for the request are completed below.

LANDFILL CERTIFICATION

This facility certifies that this request to accept and dispose non-hazardous industrial waste is complete and that to the best of our knowledge and belief the information contained herein is true and accurate. We understand that this request for disposal must be approved by the Department and necessary analytical testing may be ordered and results reviewed before disposal will be allowed. This facility further certifies that we have read and understand Dakota County Ordinance 110, Solid Waste Management, and that the proposed acceptance meets the requirements of Section 5.02(A). We further agree to comply with said Ordinance requirements regarding Section 5.02(C).

Signature

Title

Date



Requested Disposal Facility: --- Select a Facility ---	Waste Profile #
Sales Rep <i>It.</i>	

Saveable fill in form. Restricted printing until all required (yellow) fields are completed.

I. Generator Information

Generator Name:			
Generator Site Address:			
City:	County:	State: -- Select a State --	Zip:
State ID/Reg No:	State Approval/Waste Code: (if applicable)		NAICS # :
Generator Mailing Address (if different):			
City:	County:	State: -- Select a State --	Zip:
Generator Contact Name:			Email:
Phone Number:	Ext:	Fax Number:	

Ila. Transporter Information

Transporter Name:		Contact Name:
Transporter Address:		
City:	County:	State: Zip:
Phone Number:	Fax Number:	State Transportation Number:

Ilb. Billing Information

Bill To:	Contact Name:		
Billing Address:	Email:		
City:	State:	Zip:	Phone:

III. Waste Stream Information

Name of Waste:	
Process Generating Waste:	
Physical State: ☐ SOLID ☐ SEMI-SOLID ☐ POWDER ☐ LIQUID	
Method of Shipment: ☐ BULK ☐ DRUM ☐ BAGGED ☐ OTHER:	
Estimated Annual Volume:	-- Select Volume Type --
Frequency: ☐ ONE TIME ☐ ANNUAL	
Disposal Consideration: ☐ LANDFILL ☐ SOLIDIFICATION ☐ BIOREMEDIATION	

IV. Representative Sample Certification

☐ NO SAMPLE TAKEN

is the representative sample collected to prepare this profile and laboratory analysis, collected in accordance with U.S. EPA 40 CFR 261.20(c) guidelines or equivalent rules?	☐ YES or ☐ NO
Sample Date:	Type of Sample: ☐ COMPOSITE SAMPLE ☐ GRAB SAMPLE
Sample ID Numbers:	



REPUBLIC SPECIAL WASTE PROFILE (continued)
SERVICES

Page 2 of 2

Waste Profile #

V. Physical Characteristics of Waste

Characteristic Components		% by Weight (range)			
1 .					
2 .					
3 .					
4 .					
5 .					
Color	Odor (describe)	Does Waste Contain Free Liquids? ☐ Yes or ☐ No	% Solids	pH:	Flash Point or

Attach Laboratory Analytical Report (and/or Material Safety Data Sheet) Including Chain of Custody and Required Parameters Provided for this Profile

Does this waste or generating process contain regulated concentrations of the following Pesticides and/or Herbicides: Chlordane, Endrin, Heptachlor (and it epoxides), Lindane, Methoxychlor, Toxaphene, 2,4-D, or 2,4,5-TP Silvex as defined in 40 CFR 261.33?	Yes or ☐ No
Does this waste contain reactive sulfides (greater than 500 ppm) or reactive cyanide (greater than 250 ppm) [reference 40 CFR 261.23(a)(5)]?	Yes or ☐ No
Does this waste contain regulated concentrations of Polychlorinated Biphenyls (PCBs) as defined in 40 CFR Part 761?	Yes or ☐ No
Does this waste contain concentrations of listed hazardous wastes defined in 40 CFR 261.31, 261.32, 261.33, including RCRA F-Listed Solvents?	Yes or ☐ No
Does this waste exhibit a Hazardous Characteristic as defined by Federal and/or State regulations?	☐ Yes or ☐ No
Does this waste contain regulated concentrations of 2,3,7,8-Tetrachlorodibenzodioxin (2,3,7,8-TCDD), or any other dioxin as defined in 40 CFR 261.31?	Yes or ☐ No
Is this a regulated Radioactive Waste as defined by Federal and/or State regulations?	☐ Yes or ☐ No
Is this a regulated Medical or Infectious Waste as defined by Federal and/or State regulations?	☐ Yes or ☐ No
Is this waste a reactive or heat generating waste?	☐ Yes or ☐ No
Does the waste contain sulfur or sulfur by-products?	☐ Yes or ☐ No
Is this waste generated at a Federal Superfund Clean Up Site?	☐ Yes or No
Is this waste from a TSD facility, TSD-like facility or waste consolidator?	☐ Yes or No

VI. Certification

I hereby certify that to the best of my knowledge and belief, the information contained herein is a true, complete and accurate description of the waste material being offered for disposal and all known or suspected hazards have been disclosed. All Analytical Results/Material Safety Data Sheets submitted are truthful and complete and are representative of the waste.

I further certify that by utilizing this profile, neither I nor any other employee of the company will deliver for disposal or attempt to deliver for disposal any waste which is classified as toxic waste, hazardous waste or infectious waste, or any other waste material this facility is prohibited from accepting by law. I shall immediately give written notice of any change or condition pertaining to the waste not provided herein. Our company hereby agrees to fully indemnify this disposal facility against any damages resulting from this certification being inaccurate or untrue.

I further certify that the company has not altered the form or content of this profile sheet as provided by Republic Services Inc.

Authorized Representative Name/Title (Type or Print)

Company Name

Authorized Representative Signature

Date

APPENDIX C

REPRESENTATIVE SAMPLING FACT SHEET

**REPRESENTATIVE SAMPLING INFORMATION
FOR
NON-HAZARDOUS INDUSTRIAL SOLID WASTE GENERATORS
USING PINE BEND LANDFILL**

It is recommended that you ascertain any and all regulations and requirements with your environmental consultant or attorney. It is further recommended that this information sheet be used for educational purposes only and should be supplemented by specific process and regulatory knowledge of the industrial solid waste (ISW) generator.

Why is it important to take a representative sample?

A representative sample is required by regulation and allows you to properly characterize your ISW. Once done, you can develop proper techniques to manage your ISW in accordance with applicable regulations.

What is a representative sample?

A representative sample is:

- A sample that has the properties and chemical composition of the ISW from which it was collected.
- A sample that exhibits average proportions of the ISW as a whole.

How is a representative sample obtained?

The first thing to do is use the proper sampling equipment.

The proper sample container to use depends on the type of material being sampled and what analyses will be run on the sample. The minimum size of the container should be 8 ounces although 16-ounce containers are preferred. All containers and utensils used for sampling must be new or chemically cleaned with appropriate cleaners. Polyethylene is an acceptable container for metals analysis while organics testing requires a glass container.

Use a clean utensil such as a steel, aluminum or plastic scoop or shovel (not chrome plated). A stainless steel bowl/container is recommended for mixing. A plastic bucket works well for mixing a composite sample for metals analysis. It is crucial that the sample is not contaminated during and after sampling.

If you are sampling two different ISW streams, the sampling scoop, shovel, and container must be well cleaned between samples to avoid contamination.

The proper procedure for taking the sample is the next thing to consider.

If you are taking a composite sample from a process line, obtain samples from the line over a one to four hour period, mix the samples and take a final sample from the mixture. If you are taking a composite sample from a small homogeneous ISW pile (less than 25 cubic yards), a box or a roll-off container, obtain samples from a number of depths

and locations (6 to 7), mix them well in a container and take a final sample from the mixture. Begin sampling at the bottom of the pile.

If you are taking a **composite sample from a large homogeneous ISW pile (greater than 25 cubic yards)**, follow the same procedure as above but take additional samples.

If you are taking a sample from **a single drum of ISW containing a loose material or sludge**, use a sampling tube to get a sample from top to bottom of the drum.

If you are taking a sample from **more than one drum of ISW**, take one composite sample from each ten drums of ISW (or fewer if less than ten drums are delivered).

If you are taking a sample from ISW **with more than one layer**, take enough samples at each layer to ensure that all wastes are being represented properly.

Helpful Hints

Here are some additional helpful hints on representative sampling.

- You should obtain EPA Publication SW846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", which establishes the industry standards on representative sampling techniques. The Dakota County Environmental Management Department requires that all sampling follow this protocol.
- Your laboratory may be an asset. Your lab may select and supply you with the proper containers for the samples. Laboratory personnel will usually come on site and take the samples if requested. The laboratory may also provide you with sample preservation guidelines.
- It is suggested that records of sample collection be kept. These records should include such information as name of the collector, when and where the sample was taken, equipment used, climatic conditions, sample number and verification that protocol was followed.
- It is recommended that the person with the most knowledge of the ISW stream be the sample collector. In this way, accuracy and precision will be maximized and safety concerns can be minimized.

APPENDIX D

PRE-APPROVAL SAMPLING FORM

DAKOTA COUNTY ENVIRONMENTAL MANAGEMENT DEPARTMENT

Pre-Approval Sampling Form

This form must accompany all applications for industrial waste disposal. All sampling must follow EPA's SW 846 Procedures: Failure to follow these procedures may result in the application for Industrial Waste Disposal being denied.

Generator Name: _____

Site Address: _____

City, State, Zip: _____

Description of the process and/or waste: _____

Does the waste vary from batch to batch? ☐ Yes ☐ No If yes, how? _____

Is the waste homogeneous? _____ If No, how many layers? _____

Amount of waste (gal/lbs/yds): _____ Per (wk/mo/yr): _____

Has the waste been mixed with anything prior to sampling (include solidification)? If yes, describe: _____

When was the waste generated? _____

Location of sampling (e.g. the middle of the drum, the filter from the upper left corner of the paint booth). _____

Time of sampling: _____ a.m. / p.m. Date: _____

Name of sampler: _____

Number of samples taken: _____

Is this sample a composite? _____ If yes, from how many subsamples? _____

Method of sampling: (grab, core) _____

Equipment used for sampling, including a description of the sample container: (attach a copy of sampling plan). _____

Has the waste been sample previously? ☐ Yes ☐ No

If yes, when? (Attach all previous test results) _____

I certify that the above information is true and correct to the best of my knowledge.

Sampler's Signature

Date

Landfill Certification

This facility certifies that we have reviewed the results of the generator's analytical testing conducted on this waste and that, based on those results, the waste meets the requirements of Dakota County Solid Waste Management Ordinance 110, Section 5.02(A)(4). This facility further certifies that we have utilized best efforts to review all of the data and information reasonably available regarding this waste and to the best of our knowledge believe the analysis that was done was appropriate for the waste proposed for codisposal and meets the requirements of Chapter 5 of Ordinance 110, including Section 5.02(A)(7).

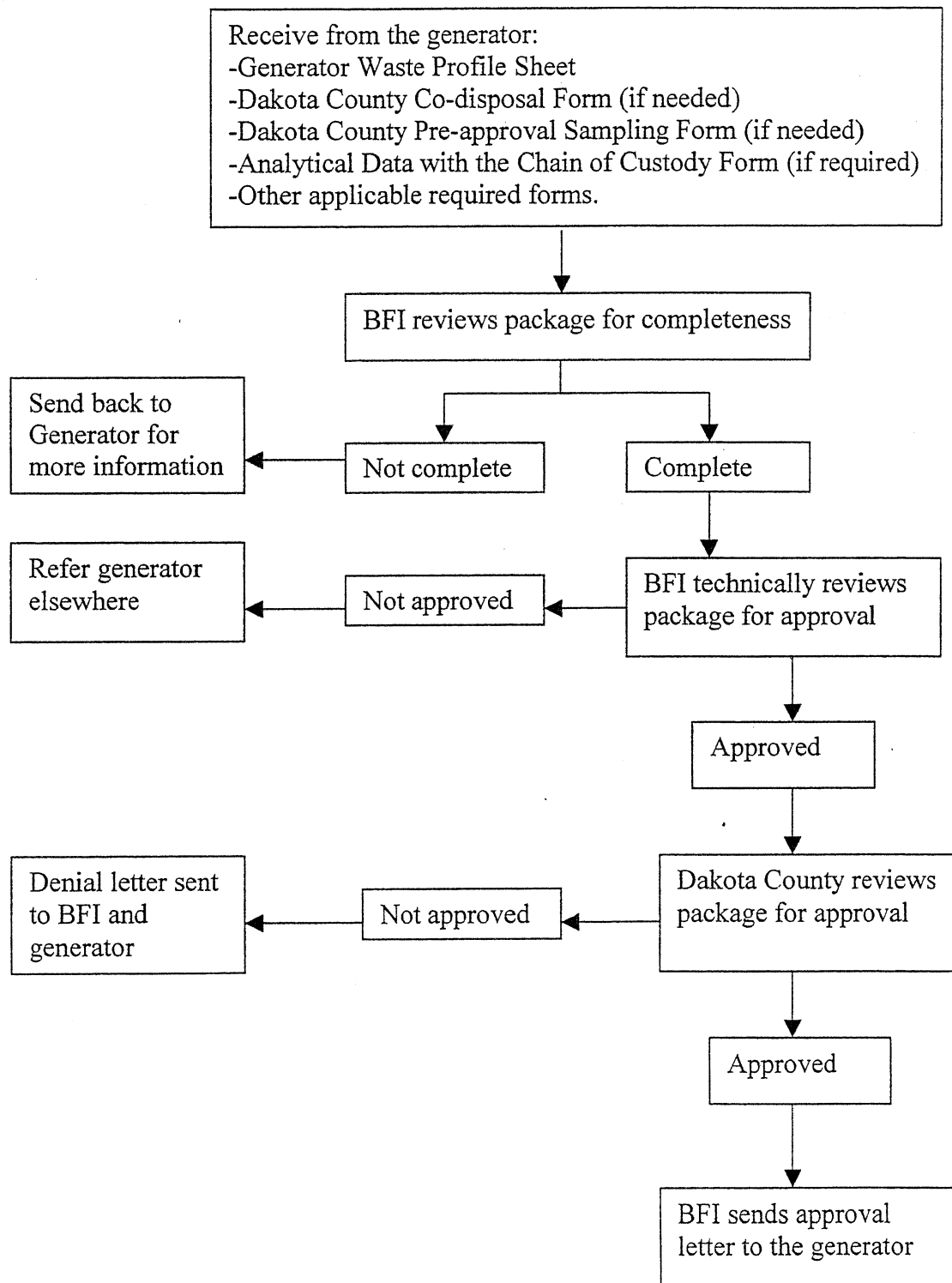
Signature

Date

APPENDIX E

INDUSTRIAL SOLID WASTE EVALUATION PROCESS

INDUSTRIAL SOLID WASTE EVALUATION PROCESS PINE BEND LANDFILL



APPENDIX E - 1

ACCEPTANCE POLICY FOR CLEAN FILL AND ALTERNATIVE COVER MATERIAL

ACCEPTANCE POLICY FOR CLEAN FILL AND ALTERNATIVE COVER MATERIAL

The following are procedures used to evaluate clean fill and other materials for use as daily cover:

- Materials with not soil-like in nature must be approved by MPCA prior to use as daily cover.
- Materials with soil-like in nature are classified in three categories, clean fill material such as virgin soil or sand from a known non-contaminated site, contaminated soil such as petroleum or other contaminants impacted soil, and unregulated fill. Prior to accepting any material for use as daily cover, the following procedures will be followed:

History/Background: Site contractor or source provider must provide Pine Bend Landfill documentation of the history of the site, included but not limited to location, current and past use of the site, and any past or current known contamination sources. Example of such documentation includes Phase I Investigation study.

Evaluation: If the soil material is generated from a contaminated site, it will be considered as industrial solid waste, and will therefore be evaluated and managed in accordance with this Plan. The site owner or contractor will be required to submit analytical data of the soil. Parameters to be tested for will depend on the contaminants existed in the soil. The contaminated soil must meet Dakota County's computerized model standards or the Tier II Industrial Soil Reference Value whichever is more restrictive. If the clean fill material comes from a known non-contaminated soil, no analytical data will be required.

Inspection: Prior to accepting any material, Landfill staff will inspect the site where the material is generated from to ensure that the material is suitable for use as daily cover and is free of construction debris, large boulders and other waste materials. Landfill staff will also visually inspect the fill material while it is being dumped at the landfill. In addition, the contaminated soil will be fingerprinted in accordance to the Landfill's waste acceptance policy.

APPENDIX F

RADIATION ALARM PROCEDURE

RADIATION MONITORING PROCEDURE

1.0 SURVEY PROCEDURES

The following procedure should be used to perform the initial waste vehicle scan with the stationary monitor. A radiation, contamination, and characterization survey with portable survey instruments should be conducted on all vehicles that cause an Action Level 1 alarm. The radiation, contamination and characterization surveys should be performed by a Radiation Supervisor, by a consultant who is contracted by the facility, or potentially by the appropriate radiation protection authority (ARPA). A list of state agencies is located in Attachment G.

1.1 Vehicle Scan

The stationary radiation monitor should be prepared for use daily according to the manufacturer's instructions and by conducting the response and alarm checks and noting the background reading on Attachment E, "Stationary Monitor Response Checks". The vehicle should be stopped at the entrance to the scale before entering the detection area of the stationary monitor. The scalehouse personnel should signal the vehicle to proceed onto the scale and through the scale monitor. If there is a radiation alarm, the radiation monitor should be reset and the driver should be requested to drive through the monitor a second time. If there is no alarm on the second pass, the load may be accepted as normal waste and no documentation is necessary. If there is also an alarm on the second pass, the driver should be instructed to move the vehicle to the DA for the radiation survey.

Note: If the radiation level from the vehicle is observed to be more than triple the alarm set point above background, a second pass is not necessary and the vehicle may be directed to the DA for the radiation survey.

1.2 Radiation Survey

As applicable, the portable radiation survey meter should be prepared for use according to the manufacturer's instructions and by conducting the response check and noting the background reading. The instrument information and the response check and background information should be recorded on the "Vehicle Survey Form", Attachment F. If the driver is a source of radiation, have the driver move far enough away to not interfere with the vehicle survey.

The vehicle should be approached with the survey meter on the lowest range that gives a reading that is not off-scale. The range control should be adjusted as needed to keep the reading on-scale. The surface of the vehicle should be surveyed with the detector no more than 2 inches (5 centimeters) from the accessible surface. The location(s) with the highest radiation reading should be marked and the radiation level recorded on the survey form. The inside of the cab should be surveyed if radiation levels outside the cab are greater than 10 $\mu\text{R/hr}$ above background.

Note: If an exposure rate from the vehicle or any container exceeding 50 mR/hr is observed at any time during the survey, terminate the survey and restrict personnel access in those areas with radiation levels in excess of 2 mR/hr. Notify the ARPA and take no further action without the approval of the ARPA.

Note: If the initial survey detects dose rates greater than 50 mR/hr in the cab of the vehicle or removable contamination in excess of 6,600-dpm/300 cm², the vehicle cannot be moved. If the driver/passenger is a source of radiation and no radiation levels in excess of 10 μ R/hr above background are found on the vehicle, the load can be processed as normal waste. The event should be documented for the annual report.

If the driver/passenger is not the source of the radiation and no exposure rates in excess of 50 mR/hr were observed, the radiation survey should be completed and the contamination survey and characterization of the waste should be performed.

If no radiation levels in excess of the stationary alarm limits are found during the survey with the portable instrument, the waste may be processed as normal waste. The event should be documented for the annual report. The difference in the two readings can, in some cases, be caused by differences in the energy response of the stationary and portable detectors or the summing of the readings of the two stationary detectors. If the difference cannot be resolved, the discrepancy should be reported to the ARPA, and the waste processed according to the ARPA instructions.

1.3 Contamination Survey

As applicable, the portable contamination survey meter should be prepared for use according to the manufacturer's instructions and by conducting the response check and noting the background reading. The instrument information and the response check and background information should be recorded on the survey form. A location should be chosen that is most likely to have removable contamination and an area of approximately 300 cm² on the exterior surface of the vehicle or object should be swabbed with a wipe or smear. If necessary, move to an area with a normal background reading. Measure the count rate with the smear or wipe in the position that was used for calibration, with the smear and detector as close as possible without touching, and record the reading on the survey form. Determine the disintegration rate for the removable activity and record on the survey form. If the removable activity is greater than 6,600-dpm/300 cm², the event is classified as Level 2. No action is required for removable activity less than 6,600 dpm/300 cm².

1.4 Characterization

Characterization of the RAM in the waste is the identification of the radionuclide and any additional information that can be used to determine the proper disposition of the waste. A gamma ray detector with a multi-channel analyzer is usually used to determine the radionuclide(s). Additional information might be available if the origin of the waste is known. Characterization may also be accomplished by visual observation, if the radiation source is visible in the waste or has been separated from the waste. The identification of the nuclide from

a label is sufficient for characterization and might be the only available method for an alpha or beta radiation source.

1.5 Visual Inspection

If an item is observed to have a RAM label, immediately notify the Radiation Supervisor, who will direct the response and determine the appropriate survey and classification procedures. The ARPA or the consultant may be contacted for assistance.

2.0 ALARM RESPONSE

2.1 Event Classification

The results of the radiation and contamination survey are used to classify the event. If the alarm was caused by RAM in the waste and the dose rate at the surface of the vehicle or a waste container is 50 mR/hr or greater, or the dose rate in the cab is 2 mR/hr or greater, or the removable contamination on the surface of the vehicle or waste container exceeds 6,600 dpm/300 cm², the event is classified as Level 2. Proceed with the Level 2 response, as indicated in the Follow-up Action Flow Chart - Level 2 in Attachment C.

If the alarm was caused by RAM in the waste and the Level 2 conditions are not met, the event is Level 1. Proceed with the Level 1 response as indicated in the Follow-up Action Flow Chart - Level 1 in Attachment C.

2.2 Action Level 1 Response

If the alarm was caused by RAM in the waste and the Level 2 conditions are not met, the event is Level 1. Under an Action Level 1 Scenario, an alarm would sound at the scalehouse indicating the presence of radioactive material in the incoming waste. The facility operator must then determine the cause of the alarm, identify the type of radioactive material present and the facility's next course of action. If the radioactivity in the solid waste is from the natural environment; contaminated waste from a medical patient that will decay rapidly; or an unlicensed, unregulated consumer item, the ARPA would likely allow the waste to be disposed of at the solid waste facility.

Examples of waste containing radioactive material under an Action Level 1 scenario may include solid waste from a patient's home, naturally occurring radioactive materials in soil and rocks, or consumer products such as smoke detectors.

Note: If dose rates of 50 mR/hr or greater are measured on waste containers during the response to an Action Level 1 event, the event becomes Action Level 2. Terminate any further actions, restrict access in areas with dose rates of 2 mR/hr or greater and notify the ARPA for instructions.

2.3 Action Level 2 Response

Although less likely, it is possible that radioactive sources of a more serious nature may become mixed with municipal, commercial, or industrial waste. If the vehicle radiation or contamination levels exceed the following values, the facility operator must follow guidelines under an Action Level 2 scenario. An Action Level 2 response is required if:

- The radiation level on the exterior surface of the vehicle or a package of waste is 50 mR/per hour or greater;
- The radiation level in the cab of the vehicle is 2 mR/hr or greater; or
- Removable contamination exceeding 6,600-dpm/300 cm² is found on the exterior of the vehicle or package of waste.

Restrict access in areas with dose rates of 2 mR/hr or greater. Notify the ARPA IMMEDIATELY. Do not proceed further without approval of the ARPA. In most cases, a trained health physicist or representative of the ARPA will respond to the site and ensure that the radioactive material is properly identified, handled, and returned to the point of origin or disposed at a licensed low-level radioactive waste disposal facility.

Notify Republic Services Corporate Compliance immediately in the event of a verified Action Level 2 events.

If a vehicle that has caused an Action Level alarm leaves the site without receiving a DOT Exemption or an ARPA exemption for household waste, notify state or local law enforcement. Provide the state or local law enforcement with information on the vehicle make, color, carrier name, license plate number, time it departed the site, the direction of travel and the destination, if known. Also, notify the ARPA. Refer to the "Notification Sheet" for contact information in Attachment D. A trailer with waste may be left in the DA and the tractor removed if the tractor has no removable contamination and its surface gamma exposure rate does not exceed 10 µR/hr above background.

3.0 DISPOSITION OF RADIOACTIVE MATERIAL

The management of the solid waste facility may refuse to accept any waste containing RAM that is not considered appropriate for the solid waste facility. The facility to receive the waste must agree to accept it. A United States Department of Transportation (DOT) exemption for the waste should be received from the ARPA before the vehicle can leave the facility.

Radioactive material identified as naturally occurring radioactive material (NORM) in its natural physical state or potassium-40 (K-40) can be accepted for processing at any facility because there are generally no restrictions on the processing or disposal of this material.

3.1 Short Half-life Medical Radionuclides

- At a Transfer Facility - If RAM that has been identified as a radionuclide used for medical or veterinary procedures having a half-life of 65 days or less is found in the waste, the waste shall be rejected and returned to its origin or sent to a facility permitted to dispose of it. A DOT exemption form must accompany the waste vehicle.
- At a Landfill - If RAM that has been identified as a radionuclide used for medical or veterinary procedures having a half-life of 65 days or less is found in the waste, the waste may be disposed following characterization and proper recordkeeping.
- At a Processing Facility – If RAM that has been identified as a radionuclide used for medical or veterinary procedures having a half-life of 65 days or less is found in the waste, the ARPA must be contacted for disposal options.

3.2 Consumer Products

Consumer products (such as smoke detectors, watch/clock dials, exit signs, or certain glazed glass products) containing RAM generally should not be accepted for processing without specific approval from the ARPA. This plan allows for specific individual items of these exempt sources to be disposed but prohibits the disposal of bulk quantities without written approval from the ARPA. If bulk quantities of a RAM-containing consumer product are found in the waste through the implementation of this plan, the generator of the waste should be identified (if possible), the waste rejected, and returned to its origin using the appropriate DOT exemption form.

3.3 Potassium-40

Material in which the radiation source is K-40 can be accepted without restrictions. This radionuclide is naturally occurring and is a small fraction of all potassium atoms. It is normally present in the body in the normal equilibrium concentration of potassium and is a normal part of the diet. The presence of potassium in some materials might cause an Action Level 1 alarm, but the concentration of K-40, even in pure potassium, is too low to produce a significant external radiation hazard to personnel. Ingestion or inhalation of additional amounts should not significantly change the normal equilibrium concentration of potassium and should have little effect on the dose normally received by the body from this isotope.

3.4 NORM

Naturally occurring radioactive material (NORM) is found in the undisturbed natural environment, such as soil or rocks, which have not been processed to increase the concentration of radioactive material. This material should not be accepted without approval from the Republic Services Special Waste Department. NORM is primarily the uranium and thorium natural decay series radionuclides including isotopes of uranium, thorium and radium as found in nature.

3.5 TENORM

TENORM is technically enhanced naturally occurring radioactive material. This is material in which the concentration of NORM has been increased by human activities, such as certain wastewater treatment sludges. TENORM waste should not be accepted at any solid waste facility for disposal without specific approval of the ARPA and approval from the Republic Services Special Waste Department.

3.6 Other Radioactive Material

RAM that is under a United States Nuclear Regulatory Commission (NRC) or Agreement State specific or general license shall not be accepted at any solid waste facility and the ARPA shall be contacted for instructions.

3.7 Storage

In some instances it may be necessary to store a load of waste or items containing RAM at solid waste facility until disposal can be arranged. Storage must be in a secure location. Radiation levels from the stored material must not exceed 0.05 mR/hr (50 μ R/hr) in unrestricted areas (e.g., facility fence line).

4.0 TRANSPORTATION OF WASTE CONTAINING RADIOACTIVE MATERIAL

Interstate transportation of RAM is regulated by the Hazardous Material Regulations of the DOT. These regulations contain requirements for packages, vehicles and training of drivers and persons authorizing shipments. The DOT has issued an exemption from these requirements for RAM that has been discovered in waste shipments. The ARPA is authorized to issue this exemption for waste shipments that have caused an alarm at a waste disposal site and must be returned to the place of origin or transferred to another disposal site. The exemption may not be issued for waste loads for which any of the following conditions apply:

- the dose rate at the surface of the vehicle or on individual waste containers exceeds 50 mR/hr;
- the dose rate in the driver's compartment of the vehicle exceeds 2 mR/hr; or
- there is removable contamination on the outside of the vehicle exceeding 6,600-dpm/300 cm².

4.1 DOT Exemption

The DOT exemption form should be completed by the Radiation Supervisor and submitted to the ARPA for approval. Upon receipt of an approved copy of the exemption, the Radiation Supervisor should provide a copy of the exemption to the driver with instructions on the destination for the shipment. The solid waste facility should keep a copy of the exemption for its records.

4.2 Household Waste

The DOT Hazardous Material Regulations do not apply to household waste, so a DOT exemption is not required for loads containing household waste. However, the ARPA must approve such shipments. The Exempt Material Transportation Approval Form for Household Municipal Waste must be submitted to the ARPA and approved before the load of waste can be transported. The solid waste facility should provide a copy of the exemption to the driver with instructions on the destination for the shipment. The solid waste facility should keep a copy of the exemption for its records.

4.3 Law Enforcement Notification

If a driver leaves the solid waste facility with a load of waste that has triggered the radiation monitor without an approved DOT exemption or an ARPA exemption for household waste, the solid waste facility should notify the state or local law enforcement of the violation with a description of the vehicle and any additional information that would assist the police.

5.0 RECORDS AND REPORTS

5.1 Daily Records

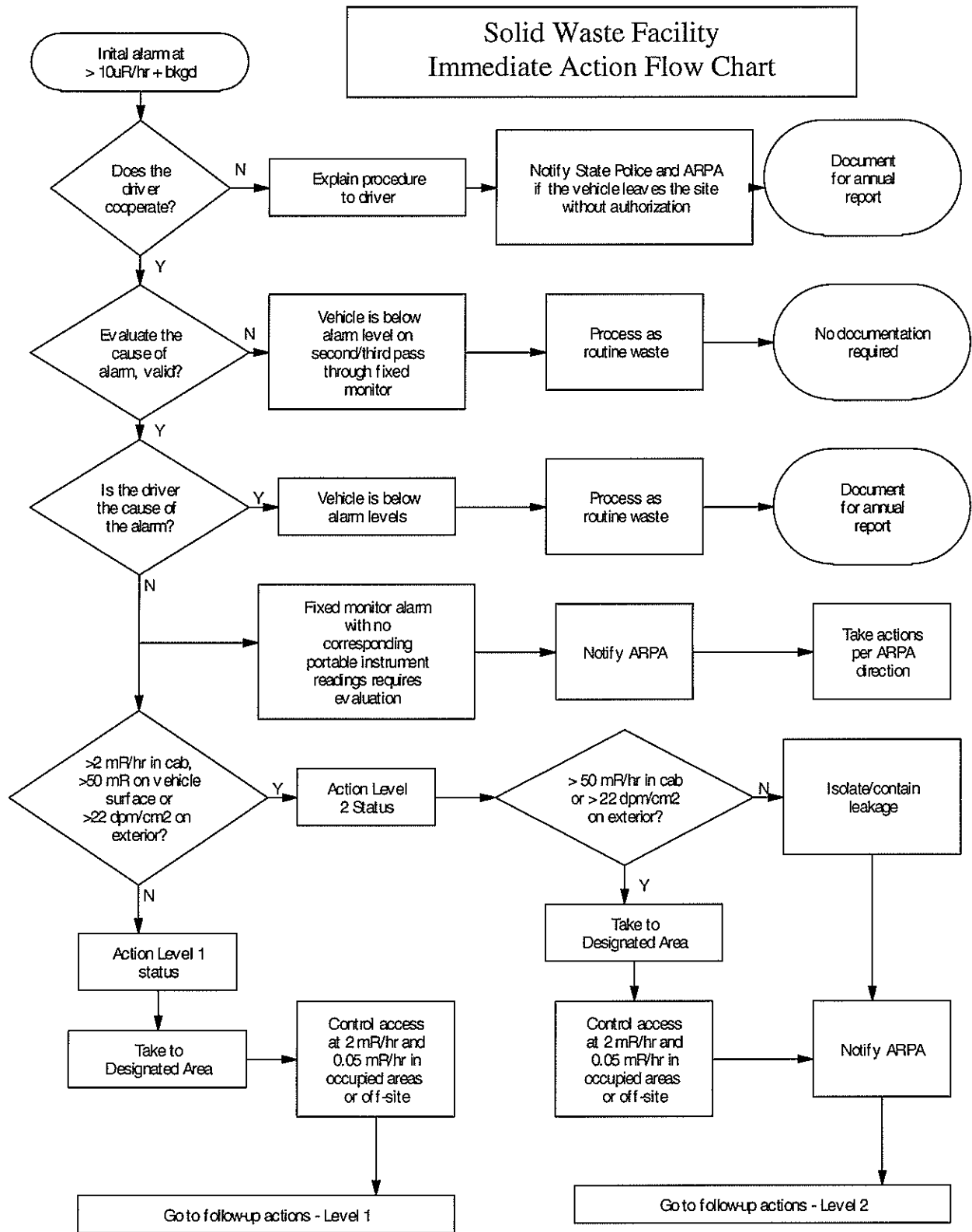
The daily record of disposal operations should include a record of each incident in which RAM is detected in waste loads. The record should include the following:

- The date, time and location of the occurrence
- A brief narrative description of the occurrence
- Specific information on the origin of the material, if known
- A description of the RAM involved, if known
- The name, address and telephone numbers of the supplier or handler of the RAM and the name of the driver
- The final disposition of the material.

5.2 Annual Operations Report

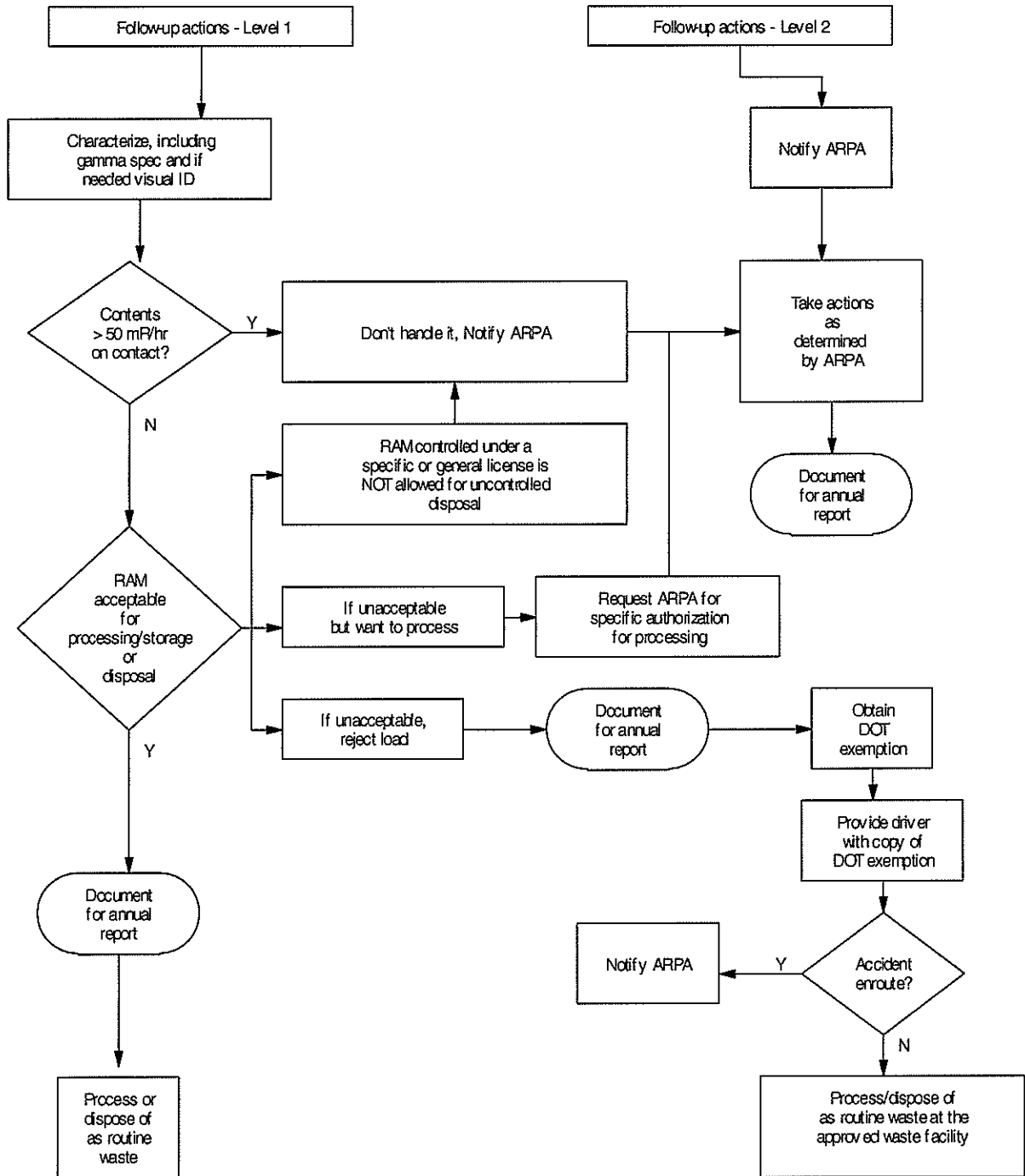
The annual operations report for the facility should include a record of detected RAM.

Attachment B
Immediate Action
Flow Chart



Attachment C
Follow-up Action
Flow Chart

Solid Waste Facility Follow-up Action Flow Chart



Attachment D
Republic Services
Notification Sheet



NOTIFICATION SHEET

Facility Name:

Address:

Phone:

FAX:

Facility Manager:

Phone:

RMP Supervisor:

Phone:

RMP Supervisor:

Phone:

ARPA:

Phone:

Attachment E
Stationary Monitor
Response Checks

Attachment F
Vehicle Survey
Form

VEHICLE SURVEY FORM

I. Initial Information

SURVEYOR NAME (Printed):	SURVEYOR SIGNATURE:
Alarm Date/Time:	Driver Name:
Truck License Plate No.:	Company Name:
DCSWA Permit No.:	Truck Type/Description:

II. Instruments Used

Survey Meter:	SN:	Cal Due:	Response OK?
MCA:	SN:	Cal Due:	Response OK?
Other:	SN:	Cal Due:	Response OK?

III. Holding Area Checks

Is the driver move far enough away to not interfere with the vehicle survey?		YES	NO
Abbrev. Vehicle Survey (☐ R/hr)	Background: _____ Front: _____ Back: _____ Left: _____ Right: _____		
Driver Survey Results (☐ R/hr)	Background: _____ Contact: _____		
Route Information:			

IV. Vehicle Survey: (Note all dose rates and units. Mark highest dose rate and circle on form.)

1. _____ 16. _____
CAB

2. _____ 11. _____

3. _____ 10. _____

4. _____ 9. _____

5. _____ 8. _____

6. _____ 7. _____

12. _____ 13. _____

14. _____
(Under)
15. _____

Large Area Smear (LAS)

(Outside of truck representative of the load)

Smear Area Description: _____

dpm = Smear cpm - Bkg cpm X 10 dpm/cpm

= _____ cpm - _____ cpm X 10 dpm/cpm

= _____ dpm/LAS

≥ 1000 dpm/LAS may indicate contamination present.

Isotopic Identification (from MCA)

Location of scan: _____

Dose Rate: _____ (for Classifying Truck)

Isotopes Identified: _____

Spectrum No.: _____

VEHICLE SURVEY FORM

V. Waste Load Preparation/Survey

Area/Vehicle Properly Posted?	Notifications Complete?	Initials:
-------------------------------	-------------------------	-----------

VI. RAM Retrieval and Characterization

RAM Dose Rate:	Contact:	30 cm (1 ft):	Initials:
RAM Separated from the Load?	YES/NO (circle one)		Initials:
Disposition of the RAM? (circle one)	PROCESSED/STORED		Initials:
If stored, item is to be: Double Bagged, Labeled, and Secured.			Initials:

RAM physical description/dimensions and other findings/comments.
--

VII. Area Recovery

Vehicle Survey Completed; All Smears < 1000 dpm/100 cm ² ?	Initials:
Clean Area Survey Completed; All Smears < 1000 dpm/100 cm ² ?	Initials:

Clean Area Survey Data:

Large Area Smear (LAS) present. Smear Area Description: _____ dpm = <u>Smear</u> cpm – <u>Bkg</u> cpm X 10 dpm/cpm = _____ cpm - _____ cpm X 10 dpm/cpm = _____ dpm/LAS	≥ 1000 dpm/LAS may indicate contamination <u>Comments:</u>
--	--

Survey No.:	Reviewed by:
-------------	--------------

Abbreviations:

□R/hr = micro-Rem per hour
 mR/hr = milli-Rem per hour
 1,000 R/hr = 1 mR/hr
 RAM = Radioactive Material
 dpm = disintegrations per minute
 cpm = counts per minute
 LAS = Large Area Smear

Action Level 2:

Dose Rate in Cab ≥ 2 mR/hr

 Dose Rate on Truck ≥ 50 mR/hr

 Contamination ≥ 2,200 dpm/100 cm²

APPENDIX G

RANDOM INSPECTION PROGRAM

USING RANDOM INSPECTIONS TO EXCLUDE THE RECEIPT OF HAZARDOUS, PCB, UNAPPROVED INDUSTRIAL AND UNAUTHORIZED WASTE

To meet the requirements under MPCA and federal regulations for detecting and preventing the disposal of hazardous, PCB, unapproved industrial and other unauthorized wastes, Pine Bend Landfill (PBL) has implemented a program of conducting random inspections on incoming waste loads of MSW from non-residential sources and construction waste or debris.

Inspections

PBL conducts at least ten (10) random inspections per month of incoming MSW loads from non-residential sources and at least one (1) random inspection of construction waste loads (provided construction waste or debris is received at the landfill during that month). The random inspection consists of the following:

1. Selecting a random load;
2. Directing the vehicle to a specified area for the inspection;
3. Ejection of the load;
4. Visually observing the load for unapproved ISW and unauthorized wastes under MPCA, Federal and Dakota County regulations;
5. Flagging or segregating suspect materials;
6. Determining if the waste is acceptable for disposal; and
7. Accepting or rejecting the reviewed wastes.

Recordkeeping

Inspections are recorded on Load Inspection Forms and are completed by the inspector during each inspection. These forms are maintained in the landfill's operating record for a period of at least three (3) years.

Training

Inspectors, operators and other applicable personnel are trained in the following areas:

1. Inspection for unapproved industrial wastes and unauthorized wastes;
2. Elements of a random inspection and how to conduct an inspection;
3. Procedures to follow when unapproved industrial wastes or unauthorized wastes are discovered; and
4. Documentation, notification and recordkeeping requirements.

Notification

PBL personnel will notify Dakota County and/or MPCA if regulated quantities of unauthorized wastes are discovered during a random inspection. Notification includes both written notification and notification by telephone, if required.

APPENDIX H

ACCEPTANCE AND HANDLING PROCEDURES FOR SPECIAL TYPES OF WASTE



CONTAMINATED, RECALLED, OUTDATED FOOD WASTE MANAGEMENT PROCEDURE

Purpose: The purpose of this document is to outline procedures for acceptance and disposal of contaminated, recalled, or outdated food wastes and prevent these wastes from negatively impacting Republic Services landfills.

Applicability: This guidance applies specifically to contaminated, recalled or outdated food wastes such as:

- Food products that have been damaged or contaminated as result of an accident.
- Meat or other food product for reasons such as contamination with infectious agent and/or biological toxin.
- Manufacturing food products that have become spoiled or outdated (NOT retail outdated and/or spoiled foods).

This guidance does not apply to the disposal of **retail** outdated and/or spoiled food waste. Unless local state regulation specifies otherwise, the disposal of retail outdated and/or spoiled food waste can be disposed of as a municipal solid waste.

Background: Contaminated, recalled food wastes are occasionally generated by the food industry during processing, distribution, and transport. Due to health, safety, and environmental concerns presented by these waste streams, the generator is required to remove them from their inventory and seek proper destruction. Land disposal is often requested as the preferred method of destruction of these wastes.

Potential Concerns:

- 1) Personnel – Management of food contaminated with infectious agent or biological toxin could pose health concerns to facility operational personnel. Knowing and implementing proper personal protection equipment management practices in the handling of the waste is an issue to be researched and addressed.
- 2) Public – High profile food recall events due to contamination by specific biological toxins, such as botulism or disposal of terrorist contaminated food, public opposition to disposal. Future ability to renew or expand the facility permit could potentially negatively impacted by the acceptance of these waste.
- 3) Regulatory – Acceptance of various contaminated foods may require additional prior approval by local or state regulatory agencies or pose conflict with the facility permit provisions.
- 4) Odor – Depending upon the type of recalled, contaminated, or outdated food waste, odor could be a concern to the disposal facility. Where the facility has

already experienced issues with odor, greater scrutiny should be given to the acceptance of and management procedure for these wastes.

- 5) Leachate – Certain infectious agents or biological toxins can survive the landfill environment and be transported by leachate to storage and treatment facilities. This could potentially result in greater exposure to the community of the agents or toxins as well as make the leachate unacceptable for disposal at a wastewater treatment plant.
- 6) Destruction Documentation – In many instances disposing of contaminated, recalled, outdated food wastes the generator or responsible party requires a certification of destruction of the wastes. This is an added administrative function to the disposal facility that must be incorporated into the management of the wastes. An example Certification of Destruction form is attached as Attachment 1.

Procedure: The following outlines the two (2) procedures, depending upon the type of contamination of the food wastes, to be followed for their acceptance and disposal.

1) Food products that have been damaged or contaminated as result of an accident.

Damaged or contaminated food products as a result of an accident are generally managed as a special waste and approval process is as outlined in Section 4.0 of the Republic Services Special Waste Management Plan.

2) Food product contaminated with infectious agent and/or biological toxin.

All food products contaminated with infectious agent and/or biological toxin are a special waste and considered a waste of significant concern. Consequently, for management of these food items the waste must be reviewed and approved by the Special Waste Review Committee prior to their acceptance. The facility must address the potential concerns listed above and demonstrate the ability to manage the material in a manner that minimizes the impact on the facility long-term.

If you have any questions regarding this guidance, please contact Corporate Director of Compliance.



ATTACHMENT 1

Example Certificate of Destruction



CERTIFICATE OF DESTRUCTION

I, _____, of _____
(RSI facility), hereby certify that the entire product described in Section A has
been properly and legally disposed of in _____
on _____, 20__ (attach any appropriate documentation).

I understand that due to potential concerns related to such things as health,
quality, and loss of goodwill, _____ (Company) does not
want this product to be eaten by consumers, even through so called "distressed
merchandise" channels of trade, and I further certify that these items were
destroyed in such a manner that it cannot be sold, and that the company has
taken every reasonable step to prevent resale of said items.

Name (print): _____

Signature: _____

Title: _____

Date: _____

Section A- Products Destroyed (attached additional sheets if needed):

Description of Product

Quantity or Weight



DISEASED ANIMAL MANAGEMENT PROCEDURE

Purpose: The purpose of this document is to outline procedures for acceptance and disposal of diseased animals and prevent these from negatively impacting Republic Services landfills.

Applicability: This guidance specifically applies to infected carcasses (and associated fecal matter) from animals that are diseased with the following:

- Avian Influenza (AI) or Avian Bird Flu
- Chronic Wasting Disease (CWD)
- Bovine Spongiform Encephalopathy (BSE) or Mad Cow Disease

This list of diseases is not all inclusive and there may be additional diseases that are incorporated into this guidance as they become known.

Background: The following provides information related to several diseases that potentially could infect animals proposed for disposal at a Republic Services landfill.

1) Avian Influenza (AI)

AI is a viral disease. The AI virus is relatively unstable in the environment and does not have the ability to withstand harsh environmental conditions. Physical factors such as heat, extremes for pH, UV irradiation and dryness can inactivate the AI virus. Because AI viruses have lipid envelopes, they are also inactivated by organic solvents and detergents in the absence of organic matter such as manure or soil. However, it is important to note that under certain conditions, such as cold temperatures or in fecal matter, the virus can survive for long periods of time in the environment.

The highly pathogenic form of AI (HPAI) is a serious threat to bird health. Occurrence of HPAI in the U.S. has been very infrequent, quickly contained and normally only affects the birds. The HPAI form of the disease has not been reported in the U.S. as of 2006, but has been reported in Europe, Asia and Africa. This form of the virus has the potential to spread to humans through sustained close contact with live birds.

The AI virus has the potential to generate large numbers of animal carcasses in response to an AI outbreak. Proper inactivation and elimination of the AI viruses in the diseased carcasses is essential in the control of contamination during transport and disposal at a Republic landfill.

2) Chronic Wasting Disease (CWD) and Bovine Spongiform Encephalopathy (BSE)

CWD and BSE are prion diseases. Prions are microscopic particles made of protein that can cause neurological disorders. Prions are extremely persistent and difficult to

render harmless. Alkaline hydrolysis tissue digestion is the only known method to destroy the disease-causing prions.

The extent of CWD in the United States has been limited to Colorado, Kansas, Montana, Minnesota, New Mexico, Oklahoma, South Dakota, Utah, Wisconsin and Wyoming. There have been three cases of BSE identified in the United States through 2008.

Presently, it is unknown whether prions can be safely contained within a landfill. The EPA is currently researching the fate and transport of prions in a landfill environment in an effort to develop best management practice guidelines.

Potential Concerns:

- 1) Personnel – Management of diseased animals could pose health concerns to facility operational personnel. Knowing and implementing proper personal protection equipment management practices in the handling of the waste is an issue to be researched and addressed.
- 2) Public – High profile infection events due to contamination by specific diseases may result in public opposition to disposal. Future ability to renew or expand the facility permit could potentially be negatively impacted by the acceptance of these wastes.
- 3) Regulatory – Acceptance of diseased animal carcasses may require additional prior approval by local or state regulatory agencies or may potentially pose conflict with the facility permit provisions.
- 4) Odor – Depending upon the quantity and condition of diseased carcasses, odor could be a concern to the disposal facility. Where the facility has already experienced issues with odor, greater scrutiny should be given to the acceptance and management procedure for these wastes.
- 5) Leachate – Certain infectious agents can survive the landfill environment and be transported by leachate to storage and treatment facilities. This could potentially result in greater exposure to the local community of the agents as well as make the leachate unacceptable for disposal at a wastewater treatment plant.
- 6) Destruction Documentation – In many instances, the generator or responsible party requires a “certification of destruction” upon disposal at the landfill. This is an added administrative function to the disposal facility that must be incorporated into the management of the wastes. An example Certification of Destruction form is attached as Attachment 1.

Procedure: The following outlines two (2) procedures to be followed, dependent upon the status of the carcass (infected vs. non-infected), to be followed for their acceptance and disposal.

- 1) **Carcasses not infected with AI, CWD, or BSE:** Non-diseased carcasses are generally managed as a special waste and approval process is as outlined in Section 4.0 of the Republic Services Special Waste Management Plan.

Information should be provided to document the carcasses are not infected. This information may be knowledge that the disease is not known to exist in the geographic location of the generated carcasses.

- 2) **Carcasses infected or potentially infected with AI, CWD or BSE:** Diseased carcasses are a special waste and considered a waste of significant concern. Consequently, management of these items must be reviewed and approved by the Special Waste Review Committee prior to their acceptance. The facility must address the potential concerns listed above and demonstrate the ability to manage the material in a manner than minimizes the impact on the facility long-term.

If you have any questions regarding this guidance, please contact Corporate Director of Compliance.



ATTACHMENT 1

Example Certificate of Destruction



CERTIFICATE OF DESTRUCTION

I, _____, of _____
(RSI facility), hereby certify that the entire product described in Section A has
been properly and legally disposed of in _____
on _____, 20__ (attach any appropriate documentation).

I understand that due to potential concerns related to such things as health,
quality, and loss of goodwill, _____ (Company) does not
want this product to be eaten by consumers, even through so called "distressed
merchandise" channels of trade, and I further certify that these items were
destroyed in such a manner that it cannot be sold, and that the company has
taken every reasonable step to prevent resale of said items.

Name (print): _____

Signature: _____

Title: _____

Date: _____

Section A- Products Destroyed (attached additional sheets if needed):

Description of Product

Quantity or Weight

APPENDIX I

REJECTED LOAD FORM



REJECTED LOAD FORM

1. Waste Authorization Number: _____
2. Waste Name: _____
3. Generator Name: _____
4. Generator Address: _____

5. Transporter Name: _____
6. Vehicle License Number: _____
7. Driver's Name: _____
8. Reason(s) for Rejection:

ATTACH A COPY OF ANY ON-SITE TEST RESULTS (if applicable) AND A COPY THE NON-HAZARDOUS SPECIAL WASTE MANIFEST.

Signature of Site Inspector

Date

APPENDIX J

HOUSEHOLD HAZARDOUS WASTE MANAGEMENT PLAN

HOUSEHOLD HAZARDOUS WASTE MANAGEMENT PLAN PINE BEND LANDFILL

I Introduction

The Minnesota Pollution Control Agency (MPCA) has responded to the increasing concern about hazardous waste generated from households by requiring that all solid waste facilities develop a Household Hazardous Waste (HHW) Management Plan.

BFI Waste Systems of North America, LLC has developed this plan for Pine Bend Landfill to address the disposal of Household Hazardous Waste.

II Dakota County Eco-Site

Dakota County Eco-Site collects HHW free of charge to County residents: Dakota County Eco-Site
3365 South Highway 149
Eagan, MN
612-891-7020

The following are some examples of the HHW Eco-Site accepts: fluorescent light bulbs, car batteries, cleaning chemicals, motor oil and filters, solvents, oil-based paints, pesticides (including herbicides and insecticides), and ballasts from lighting fixtures.

III Pine Bend Landfill HHW Program

Pine Bend Landfill provides training to appropriate employees in identifying HHW and handling household hazardous waste issues.

A four-foot sign is located near the scale house, which states that hazardous materials are not accepted for disposal. Another sign is located at the citizen's drop off area, which lists the types of household materials that are not accepted.

Pine Bend Landfill will coordinate with Dakota County to address HHW that is discovered in loads delivered to the landfill.

Pine Bend Landfill will assist Dakota County with educational programs. Typically, this type of assistance includes funding specific projects, volunteering and donations of equipment when necessary.

The landfill scale house has flyers that were developed by Dakota County describing their program; these are distributed to interested haulers and residents.

Additionally, Pine Bend Landfill will post any public announcement regarding future HHW programs offered by Dakota County.

Appendix B CON Analysis





Stantec Consulting Services Inc.
1800 Pioneer Creek Center
Maple Plain MN 55359-9000

September 15, 2022

Project/File: 227704791

Solid Waste Permit Document Coordinator

Minneapolis Pollution Control Agency
520 Lafayette Road North
St. Paul, Mn 55155-4194

Dear Solid Waste Permit Document Coordinator,

Reference: Pine Bend Landfill, Addendum submittal to the June 3, 2022 SW-45 Application for Permit Major Modification

On behalf of BFI Waste Systems of North America, LLC and the Pine Bend Landfill (PBL), please find enclosed an Addendum to the Application for Permit Major Modification SW-45, which was submitted on June 3, 2022 and was determined to be incomplete by the MPCA solid waste engineer to the Minnesota Pollution Control Agency (MPCA) as detailed in a July 6, 2022 letter to PBL. This submittal also includes the previously submitted MPCA Permit Application Forms for the Request for Major Modification Application of Permit SW-45. The MPCA Application Forms have been updated to reflect that this Application is for "Resubmittal of an Incomplete Application Originals submitted on June 3, 2002".

The addendum information is being submitted in both hard copy and electronic format. Copies of the original Request for Major Modification Application and EAW are not included with this submittal.

If you have any questions or comments, or require additional information, please contact us at 763-479-4226 or Ethan at 763-479-5187. Thank you for your assistance on this project.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Thomas Shustarich PE
Sr. Associate/Project Manager
Phone: (763) 479-4226
thomas.shustarich@stantec.com

Ethan Ketelsen PE
Project Engineer
Phone: (763) 479-5187
ethan.ketelsen@stantec.com

Reference: Pine Bend Landfill, SW-45 Application for Permit Major Modification

c: Mr. Aaron Janusz, Pine Bend Landfill
Mr. Tyler Kraft, Pine Bend Landfill
Ms. Ally Sutherland, City of Inver Grove Heights
Mr. Dave Magnuson, Dakota County
Mr. Abdi Hassan, MPCA
Ms. Beth Gawrys, MPCA
Mr. Dan Card, MPCA
Mr. Peder Sandhei, MPCA

Attachments: 1) Updated MPCA Application Forms
2) Addendum Letter

ATTACHMENT 1

MPCA Application Forms

Permit application for issuance, reissuance, or major modification

Solid Waste Permit Program

Doc Type: Permit Application

Print or type application: Before submitting, make a photocopy for your records. The Minnesota Pollution Control Agency (MPCA) will review the application for completeness and provide an official response to the permittees within 30 business days of receipt of the application.

MPCA Use Only	
AI number:	
Activity ID:	

Permit application assembly: To expedite the processing and review of your application, **put this form at the beginning** of your submittal package. Please place all checklists directly behind this application form in order by the number found on the bottom left hand corner of each checklist. **Do not place forms and checklist in an appendix** as this makes it difficult and time consuming for staff to locate them.

Completeness instructions: Without properly completed forms, an application cannot be processed and will be determined to be incomplete. All sections of this form must be completed. If portions do not apply to this facility, please indicate so with "n/a".

The completed form is to be returned to: **Solid Waste Permit Document Coordinator**
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Submittal: You must submit one (1) paper copy **and** one (1) electronic copy (i.e., disc or thumb drive) of your application.

Application is for (check appropriately): ☐ New permit ☐ Permit reissuance ☐ Major modification

☒ Resubmittal of 'Incomplete' application originally submitted on: 06/03/2022

Note: Different forms are available for Minor Modifications or Change in Ownership/Operation. (Found on the MPCA's Solid Waste Permitting website at <https://www.pca.state.mn.us/waste/solid-waste-permitting>.) (mm/dd/yyyy)

Facility name and address

Facility name: Pine Bend Landfill

Address: 2495 East 117th Street

City: Inver Grove Heights State: MN Zip: 55077

MPCA Region (check one): ☐ Brainerd ☐ Detroit Lakes ☐ Duluth ☐ Marshall ☒ Metro ☐ Rochester

Applications for metro facilities must include information to demonstrate the proposed facility is in accordance with the metropolitan policy plan (Minn. Stat. 473.823).

Is there an existing solid waste permit for the facility? ☒ Yes ☐ No

If yes, what is the permit number: PBR _____ or SW 45

Permit expiration date (mm/dd/yyyy): 07/30/2025

Checklists required (Please check all that are included with this application.)

All applicable checklists must be completed and submitted with this application. The MPCA will not process an application that does not include all of the required checklists. All checklists can be found on the MPCA's website at <https://www.pca.state.mn.us/waste/solid-waste-permitting>.

All solid waste facilities

☒ [Solid Waste Facility Application Checklist](#)

☒ [Metro permit review application checklist \(w-sw7-44\)](#)
(Required for metro facilities only)

Activity specific checklist

☒ [MSW Landfill Application Checklist](#)

☐ [SSOM Compost Facility Application Checklist](#)

☐ [MSW Combustor Ash Landfill Application Checklist](#)

☐ [Checklist for a Site Suitability Workplan for a Source-Separated Compost Facility](#)

☐ [Demolition Debris Landfill Application Checklist](#)

☐ [Refuse-Derived Fuel Processing Facilities Application Checklist](#)

☐ [Industrial Solid Waste Landfill Application Checklist](#)

☐ [Solid Waste Transfer Station Application Checklist](#)

☐ [Solid Waste Compost Facility Application Checklist](#)

I. Facility information

A. Legal description of property (acreage includes the entire area of the facility)

255 Acres $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ Section 33 T 27 N R 22 W
Township name: _____ MN Legislative District: _____
County: Dakota
Latitude: 44 Deg 46 Min 59 Sec North
Longitude: 93 Deg 3 Min 15 Sec West

B. General information

1. Directions to the facility (physical location) [Minn. R. 7001.3300, item A]:
Approximately 4,000 feet West of Highway 52 on north side of 117th Street
2. Current land use [Minn. R. 7001.3300, item N]:
MSW Landfill
3. Current zoning designation of the site and the surrounding areas within a quarter mile radius [Minn. R. 7001.3300, item N]:
Industrial site surrounded by mostly industrial usage and some agriculture to the west
4. Describe the key topographic features at and around the facility [Minn. R. 7001.0050, item F]:
See Section C below.
5. a) Has either an Environmental Assessment Worksheet (EAW) or Environmental Impact Statement (EIS) been completed in the past? [Minn. R. 7001.0050, item G] ☒ Yes ☐ No
If yes, please provide date of completion:
An EAW was prepared as part of the previous major modification (3:1 slopes vertical expansion) and submitted in the spring of 2016, the document was published in June of 2016.
b) Does this application require a new Environmental Assessment Worksheet (EAW) [Minn. R. 4410.4300] or Environmental Impact Statement (EIS) [Minn. R. 4410.4400]? ☒ Yes ☐ No
Explain:
Minnesota Environmental Review Rules, Section 4410, 4300, Subp. 17, state that an EAW is mandatory for the expansion of a mixed municipal solid waste project by at least 10 percent but less than 25 percent of the previous disposal capacity for 100,000 cubic yards or more of waste fill per year.
6. a) Have variances been approved in the past for this facility? ☐ Yes ☒ No
If yes, please list and provide approval dates and documentation:
b) Are there new variances requested in this application in accordance with Minn. R. 7000.7000? ☐ Yes ☒ No
If yes, list/explain (this should include the applicable rule citation for the requested variance(s)):
7. Is this facility in an environmental justice area? Please use the link below to identify ☐ Yes ☒ No
<http://mpca.maps.arcgis.com/apps/MapSeries/index.html?appid=f5bf57c8dac24404b7f8ef1717f57d00>
If yes, which areas apply?
☐ At least 40% of people reported income less than 185% of the federal poverty level
☐ 50% or more people of color
☐ Federally recognized tribal areas
8. a) Has Certificate of Need (CON) been granted in the past for this facility? ☒ Yes ☐ No
If yes, please list and provide approval dates and amounts issued:
2,398,746 tons approved on Decemebr 15, 2021.

b) Is additional CON requested in this application in accordance with Minn. Stat. 115A.917
Metropolitan Policy Plan?

☐ Yes ☒ No

C. Identify the following features within a one mile radius of the site

Feature	Name of feature	Distance	Units
Current and former water supply or monitoring wells	See attached CWI		
Airports (Minn. R. 7035.2815, subp 2(C))	N/A		
Lakes or ponds (Minn. R. 7035.2555, subp 2(A))	N/A		
Rivers, streams or springs (Minn. R. 7035.2555, subp 2(A))	Mississippi River	5,000 feet from NE corner of site	
Wetlands (Minn. R. 7035.2555, subp 2(B))	Various wetlands located on west 100 acre property	Adjacent	
Floodplains (Minn. R. 7035.2555, subp 1)	N/A		
Karst features (sinkholes, caves) (Minn. R. 7035.2815, subp 2(1); Minn. R. 7035.2825, subp 2(A))	N/A		
Parks or wildlife refuges	N/A		
Present or proposed access and major haul roads, and their weight restrictions	Highway 52	3,000 feet East of Site	
Easements or right-of-way	N/A		
Recreational areas	N/A		
Historical or archeological areas	N/A		

II. Waste activity information

A. Waste Activities that occur at the facility (complete a row for each waste activity area and each waste type)

[illegible]

B. Land disposal (complete a row for each separate waste disposal area, closed and active areas)

[illegible]

III. Operational information

- A. The facility will have capacity to receive 400 vehicles per day and expects to receive an average of 150 vehicles per day.** List the vehicle types (i.e., packer trucks, roll-off boxes, private citizen vehicles) using the facility including those that transport special wastes, such as tires or white goods.

Vehicle type	Vehicle capacity	Waste type transported
Transfer Trailer	80 to 100 CY	MSW
Packer Trucks	25 to 35 CY	MSW, Industrial
Private Citizen Vehicles	Varies	MSW
Side dumps, Roll-offs	10 to 15 CY	Contaminated soils

- B. Describe the equipment to be located and used on site at the facility, or the availability and arrangement for use of equipment kept off-site, managing the waste:**

836G and 836H Landfill Compactor, D8-T Dozer, Motor Grader, Wheel Loader 930, skid steer, 2 farm tractors with mower decks, water truck and other equipment as necessary

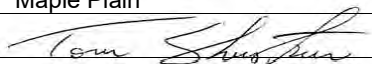
IV. Solid waste annual report contact

Print name: Aaron Janusz Title: Environmental Manager
Email: ajanusz@republicservices.com Phone: 651-434-9843
Organization: BFI Waste System of North America, LLC
Address: 2495 E 117th Street
City: Inver Grove Heights State: MN Zip: 55077

V. Signature and certification

A. Engineer (Consultant)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Print name: Thomas J. Shustarich License number: 21210
Title: Project Manager State licensed: MN
Email: thomas.shustarich@stantec.com Phone: (763) 479-4226
Organization: Stantec
Address: 1800 Pioneer Creek Center
City: Maple Plain State: MN Zip: 55359
Signature:  Date (mm/dd/yyyy): 6/1/2022

B. Permittees

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I further certify that the construction and operation of the above described facility will be in accordance with the plans, specifications, reports and related communications accepted by the MPCA and on file in its office; and in accordance with conditions imposed in the permit issued by the MPCA.

I certify that the facility is consistent with local solid waste management plans. I am aware an MPCA permit must be obtained before construction or operation of the facility may begin and all local permits, licenses or other government approval must be obtained before an MPCA permit can be issued.

I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment.

Landowner

Print name: Tyler Kraft Title: General Manager
Email: tkraft2@republicservices.com Phone: 651-403-2200
Organization: BFI Waste Systems of North America, LLC
Address: 11380 Courthouse Blvd
City: Inver Grove Heights State: MN Zip: 55077
Signature: *Tyler Kraft* Date (mm/dd/yyyy): 06/02/2022

Activity owner (Applicant)

Print name: Tyler Kraft Title: General Manager
Email: tkraft2@republicservices.com Phone: 651-403-2200
Organization: BFI Waste Systems of North America, LLC
Address: 11380 Courthouse Blvd
City: Inver Grove Heights State: MN Zip: 55077
Signature: *Tyler Kraft* Date (mm/dd/yyyy): 06/02/2022

Operator*

Print name: Ross Ziegenhagen Certification No: _____
Title: Operations Supervisor Expiration date: _____
Email: rziegenhagen@republicservices.com Phone: 651-308-1064
Organization: BFI Waste Systems of North America, LLC
Address: 2495 E 117th Street
City: Inver Grove Heights State: MN Zip: 55077
Signature: *Ros Ziegenhagen* Date (mm/dd/yyyy): 06/02/2022

***Provide the same information for other certified operators.**

Aaron Janusz
Type II Operator
Cert # 53794014
Expires 11/15/2022

Drake Vocovich
Type II Operator
Cert # 77732252
Expires 3/4/2025

VI. Local acknowledgment

This section is primarily meant to notify the county and local authorities of the applicant's intent so that all county and local ordinances and plans can be met. It is intended to validate that counties and local authorities were properly notified of this permit application for construction and operation. Signature by the county or local authority is not meant to imply approval.

A. County acknowledgment/permission (to be completed by County Solid Waste Administrator or County Zoning Administrator)

Print name: Dave Magnuson Title: Waste Regulations Supervisor
Email: dave.magnuson@co.dakota.mn.us Phone: 952-891-7551
Organization: Dakota County
Address: 14955 Galaxie Avenue
City: Apple Valley State: MN Zip: 55124
Signature: *Dave Magnuson* Date (mm/dd/yyyy): 06/02/2022

B. Local acknowledgment/permission (to be completed by local building or zoning office)

Print name: Ally Sutherland Title: Environmental Specialist
Email: asutherland@ighmn.gov Phone: 651-604-8511
Organization: City of Inver Grove Heights
Address: 8150 Barbara Avenue
City: Inver Grove Heights State: MN Zip: 55077
Signature: _____ Date (mm/dd/yyyy): _____

In lieu of completion of this part of the application, the applicant may submit documentation that the applicant has sent appropriate notification to the county and local authorities. Documentation must consist of copies of letters sent to the county and local authorities via certified mail, return receipt requested and copies of the signed return receipt.

C. Local approvals

Have all local licenses/approvals been acquired? ☐ Yes ☒ No

If yes, please list all approvals, include issuances and expiration dates (include a copy of each approval)

If no, please explain:

The Pine Bend Landfill is currently permitted and licensed, and in good standing with the City of Inver Grove Heights and Dakota County. Pine Bend will be working with the City and County to ensure that all permits and licenses are updated.

D. Solid waste transfer facilities and source-separated organic material (SSOM) compost facilities

The applicant for a transfer facility or SSOM compost facility must attach copies of all required municipal licenses/approvals, unless the applicant is a municipality. The MPCA will not process an application without these approvals. See Minn. R. 7001.3400, item C, or 7001.3375 item L for more details. If no municipal approvals are required the owner or operator must sign the statement below stating that no municipal approvals are required.

I certify, no municipal approvals are required:

Print name: _____ Title: _____
Signature: _____ Date (mm/dd/yyyy): _____

E. Land disposal facilities

The MPCA may not issue a permit for a new disposal area or an expansion of an existing disposal area prior to local units of government granting approval. All local approval will need to be obtained prior to issuance of the MPCA solid waste permit for disposal activities. See Minn. Stat. § 116.07, subd. 4j, item d(1) for more details.

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Organization: Dakota County
Address: 14955 Galaxie Avenue
City: Apple Valley State: MN Zip: 55124
Signature: _____ Date (mm/dd/yyyy): _____

B. Local acknowledgment/permission (to be completed by local building or zoning office)

Print name: Ally Sutherland Title: Environmental Specialist
Email: asutherland@ighmn.gov Phone: 651-604-8511
Organization: City of Inver Grove Heights
Address: 8150 Barbara Avenue
City: Inver Grove Heights State: MN Zip: 55077
Signature: *Ally Sutherland* Date (mm/dd/yyyy): 06/02/2022

In lieu of completion of this part of the application, the applicant may submit documentation that the applicant has sent appropriate notification to the county and local authorities. Documentation must consist of copies of letters sent to the county and local authorities via certified mail, return receipt requested and copies of the signed return receipt.

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ATTACHMENT 2

Addendum Letter



Stantec Consulting Services Inc.
1800 Pioneer Creek Center
Maple Plain MN 55359-9000

September 15, 2022

Project/File: 227704791

Mr. Abdi Hassan

Engineer

Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, MN 55155

Dear Mr. Hassan,

Reference: Addendum to the Request for Major Modification of Permit SW-45

This addendum letter submittal is in response to your July 6, 2022 incomplete determination letter following your review of the Major Modification Application submitted on June 3, 2022 for the Pine Bend Landfill (PBL), SW-45. The following information was requested as part of the resubmitted and revised application by the MPCA:

1. *The facility was issued CON on December 15, 2021 for the facility to continue to utilize existing permitted capacity. Tat space is expected to last the landfill for a period of approximately seven years. MPCA will open the nest metro CON process before metro area landfills are close to reaching their permitted capacities. However, the Pine Bend facility application cannot be considered complete under MPCA rules without having CON in place. Since the facility has not received CON for the applied expansion yet, the facility must wait to apply for expansion until after the next CON cycle which is expected to be in about 4-5 years depending on fill rates.*
2. *The MPCA Environmental Review Unit (ERU) has determined that the EAW submittal sent in by Pine Bend is incomplete due to the incomplete solid waste permit application and therefore ERU cannot process the EAW until a complete EAW (with complete solid waste permit application) is submitted.*

With regards to the above request for additional information, several meetings and conversations between PBL and MPCA management and staff have taken place per the MPCA request, PBL is providing an updated analysis of Airspace consumption versus CON consumption, which is included as an Attachment to this addendum. In support of that analysis, an Isopach Map detailing the remaining airspace at the Pine Bend Landfill as of May 2022 is also attached.

Reference: Addendum to the Request for Major Modification of Permit SW-45

It is PBL's understanding that this Addendum and attached information addresses the MPCA's request for additional information and the MPCA review of the request for Major Modification Application for SW-45 and the Environmental Assessment Worksheet may move forward.

Sincerely,

STANTEC CONSULTING SERVICES INC.

A handwritten signature in black ink that reads "Tom Shustarich". The signature is fluid and cursive, with the first name "Tom" and last name "Shustarich" clearly legible.

Thomas Shustarich PE
Sr. Associate/Project Manager
Phone: (763) 479-4226
thomas.shustarich@stantec.com

Attachments: Isopach Map
PBL Airspace Consumption vs CON Consumption

**Pine Bend Landfill
Airspace Consumption vs CON Consumption
9/6/2022**

Airspace Analysis

Remaining Permitted Airspace May 2022 (cy)	2,902,555	Stantec analysis of survey
Density (lb/cy)	1,350	Current density
Annual Tonnage (tons/yr)	480,000	2022 Actuals + Forecast
Annual Airspace Estimate (cy/yr)	711,111	
Years Airspace Remaining from May 2022	4.1	July 2026
Cell 5F-2 (Infrastructure Cell) Airspace (cy)	864,120	
Remaining Permitted Airspace Less 5F-2 (cy)	2,038,435	
Years Airspace Remaining Less 5F-2 from May 2022	2.9	April 2025

CON Analysis (Metro + Out-State)

Metro CON at Start of 2022 (tons)	2,398,746	Initial amount granted
Wright County (tons)	-	36,800 tons x 7 years
Tri-County (tons)	-	50,00 tons x 7 years
Total CON at Start of 2022 (tons)	2,398,746	
CON Consumed through May 2022 (tons)	161,238	Landfill Tonnage Reports
CON Remaining May 2022 (tons)	2,237,508	
Estimated Annual CON Consumption (tons/yr)	400,000	All MN MSW
Years CON Remaining from May 2022	5.6	January 2028

Appendix C Plan Sheets



BFI Waste Systems
of North America, LLC
Pine Bend Landfill
Inver Grove Heights, Minnesota
2022 Major Permit Modification

Prepared By:



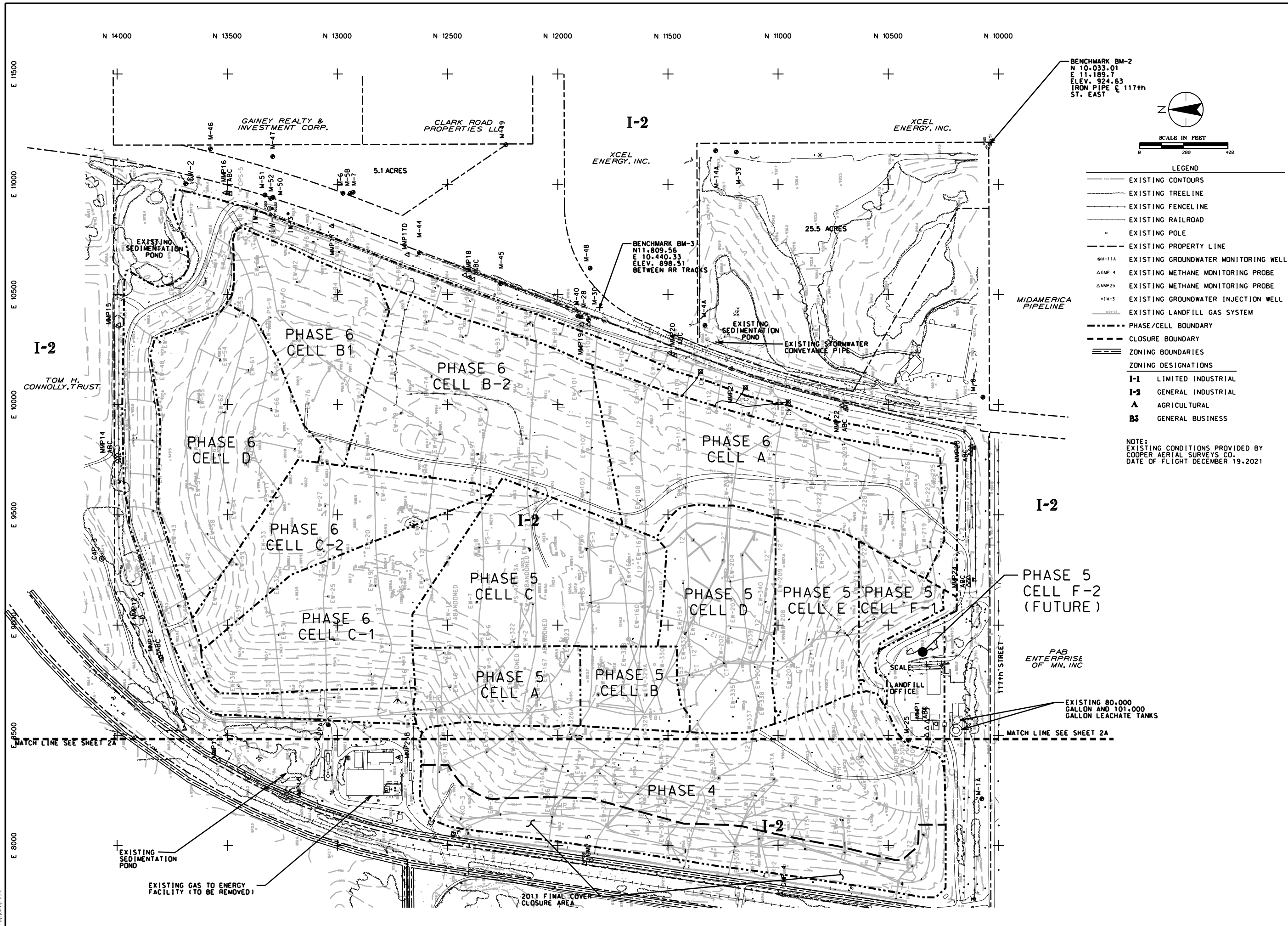
Stantec Consulting Services, Inc.
1800 Pioneer Creek Center
Maple Plain, MN 55359

2022.02.21

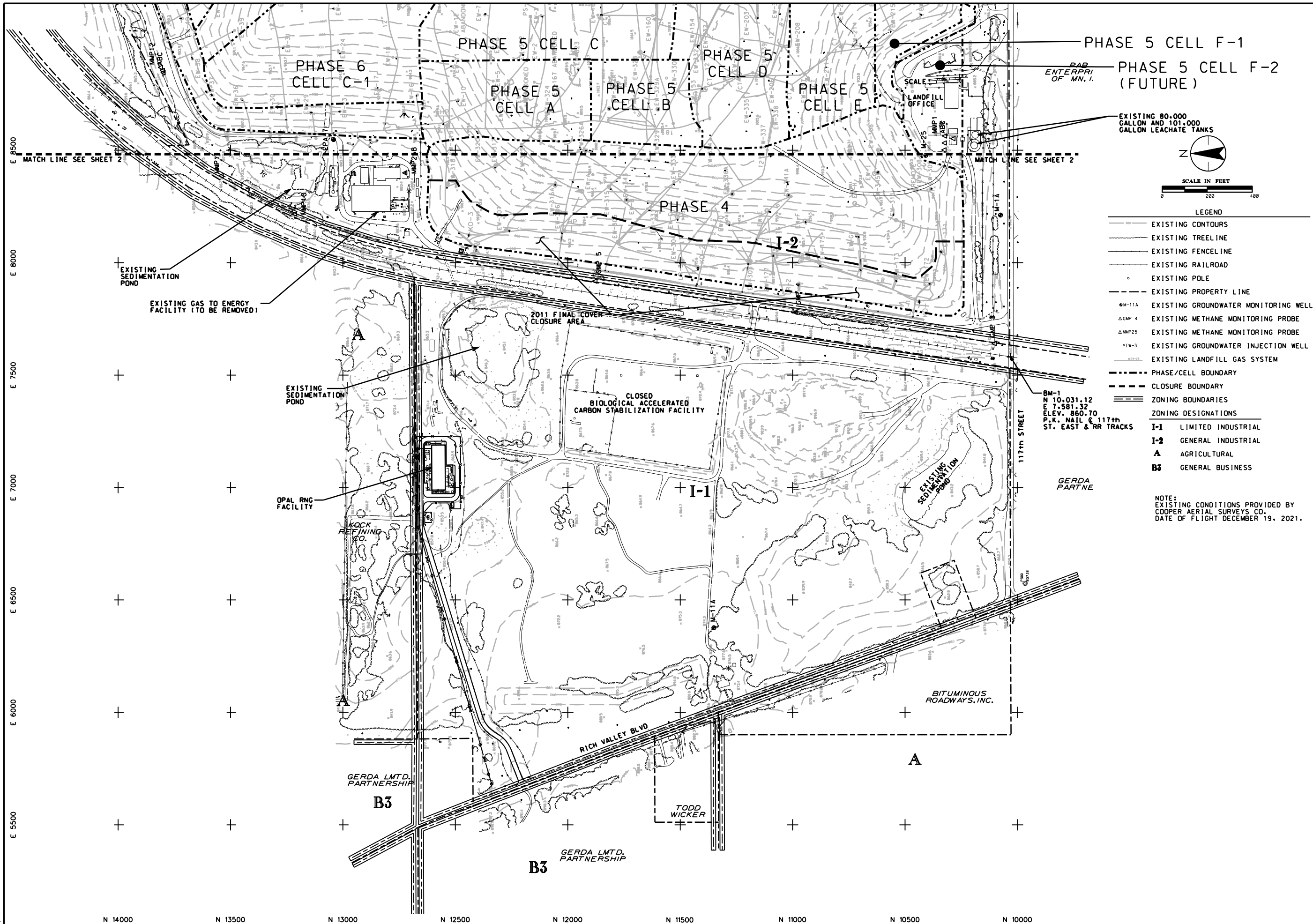
PROJECT NUMBER: 22704791

INDEX

1. TITLE AND INDEX SHEET
2. EXISTING CONDITIONS MAP (EAST SIDE)
- 2A. EXISTING CONDITIONS MAP (WEST SIDE)
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FINAL COVER GRADING PLAN
5. PHASE 7-VERTICAL EXPANSION
SURFACE WATER MANAGEMENT PLAN
6. EXISTING GAS PIPING PLAN NORTH HALF
7. EXISTING GAS PIPING PLAN SOUTH HALF
8. PROPOSED GAS PIPING PLAN NORTH HALF
9. PROPOSED GAS PIPING PLAN SOUTH HALF
10. CROSS-SECTION A
11. CROSS-SECTION B
12. CROSS-SECTION C
13. LINER SYSTEM DETAILS
14. LEACHATE RISER MANHOLE DETAILS
15. SURFACE WATER MANAGEMENT DETAILS
16. GAS SYSTEM DETAILS
17. GAS SYSTEM DETAILS
18. GAS SYSTEM DETAILS



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By: jstusarich 10/25/2022



Client/Project	By	App'd	Issued
BH WASTE SYSTEMS OF NORTH AMERICA, LLC PINE BEND LANDFILL			YJW/JDO
2022 MAJOR PERMIT MODIFICATION INVER GROVE HEIGHTS, MINNESOTA			
Existing Conditions Map (West Half)			

Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA
Existing Conditions Map (West Half)

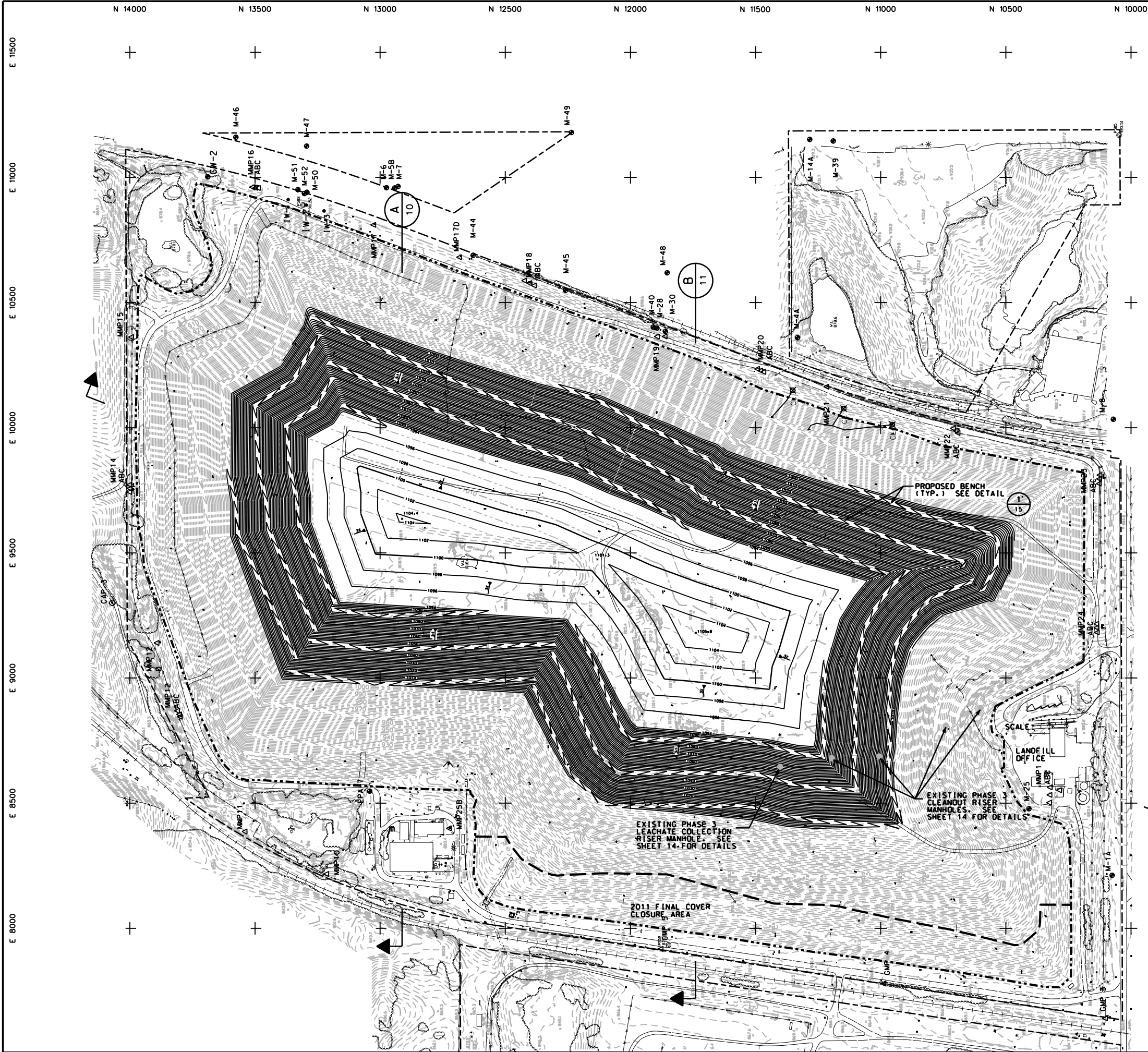
Permit-Seal
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME _____ THOMAS J. SHUSTARICH
SIGNATURE _____
DATE ____/____/____ LICENSE # ____ 21210
Project Number: 227704791
04791e_sp_02a.dgn
JWI 2022.02.25

Drawing No. 2A
Revision Sheet
0 3 of 18



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By jstisharich 10/25/20



- LEGEND
- 860 EXISTING CONTOURS
 - EXISTING TREE LINE
 - EXISTING FENCE LINE
 - EXISTING RAILROAD
 - EXISTING POLE
 - EXISTING PROPERTY LINE
 - M-11A EXISTING GROUNDWATER MONITORING WELL
 - GMP-4 EXISTING METHANE MONITORING PROBE
 - GMP-25 EXISTING METHANE MONITORING PROBE
 - IW-3 EXISTING GROUNDWATER INJECTION WELL
 - EXISTING WASTE BOUNDARY
 - CLOSURE BOUNDARY
 - 1020 FUTURE FINAL COVER CONTOURS
 - 1020 PROPOSED FINAL COVER CONTOURS

NOTE:
EXISTING CONDITIONS PROVIDED BY
COOPER AERIAL SURVEYS CO.
DATE OF FLIGHT DECEMBER 19, 2021.



Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA

Phase 7 Vertical Expansion Final Cover Grading Plan

Permit-Seal
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION,
OR REPORT WAS PREPARED BY ME OR UNDER
MY DIRECT SUPERVISION AND THAT I AM A DULY
LICENSED PROFESSIONAL ENGINEER UNDER THE
LAWS OF THE STATE OF MINNESOTA.

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE yy/mm/dd LICENSE # 21210

Project Number: 227704791

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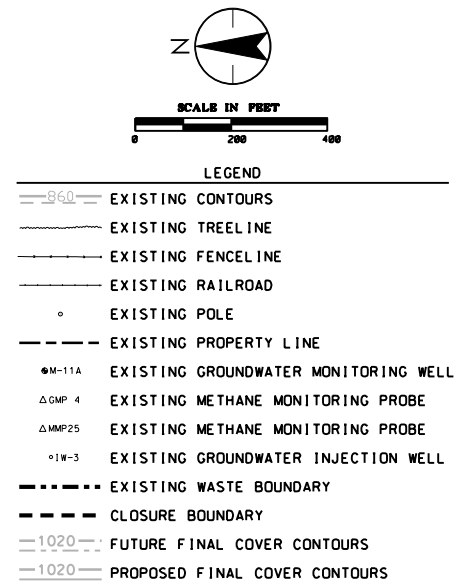
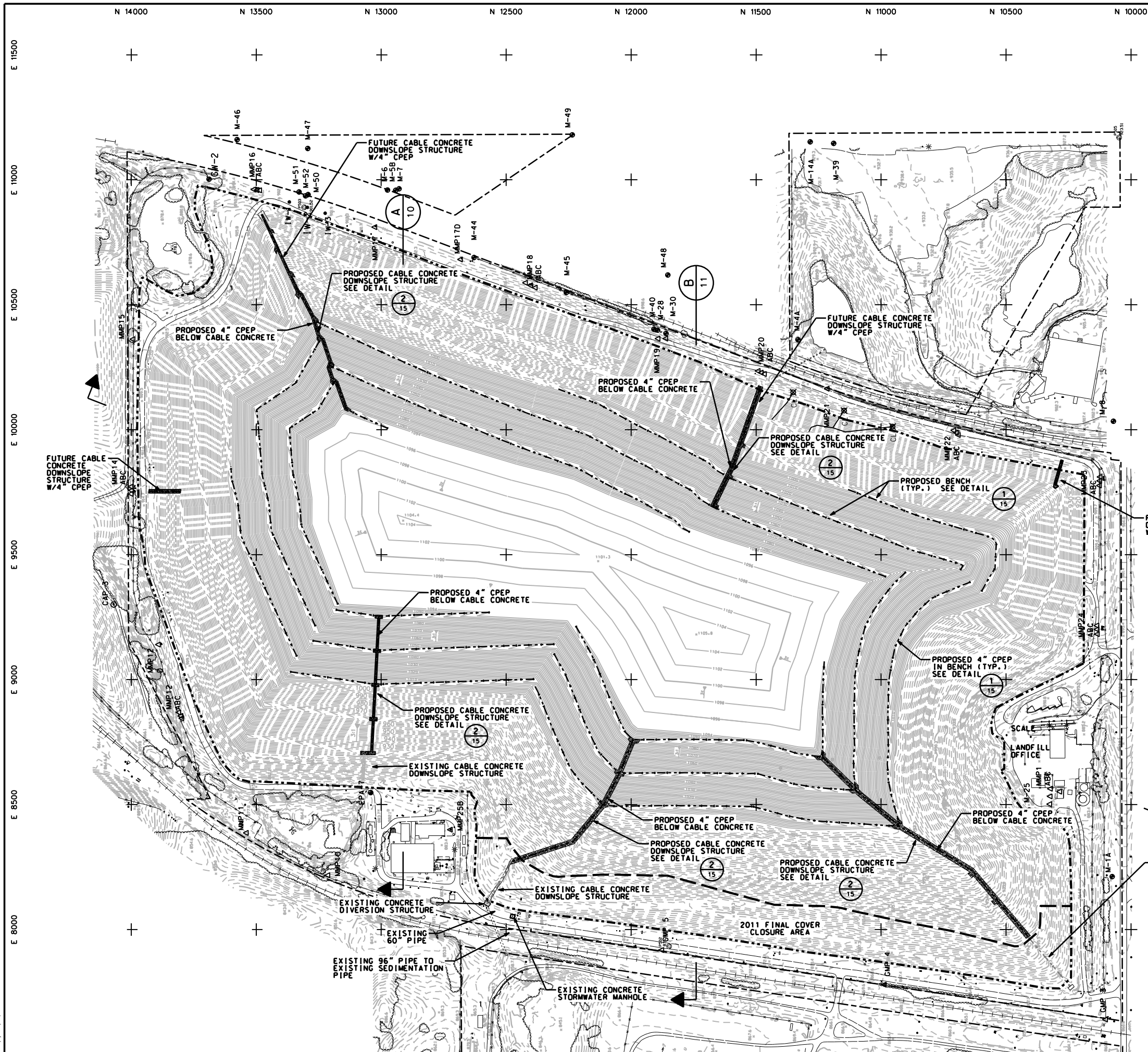
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Drawing No. 4

Revision Sheet

0 4 of 18

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By: jstusarich



NOTE:
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DATE OF FLIGHT DECEMBER 19, 2021.



Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA

Phase 7 Vertical Expansion Surface Water Management Plan

Permit-Seal
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION,
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SIGNATURE: _____
DATE: yy/mm/dd LICENSE # 21210
Project Number: 227704791
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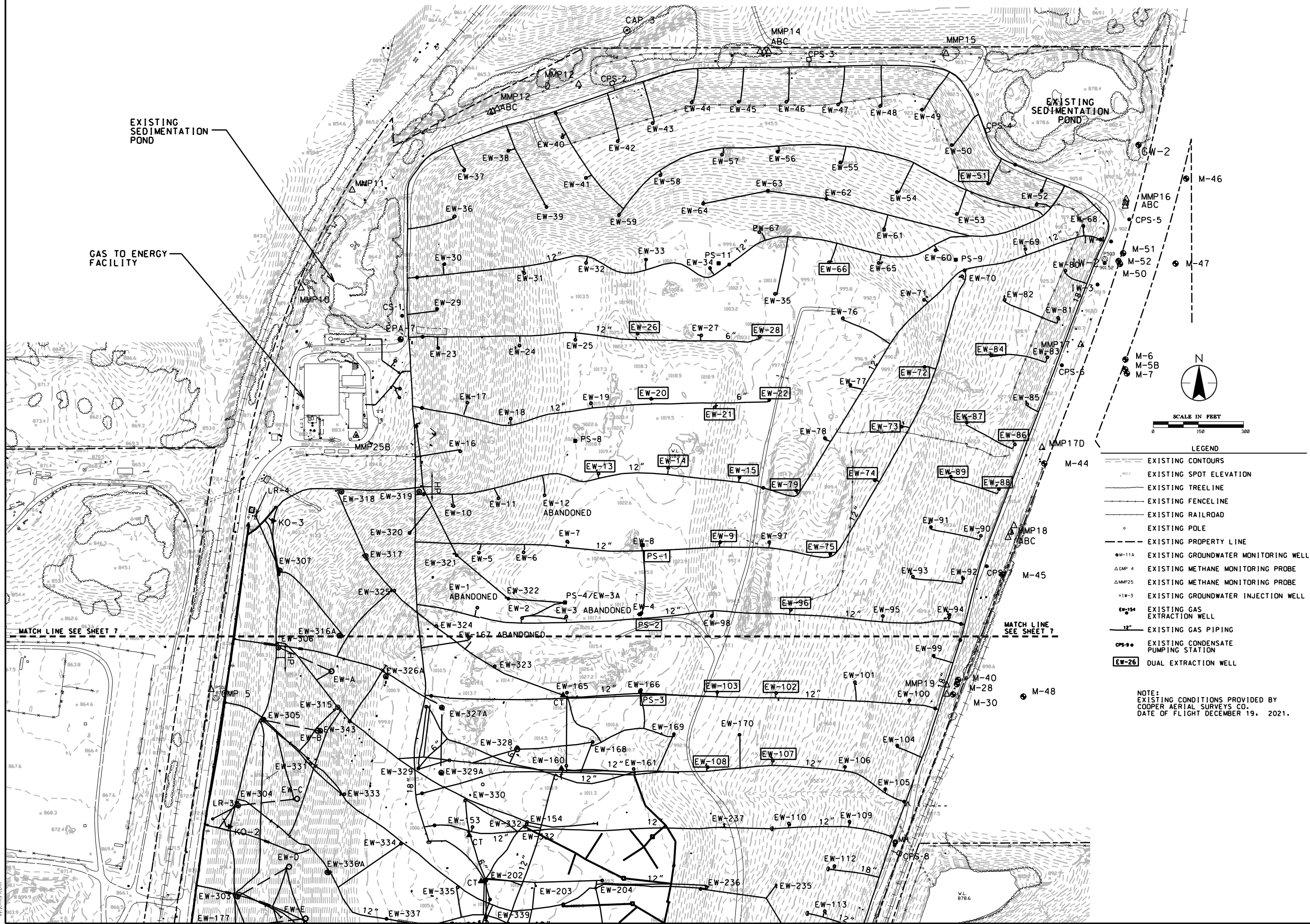
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Drawing No. 5

Revision Sheet

0 5 of 18

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By: jstustarich



- LEGEND
- EXISTING CONTOURS
 - EXISTING SPOT ELEVATION
 - EXISTING TREELINE
 - EXISTING FENCELINE
 - EXISTING RAILROAD
 - EXISTING POLE
 - EXISTING PROPERTY LINE
 - EXISTING GROUNDWATER MONITORING WELL
 - EXISTING METHANE MONITORING PROBE
 - EXISTING METHANE MONITORING PROBE
 - EXISTING GROUNDWATER INJECTION WELL
 - EXISTING GAS EXTRACTION WELL
 - EXISTING GAS PIPING
 - EXISTING CONDENSATE PUMPING STATION
 - DUAL EXTRACTION WELL

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PINE BEND LANDFILL

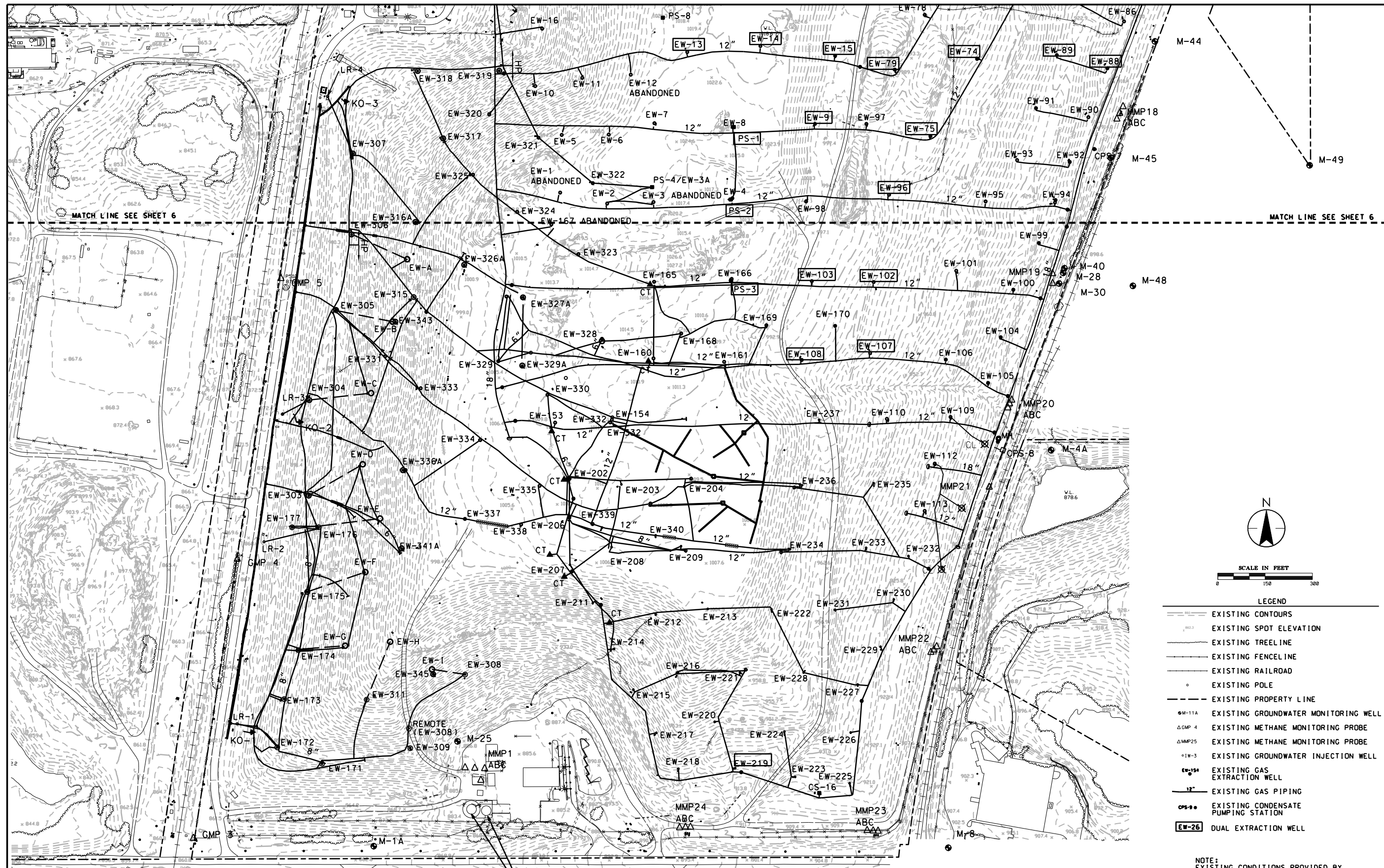
2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA
Existing Gas Piping Plan - North Half

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Drawing No. 6
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0 6 of 18



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- EXISTING 80,000
GALLON AND 101,000
GALLON LEACHATE TANKS

HORIZONTAL COLLECTION SYSTEM TRENCH POINT	APPROXIMATE DEPTH (FT)
①	8
②	14
③	8
④	7
⑤	7
⑥	7
⑦	9
⑧	8



- LEGEND
- EXISTING CONTOURS
 - EXISTING SPOT ELEVATION
 - EXISTING TREELINE
 - EXISTING FENCELINE
 - EXISTING RAILROAD
 - EXISTING POLE
 - EXISTING PROPERTY LINE
 - EXISTING GROUNDWATER MONITORING WELL
 - EXISTING METHANE MONITORING PROBE
 - EXISTING METHANE MONITORING PROBE
 - EXISTING GROUNDWATER INJECTION WELL
 - EXISTING GAS EXTRACTION WELL
 - EXISTING GAS PIPING
 - EXISTING CONDENSATE PUMPING STATION
 - CURRENTLY PERMITTED CONTOURS
 - PROPOSED CONTOURS
 - PROPOSED 12" SUBHEADER
 - PROPOSED 6" SUBHEADER
 - PROPOSED GAS WELLS
 - PROPOSED CONTROL VALVE
 - PROPOSED HORIZONTAL COLLECTOR WELLHEAD
 - PROPOSED HORIZONTAL COLLECTOR PIPING (6" HDPE SDR 17)
 - PROPOSED LATERAL GAS SUBHEADER (8" HDPE SDR 17)
 - PROPOSED CONDENSATE SUMP
 - PROPOSED PUMPING STATION

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DATE OF FLIGHT DECEMBER 19, 2021.



By	Y.M.W.D.D.
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PINE BEND LANDFILL

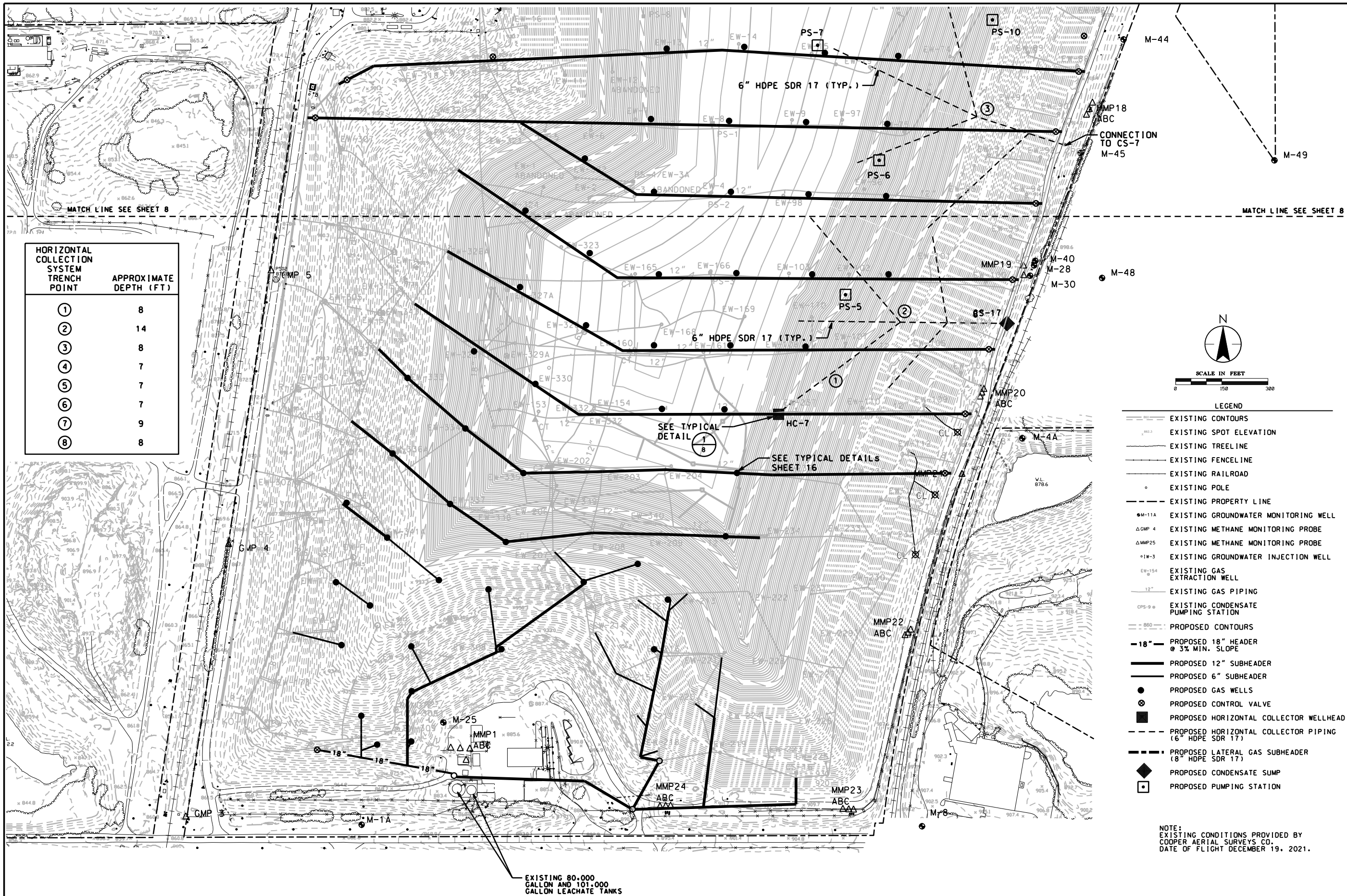
2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA
Proposed Gas Piping Plan - North Half

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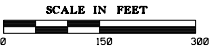
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DATE yy/mm/dd LICENSE # 21210
Project Number: 227704791
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Drawing No. 8
Revision Sheet
0 8 of 18

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By: jstustarich



HORIZONTAL COLLECTION SYSTEM TRENCH POINT	APPROXIMATE DEPTH (FT)
①	8
②	14
③	8
④	7
⑤	7
⑥	7
⑦	9
⑧	8



LEGEND

- EXISTING CONTOURS
- EXISTING SPOT ELEVATION
- EXISTING TREELINE
- EXISTING FENCELINE
- EXISTING RAILROAD
- EXISTING POLE
- EXISTING PROPERTY LINE
- EXISTING GROUNDWATER MONITORING WELL
- EXISTING METHANE MONITORING PROBE
- EXISTING METHANE MONITORING PROBE
- EXISTING GROUNDWATER INJECTION WELL
- EXISTING GAS EXTRACTION WELL
- EXISTING GAS PIPING
- EXISTING CONDENSATE PUMPING STATION
- PROPOSED CONTOURS
- PROPOSED 18" HEADER @ 3% MIN. SLOPE
- PROPOSED 12" SUBHEADER
- PROPOSED 6" SUBHEADER
- PROPOSED GAS WELLS
- PROPOSED CONTROL VALVE
- PROPOSED HORIZONTAL COLLECTOR WELLHEAD
- PROPOSED HORIZONTAL COLLECTOR PIPING (6" HDPE SDR 17)
- PROPOSED LATERAL GAS SUBHEADER (8" HDPE SDR 17)
- PROPOSED CONDENSATE SUMP
- PROPOSED PUMPING STATION

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DATE OF FLIGHT DECEMBER 19, 2021.



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Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA
Proposed Gas Piping Plan - South Half

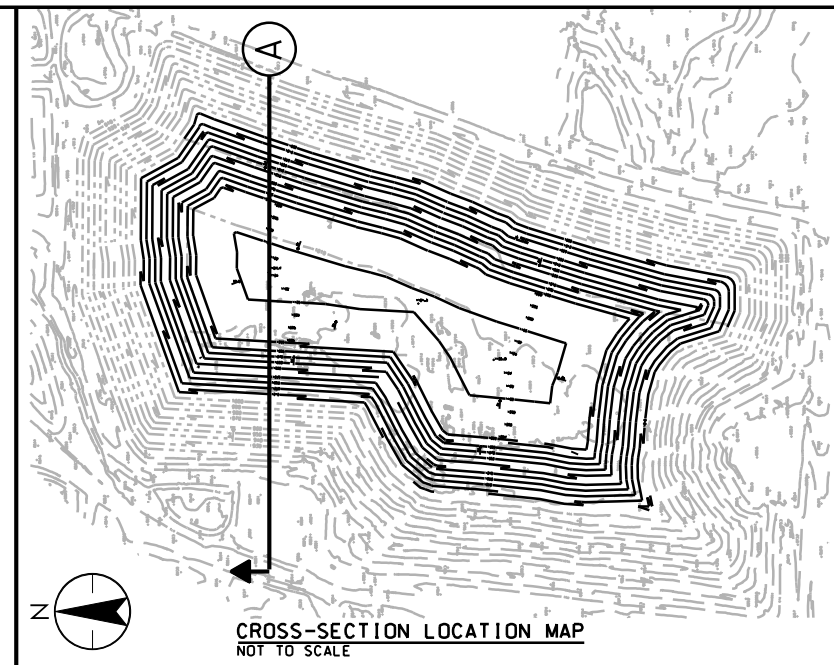
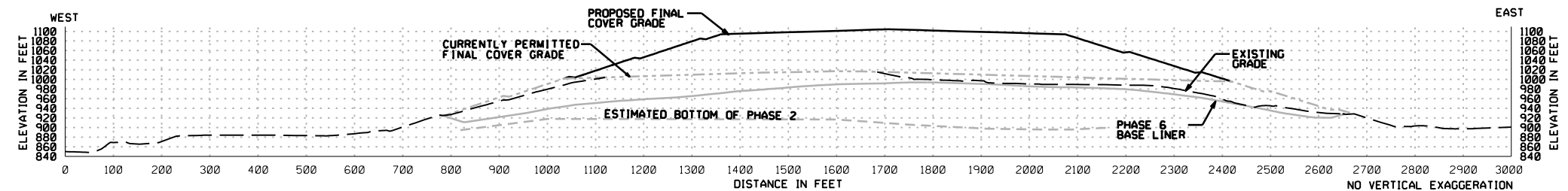
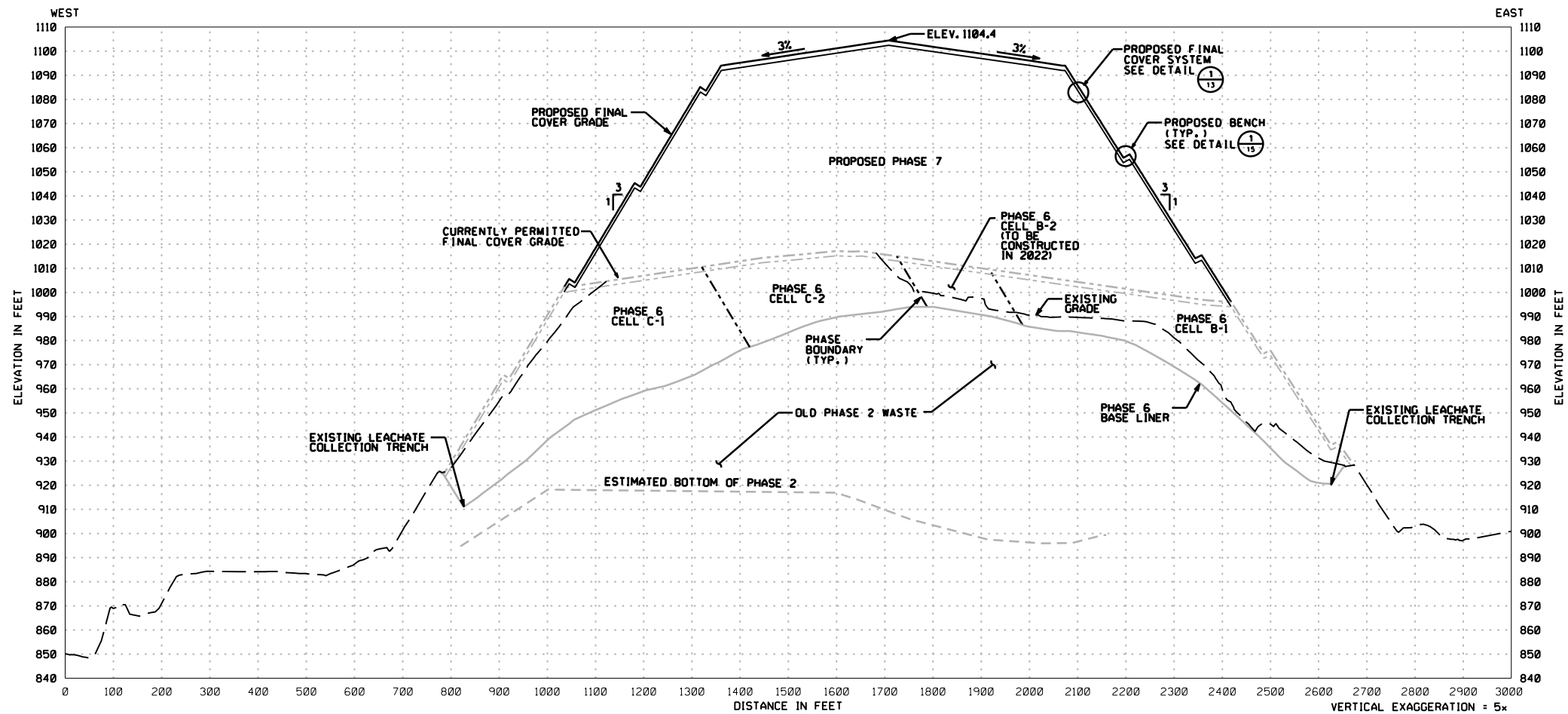
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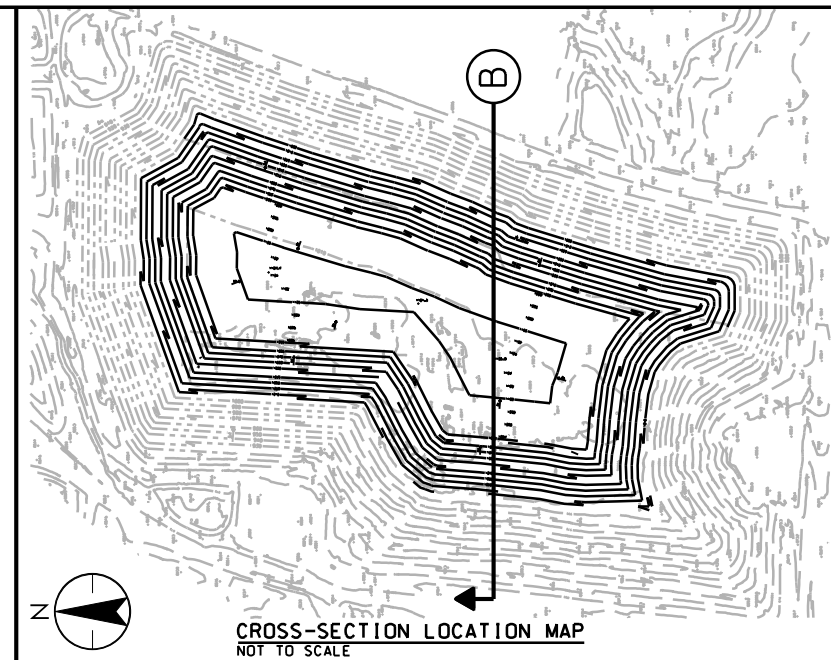
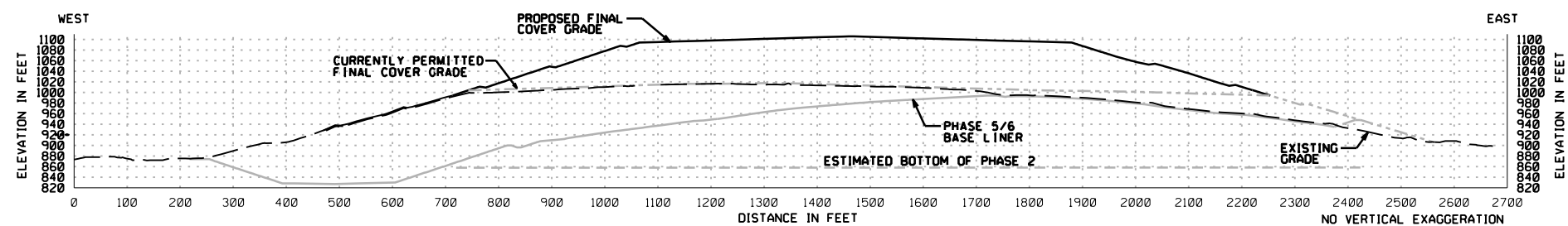
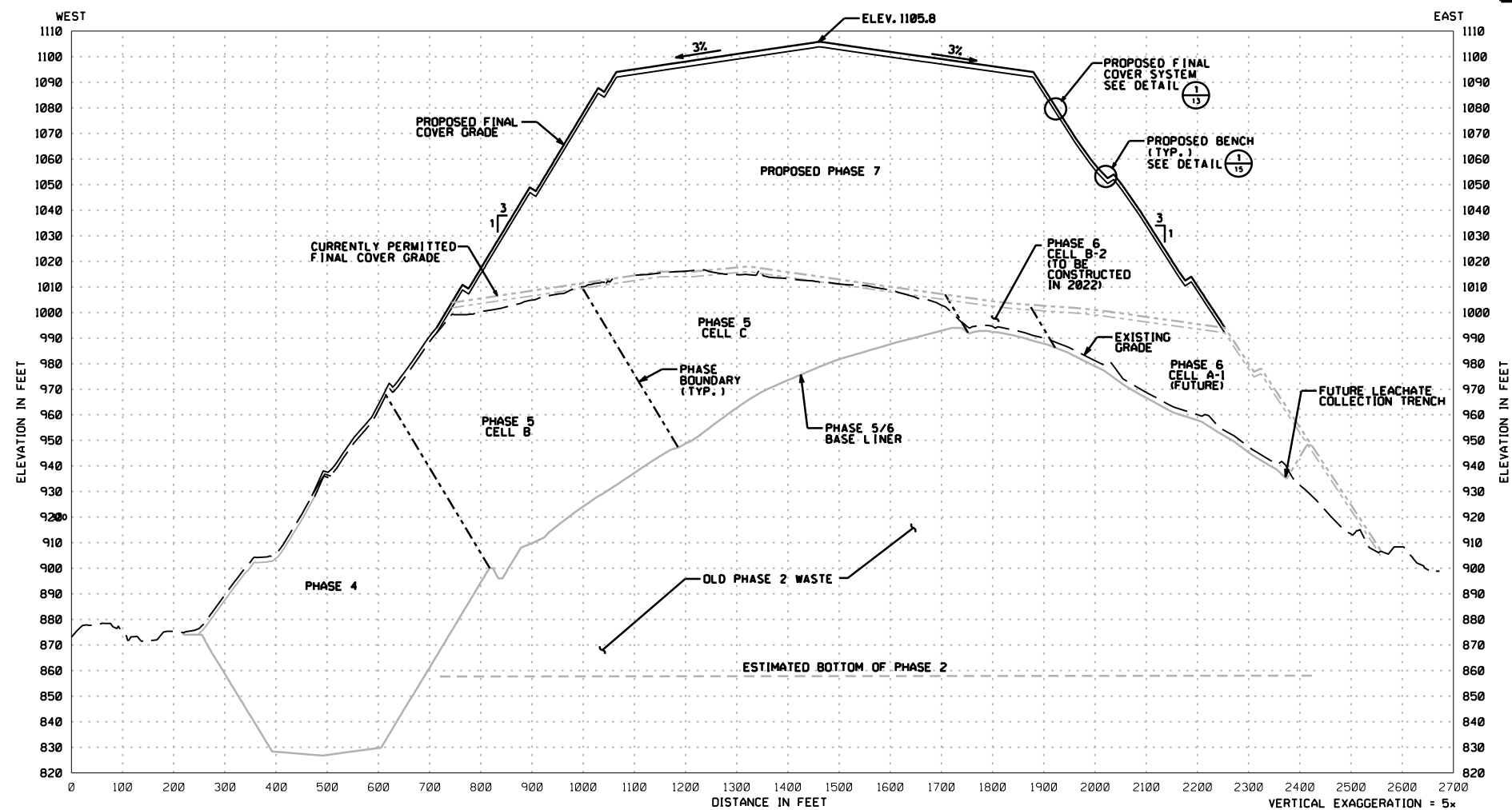
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Project Number 227704791
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Drawing No. 9
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By: jstuart



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Client/Project
CBFI WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
NORVUE GROVE HEIGHTS, MINNESOTA

Cross-section B

Permit-Seal

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PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE _____

DATE yy/mm/dd LICENSE # 21210

Project Number: 227704791

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JWT 2022.03.1

Drawing No. 11

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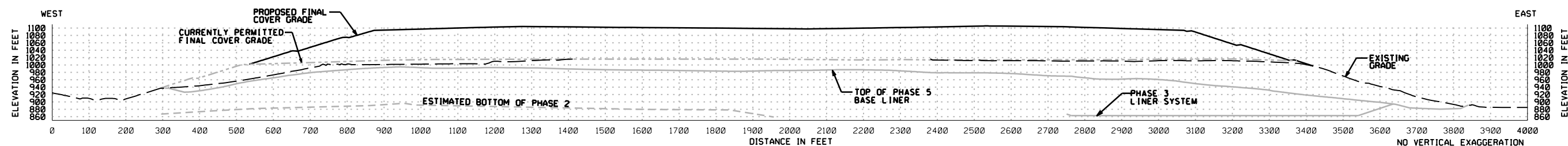
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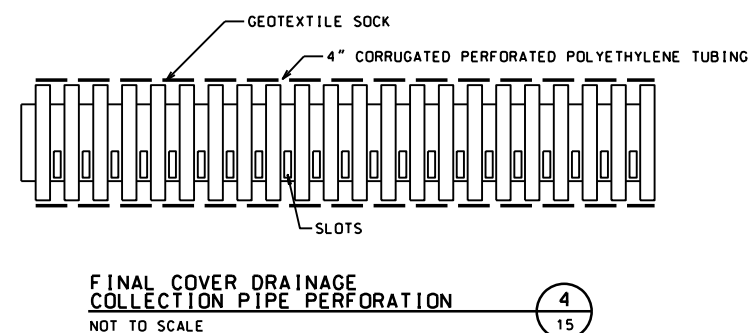
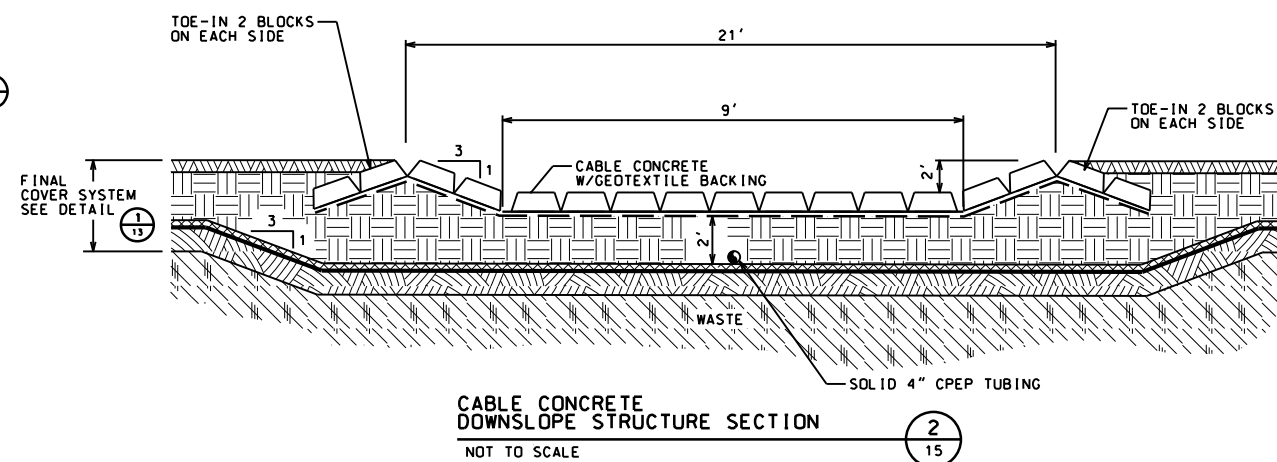
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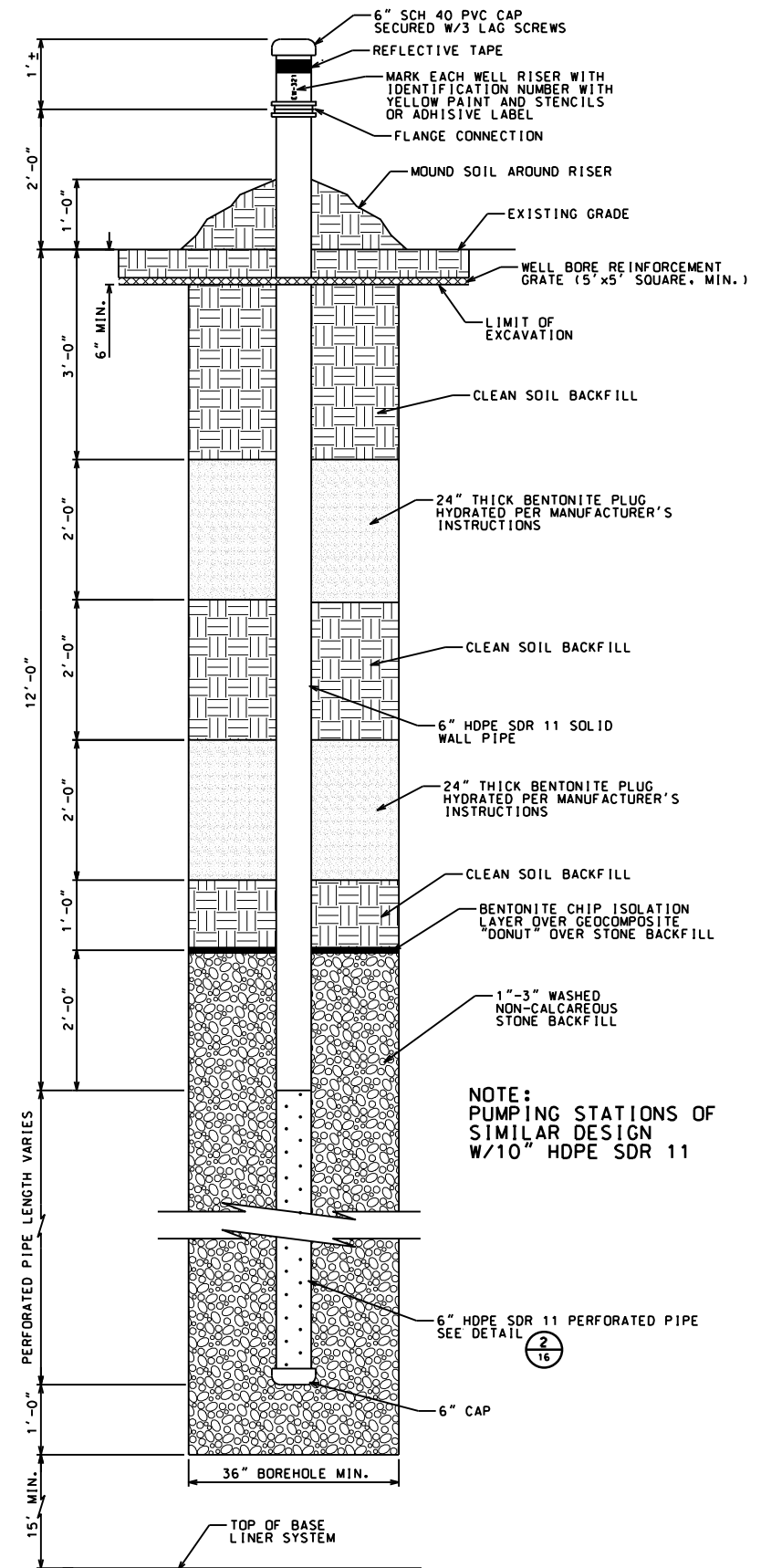
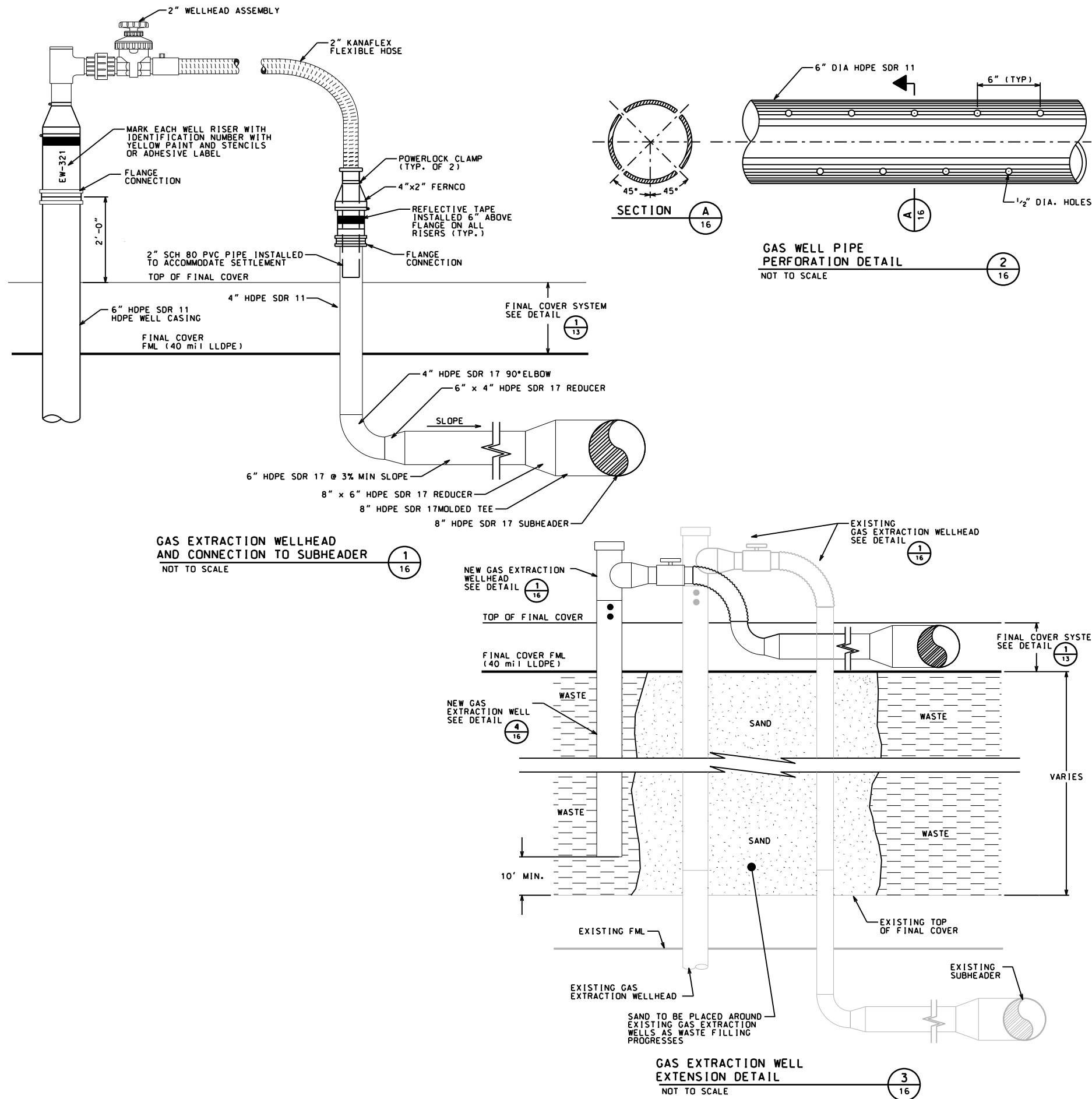


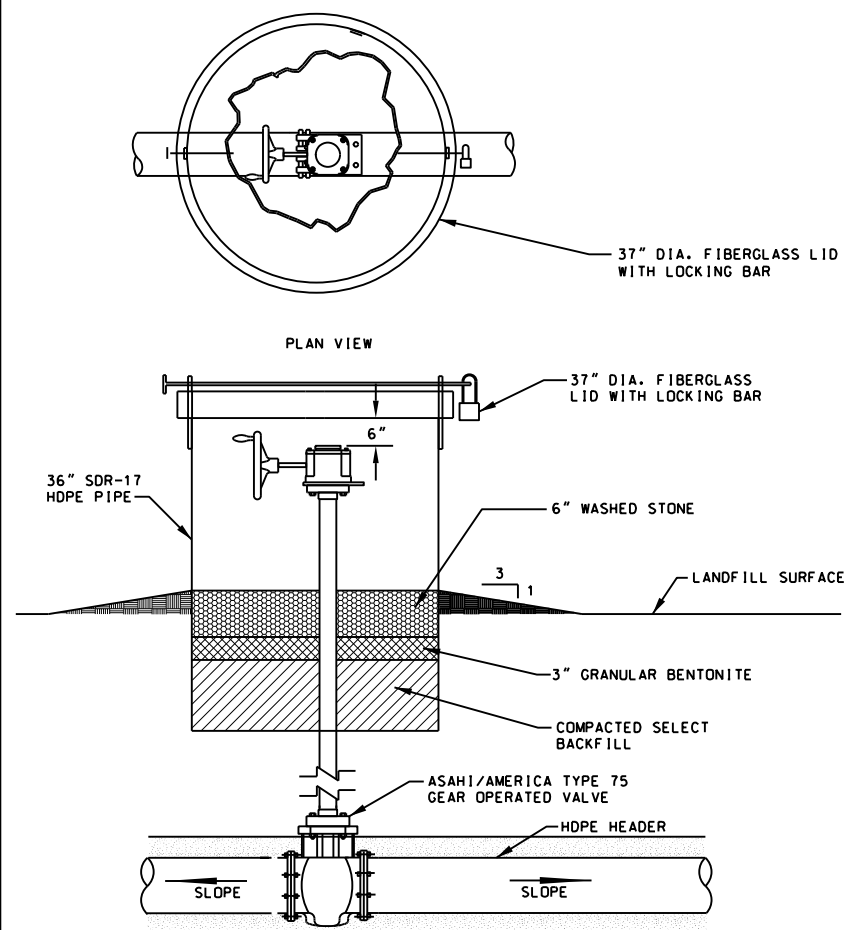


NIVER GROVE HEIGHTS, MINNESOTA
Surface Water Management Details

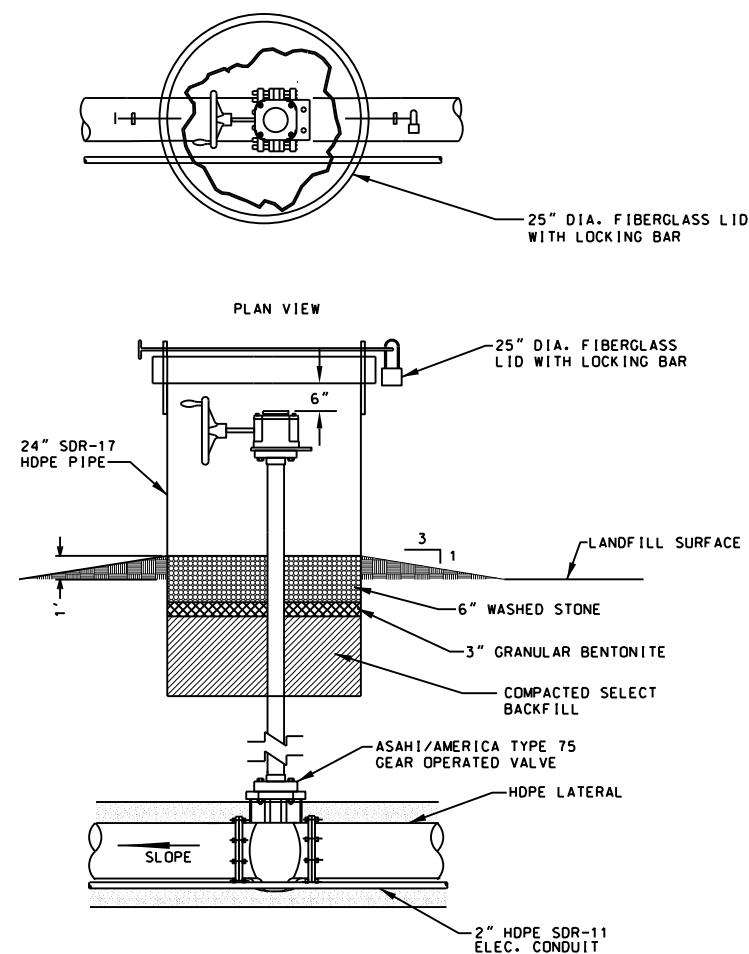
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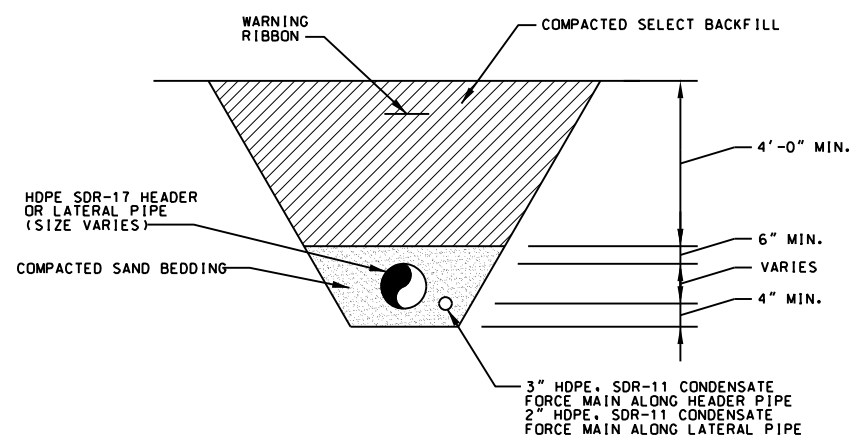




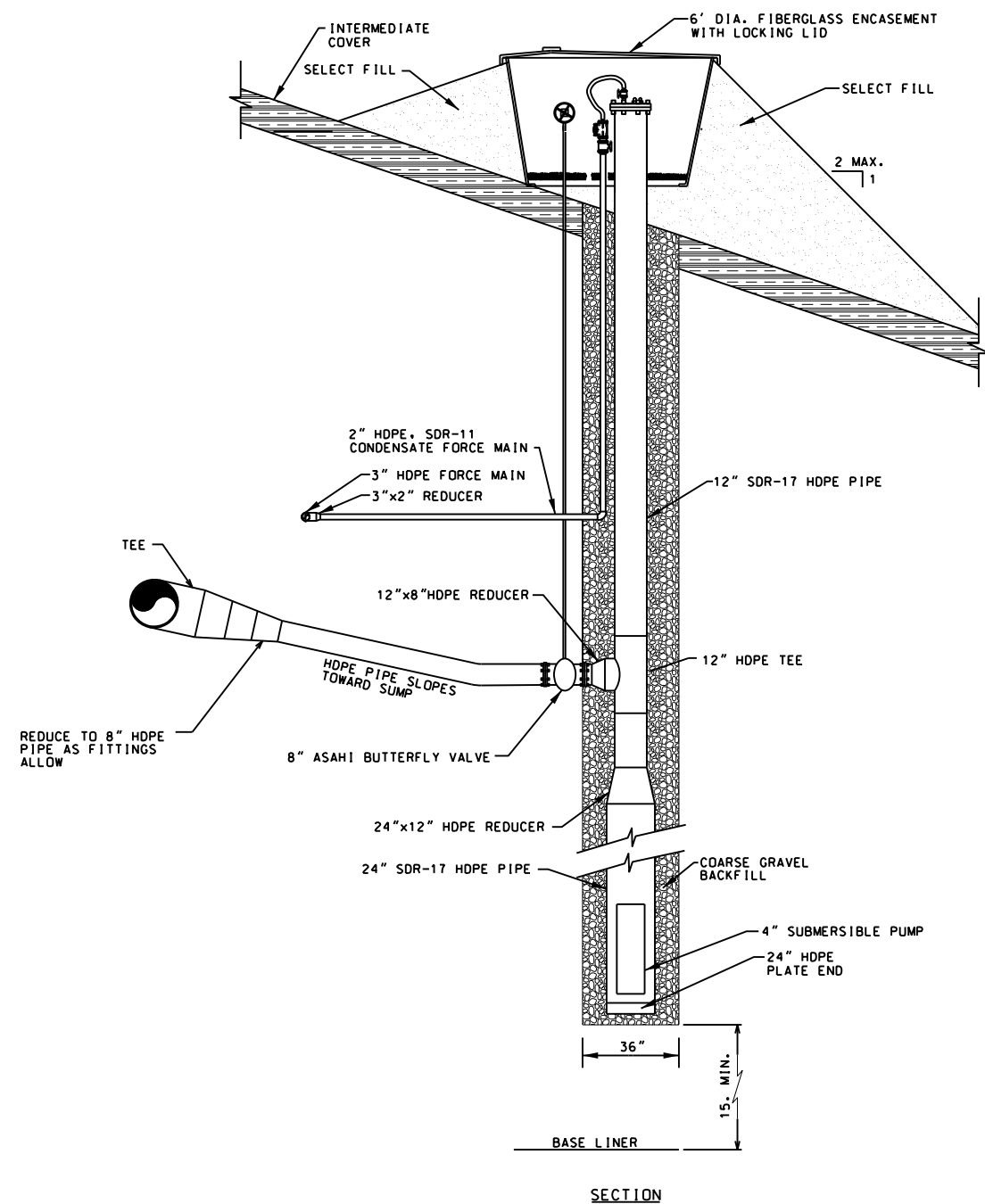
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ISOLATION VALVE DETAIL (LATERAL) 2
NOT TO SCALE 17



TYPICAL PIPE TRENCH DETAIL
NOT TO SCALE



CONDENSATE SUMP DETAIL 3
NOT TO SCALE 17

Appendix D Geotechnical Analysis and Comments





Stantec Consulting Services Inc.
1800 Pioneer Creek Center
Maple Plain, MN 55359

To: Tom Shustarich, PE
From: Paul T. Eickenberg, PE
Date: March 29, 2022
Subject: Pine Bend Landfill | Vertical Expansion Geotechnical Evaluation
Project #: 227704791

1.0 Purpose of Technical Memorandum

The purpose of this technical memorandum is to provide an understanding of the overall (or global) stability and the veneer stability of the vertical expansion at Pine Bend Landfill. With respect to the veneer analyses, the following cover system is considered:

- 6-inches of topsoil;
- 18-inches of cover soil;
- Geocomposite (defined as a geonet with a geotextile heat bonded to both sides)
- Textured 40-mil LLDPE geomembrane;
- 6-inches intermediate (buffer) cover soil;
- Waste materials.

The geosynthetic drainage system may consist of a drain liner with an overlying geotextile or a geonet geocomposite (as defined above). The exact materials have not been included herein as manufacturers are subject to change and new products may be developed for consideration.

The veneer stability analysis was completed (shown herein) to evaluate the currently permitted final cover profile design. Interface friction values were assigned based on properties found in literature. If alternate products are used for the geosynthetic drainage system option (i.e. drain liner and geotextile), applicable interface friction values will be reviewed at the time of construction and compared to the completed assessment to confirm stability.

2.0 Methodology

The overall stability analyses were calculated using Slope/W, a two-dimensional limit-equilibrium slope stability program created by GeoSlope International. A limit-equilibrium method calculates the driving and resisting forces and/or moments acting on a soil mass and compares them to calculate the slope factor of safety. As a result, a factor of safety of less than 1.0 suggests that the slope is on the verge of failing due to the driving forces being greater than the resisting forces. On the other hand, a factor of safety greater than 1.0 suggests that the slope is stable because the resisting forces are greater than the driving forces.

Even though a factor of safety (FS) equal to 1.0 suggests that the slope is theoretically stable, the geotechnical engineering community typically prefers minimum factor of safety values ranging from 1.3 to 1.5 for long-term conditions and 1.0 to 1.2 for short-term conditions to account for unanticipated loading or

Pine Bend Landfill | Vertical Expansion Geotechnical Evaluation

material nonuniformities. As the completed analyses consider a long-term situation, a minimum factor of safety of 1.5 is considered.

3.0 Material Properties

The assumed shear strength and interface parameters for the cover slope stability analyses are provided in Table 2. These parameters are consistent with those provided in the Wenck (August 27, 2015) "Pine Bend Landfill Phase 6 Expansion Geotechnical Evaluation" stability memo.

Table 2. Shear Strength Parameters used in the Global Stability Analyses

Material	Unit Weight	Cohesion	Friction Angle
Cap Liner	1 pcf	0 psf	8 degrees
Existing Waste	65 pcf	0 psf	35 degrees
Proposed Waste	65 pcf	0 psf	35 degrees
Native Material	110 pcf	0 pcf	35 degrees

Table 2. Shear strength parameters used for the veneer cap liner stability analyses

Material	Unit Weight	Cohesion	Friction Angle
Layer 1. Topsoil	100 pcf	--	--
<i>Interface Properties between Layer 1 and Layer 2 – Peak, Figure 1</i>	--	50 psf	20 degrees
<i>Interface Properties between Layer 1 and Layer 2 – Large Displacement, Figure 2</i>	--	25 psf	20 degrees
Layer 2. Cover Soil	105 pcf	--	--
<i>Interface Properties between Layer 2 and Layer 3 – Peak, Figure 1</i>	--	50 psf	25 degrees
<i>Interface Properties between Layer 2 and Layer 3 – Large Displacement, Figure 2</i>	--	50 psf	23 degrees
Layer 3. Geocomposite	--	--	--
<i>Interface Properties between Layer 3 and Layer 4 – Peak, Figure 1</i>	--	50 psf	19 degrees

Pine Bend Landfill | Vertical Expansion Geotechnical Evaluation

Material	Unit Weight	Cohesion	Friction Angle
<i>Interface Properties between Layer 3 and Layer 4 – Large Displacement, Figure 2</i>	--	59 psf	13.4 degrees
Layer 4. Textured 40-mil LLDPE Geomembrane	--	--	--
<i>Interface Properties between Layer 4 and Layer 5 – Peak, Figure 1</i>	--	50 psf	25 degrees
<i>Interface Properties between Layer 4 and Layer 5 – Large Displacement, Figure 2</i>	--	50 psf	22 degrees
Layer 5. Intermediate Cover	110 pcf	--	--
<i>Interface Properties between Layer 5 and Layer 6 – Peak, Figure 1</i>	--	50 psf	20 degrees
<i>Interface Properties between Layer 5 and Layer 6 – Large Displacement, Figure 2</i>	--	25 psf	20 degrees
Layer 6. Waste	--	--	--

4.0 Results of Stability Analyses

The results of these global limit-equilibrium slope stability analyses are provided below. Both cases indicate that the design factor of safety is greater than the required value of 1.5.

- Case 1: Overall System: FS = 1.81 (see Figure 1)
- Case 2: Lower Liner: FS = 1.91 (see Figure 2)

Pine Bend Landfill | Vertical Expansion Geotechnical Evaluation

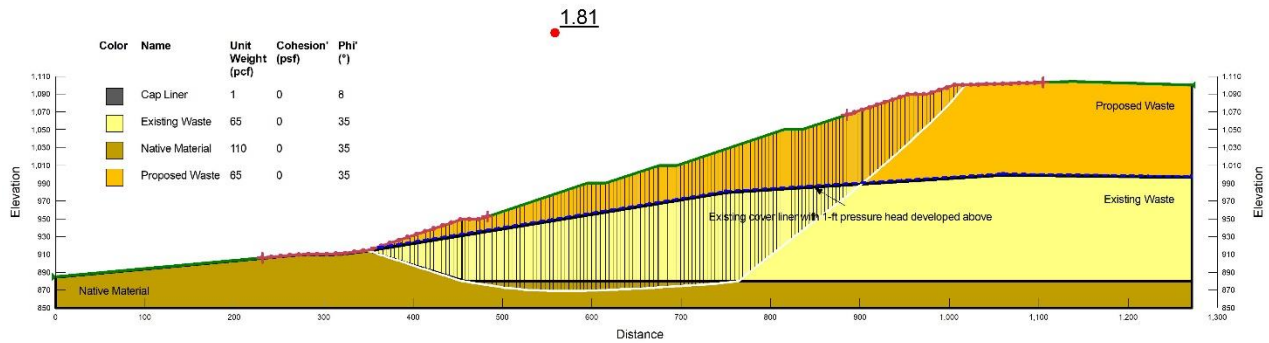


Figure 1. Overall System

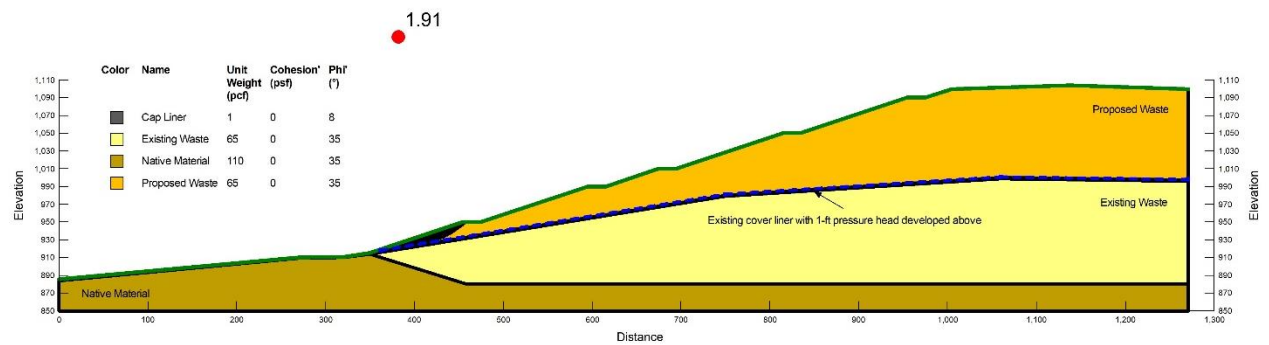


Figure 2. Liner

The requirements and results of the slope stability analyses for the design case is provided in Table 2 below. Also shown below are results for peak and large-displacement conditions associated with the geomaterial interfaces. The calculations for each of these conditions is provided as an attachment to this memo.

Table 2. Results for the veneer cap analyses.

Case ID and Condition	Required FS	Calculated FS
Dry Conditions by Koerner (1994) Method		
Peak	1.50	2.22
Large Displacement	1.25	1.84
Dry Conditions by Koerner and Soong (1998) Method		
Peak	1.50	2.22

Pine Bend Landfill | Vertical Expansion Geotechnical Evaluation

Case ID and Condition	Required FS	Calculated FS
Large Displacement	1.25	1.84
75% soil saturation running parallel to the surface		
Peak	1.20	1.48
Large Displacement	1.10	1.32
Loading by CAT D6 dozer running perpendicular (up slope) by Impact method		
Peak	1.20	2.02
Large Displacement	1.10	1.70
Loading by CAT D6 dozer running perpendicular (up slope) by Koerner and Soong (1998) Method		
Peak	1.20	2.10
Large Displacement	1.10	1.78

As shown in Table 2, the factor of safety of the cap slope meets the required factor of safety values.

5.0 Summary and Conclusion

The calculated factors of safety are all greater than the required values. Therefore, the system discussed herein is applicable for this situation.

Regards,

STANTEC CONSULTING SERVICES INC.


Paul T. Eickenberg MSCE, MSLE, PE
Associate, Senior Geo-Structural Engineer
Phone: (612) 248-6099
paul.eickenberg@stantec.com

**Pine Bend Landfill
2022 Major Permit Mod Modification**

Deflection Determination - Method 1

Pipe Evaluated: 6" HDPE SDR 11
MSW Cell Leachate Collection Pipe

References: "Modulus of Soil Reaction Values for Pipeline Design",
J Jeyapalan and R Watkins

Solution: **1. Determine Vertical Stress**

Material	Density (pcf)	Depth (ft)	Load (psf)
Final Cover Soils	130	1.5	195
Drainage Layer	120	1	120
Waste and Cover	65	160	10400
Drainage Layer	120	1	120
Intermediate Filter	120	1	120
Coarse Aggregate	130	1.5	195
Total Load =			11150 psf

Total Vertical Load (P) =	77.4 psi
----------------------------------	--------------------

2. Determine Dynamic Stress (DL) on Pipe

Assume Caterpillar D4 dozer or equivalent is placing materials.

From Caterpillar performance handbook ground pressure of D4
580 psf x 1.3 dynamic factor = 754 psf

DL = dynamic pressure (psf) / 144 psi/psf =	5.2 psi
--	-------------------

3. Determine Total Vertical Stress on Solid Pipe (TP)

Total Vertical Stress (TP) = Static Stress + Dynamic Stress =	82.7 psi
--	--------------------

4. Determine Strain in Aggregate Envelope using Hookes Law

Hookes Law
Stress / Strain = Elastic Modulus

Therefore the elastic strain in the soil/pipe system is equal to the stress applied to the aggregate envelope divided by E'

Determine Soil Reaction Modulus

Assume bedding is coarse aggregate (USCS Classification GP or GW) compacted to 90% of standard proctor density.

Adjustment is 25 psi at 85% compaction and 100 psi at 100% compaction.

Adjust E' by 50 psi for every foot of additional soil cover above 5'.

Initial E' for 5' of soil cover =	1000 psi
Adjust E' above 5' =	8050 psi
Total E' =	9050 psi

**Pine Bend Landfill
2022 Major Permit Mod Modification**

Deflection Determination - Method 1

Pipe Evaluated: 6" HDPE SDR 11
MSW Cell Leachate Collection Pipe

Assume FS = 2.0, then E' = 4525

Therefore the strain in the soil/pipe system is equal to $TP/E' \times 100\% =$	1.83%
---	--------------

5. Determine Safety Factor Against Wall Crushing

Determination of stress in pipe S_a

$$S_a = (SDR-1) \times TP / 2$$

S_a = Stress in Pipe

SDR = Standard Dimension Ratio = 11

$S_a =$ 413 psi

Allowable $S_a = 1500$ psi, where 1500 psi is the compressive yield strength

$$FS = 1500/S_a$$

FS = 3.6 > 2.0 O.K.

6. Determine Safety Factor Against Wall Buckling

$$P_c = 5.65[(B' E_p E_s I)/D_m^3]^{1/2}$$

P_c = Critical collapse pressure (psi)

B' = Dimensionless Vertical Stress Factor

$$B' = 1/(1+4e^{(-.065H)})$$

H = Height of Soil Cover above Pipe = 166 Ft

$$B' = 1.000$$

E_p = Modulus of Elasticity = 28,200 psi

E_s = Modulus of soil reaction = 3800 psi

OD = 6 inch SDR 11 = 6.625

D_m = mean diameter = OD - t = 6.023 in

I = Moment of Inertia = $t^3/12$ = 0.0182 in³

t = wall thickness = 0.602 in

$P_c =$ 533 psi

$$FS = P_c/TP$$

FS = 6.5 > 2.0 O.K.

To: Abdi Hassan
Minnesota Pollution Control Agency

From: Aaron Janusz, Pine Bend Landfill
Tom Shustarich, Stantec Consulting Services, Inc.
Ethan Ketelsen, Stantec Consulting Services, Inc.

CC: Ally Sutherland, City of Inver Grove Heights
Bryan Pitterle, Barr Engineering
Jeff Ubl, Barr Engineering
Terry Muller, Dakota County

Project/File: 227706442 Date: February 12, 2024

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

Comments regarding the 2022 Pine Bend Landfill Major Modification of Permit #SW-45 Report, provided in a letter prepared by Barr and the City of Inver Grove Heights and dated November 28, 2023, are presented below followed by the responses.

A. Waste Acceptance

1. *The Operations and Maintenance Manual dated August 2015 is listed as an approved plan in the May 2019 Modified MPCA Permit, and the July 2014 Solid Waste Management Plan is an appendix to the Operations and Maintenance Manual. The June 2022 Application and September 2022 Addendum should indicate that the July 2014 Solid Waste Management Plan version is still current.*

Response: We agree, and the application has been updated to indicate this.

2. *The Operations and Maintenance Plan dated June 2, 2022, should include the July 2014 Solid Waste Management Plan as an Appendix.*

Response: We agree, and the Operations and Maintenance Plan has been updated to include this.

B. Solid Waste Composting.

1. *Please clarify if solid waste composting is proposed to be performed as part of the June 2022 Application and September 2022 Addendum.*

Response: The site intends to evaluate potential solid waste composting opportunities in the future. This activity would be regulated, operated, and reported under SW-45 along with the appropriate local approvals prior to any composting activities.

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

2. *If solid waste composting is not being proposed, please confirm that PBL will obtain City and County approval prior to initiating any solid waste composting activities.*

Response: Per the prior response PBL intends to evaluate potential opportunities for solid waste composting activities, and PBL will obtain the appropriate City and County approvals prior to implementing any solid waste composting activities.

C. Surface Water Management

1. *Please provide the Hydro CAD model files for review with the next submittal.*

Response: The model file will be submitted electronically with the next submittal. Note that some model updates and improvements were made to reflect existing conditions more accurately as of now. These do not make substantial changes to the outcome of the storm events or stormwater management currently or in the future.

2. *Design Report, Section 4.6.3.1. Provide an explanation for the choices of curve numbers B and C for the sloped and flat areas, respectively. These curve numbers will result in steeper sloped areas producing less runoff volume than flatter areas. Is the cover soil different? It seems that if the cover soil were the same, the steeper sloped areas would produce greater runoff volume than the flatter areas.*

Response: The curve numbers have been updated in the model to reflect C soils at 70% cover in both flat and sloped areas.

3. *Design Report, Section 4.6.3.5, Infiltration subheading. New impervious area is not quantified. If new impervious is created by the project, provide a drainage area figure showing the new impervious area locations, and a table quantifying new impervious area, by drainage area.*

Response: No new impervious area is created by the project.

4. *Design Report, Section 4.6.3.5, Infiltration subheading. Ponds used to meet infiltration requirements must be designed to meet MPCA requirements, e.g., they must draw down within 48 hours following the event and runoff must be pretreated before entering the infiltration area. If new impervious is being created by the project (see above comment) then provide pond details showing that MPCA design guidelines are met.*

Response: No new impervious area is created by the project.

5. *Design Report, Appendix C, Peak Run-off subheading. Sample calculations for sloped and flat areas appear to indicate that sloped areas would be HSG C while flat would be HSG B, which contradicts the earlier text.*

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

Response: The curve numbers have been updated in the model to reflect C soils at 70% cover in both flat and sloped areas. The text in the report has been updated to agree.

6. *Design Report, Appendix C, Peak Run-off subheading. Sheet flow lengths up to 300 feet are used to calculate times of concentration. This is "allowed" in Hydro CAD, but some agencies (e.g., NRCS) limit sheet flow length to a maximum of 100 ft. The city recommends that sheet flow lengths be limited to 100 feet as a conservative assumption.*

Response: While general guidance does allow for sheet flow lengths of 300 feet, we have updated sheet flows to be no longer than 100 feet, the remaining length is calculated using shallow concentrated flows as recommended.

7. *Design Report, Appendix C, Hydro CAD model output. There are several warnings where water depth exceeded reach inlets or outlets. Warnings should be resolved and/or it should be confirmed whether the 100-year event is appropriately contained within each reach as stated within the report.*

Response: The results from the model ran after the updates indicated that all water can be maintained in the stormwater ponds. Reach warnings were typically less than one foot and would still be contained where one reach meets another. In the case of any reach overtopping for any reason the stormwater would run down the slope as overland flow to the next reach.

D. Waste Capacity.

1. *Introduction Section, page 3 table. The permitted and proposed elevations are reported using "Local Landfill Datum". Additionally, the Design Report Section 3.1, Section 4.3.1, and Section 4.6.1 refers to elevation as "NGVD", "MSL, and "AMSL" respectively. The City assumes all elevations should be using the NGVD 29 vertical datum. Please clarify and make consistent throughout the application.*

Response: All elevations are using the NGVD 29 vertical datum. Updates have been made throughout both documents.

2. *Design Report, Disposal Area Summary table on page 3. The Ultimate Design Capacity and Remaining Permitted Design Capacity values are different than the corresponding values on page 3 of the Introduction Section. Please reconcile.*

Response: The Introduction Section is correct; the Design Report has been updated.

3. *Update the values in the Design Report, Section 2.2 (Waste Flows / Site Capacity /Phasing) to provide information from 2022.*

Response: This section has been updated to reflect the remaining capacity of Phase 6 as of December 7, 2023. Phase 5F-2 and Phase 7 volumes are the same.

E. Liner and Leachate Collection System Design

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

1. *Design Report, Section 4.5.1, Historical Leachate Collection Data. The quantity of leachate collected for year 2017 through 2020 do not appear to match the annual reports for those years. Please address.*

Response: This table has been corrected and updated, and now includes 2022 as well.

2. *Design Report, Section 4.5.1, Historical Leachate Collection Data Update the leachate collection data to include year 2022.*

Response: This has been updated.

3. *Provide a summary of what areas have yet to receive a liner from Phase 5 and 6.*

Response: As of the end of 2023 Phase 6 is completely constructed and Phase 5F-2 is the only cell remaining to construct in Phase 5.

4. *Provide a summary of which areas will have subgrade prepared on natural soil surface as described in the Design Report, Section 4.2 (Subbase Preparation).*

Response: Phase 5F-2, the only remaining cell to be constructed, will have a natural soil subgrade.

5. *Provide analysis of additional strain on the existing liner and the potential for failure due to differential settlement from the Phase 7 vertical expansion (there seems a relatively high probability that the liner will experience excess strain at locations due to increased load from Phase 7 and resulting increased differential consolidation of waste below the liner).*

Response: A settlement analysis of the site was performed and submitted in a memo entitled, "Pine Bend Landfill Phase 6 Geotechnical Evaluation, August 27, 2015" as part of the Phase 6 Expansion Permitting Documents. The analysis used consecutive years of site survey data to estimate total potential settlement from physical creep and followed a method developed by Leonard and Floom (2003) to estimate settlement due to biodegradation of waste. A portion of that analysis was updated to estimate the total potential settlement due to the Phase 7 expansion. The calculations indicated a potential differential settlement (maximum – minimum) of approximately 3.1 feet. It should be noted that this calculation assumes no settlement has yet occurred and is therefore conservative. Over an area of liner 100 x 100 ft, this equates to approximately 3.1% liner elongation potential. The yield threshold for liner material is generally 15% elongation, suggesting that the calculated differential settlement is acceptable for liner performance. The updated settlement calculations are included in Attachment A of this comment response.

6. *The Geotechnical Evaluation provided as Application Appendix D is generally inadequate and should include:*
 - a. *Demonstration of effectiveness (technical papers or other) of the suggested "drain liner with an overlying geotextile" as substitute for a geonet composite. For the former, a geotextile that is not*

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

bonded to the geonet could yield excessively and fill gaps in the geonet thereby reducing the geonet's flow transmission capability.

Response: After additional review PBL intends to use the geonet geocomposite shown on the permit drawings rather than evaluate alternatives. The model reflects the geonet geocomposite already.

b. Literature and site-specific test data that supports the cohesion values and friction angles used in the stability analyses that are presented. The factors of safety appear unreasonably high for a 3H:1V slope and are likely the result of cohesion values and friction angles for which supporting literature and test data is not provided.

Response: Interface friction and cohesion values for the proposed cover and liner components were previously established in a comment response submittal completed for the Pine Bend site on June 24, 2016, entitled, "Response to Geotechnical Comments – City of Inver Grove Heights, Request for Major Modification of Permit SW-45, Pine Bend Landfill." The liner component interface friction and cohesion values established in that submittal were based on interface friction testing of the liner components over a range of potential effective stress loads representing the proposed waste overlay. The values presented in that submittal were adopted for use in this comment response and are presented in the table below. In addition, conservative values of internal friction and cohesion are shown for cover soils, MSW, and existing native soils:

Interface	Friction (degrees)	Cohesion (psf)
Peak Strength		
Buffer Soil/Liner	27.1	86
Liner/Geo-Composite	19.1	58
Geo-Composite/Cover Soils	33.3	62
Large Displacement		
Buffer Soil/Liner	26.5	81
Liner/Geo-Composite	13.4	59
Geo-Composite/Cover Soils	33.3	55
Other Materials		
Cover Soils	28	0
MSW	30	0
Native Soils	30	0

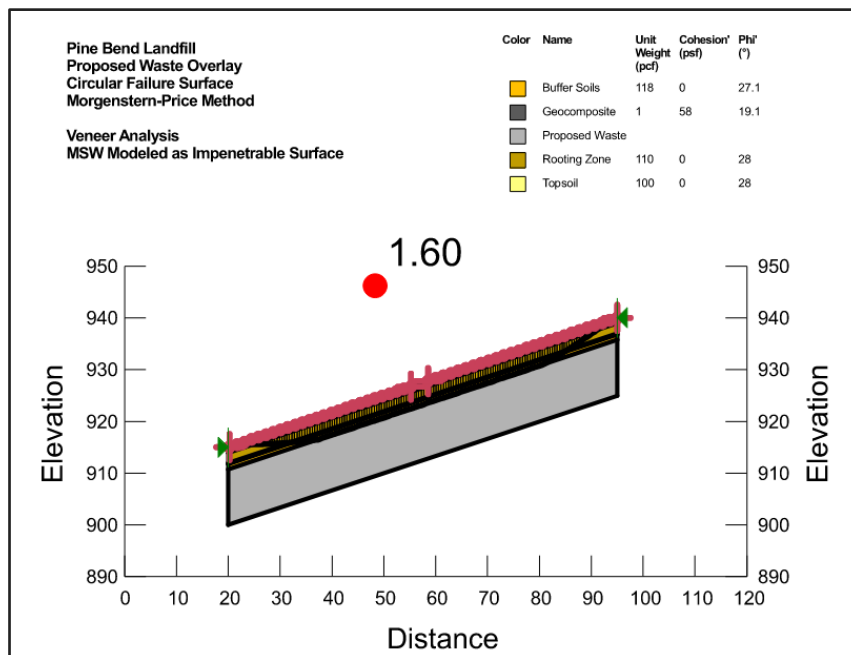
c. A veneer stability analyses of an isolated segment of the cover system on a 3H:1V slope appears to be absent from the analysis but is required to confirm stability of the proposed cover system.

Response: A veneer stability analysis of an isolated segment of the proposed cover system on a 3H:1V slope was completed using SLOPE/W, a limit equilibrium slope stability analysis software. In the first analysis, all cover components were modeled assuming zero cohesion in the interface strength, except for the liner/geo-composite interface. Interface friction testing shows that cohesion is a component of the strength at this interface, and this should not change based on variations in the soil components of the cover. The MSW waste material was modeled as an impenetrable surface to limit the analysis to the cover components. The program's optimization function was enabled to allow the program to determine if the critical

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

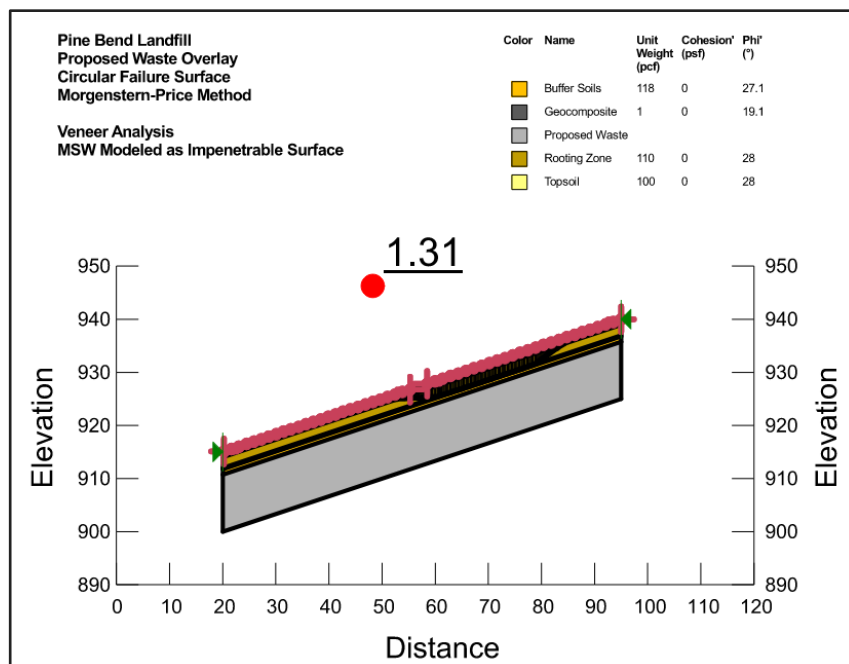
failure surface would closer resemble a circular or block type failure. The resulting factor of safety for this veneer analysis was 1.60, exceeding the desired minimum factor of safety of 1.5 for long term stability.

As a check, a second analysis as performed assuming no cohesion in the liner/geo-composite interface to represent a conservative and short-term case. The resulting factor of safety was 1.31, exceed the desired minimum factor of safety of 1.2 for short-term stability. The outputs for both veneer analyses are shown below.



Veneer Analysis – Long Term Slope Stability

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

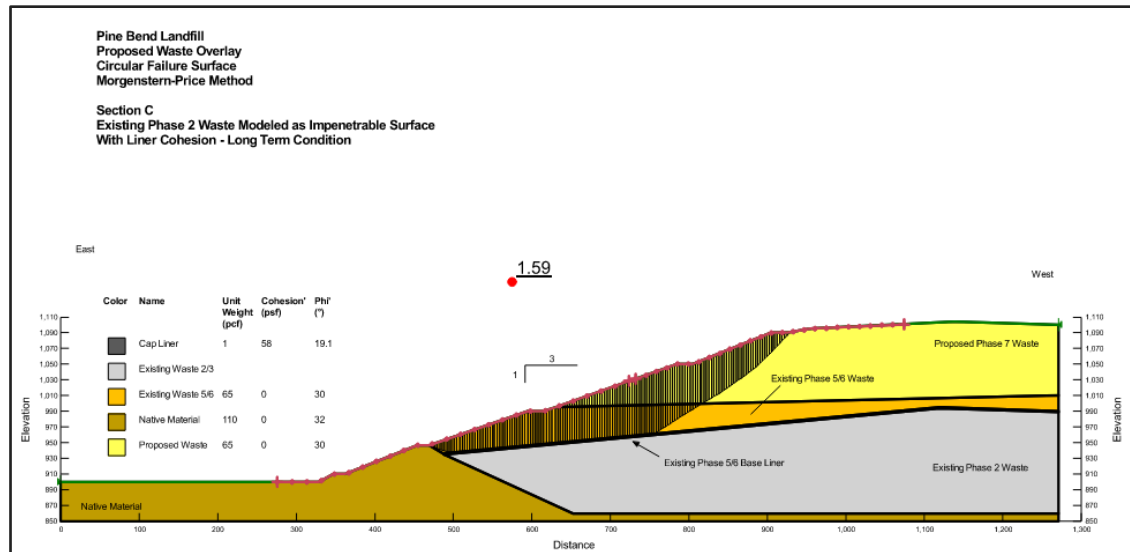


Veneer Analysis – Short Term Slope Stability

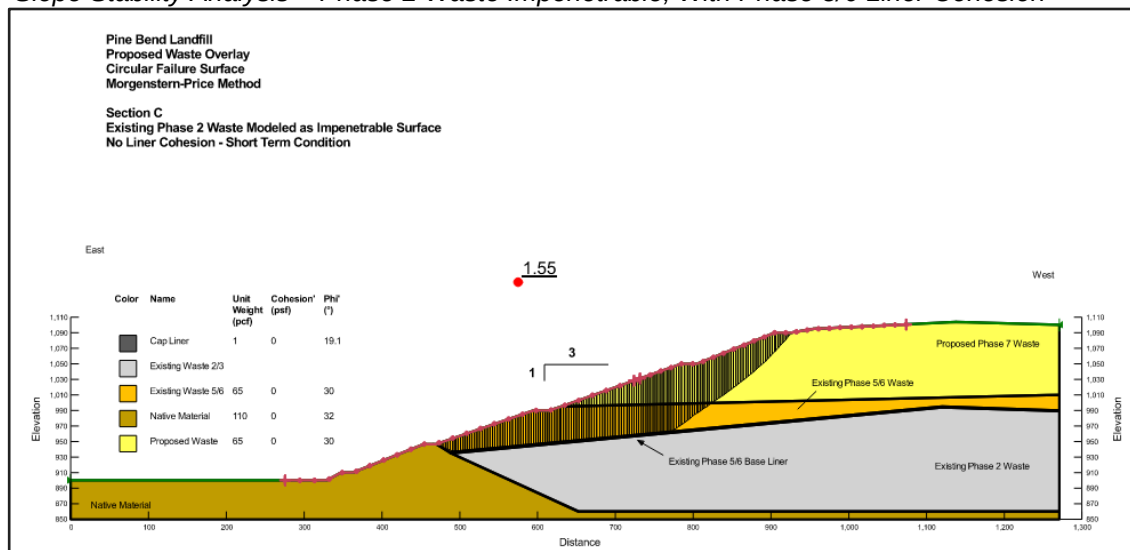
- d. The overall slope stability analysis lacks evaluation of alternate failure surface entry and exit points and does not include analyses that treat the “existing cover liner” as an impenetrable surface. These additional analyses are critical to understanding overall stability of the proposed slope system.

Response: The model was updated to reflect the existing and proposed conditions as illustrated in Section C of the plan set. Analyses were completed to evaluate the proposed overlay slope stability assuming that the existing Phase 2 waste material below the Phase 5/6 liner is an impenetrable surface. This configuration was modeled assuming no cohesion in the waste or native materials and with and without cohesion on the Phase 5/6 liner. A third analysis considered global slope stability with all layers defined as penetrable and no cohesion strength attributed to any materials. As in the veneer analysis above, the program’s optimization function was enabled to allow the program to determine if the critical failure surface would closer resemble a circular or block type failure. In each case, the resulting factor of safety exceeded the desired long-term factor of safety of 1.5. The model outputs are included below for reference.

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

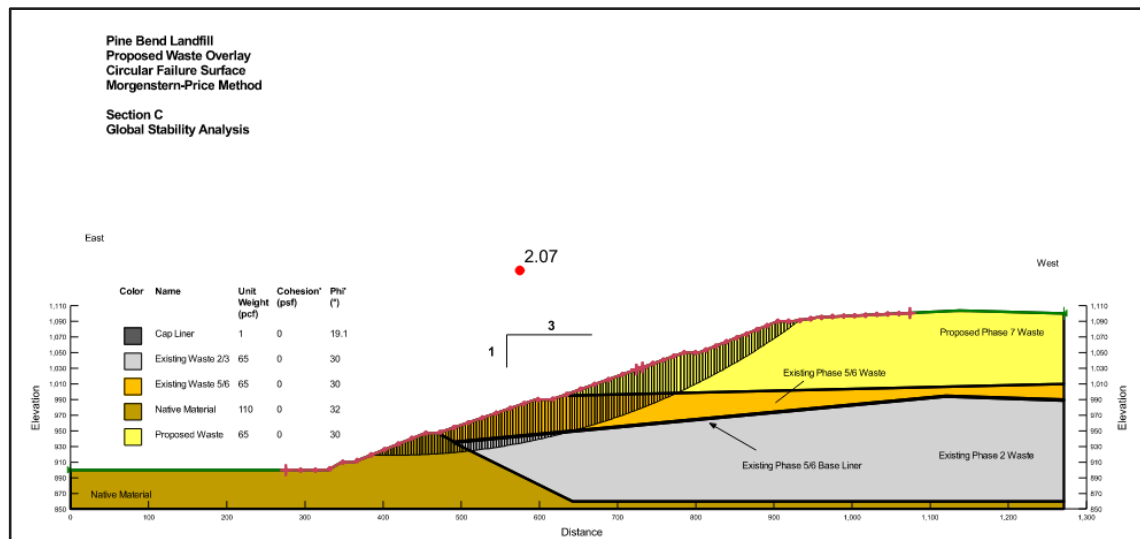


Slope Stability Analysis – Phase 2 Waste Impenetrable, With Phase 5/6 Liner Cohesion



Slope Stability Analysis – Phase 2 Waste Impenetrable, No Phase 5/6 Liner Cohesion

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency



Slope Stability Analysis – Global Stability, All Layers Penetrable, No Cohesion

- e. The slope stability analysis outcomes are based on cohesion being present in all of the soil layers and at the interface between soils and geomembrane. This is potentially not a realistic assumption (non-cohesive soils may be used for construction) and it does not represent a conservative approach to the analyses. The stability analyses should be expanded by analyzing stability with zero cohesion.

Response: The analyses included in this comment response memo were performed with zero cohesion in the soil layers and with and without cohesion on the Phase 5/6 liner.

F. Gas Monitoring and Gas Extraction/Treatment Systems

1. Design Report, Section 4.7.1 should include a discussion that subsurface landfill gas is migrating beyond the property boundary at concentrations above the LEL and a summary of the efforts to mitigate.

Response: This section has been updated to include the discussion referenced above.

2. Design Report, Section 4.7.4.2 describes the horizontal gas collectors installed in the Phase 6 expansion area. However, no discussion is included about any horizontal gas collectors as part of the Phase 7 expansion although Plan Drawings 8 and 9 seem to indicate that horizontal collectors will be installed as part of Phase 7. Please address this apparent discrepancy.

Response: The horizontal gas collectors shown in the drawings are intended to be installed as part of Phase 6. Construction of horizontal collectors will begin in 2024. Since the Phase 6 waste mass was not deep enough to install vertical gas extraction wells horizontal collectors

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

will be installed. In Phase 7 the waste mass will be deep enough to install gas extraction wells, which will also collect gas from portions of Phase 6. Additional gas collectors may be installed in the future by PBL in addition to the vertical extraction wells, at their discretion.

G. Final Cover Design

1. *Update the text to describe the current conditions in the Design Report, Section (Introduction).*

Response: The current phase construction status has been updated.

2. *Provide a summary of which portions of the 3H:1V slope area has final cover in place, how long it has been in place, and how has it performed from an infinite slope stability and erosion control standpoint.*

Response: Approximately 11 acres of final cover have been installed in Phase 4 on the west side of the landfill. The final cover was constructed in 2011 and has had no slope stability or erosion control issues noted.

3. *If there is no on-site demonstration of suitable performance of this cover design, then provide evidence of adequate performance of this 3H:1V cover design from similar sites.*

Response: The in-place cover has demonstrated suitable performance to continue with this cover design.

4. *Clarify the thickness of the Buffer Soils beneath the final cover section (12" thickness shown in the Drawings on Drawing No. 13 whereas a 6" thickness is specified in the Design Report, Section 4.6.1 – Design Overview).*

Response: The detail in the drawing is correct, 12 inches of buffer soils will be installed, and the design report has been updated to reflect that.

H. Closure, Post Closure, Contingency Action, and Operations and Maintenance Plans.

1. *Section 3.5 (Waste Placement Techniques) of the Operations and Maintenance Plan considers the proposed Phase 7 expansion, provide consideration for all areas yet to be constructed.*

Response: The only remaining phase to be constructed is Phase 5F-2, and the waste placement techniques described in Section 3.5 would apply in 5F-2 the same way they would in Phase 7.

2. *Provide landfill design volumes and estimated dates for each phase closure within the Closure, Post-Closure, Contingency Action Plan Section 2.2 (Notification of Cell Closure).*

Response: This section has been updated to include more information about planned closure phasing.

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

3. *Provide a closure phasing plan within the Closure, Post-Closure, Contingency Action Plan Section 2.4 (Closure Schedule).*

Response: This section has been updated to include more information about the planned closure phasing.

4. *Section 2.9 (Closure Cost Estimate) within the Closure, Post-Closure, Contingency Action Plan reports an area of 69.4 acres whereas Table 1 lists 32.6 acres. Please reconcile or provide rationale for the difference.*

Response: This has been reconciled, Table 1 has been updated.

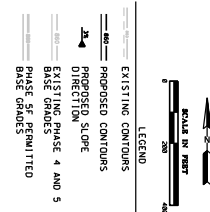
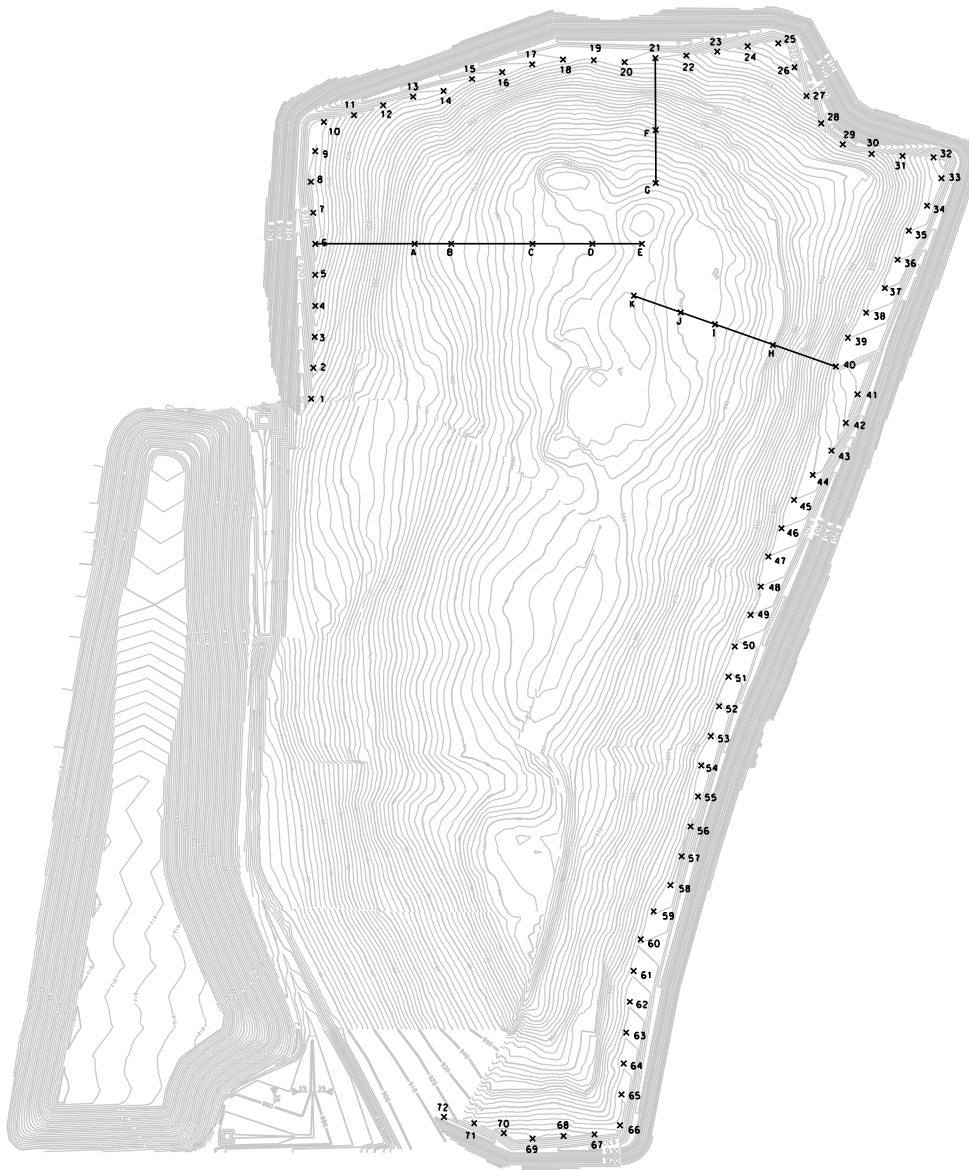
I. Financial Assurance Cost Estimates

1. *The total financial assurance value should be updated to match the 2022 Annual Report value of \$20,846,216.*

Response: The financial assurance values in the 2022 Annual Report are based on approved closure, post-closure, and contingency action costs from the 2018 expansion. The closure, post-closure, and contingency action cost estimates were updated based on this expansion and current unit costs. Entering those values into the MPCA's Payment Rate Estimator results in a total of approximately \$25.4 Million for 2024.

2. *Please provide the value of the bond to Dakota County.*

Response: The bond in place with Dakota County is for \$643,631.00



FILE NAME: M/0951/PINEBEND/2015 PERMIT/SETTLEMENT FIGURE

FIGURE
1



Responsive partner. Exceptional outcomes.

1800 PIONEER CREEK CENTER
MAPLE PLAIN, MN 55557

PHONE: 763-479-4200
FAX: 763-479-4242

PROJECT

2015 PERMIT MODIFICATION
BFI WASTE SYSTEMS
OF NORTH AMERICA, LLC
PINE BEND LANDFILL
INVER GROVE HEIGHTS, MINNESOTA

SHEET TITLE
SETTLEMENT ANALYSIS POINTS

DATE: AUG. 2015

REVISIONS DATE

DWN OMP CHK'D APP'D TJB

Pine Bend Landfill Phase 7 Expansion Settlement Analysis

Physical Creep Compression Settlement Parameters

# of Years for Determination of Physical Creep Compression Settlement	47	(17 Year Site Life + 30 Year PC Period)
Log Factor for Physical Creep Compression Settlement (LF)	1.67	
Calculated % Settlement Per Log Cycle of Time (SLCT)	2.3%	

Biodegradation Settlement Parameters

Settlement Factor for Biodegradation Settlement (SF)	0.128	
Assumed Organic Content of Waste (OC)	26%	Typical Range is 22-26%

[illegible]

To: Abdi Hassan
Minnesota Pollution Control Agency

From: Aaron Janusz, Pine Bend Landfill
Tom Shustarich, Stantec Consulting
Services, Inc.
Ethan Ketelsen, Stantec Consulting
Services, Inc.

CC: Ally Sutherland, City of Inver Grove Heights
Bryan Pitterle, Barr Engineering
Jeff Ubl, Barr Engineering
Terry Muller, Dakota County

Project/File: 227706442 Date: April 12, 2024

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

Comments regarding the 2022 Pine Bend Landfill Major Modification of Permit #SW-45 Report, provided in a letter prepared by Barr and the City of Inver Grove Heights and dated April 5, 2024, are presented below followed by the responses.

A. Waste Acceptance

Comments 1-2 resolved.

B. Groundwater Monitoring System

No comments.

C. Leachate Recirculation

No comments.

D. Solid Waste Composting.

Comments 3-4 resolved.

E. Groundwater Quality

No comments.

F. Surface Water Management

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

5. *The HydroCAD model file was received with Stantec's February 2024 Response submittal. Barr noticed that node 7P outlet was sized as a 96-inch RCP, rather than the 60-inch RCP as specified in Section 4.6.3.5 of the report and in the node description within the HydroCAD model. Please update the model as necessary to reflect the correct pipe size, rerun, and confirm that the results still meet all requirements.*

Response: Agreed, in the model the outlet was revised to match the existing pipe size of 60-inch. Node 7P still meets requirements with this update.

6. *Comments 6-10 resolved.*

11. a. *For back-to-back 100-year events, model contains warnings and errors that terraces and downslope channels, and ponds (3P) cannot contain the event, contrary to what the report says in Section 4.6.3.3. Please update the report to remove this statement if it is not part of the design criteria (i.e., system is not designed to convey the back-to-back 100-year events).*

Response: Agreed, the statement in Section 4.6.3.3 was intended to say 100-year event instead of back-to-back 100-year events. This has been updated.

11. b. *For the 100-year event, the model contains warnings that the downslope channels cannot contain the event, contrary to what the report says in Section 4.6.3.2. Please update the report by removing the statement that channels can contain the event and include the Stantec February 2024 response for channels that may overtop.*

Response: In the 100-year event there are no reaches that overtop, all reaches are at least 1.83 feet deep at the point where they meet the downslopes and the outlet depth at that point are less, so they will be contained either within the reach leading to the downslope or the downslope itself. In the back-to-back 100-year event there is one reach that exceeds the storage capacity of the reach, and in that scenario would overtop the edge of the reach by 0.08 feet. We have added the statement that in the scenario where a reach could overtop the water would be directed to a downslope reach via overland flow and ultimately be directed to the same pond it would have in the original reach.

11. c. *Pond 9P storage is exceeded during the 100-year event, ensure proper overflows are accounted for or that 100-year event is appropriately contained within the structure.*

Response: The Pond 9P (a rectangular concrete diversion structure with culvert outlet) was previously modeled to a maximum elevation of 862, as that's where the cable concrete enters the structure in a small plunge pool with minimal storage that's lower than the adjacent ditches emptying into it. The storage could actually reach 865 before overtopping the area where the cable concrete meets the diversion structure. We have remodeled the node to include storage up to that point, and during the 100-year event the peak elevation is 863.61, where water would begin to pool at the end of the cable concrete but would not overtop any incoming reaches.

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

G. Waste Capacity.

Comments 12-14 resolved.

H. Liner and Leachate Collection System Design

Comments 15-16 resolved.

17. *Drawing 2 shows some of the Phase 6 Cells as future cells. Please update.*

Response: Agreed, as of the original submittal this was true, and since then Phase 6B-2 and 6A (constructed as one phase) have both been constructed, certified and approved. This has been updated.

Comment 18 resolved.

19. *The February 2024 response requires clarification as to the yield threshold applicable to the site-specific geomembrane liner and the yield threshold applicable to the site-specific geosynthetic clay liner, both of which are understood to underlie the proposed Phase 7 expansion. Please provide.*

Response: QC test results from individual cells are included as an attachment. Yield threshold of GCL is not usually tested during MQC, however a typical value is approximately 10%. The minimum observed yield elongation for any individual roll of the 60-mil HDPE was 14%. As described in the previous comment response memorandum the likely liner elongation potential in a 100x100 area is approximately 3.1%, suggesting that the liner and GCL performance should be considered acceptable.

20. a. *Comment resolved.*

20. b. *It is understood from previous responses that the 3H:1V covered areas are reported to be performing well. Include in future annual reports descriptions of any veneer (cover) instability and/or extra maintenance required on 3H:1V covered areas, if either condition occurs.*

Response: PBL will include any information regarding cover instability or noted maintenance and repairs of the cover area in annual reports, or a statement declaring that no issues were noted.

20. c-e. *Comments resolved. It is acknowledged that Barr did not perform confirmatory modeling in the comment but agrees that the analyses appear to be satisfactory.*

I. Gas Monitoring and Gas Extraction/Treatment Systems

Comments 21-22 resolved.

J. Final Cover Design

Comments 23-26 resolved.

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

K. Closure, Post Closure, Contingency Action, and Operations and Maintenance Plans.

Comments 27-29 resolved.

30. a. *Closure, Post-Closure, Contingency Action Plan, Table 1. The unit cost for 40-mil LLDPE Liner decreased from \$0.70/Square Feet in the June 2022 Application and September 2022 Addendum to \$0.35/Square Feet in the February 2024 Response. Please reconcile or provide rationale for the difference.*

Response: The original value was a typical landfill cost estimate. Republic Services gets a discounted rate from manufacturers due to a high volume of purchases nationwide, the updated cost estimate includes a value based on their current rate to order and install the material.

30. b. *The unit cost for Geocomposite decreased from \$1.13/Square Feet in the June 2022 Application and September 2022 Addendum to \$0.44/Square Feet in the February 2024 Response. Please reconcile or provide rationale for the difference.*

Response: The original value was a typical landfill cost estimate. Republic services gets a discounted rate from manufacturers due to a high volume of purchases nationwide, the updated cost estimate includes a value based on their current rate to order and install the material.

30. c. *The lump sum unit cost for Gas Collection System Infrastructure was \$200,000 in the June 2022 Application and September 2022 for 32.6 acres of final cover. The lump sum unit cost stayed the same in the February 2024 Response however the final cover area of 173 acres was over 5 times greater. It appears that the lump sum cost should be increased proportionally to approximately \$1,000,000. Please reconcile or provide rationale for the difference.*

Response: Pine Bend intends to complete the majority of the gas collection system installation in Phase 7 during Phase 7 operations, prior to closure events. At this time we are proposing to leave the value in the cost estimate at \$200,000 as an estimate of the last gas system construction event to be completed at the time of final closure.

30. d. *It appears that final cover should be and could be installed in smaller acreages as areas reach final grades rather than having 173 acres without final cover. Please explain or modify.*

Response: The cost estimate was originally set up as a single, maximum possible event. The likely scenario is approximately 5 events of 20-40 acres of closure at a time, and the cost estimate has been updated as such.

L. Financial Assurance Cost Estimates

31. *The values for Closure (\$15,054,640) and Contingency Action (\$1,163,414) shown in Section 5 of the Closure, Post-closure, Contingency Action Plan dated June 1, 2022, revised February 2024 do not appear to match the value in the subsequent tables. Please review and modify.*

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

Response: The values in the tables were 2023 cost estimates, which were then inflated to 2024 dollars using the MPCA Payment Rate Estimate Table (included as Table 7 after the cost estimate tables). Table 1 and Table 7 have both been updated in accordance with comments and responses above, with the same methodology as the previous submittal. With the updates to the cost estimate tables PBL is proposing to use the new values as "2024 approved cost estimates" for the 2024 Annual Report if the permit is issued before then. Financial assurance will be updated once an approved permit is issued.

32. Comment resolved.

To: Abdi Hassan
Minnesota Pollution Control Agency

From: Aaron Janusz, Pine Bend Landfill
Tom Shustarich, Stantec Consulting Services, Inc.
Ethan Ketelsen, Stantec Consulting Services, Inc.

CC: Ally Sutherland, City of Inver Grove Heights
Bryan Pitterle, Barr Engineering
Jeff Ubl, Barr Engineering
Terry Muller, Dakota County

Project/File: 227706442 Date: April 29, 2024

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

Comments regarding the 2022 Pine Bend Landfill Major Modification of Permit #SW-45 Report, provided in a letter prepared by Barr and the City of Inver Grove Heights and dated April 23, 2024, are presented below followed by the responses.

H. Liner and Leachate Collection System Design

19. *Please provide a supporting reference(s) for the stated yield threshold of GCL of approximately 10%, and specifically for the GCL type to be used on this project.*

Response: Please see attached the excerpt from the Geotechnical Fabrics Report's 1997 Specifier's Guide, showing greater than 10% tensile elongation for most GCLs, including Bentomat ST, the primary GCL used in Phase 6 cell construction events. Phone conversations with CETCO led to the discovery that there aren't recent published values widely available due to it not being a typical test, but in testing find the elongation at failure to be a wide range of approximately 5-40%, dependent on GCL type, individual samples, peak tensile strength at the time of failure, etc. With the previously described liner elongation potential of 3.1% the GCL performance should still be considered satisfactory.

K. Closure, Post Closure, Contingency Action, and Operations and Maintenance Plans.

30. *a. Financial assurance is required in case a landfill owner walks away from the facility. Therefore, the financial assurance cost estimates do not reflect the prices that the landfill owner could obtain but instead must reflect the costs that the MPCA or some other party would need to pay. Please review the April 5, 2024 Barr recommendation above and reply.*

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's 2022 Request for Major Modification of Permit #SW-45 Submitted to the Pollution Control Agency

Response: The rationale makes sense and we have reverted the unit cost to the original cost.

30. *b. Financial assurance is required in case a landfill owner walks away from the facility. Therefore, the financial assurance cost estimates do not reflect the prices that the landfill owner could obtain but instead must reflect the costs that the MPCA or some other party would need to pay. Please review the April 5, 2024 Barr recommendation above and reply.*

Response: The rationale makes sense and we have reverted the unit cost to the original cost.

30. *c. The closure cost estimate must reflect the cost to close the landfill based on the area that is open. Because the gas collection system infrastructure is part of closure that a party like the MPCA may need to perform if PBL were to walk away from the site, the cost for it must be included in the closure cost estimate. Please review the April 5, 2024 Barr recommendation above and reply.*

Response: The rationale makes sense and we have updated the cost based on the size of the open area at the site.

Appendix B

GCL Information from *Geotechnical Fabrics Report "1997 Specifier's Guide"*

GEOSYNTHETIC CLAY LINERS

Product Name	GCL Dimensional Properties			GCL Hydraulic Properties	Base Bentonite Properties		Upper Geosynthetic		Lower Geosynthetic		GCL Tensile Properties ASTM D 4595 for geotextiles as lower component ASTM D 638 for geomembranes as lower component		Manufacturer's Suggested Applications [3]
	Panel Size Roll Width/Length	Average Roll Weight	Bentonite Mass/Unit Area Exclusion of Glue Weight	Flux at $i = 1.0$ [1] ASTM D 5084 [2]	Swell Index USP-NF-XVII	Fluid Loss API-13B (ml)	Weight ASTM D 3776	Type or Structure	Weight ASTM D 3776 or Thickness ASTM D 5199	Type or Structure	Tensile Strength kN/m (lb/in)	Tensile Elongation %	
	m/m (ft/ft)	kN (lb)	kN/m ² (lb/ft ²)	m/s (cm/sec)	(min) ml/2g		g/m ² (oz/yd ²)		g/m ² or mm (oz/yd ² or mil)				

Colloid Environmental Technologies Co. (CETCO)

Claymax 200 R	4.2/45.7 (13.83/150)	1044 kg (2300)	3.7 ^A (0.75)	5×10^{-11} (5×10^{-9})	24	18	woven	108 (3.2)	nonwoven	203 (6.0)	13.1 ^A (75)	>10	LL
Claymax 500 SP	4.2/45.7 (13.83/150)	1044 kg (2300)	3.7 ^A (0.75)	5×10^{-11} (5×10^{-9})	24	18	woven	108 (3.2)	woven	108 (3.2)	26.3 ^A (150)	>10	LL
Claymax 600 SP	4.2/45.7 (13.83/150)	1044 kg (2300)	3.7 ^A (0.75)	5×10^{-12} (5×10^{-10})	24	18	woven	108 (3.2)	woven/FHL composite	223 (6.6)	26.3 ^A (150)	>10	LC, SIC
Bentomat ST	4.6/45.7 (15/150)	1090 kg (2400)	3.7 ^A (0.75)	5×10^{-11} (5×10^{-9})	24	18	woven	112 (3.3)	nonwoven	203 (6.0)	15.8 ^A (90)	>10	LL, LC, SIC
Bentomat DN	4.6/45.7 (15/150)	1112 kg (2450)	3.7 ^A (0.75)	5×10^{-11} (5×10^{-9})	24	18	geotextile	203 (6.0)	nonwoven	203 (6.0)	26.3 ^A (150)	>10	LL

GSE Lining Technology Inc.

GSE GundSeal	5.3 ^C /61 ^A (17.5/200)	1900 (4200)	0.048 (1.0)	$<4 \times 10^{-14}$ ($<4 \times 10^{-12}$)	28	18	none	NA	smooth geomembrane	0.3–2.0 mm (12–80 mil)	varies w/ GM type	>10	caps, containment
GSE GundSeal Textured	5.3 ^C /62 ^A (17.5/170)	1900 (4200)	0.048 (1.0)	$<4 \times 10^{-14}$ ($<4 \times 10^{-12}$)	28	18	none	NA	textured geomembrane	0.75–2.0 mm (30–80 mil)	varies w/ GM type	>10	caps, containment, slope applications

GSE GundSeal Geobond	5.3' /61° (17.5/200)	1900 (4200)	0.048 (1.0)	$<4 \times 10^{-14}$ ($<4 \times 10^{-13}$)	28	18	nonwoven	25 (0.75)	smooth or textured geomembrane	0.3–2.0 mm (12–80 mil)	varies w/ GM type	>10	caps, containment
GSE GundSeal Weldable	5.3' /62° (17.5/170)	1900 (4200)	0.048 (1.0)	$<4 \times 10^{-14}$ ($<4 \times 10^{-13}$)	28	18	nonwoven optional	if used 25 (0.75)	geomembrane w/ bentonite-free edges	0.75–2.0 mm (30–80 mil)	varies w/ GM type	>10	GM/clay composite lining applications (welded seams)

National Seal Co./Fluid Systems/Columbia Geosystems Ltd.

NSC FSI Bentofix Thermal-Lock NW	4.7/38.1 (15.5/125)	977 (2150)	0.0439 (0.90)	5×10^{-11} (5×10^{-9})	24	18	nonwoven	200 (6.0)	nonwoven	200 (6.0)	12.1 (70)	NP	LC, LL, SIC
NSC FSI Bentofix Thermal-Lock NS	4.7/38.1 (15.5/125)	977 (2150)	0.0439 (0.90)	5×10^{-11} (5×10^{-9})	24	18	nonwoven	105 (3.1)	woven	200 (6.0)	12.1 (70)	NP	LC, LL, SIC

Naue Fasertechnik GmbH & Co.

B4000	4.8/30 (15.7/98)	NP	4700 g/m ²	2×10^{-11} (2×10^{-9})	25	18	PP nonwoven	300 (8.9)	PP scrim reinforced nonwoven	400 g/m ² (10.3)	12 (DIN 53857)	50	SIC, WR, LC
D4000	4.8/30 (15.7/98)	NP	4700 g/m ²	2×10^{-11} (2×10^{-9})	25	18	PP nonwoven	300 (8.9)	PP scrim reinforced nonwoven	350 g/m ² (10.3)	12 (DIN 53857)	50	LL, LC
BIG 5000	4.8/30 (15.7/98)	NP	5000 g/m ²	2×10^{-11} (2×10^{-9})	25	18	PP nonwoven	300 (8.9)	PP woven	200 g/m ² (15.9)	8 (DIN 53857)	5	WR, LC, SIC
NSP 4900	4.8/30 (15.7/98)	NP	5600 g/m ²	2×10^{-11} (2×10^{-9})	25	18	PP nonwoven	220 (6.5)	PP woven	110 g/m ² (3.2)	6 (DIN 53857)	8	LL, LC, SIC

(1) Flux is defined as "flow rate/unit area," which can be converted to permeability using the equation:

Permeability = flux/hydraulic gradient

(2) Report result at a confining stress of 69 kN/m² (10psi) and 34 Kpa (5psi) head pressure

(3) CL = Canal liner

LL = Landfill liner

SIC = Surface impoundment cover

NP = Not provided by manufacturer

NA = Not applicable, per manufacturer

(A) Reported at 0 percent moisture content and kg/m²

(B) ASTM D 4632 Results (machine direction MARV)

(C) Available in 2.4 m (8 ft) widths

(D) Roll length depends upon geomembrane thickness.

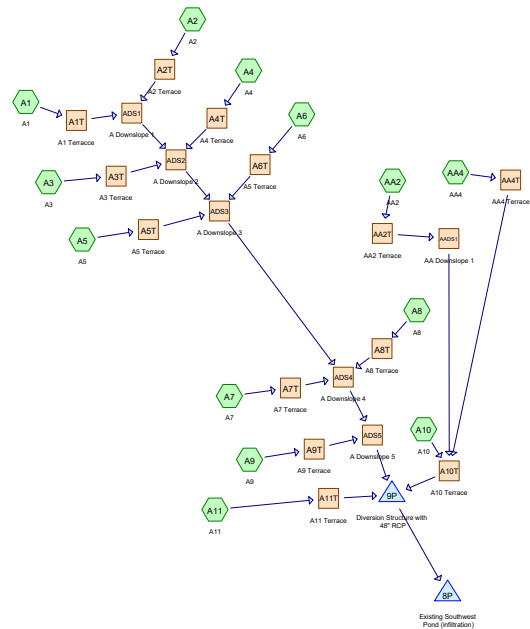
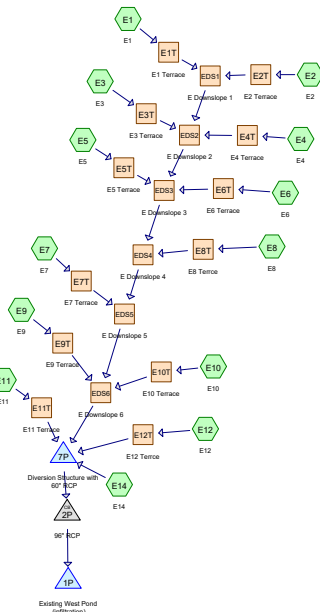
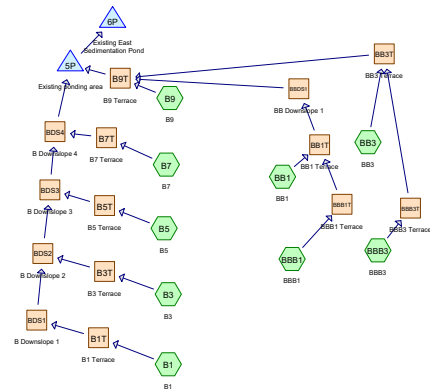
Companies were requested to provide minimum average roll values (MARV). All claims are the responsibility of the manufacturer.



GEOSYNTHETIC CLAY LINERS

Appendix E Stormwater Management Model and Calculations





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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
7,832,915	74	(A1, A10, A11, A2, A3, A4, A5, A6, A7, A8, A9, AA2, AA4, B1, B3, B5, B7, B9, BB1, BB3, BBB1, BBB3, C0, C1, C10, C2, C3, C4, C5, C6, C7, C8, CC2, CC4, D1, D10, D11, D12, D2, D4, D5, D6, D7, D8, D9, E1, E10, E11, E12, E14, E2, E3, E4, E6, E7, E8, E9)
464,661	83	(C9, D3, E5)
8,297,576	75	TOTAL AREA

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
0	HSG C	
0	HSG D	
8,297,576	Other	A1, A10, A11, A2, A3, A4, A5, A6, A7, A8, A9, AA2, AA4, B1, B3, B5, B7, B9, BB1, BB3, BBB1, BBB3, C0, C1, C10, C2, C3, C4, C5, C6, C7, C8, C9, CC2, CC4, D1, D10, D11, D12, D2, D3, D4, D5, D6, D7, D8, D9, E1, E10, E11, E12, E14, E2, E3, E4, E5, E6, E7, E8, E9
8,297,576		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	0	0	8,297,576	8,297,576		A 1 , A 1 0 , A 1 1 , A 2 , A 3 , A 4 , A 5 , A 6 , A 7 , A 8 , A 9 , A A 2 , A A 4 , B 1 ,

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Ground Covers (all nodes) (continued)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	0	0	8,297,576	8,297,576	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	2P	856.00	855.70	150.0	0.0020	0.011	96.0	0.0	0.0
2	5P	895.39	888.64	135.0	0.0500	0.011	36.0	0.0	0.0
3	5P	895.00	888.25	135.0	0.0500	0.011	36.0	0.0	0.0
4	7P	870.00	867.00	94.0	0.0319	0.011	60.0	0.0	0.0
5	9P	852.50	845.00	433.0	0.0173	0.011	48.0	0.0	0.0

Time span=0.00-62.00 hrs, dt=0.01 hrs, 6201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA1: A1	Runoff Area=86,877 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=456' Slope=0.0303 '/' Tc=15.2 min CN=74 Runoff=11.31 cfs 31,994 cf
SubcatchmentA10: A10	Runoff Area=96,058 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=64' Slope=0.3750 '/' Tc=3.3 min CN=74 Runoff=19.95 cfs 35,375 cf
SubcatchmentA11: A11	Runoff Area=245,226 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=128' Slope=0.1250 '/' Tc=7.4 min CN=74 Runoff=43.06 cfs 90,309 cf
SubcatchmentA2: A2	Runoff Area=111,341 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=516' Slope=0.0209 '/' Tc=18.2 min CN=74 Runoff=13.27 cfs 41,003 cf
SubcatchmentA3: A3	Runoff Area=46,575 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=125' Slope=0.2720 '/' Tc=5.5 min CN=74 Runoff=8.91 cfs 17,152 cf
SubcatchmentA4: A4	Runoff Area=139,986 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=480' Slope=0.0666 '/' Tc=11.0 min CN=74 Runoff=21.25 cfs 51,553 cf
SubcatchmentA5: A5	Runoff Area=69,424 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=112' Slope=0.3036 '/' Tc=5.1 min CN=74 Runoff=13.44 cfs 25,567 cf
SubcatchmentA6: A6	Runoff Area=151,984 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=246' Slope=0.1461 '/' Tc=7.3 min CN=74 Runoff=26.83 cfs 55,971 cf
SubcatchmentA7: A7	Runoff Area=67,785 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=320' Slope=0.1219 '/' Tc=8.1 min CN=74 Runoff=11.55 cfs 24,963 cf
SubcatchmentA8: A8	Runoff Area=73,981 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=291' Slope=0.1580 '/' Tc=7.2 min CN=74 Runoff=13.12 cfs 27,245 cf
SubcatchmentA9: A9	Runoff Area=145,558 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=134' Slope=0.2980 '/' Tc=5.3 min CN=74 Runoff=27.98 cfs 53,605 cf
SubcatchmentAA2: AA2	Runoff Area=108,213 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=77' Slope=0.2600 '/' Tc=4.4 min CN=74 Runoff=21.58 cfs 39,852 cf
SubcatchmentAA4: AA4	Runoff Area=113,304 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=64' Slope=0.0940 '/' Tc=5.7 min CN=74 Runoff=21.42 cfs 41,726 cf
SubcatchmentB1: B1	Runoff Area=223,246 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=720' Slope=0.0136 '/' Tc=23.7 min CN=74 Runoff=23.23 cfs 82,215 cf
SubcatchmentB3: B3	Runoff Area=127,876 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=272' Slope=0.1030 '/' Tc=8.5 min CN=74 Runoff=21.36 cfs 47,093 cf
SubcatchmentB5: B5	Runoff Area=161,816 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=123' Slope=0.2440 '/' Tc=5.7 min CN=74 Runoff=30.58 cfs 59,592 cf

SubcatchmentB7: B7	Runoff Area=181,609 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=112' Slope=0.3210 '/' Tc=5.0 min CN=74 Runoff=35.45 cfs 66,881 cf
SubcatchmentB9: B9	Runoff Area=253,224 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=331' Slope=0.2590 '/' Tc=8.3 min CN=74 Runoff=42.91 cfs 93,255 cf
SubcatchmentBB1: BB1	Runoff Area=100,377 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=272' Slope=0.2940 '/' Tc=5.6 min CN=74 Runoff=19.05 cfs 36,966 cf
SubcatchmentBB3: BB3	Runoff Area=121,077 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=213' Tc=5.3 min CN=74 Runoff=23.28 cfs 44,589 cf
SubcatchmentBBB1: BBB1	Runoff Area=210,326 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=212' Slope=0.1410 '/' Tc=7.3 min CN=74 Runoff=37.13 cfs 77,457 cf
SubcatchmentBBB3: BBB3	Runoff Area=61,134 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=64' Slope=0.2500 '/' Tc=3.9 min CN=74 Runoff=12.45 cfs 22,514 cf
SubcatchmentC0: C0	Runoff Area=32,269 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=240' Slope=0.0500 '/' Tc=11.3 min CN=74 Runoff=4.83 cfs 11,884 cf
SubcatchmentC1: C1	Runoff Area=549,846 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=361' Slope=0.0326 '/' Tc=14.1 min CN=74 Runoff=74.30 cfs 202,491 cf
SubcatchmentC10: C10	Runoff Area=225,591 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=121' Slope=0.3620 '/' Tc=4.8 min CN=74 Runoff=44.26 cfs 83,078 cf
SubcatchmentC2: C2	Runoff Area=224,833 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=417' Slope=0.0335 '/' Tc=14.3 min CN=74 Runoff=30.18 cfs 82,799 cf
SubcatchmentC3: C3	Runoff Area=235,176 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=118' Tc=5.2 min CN=74 Runoff=45.49 cfs 86,608 cf
SubcatchmentC4: C4	Runoff Area=149,333 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=118' Slope=0.2880 '/' Tc=5.2 min CN=74 Runoff=28.89 cfs 54,995 cf
SubcatchmentC5: C5	Runoff Area=239,483 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=124' Slope=0.2880 '/' Tc=5.2 min CN=74 Runoff=46.32 cfs 88,194 cf
SubcatchmentC6: C6	Runoff Area=189,000 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=121' Slope=0.1640 '/' Tc=6.7 min CN=74 Runoff=34.21 cfs 69,603 cf
SubcatchmentC7: C7	Runoff Area=249,979 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=104' Slope=0.3070 '/' Tc=5.1 min CN=74 Runoff=48.41 cfs 92,060 cf
SubcatchmentC8: C8	Runoff Area=220,718 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=125' Slope=0.2240 '/' Tc=5.9 min CN=74 Runoff=41.39 cfs 81,284 cf
SubcatchmentC9: C9	Runoff Area=359,459 sf 0.00% Impervious Runoff Depth=5.43" Flow Length=286' Slope=0.2370 '/' Tc=6.1 min CN=83 Runoff=79.02 cfs 162,798 cf

SubcatchmentCC2: CC2	Runoff Area=87,958 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=98' Slope=0.2050 '/' Tc=5.9 min CN=74 Runoff=16.49 cfs 32,392 cf
SubcatchmentCC4: CC4	Runoff Area=212,677 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=286' Slope=0.2930 '/' Tc=5.6 min CN=74 Runoff=40.36 cfs 78,322 cf
SubcatchmentD1: D1	Runoff Area=28,583 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=259' Slope=0.0730 '/' Tc=9.8 min CN=74 Runoff=4.53 cfs 10,526 cf
SubcatchmentD10: D10	Runoff Area=67,808 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=178' Slope=0.2480 '/' Tc=5.8 min CN=74 Runoff=12.76 cfs 24,972 cf
SubcatchmentD11: D11	Runoff Area=84,848 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=176' Slope=0.3068 '/' Tc=5.3 min CN=74 Runoff=16.31 cfs 31,247 cf
SubcatchmentD12: D12	Runoff Area=46,819 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=98' Slope=0.2040 '/' Tc=5.9 min CN=74 Runoff=8.78 cfs 17,242 cf
SubcatchmentD2: D2	Runoff Area=260,979 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=240' Slope=0.0304 '/' Tc=13.8 min CN=74 Runoff=35.57 cfs 96,111 cf
SubcatchmentD3: D3	Runoff Area=31,886 sf 0.00% Impervious Runoff Depth=5.43" Flow Length=134' Slope=0.2680 '/' Tc=5.5 min CN=83 Runoff=7.21 cfs 14,441 cf
SubcatchmentD4: D4	Runoff Area=93,430 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=117' Slope=0.2740 '/' Tc=5.4 min CN=74 Runoff=17.89 cfs 34,407 cf
SubcatchmentD5: D5	Runoff Area=44,094 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=152' Slope=0.1447 '/' Tc=7.1 min CN=74 Runoff=7.85 cfs 16,238 cf
SubcatchmentD6: D6	Runoff Area=92,257 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=150' Slope=0.2660 '/' Tc=5.5 min CN=74 Runoff=17.65 cfs 33,975 cf
SubcatchmentD7: D7	Runoff Area=54,813 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=139' Slope=0.2580 '/' Tc=5.6 min CN=74 Runoff=10.40 cfs 20,186 cf
SubcatchmentD8: D8	Runoff Area=80,420 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=158' Slope=0.2525 '/' Tc=5.6 min CN=74 Runoff=15.26 cfs 29,616 cf
SubcatchmentD9: D9	Runoff Area=65,253 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=139' Slope=0.2580 '/' Tc=5.6 min CN=74 Runoff=12.38 cfs 24,031 cf
SubcatchmentE1: E1	Runoff Area=181,872 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=246' Slope=0.0296 '/' Tc=13.9 min CN=74 Runoff=24.72 cfs 66,978 cf
SubcatchmentE10: E10	Runoff Area=211,515 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=200' Slope=0.1200 '/' Tc=7.8 min CN=74 Runoff=36.56 cfs 77,895 cf
SubcatchmentE11: E11	Runoff Area=81,147 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=212' Slope=0.1880 '/' Tc=6.5 min CN=74 Runoff=14.81 cfs 29,884 cf

SubcatchmentE12: E12	Runoff Area=245,497 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=136' Slope=0.1030 '/' Tc=8.0 min CN=74 Runoff=41.99 cfs 90,409 cf
SubcatchmentE14: E14	Runoff Area=9,207 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=176' Slope=0.0230 '/' Tc=1.3 min CN=74 Runoff=2.00 cfs 3,391 cf
SubcatchmentE2: E2	Runoff Area=104,657 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=427' Slope=0.0320 '/' Tc=14.6 min CN=74 Runoff=13.95 cfs 38,542 cf
SubcatchmentE3: E3	Runoff Area=73,298 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=150' Slope=0.2660 '/' Tc=5.5 min CN=74 Runoff=14.02 cfs 26,993 cf
SubcatchmentE4: E4	Runoff Area=67,433 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=128' Slope=0.2810 '/' Tc=5.4 min CN=74 Runoff=12.91 cfs 24,834 cf
SubcatchmentE5: E5	Runoff Area=73,316 sf 0.00% Impervious Runoff Depth=5.43" Flow Length=144' Slope=0.2500 '/' Tc=5.7 min CN=83 Runoff=16.40 cfs 33,205 cf
SubcatchmentE6: E6	Runoff Area=77,079 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=125' Slope=0.2880 '/' Tc=5.3 min CN=74 Runoff=14.82 cfs 28,386 cf
SubcatchmentE7: E7	Runoff Area=114,006 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=205' Slope=0.2540 '/' Tc=5.7 min CN=74 Runoff=21.55 cfs 41,985 cf
SubcatchmentE8: E8	Runoff Area=166,528 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=131' Slope=0.0610 '/' Tc=9.9 min CN=74 Runoff=26.38 cfs 61,327 cf
SubcatchmentE9: E9	Runoff Area=67,512 sf 0.00% Impervious Runoff Depth=4.42" Flow Length=117' Slope=0.2390 '/' Tc=5.7 min CN=74 Runoff=12.76 cfs 24,863 cf
Reach A10T: A10 Terrace	Avg. Flow Depth=1.25' Max Vel=5.03 fps Inflow=46.40 cfs 116,953 cf n=0.035 L=777.6' S=0.0270 '/' Capacity=119.50 cfs Outflow=43.24 cfs 116,953 cf
Reach A11T: A11 Terrace	Avg. Flow Depth=1.28' Max Vel=3.65 fps Inflow=43.06 cfs 90,309 cf n=0.035 L=1,524.8' S=0.0138 '/' Capacity=85.34 cfs Outflow=32.76 cfs 90,309 cf
Reach A1T: A1 Terracce	Avg. Flow Depth=0.79' Max Vel=3.23 fps Inflow=11.31 cfs 31,994 cf n=0.035 L=294.0' S=0.0204 '/' Capacity=103.88 cfs Outflow=11.17 cfs 31,994 cf
Reach A2T: A2 Terrace	Avg. Flow Depth=0.83' Max Vel=3.45 fps Inflow=13.27 cfs 41,003 cf n=0.035 L=364.8' S=0.0219 '/' Capacity=107.69 cfs Outflow=13.10 cfs 41,003 cf
Reach A3T: A3 Terrace	Avg. Flow Depth=0.69' Max Vel=3.24 fps Inflow=8.91 cfs 17,152 cf n=0.035 L=400.0' S=0.0250 '/' Capacity=114.98 cfs Outflow=8.36 cfs 17,152 cf
Reach A4T: A4 Terrace	Avg. Flow Depth=0.93' Max Vel=4.09 fps Inflow=21.25 cfs 51,553 cf n=0.035 L=905.6' S=0.0265 '/' Capacity=118.38 cfs Outflow=19.38 cfs 51,553 cf
Reach A5T: A5 Terrace	Avg. Flow Depth=0.78' Max Vel=3.70 fps Inflow=13.44 cfs 25,567 cf n=0.035 L=582.4' S=0.0275 '/' Capacity=120.53 cfs Outflow=12.28 cfs 25,567 cf

Reach A6T: A5 Terrace	Avg. Flow Depth=0.99' Max Vel=4.32 fps Inflow=26.83 cfs 55,971 cf n=0.035 L=1,099.2' S=0.0273 '/' Capacity=120.13 cfs Outflow=23.05 cfs 55,971 cf
Reach A7T: A7 Terrace	Avg. Flow Depth=0.73' Max Vel=3.49 fps Inflow=11.55 cfs 24,963 cf n=0.035 L=753.6' S=0.0265 '/' Capacity=118.47 cfs Outflow=10.30 cfs 24,963 cf
Reach A8T: A8 Terrace	Avg. Flow Depth=0.74' Max Vel=4.24 fps Inflow=13.12 cfs 27,245 cf n=0.035 L=411.2' S=0.0389 '/' Capacity=143.44 cfs Outflow=12.63 cfs 27,245 cf
Reach A9T: A9 Terrace	Avg. Flow Depth=1.16' Max Vel=3.12 fps Inflow=27.98 cfs 53,605 cf n=0.035 L=870.4' S=0.0115 '/' Capacity=77.94 cfs Outflow=23.07 cfs 53,605 cf
Reach AA2T: AA2 Terrace	Avg. Flow Depth=0.82' Max Vel=5.53 fps Inflow=21.58 cfs 39,852 cf n=0.035 L=528.0' S=0.0568 '/' Capacity=173.34 cfs Outflow=20.65 cfs 39,852 cf
Reach AA4T: AA4 Terrace	Avg. Flow Depth=0.92' Max Vel=3.97 fps Inflow=21.42 cfs 41,726 cf n=0.035 L=944.0' S=0.0254 '/' Capacity=115.95 cfs Outflow=18.33 cfs 41,726 cf
Reach AADS1: AA Downslope 1	Avg. Flow Depth=0.24' Max Vel=8.92 fps Inflow=20.65 cfs 39,852 cf n=0.017 L=51.2' S=0.0781 '/' Capacity=911.05 cfs Outflow=20.60 cfs 39,852 cf
Reach ADS1: A Downslope 1	Avg. Flow Depth=0.32' Max Vel=7.45 fps Inflow=23.96 cfs 72,998 cf n=0.040 L=192.0' S=0.2083 '/' Capacity=632.29 cfs Outflow=23.94 cfs 72,998 cf
Reach ADS2: A Downslope 2	Avg. Flow Depth=0.49' Max Vel=9.16 fps Inflow=47.05 cfs 141,702 cf n=0.040 L=230.4' S=0.1910 '/' Capacity=605.37 cfs Outflow=47.00 cfs 141,702 cf
Reach ADS3: A Downslope 3	Avg. Flow Depth=0.68' Max Vel=10.02 fps Inflow=76.06 cfs 223,240 cf n=0.040 L=659.2' S=0.1547 '/' Capacity=544.91 cfs Outflow=75.72 cfs 223,240 cf
Reach ADS4: A Downslope 4	Avg. Flow Depth=0.76' Max Vel=10.88 fps Inflow=92.63 cfs 275,448 cf n=0.040 L=184.0' S=0.1630 '/' Capacity=559.35 cfs Outflow=92.55 cfs 275,448 cf
Reach ADS5: A Downslope 5	Avg. Flow Depth=1.03' Max Vel=9.11 fps Inflow=113.53 cfs 329,053 cf n=0.040 L=99.2' S=0.0806 '/' Capacity=393.39 cfs Outflow=113.45 cfs 329,053 cf
Reach B1T: B1 Terrace	Avg. Flow Depth=0.96' Max Vel=4.49 fps Inflow=23.23 cfs 82,215 cf n=0.035 L=721.6' S=0.0305 '/' Capacity=126.97 cfs Outflow=22.78 cfs 82,215 cf
Reach B3T: B3 Terrace	Avg. Flow Depth=0.81' Max Vel=5.74 fps Inflow=21.36 cfs 47,093 cf n=0.035 L=480.0' S=0.0625 '/' Capacity=181.80 cfs Outflow=20.82 cfs 47,093 cf
Reach B5T: B5 Terrace	Avg. Flow Depth=0.79' Max Vel=8.86 fps Inflow=30.58 cfs 59,592 cf n=0.035 L=246.4' S=0.1542 '/' Capacity=285.57 cfs Outflow=30.37 cfs 59,592 cf
Reach B7T: B7 Terrace	Avg. Flow Depth=0.91' Max Vel=7.74 fps Inflow=35.45 cfs 66,881 cf n=0.035 L=368.0' S=0.0978 '/' Capacity=227.44 cfs Outflow=34.96 cfs 66,881 cf
Reach B9T: B9 Terrace	Avg. Flow Depth=1.51' Max Vel=4.14 fps Inflow=93.08 cfs 274,780 cf n=0.035 L=681.6' S=0.0103 '/' Capacity=413.91 cfs Outflow=89.45 cfs 274,780 cf

Reach BB1T: BB1 Terrace	Avg. Flow Depth=1.27'	Max Vel=4.27 fps	Inflow=38.59 cfs	114,422 cf
	n=0.035	L=627.2'	S=0.0191 '/	Capacity=100.59 cfs Outflow=37.58 cfs 114,422 cf
Reach BB3T: BB3 Terrace	Avg. Flow Depth=0.82'	Max Vel=3.28 fps	Inflow=32.28 cfs	67,103 cf
	n=0.035	L=780.8'	S=0.0128 '/	Capacity=183.98 cfs Outflow=28.13 cfs 67,103 cf
Reach BBB1T: BBB1 Terrace	Avg. Flow Depth=1.21'	Max Vel=3.91 fps	Inflow=37.13 cfs	77,457 cf
	n=0.035	L=1,056.0'	S=0.0170 '/	Capacity=94.94 cfs Outflow=31.49 cfs 77,457 cf
Reach BBB3T: BBB3 Terrace	Avg. Flow Depth=0.75'	Max Vel=3.62 fps	Inflow=12.45 cfs	22,514 cf
	n=0.035	L=584.0'	S=0.0274 '/	Capacity=120.36 cfs Outflow=11.27 cfs 22,514 cf
Reach BBDS1: BB Downslope 1	Avg. Flow Depth=0.38'	Max Vel=9.85 fps	Inflow=37.58 cfs	114,422 cf
	n=0.040	L=99.2'	S=0.3024 '/	Capacity=761.80 cfs Outflow=37.55 cfs 114,422 cf
Reach BDS1: B Downslope 1	Avg. Flow Depth=0.30'	Max Vel=7.63 fps	Inflow=22.78 cfs	82,215 cf
	n=0.040	L=160.0'	S=0.2375 '/	Capacity=568.56 cfs Outflow=22.76 cfs 82,215 cf
Reach BDS2: B Downslope 2	Avg. Flow Depth=0.33'	Max Vel=9.49 fps	Inflow=30.87 cfs	129,307 cf
	n=0.040	L=120.0'	S=0.3333 '/	Capacity=799.79 cfs Outflow=30.84 cfs 129,307 cf
Reach BDS3: B Downslope 3	Avg. Flow Depth=0.47'	Max Vel=11.13 fps	Inflow=54.40 cfs	188,899 cf
	n=0.040	L=128.0'	S=0.2969 '/	Capacity=754.78 cfs Outflow=54.28 cfs 188,899 cf
Reach BDS4: B Downslope 4	Avg. Flow Depth=0.69'	Max Vel=11.47 fps	Inflow=88.16 cfs	255,780 cf
	n=0.040	L=160.0'	S=0.2000 '/	Capacity=619.51 cfs Outflow=87.87 cfs 255,780 cf
Reach C0T: C0 Terrace	Avg. Flow Depth=0.52'	Max Vel=3.17 fps	Inflow=4.83 cfs	11,884 cf
	n=0.035	L=176.0'	S=0.0341 '/	Capacity=134.27 cfs Outflow=4.78 cfs 11,884 cf
Reach C10T: C10 Terrace	Avg. Flow Depth=1.33'	Max Vel=4.39 fps	Inflow=51.96 cfs	115,471 cf
	n=0.035	L=1,273.0'	S=0.0189 '/	Capacity=99.85 cfs Outflow=42.89 cfs 115,471 cf
Reach C1T: C1 Terrace	Avg. Flow Depth=1.37'	Max Vel=6.93 fps	Inflow=74.30 cfs	202,491 cf
	n=0.035	L=1,017.0'	S=0.0452 '/	Capacity=154.66 cfs Outflow=71.88 cfs 202,491 cf
Reach C2T: C2 Terrace	Avg. Flow Depth=1.06'	Max Vel=4.57 fps	Inflow=30.18 cfs	82,799 cf
	n=0.035	L=1,008.0'	S=0.0278 '/	Capacity=121.20 cfs Outflow=28.22 cfs 82,799 cf
Reach C3T: C3 Terrace	Avg. Flow Depth=0.78'	Max Vel=8.48 fps	Inflow=28.89 cfs	54,995 cf
	n=0.035	L=363.0'	S=0.1433 '/	Capacity=275.23 cfs Outflow=28.54 cfs 54,995 cf
Reach C4T: C4 Terrace	Avg. Flow Depth=1.17'	Max Vel=5.03 fps	Inflow=45.49 cfs	86,608 cf
	n=0.035	L=1,297.0'	S=0.0293 '/	Capacity=124.47 cfs Outflow=38.12 cfs 86,608 cf
Reach C5T: C5 Terrace	Avg. Flow Depth=1.13'	Max Vel=4.99 fps	Inflow=46.32 cfs	88,194 cf
	n=0.035	L=1,853.0'	S=0.0302 '/	Capacity=126.42 cfs Outflow=35.26 cfs 88,194 cf
Reach C6T: C6 Terrace	Avg. Flow Depth=0.03'	Max Vel=22.91 fps	Inflow=34.21 cfs	69,603 cf
	n=0.035	L=1,597.0'	S=0.0351 '/	Capacity=2,703,331,657.33 cfs Outflow=33.07 cfs 69,603 cf

Reach C7T: C7 Terrace	Avg. Flow Depth=1.14' Max Vel=5.14 fps Inflow=48.41 cfs 92,060 cf n=0.035 L=1,891.0' S=0.0317 ' Capacity=129.53 cfs Outflow=37.01 cfs 92,060 cf
Reach C8T: C8 Terrace	Avg. Flow Depth=1.06' Max Vel=5.14 fps Inflow=41.39 cfs 81,284 cf n=0.035 L=1,892.0' S=0.0349 ' Capacity=135.82 cfs Outflow=31.93 cfs 81,284 cf
Reach C9T: C9 Terrace	Avg. Flow Depth=1.79' Max Vel=2.71 fps Inflow=79.02 cfs 162,798 cf n=0.035 L=2,064.0' S=0.0048 ' Capacity=50.62 cfs Outflow=47.98 cfs 162,798 cf
Reach CC2T: CC2 Terrace	Avg. Flow Depth=0.77' Max Vel=4.44 fps Inflow=16.49 cfs 32,392 cf n=0.035 L=904.0' S=0.0398 ' Capacity=145.12 cfs Outflow=14.56 cfs 32,392 cf
Reach CC4T: CC4 Terrace	Avg. Flow Depth=1.15' Max Vel=3.19 fps Inflow=40.36 cfs 78,322 cf n=0.035 L=2,488.0' S=0.0121 ' Capacity=79.85 cfs Outflow=23.26 cfs 78,322 cf
Reach CCDS1: CC Downslope 1	Avg. Flow Depth=0.23' Max Vel=6.48 fps Inflow=14.56 cfs 32,392 cf n=0.035 L=110.4' S=0.1812 ' Capacity=673.84 cfs Outflow=14.51 cfs 32,392 cf
Reach CDS1: C Downslope 1	Avg. Flow Depth=0.12' Max Vel=4.22 fps Inflow=4.78 cfs 11,884 cf n=0.040 L=123.0' S=0.2276 ' Capacity=660.94 cfs Outflow=4.77 cfs 11,884 cf
Reach CDS2: C Downslope 2	Avg. Flow Depth=0.37' Max Vel=8.42 fps Inflow=31.62 cfs 94,683 cf n=0.040 L=62.4' S=0.2244 ' Capacity=656.15 cfs Outflow=31.61 cfs 94,683 cf
Reach CDS3: C Downslope 3	Avg. Flow Depth=0.72' Max Vel=12.89 fps Inflow=102.93 cfs 297,174 cf n=0.040 L=115.0' S=0.2435 ' Capacity=683.54 cfs Outflow=102.87 cfs 297,174 cf
Reach CDS4: C Downslope 4	Avg. Flow Depth=0.92' Max Vel=12.28 fps Inflow=132.42 cfs 383,782 cf n=0.040 L=96.0' S=0.1667 ' Capacity=565.53 cfs Outflow=132.36 cfs 383,782 cf
Reach CDS5: C Downslope 5	Avg. Flow Depth=0.87' Max Vel=14.05 fps Inflow=142.49 cfs 438,777 cf n=0.040 L=104.0' S=0.2308 ' Capacity=665.46 cfs Outflow=142.41 cfs 438,777 cf
Reach CDS6: C Downslope 6	Avg. Flow Depth=1.00' Max Vel=13.44 fps Inflow=161.26 cfs 508,380 cf n=0.040 L=99.2' S=0.1815 ' Capacity=590.09 cfs Outflow=161.20 cfs 508,380 cf
Reach CDS7: C Downslope 7	Avg. Flow Depth=1.04' Max Vel=15.52 fps Inflow=196.31 cfs 596,574 cf n=0.040 L=104.0' S=0.2308 ' Capacity=665.46 cfs Outflow=196.20 cfs 596,574 cf
Reach CDS8: C Downslope 8	Avg. Flow Depth=1.11' Max Vel=16.56 fps Inflow=227.94 cfs 677,858 cf n=0.040 L=65.6' S=0.2439 ' Capacity=684.14 cfs Outflow=227.86 cfs 677,858 cf
Reach CDS9: C Downslope 9	Avg. Flow Depth=1.37' Max Vel=14.76 fps Inflow=264.82 cfs 769,918 cf n=0.040 L=142.4' S=0.1545 ' Capacity=544.49 cfs Outflow=264.55 cfs 769,918 cf
Reach D10T: D10 Terrace	Avg. Flow Depth=0.79' Max Vel=3.56 fps Inflow=12.76 cfs 24,972 cf n=0.035 L=400.0' S=0.0250 ' Capacity=114.98 cfs Outflow=12.12 cfs 24,972 cf
Reach D11T: D11 Terrace	Avg. Flow Depth=1.45' Max Vel=2.15 fps Inflow=26.36 cfs 109,569 cf n=0.035 L=496.0' S=0.0040 ' Capacity=46.18 cfs Outflow=24.93 cfs 109,569 cf

Reach D12T: D12 Terrace	Avg. Flow Depth=0.58' Max Vel=4.66 fps Inflow=8.78 cfs 17,242 cf n=0.035 L=339.2' S=0.0649 '/' Capacity=185.20 cfs Outflow=8.57 cfs 17,242 cf
Reach D1T: D1 Terrace	Avg. Flow Depth=0.55' Max Vel=2.69 fps Inflow=4.53 cfs 10,526 cf n=0.035 L=172.8' S=0.0231 '/' Capacity=110.64 cfs Outflow=4.47 cfs 10,526 cf
Reach D2T: D2 Terrace	Avg. Flow Depth=0.66' Max Vel=4.81 fps Inflow=35.57 cfs 96,111 cf n=0.035 L=425.6' S=0.0282 '/' Capacity=265.84 cfs Outflow=35.12 cfs 96,111 cf
Reach D3T: D3 Terrace	Avg. Flow Depth=0.27' Max Vel=2.65 fps Inflow=7.21 cfs 14,441 cf n=0.035 L=240.0' S=0.0250 '/' Capacity=250.32 cfs Outflow=7.01 cfs 14,441 cf
Reach D4T: D4 Terrace	Avg. Flow Depth=0.85' Max Vel=4.13 fps Inflow=17.89 cfs 34,407 cf n=0.035 L=657.6' S=0.0304 '/' Capacity=126.82 cfs Outflow=16.32 cfs 34,407 cf
Reach D5T: D5 Terrace	Avg. Flow Depth=0.56' Max Vel=4.48 fps Inflow=7.85 cfs 16,238 cf n=0.035 L=320.0' S=0.0625 '/' Capacity=181.80 cfs Outflow=7.69 cfs 16,238 cf
Reach D6T: D6 Terrace	Avg. Flow Depth=0.85' Max Vel=4.16 fps Inflow=17.65 cfs 33,975 cf n=0.035 L=580.4' S=0.0310 '/' Capacity=128.06 cfs Outflow=16.38 cfs 33,975 cf
Reach D7T: D7 Terrace	Avg. Flow Depth=0.65' Max Vel=4.38 fps Inflow=10.40 cfs 20,186 cf n=0.035 L=404.8' S=0.0494 '/' Capacity=161.64 cfs Outflow=9.99 cfs 20,186 cf
Reach D8T: D8 Terrace	Avg. Flow Depth=0.82' Max Vel=3.86 fps Inflow=15.26 cfs 29,616 cf n=0.035 L=502.4' S=0.0279 '/' Capacity=121.39 cfs Outflow=14.26 cfs 29,616 cf
Reach D9T: D9 Terrace	Avg. Flow Depth=0.68' Max Vel=4.65 fps Inflow=12.38 cfs 24,031 cf n=0.035 L=464.0' S=0.0517 '/' Capacity=165.38 cfs Outflow=11.84 cfs 24,031 cf
Reach DDS1: D Downslope 1	Avg. Flow Depth=0.39' Max Vel=9.84 fps Inflow=38.93 cfs 106,637 cf n=0.040 L=131.2' S=0.2896 '/' Capacity=745.52 cfs Outflow=38.89 cfs 106,637 cf
Reach DDS2: D Downslope 2	Avg. Flow Depth=0.47' Max Vel=11.50 fps Inflow=56.87 cfs 155,485 cf n=0.040 L=128.0' S=0.3125 '/' Capacity=774.39 cfs Outflow=56.82 cfs 155,485 cf
Reach DDS3: D Downslope 3	Avg. Flow Depth=0.59' Max Vel=12.53 fps Inflow=79.00 cfs 205,699 cf n=0.040 L=131.2' S=0.2896 '/' Capacity=745.52 cfs Outflow=78.89 cfs 205,699 cf
Reach DDS4: D Downslope 4	Avg. Flow Depth=0.66' Max Vel=14.07 fps Inflow=101.33 cfs 255,501 cf n=0.040 L=131.2' S=0.3201 '/' Capacity=783.78 cfs Outflow=101.17 cfs 255,501 cf
Reach DDS5: D Downslope 5	Avg. Flow Depth=0.78' Max Vel=13.97 fps Inflow=123.62 cfs 304,504 cf n=0.040 L=131.2' S=0.2591 '/' Capacity=705.19 cfs Outflow=123.42 cfs 304,504 cf
Reach DDS6: D Downslope 6	Avg. Flow Depth=0.85' Max Vel=15.02 fps Inflow=147.64 cfs 431,315 cf n=0.035 L=124.8' S=0.2083 '/' Capacity=722.61 cfs Outflow=147.41 cfs 431,315 cf
Reach E10T: E10 Terrace	Avg. Flow Depth=1.08' Max Vel=4.46 fps Inflow=36.56 cfs 77,895 cf n=0.035 L=1,772.8' S=0.0259 '/' Capacity=117.14 cfs Outflow=28.42 cfs 77,895 cf

Reach E11T: E11 Terrace	Avg. Flow Depth=0.87'	Max Vel=3.41 fps	Inflow=14.81 cfs	29,884 cf
	n=0.035 L=395.2' S=0.0202 '/'	Capacity=103.46 cfs	Outflow=14.05 cfs	29,884 cf
Reach E12T: E12 Terrace	Avg. Flow Depth=1.12'	Max Vel=4.62 fps	Inflow=41.99 cfs	90,409 cf
	n=0.035 L=1,984.0' S=0.0262 '/'	Capacity=117.73 cfs	Outflow=32.05 cfs	90,409 cf
Reach E1T: E1 Terrace	Avg. Flow Depth=1.01'	Max Vel=4.32 fps	Inflow=24.72 cfs	66,978 cf
	n=0.035 L=528.0' S=0.0265 '/'	Capacity=118.41 cfs	Outflow=24.09 cfs	66,978 cf
Reach E2T: E2 Terrace	Avg. Flow Depth=0.80'	Max Vel=3.89 fps	Inflow=13.95 cfs	38,542 cf
	n=0.035 L=411.2' S=0.0292 '/'	Capacity=124.23 cfs	Outflow=13.70 cfs	38,542 cf
Reach E3T: E3 Terrace	Avg. Flow Depth=0.80'	Max Vel=3.70 fps	Inflow=14.02 cfs	26,993 cf
	n=0.035 L=528.0' S=0.0265 '/'	Capacity=118.41 cfs	Outflow=12.99 cfs	26,993 cf
Reach E4T: E4 Terrace	Avg. Flow Depth=0.77'	Max Vel=3.66 fps	Inflow=12.91 cfs	24,834 cf
	n=0.035 L=515.0' S=0.0272 '/'	Capacity=119.90 cfs	Outflow=11.98 cfs	24,834 cf
Reach E5T: E5 Terrace	Avg. Flow Depth=0.83'	Max Vel=4.02 fps	Inflow=16.40 cfs	33,205 cf
	n=0.035 L=542.0' S=0.0295 '/'	Capacity=124.94 cfs	Outflow=15.35 cfs	33,205 cf
Reach E6T: E6 Terrace	Avg. Flow Depth=0.80'	Max Vel=3.86 fps	Inflow=14.82 cfs	28,386 cf
	n=0.035 L=560.0' S=0.0286 '/'	Capacity=122.92 cfs	Outflow=13.70 cfs	28,386 cf
Reach E7T: E7 Terrace	Avg. Flow Depth=0.84'	Max Vel=5.38 fps	Inflow=21.55 cfs	41,985 cf
	n=0.035 L=494.4' S=0.0526 '/'	Capacity=166.76 cfs	Outflow=20.71 cfs	41,985 cf
Reach E8T: E8 Terrace	Avg. Flow Depth=1.00'	Max Vel=3.99 fps	Inflow=26.38 cfs	61,327 cf
	n=0.035 L=1,400.0' S=0.0229 '/'	Capacity=109.94 cfs	Outflow=21.85 cfs	61,327 cf
Reach E9T: E9 Terrace	Avg. Flow Depth=0.70'	Max Vel=4.56 fps	Inflow=12.76 cfs	24,863 cf
	n=0.035 L=457.6' S=0.0481 '/'	Capacity=159.45 cfs	Outflow=12.20 cfs	24,863 cf
Reach EDS1: E Downslope 1	Avg. Flow Depth=0.38'	Max Vel=9.94 fps	Inflow=37.79 cfs	105,520 cf
	n=0.040 L=129.6' S=0.3086 '/'	Capacity=769.59 cfs	Outflow=37.75 cfs	105,520 cf
Reach EDS2: E Downslope 2	Avg. Flow Depth=0.91'	Max Vel=11.92 fps	Inflow=54.55 cfs	157,347 cf
	n=0.040 L=132.8' S=0.3012 '/'	Capacity=442.55 cfs	Outflow=54.52 cfs	157,347 cf
Reach EDS3: E Downslope 3	Avg. Flow Depth=1.06'	Max Vel=13.15 fps	Inflow=81.25 cfs	218,937 cf
	n=0.040 L=166.4' S=0.3005 '/'	Capacity=442.02 cfs	Outflow=81.11 cfs	218,937 cf
Reach EDS4: E Downslope 4	Avg. Flow Depth=0.66'	Max Vel=12.91 fps	Inflow=94.45 cfs	280,264 cf
	n=0.040 L=75.2' S=0.2660 '/'	Capacity=714.40 cfs	Outflow=94.37 cfs	280,264 cf
Reach EDS5: E Downslope 5	Avg. Flow Depth=0.90'	Max Vel=10.51 fps	Inflow=110.65 cfs	322,249 cf
	n=0.040 L=160.0' S=0.1250 '/'	Capacity=489.77 cfs	Outflow=110.46 cfs	322,249 cf
Reach EDS6: E Downslope 6	Avg. Flow Depth=0.88'	Max Vel=13.44 fps	Inflow=138.42 cfs	425,006 cf
	n=0.040 L=115.2' S=0.2083 '/'	Capacity=632.29 cfs	Outflow=138.36 cfs	425,006 cf

Pond 1P: Existing West Pond Peak Elev=850.70' Storage=476,356 cf Inflow=171.45 cfs 548,690 cf
Outflow=1.70 cfs 287,565 cf

Pond 2P: 96" RCP Peak Elev=860.92' Inflow=171.45 cfs 548,690 cf
96.0" Round Culvert n=0.011 L=150.0' S=0.0020 '/' Outflow=171.45 cfs 548,690 cf

Pond 3P: Existing Northwest Peak Elev=867.62' Storage=431,302 cf Inflow=147.41 cfs 431,315 cf
Outflow=0.00 cfs 0 cf

Pond 4P: Existing Northeast Peak Elev=890.13' Storage=1,048,162 cf Inflow=329.95 cfs 1,048,186 cf
Outflow=0.00 cfs 0 cf

Pond 5P: Existing ponding area Peak Elev=898.70' Storage=3,547 cf Inflow=146.95 cfs 530,560 cf
Outflow=146.87 cfs 530,560 cf

Pond 6P: Existing East Peak Elev=889.18' Storage=530,535 cf Inflow=146.87 cfs 530,560 cf
Outflow=0.00 cfs 0 cf

Pond 7P: Diversion Structure with 60" Peak Elev=875.79' Storage=2,124 cf Inflow=171.46 cfs 548,690 cf
60.0" Round Culvert n=0.011 L=94.0' S=0.0319 '/ Outflow=171.45 cfs 548,690 cf

Pond 8P: Existing Southwest Pond Peak Elev=844.92' Storage=445,720 cf Inflow=182.57 cfs 536,315 cf
Discarded=2.40 cfs 318,776 cf Primary=0.00 cfs 0 cf Outflow=2.40 cfs 318,776 cf

Pond 9P: Diversion Structure with 48" Peak Elev=863.61' Storage=2,896 cf Inflow=182.88 cfs 536,315 cf
48.0" Round Culvert n=0.011 L=433.0' S=0.0173 '/ Outflow=182.57 cfs 536,315 cf

Total Runoff Area = 8,297,576 sf Runoff Volume = 3,095,067 cf Average Runoff Depth = 4.48"
100.00% Pervious = 8,297,576 sf 0.00% Impervious = 0 sf

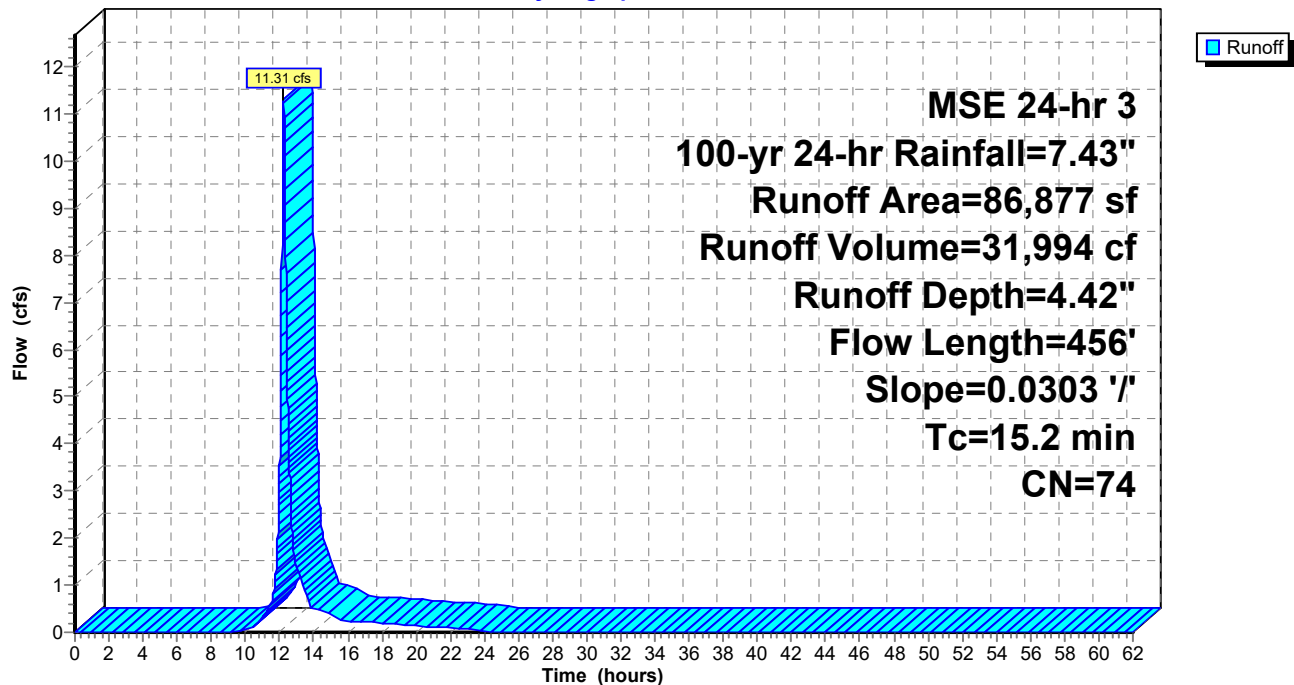
Summary for Subcatchment A1: A1

Runoff = 11.31 cfs @ 12.24 hrs, Volume= 31,994 cf, Depth= 4.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 86,877	74	
86,877		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.9	100	0.0303	0.13		Sheet Flow, A1
					Grass: Dense n= 0.240 P2= 2.80"
2.3	356	0.0303	2.61		Shallow Concentrated Flow,
					Kv= 15.0 fps
15.2	456	Total			

Subcatchment A1: A1**Hydrograph**

Summary for Subcatchment A10: A10

Runoff = 19.95 cfs @ 12.11 hrs, Volume= 35,375 cf, Depth= 4.42"

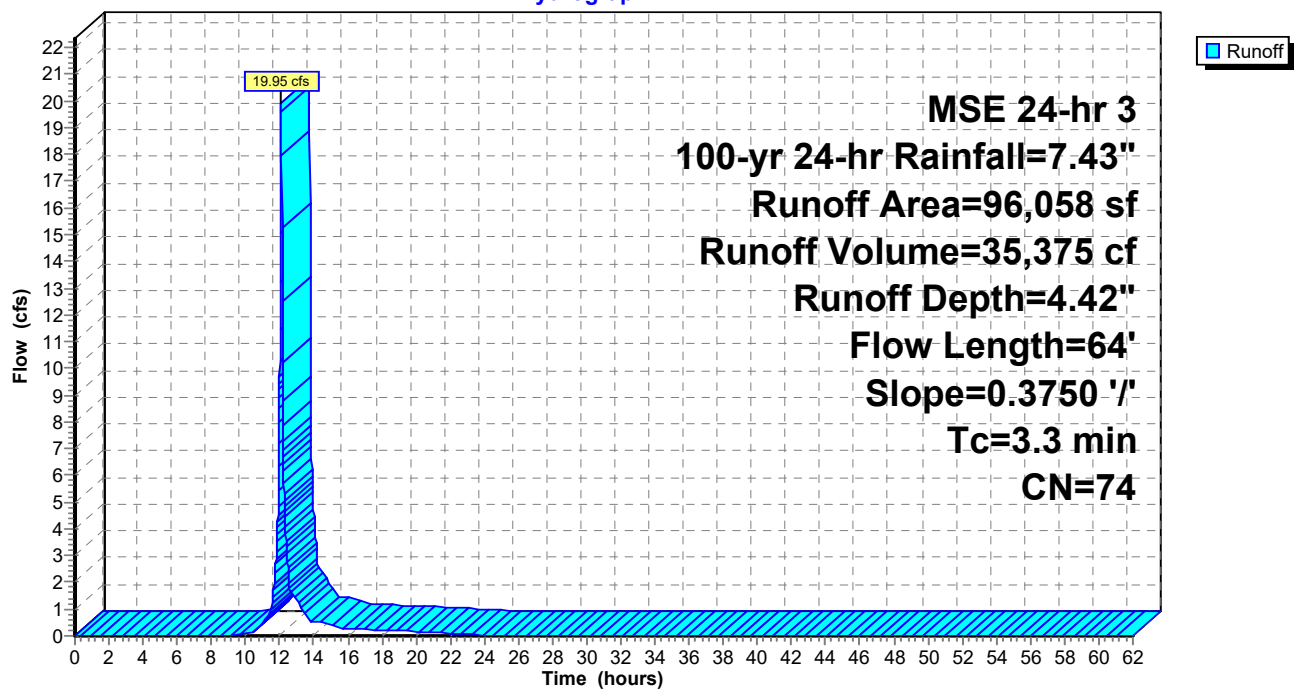
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 96,058	74	
96,058		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	64	0.3750	0.32		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"

Subcatchment A10: A10

Hydrograph



Summary for Subcatchment A11: A11

Runoff = 43.06 cfs @ 12.15 hrs, Volume= 90,309 cf, Depth= 4.42"

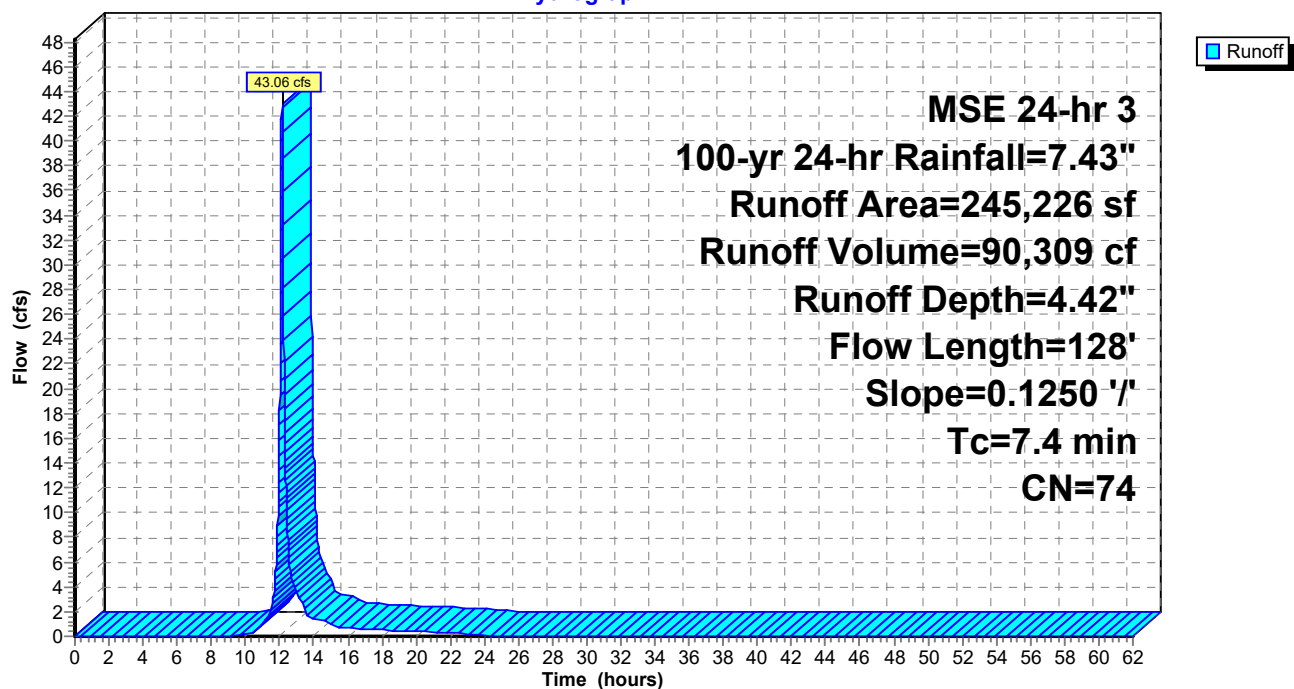
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 245,226	74	
245,226		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1250	0.23		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.1	28	0.1250	5.30		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
7.4	128	Total			

Subcatchment A11: A11

Hydrograph



Summary for Subcatchment A2: A2

Runoff = 13.27 cfs @ 12.27 hrs, Volume= 41,003 cf, Depth= 4.42"

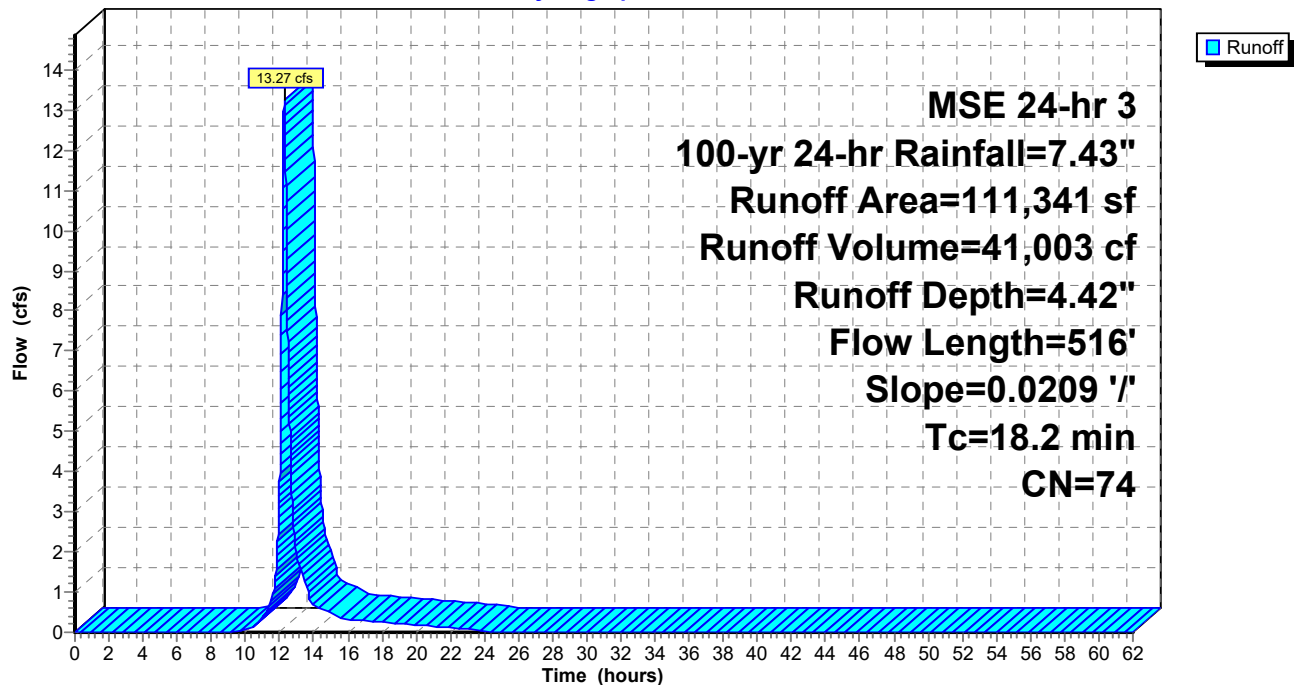
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 111,341	74	
111,341		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0	100	0.0209	0.11		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
3.2	416	0.0209	2.17		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
18.2	516	Total			

Subcatchment A2: A2

Hydrograph



Summary for Subcatchment A3: A3

Runoff = 8.91 cfs @ 12.13 hrs, Volume= 17,152 cf, Depth= 4.42"

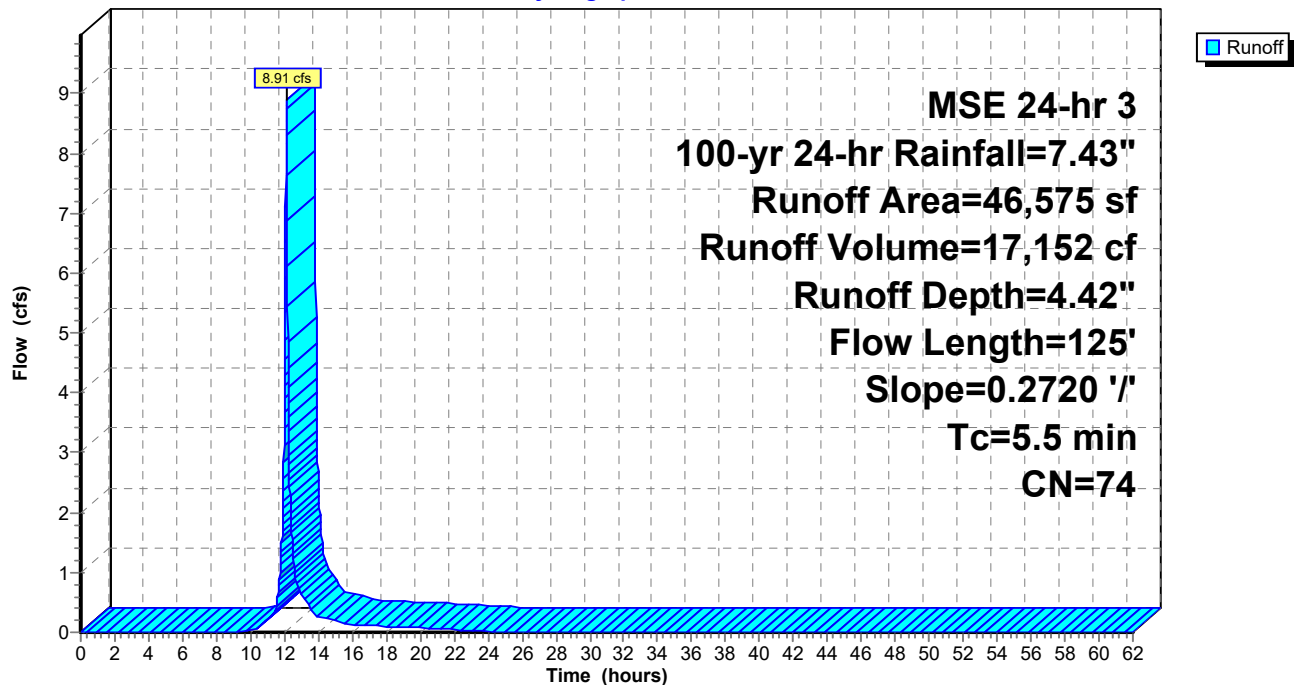
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	46,575	74	
	46,575		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2720	0.31		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	25	0.2720	7.82		Shallow Concentrated Flow, Kv= 15.0 fps
5.5	125	Total			

Subcatchment A3: A3

Hydrograph



Summary for Subcatchment A4: A4

Runoff = 21.25 cfs @ 12.19 hrs, Volume= 51,553 cf, Depth= 4.42"

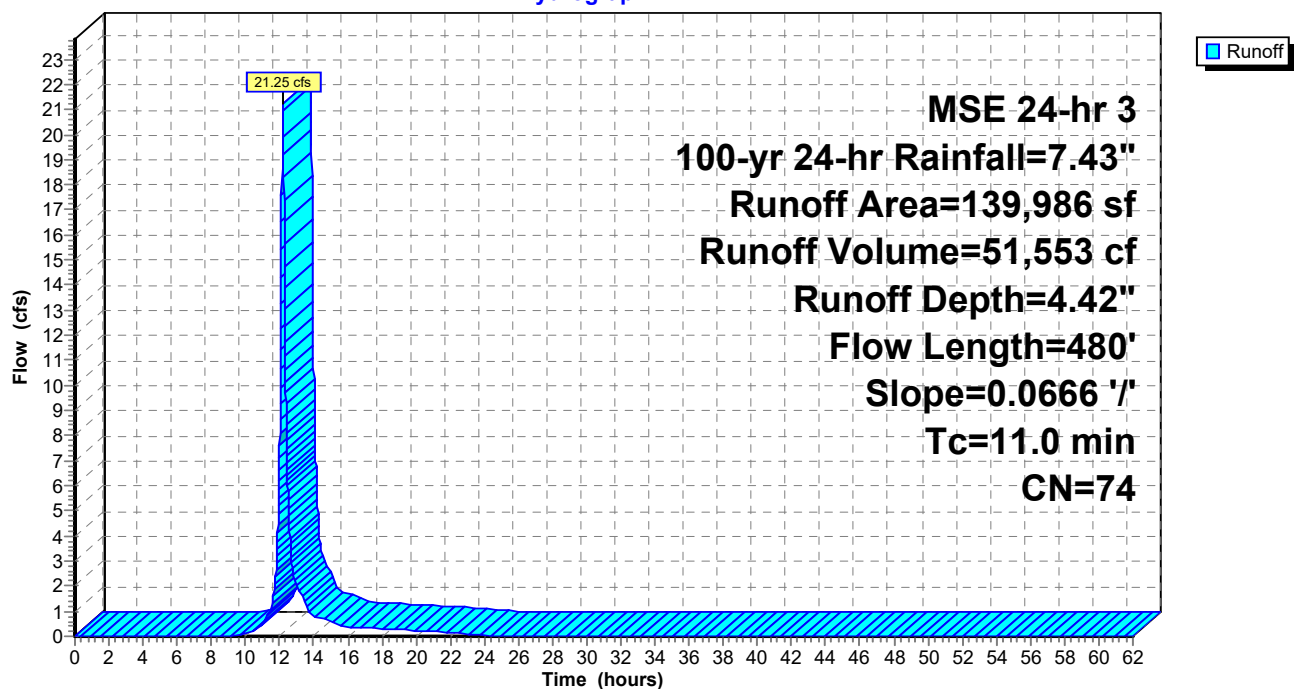
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	139,986	74	
	139,986		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	100	0.0666	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
1.6	380	0.0666	3.87		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
11.0	480	Total			

Subcatchment A4: A4

Hydrograph



Summary for Subcatchment A5: A5

Runoff = 13.44 cfs @ 12.12 hrs, Volume= 25,567 cf, Depth= 4.42"

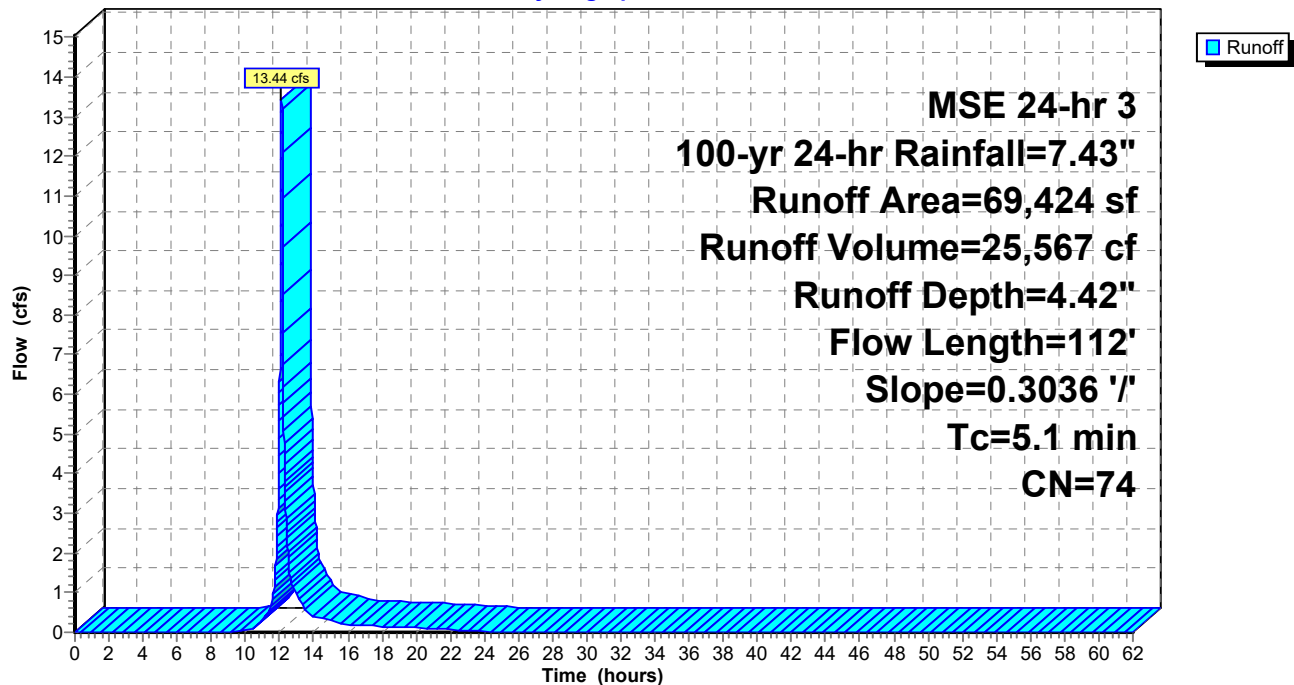
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	69,424	74	
	69,424		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	100	0.3036	0.32		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.0	12	0.3036	8.26		Shallow Concentrated Flow,
					Kv= 15.0 fps
5.1	112	Total			

Subcatchment A5: A5

Hydrograph



Summary for Subcatchment A6: A6

Runoff = 26.83 cfs @ 12.15 hrs, Volume= 55,971 cf, Depth= 4.42"

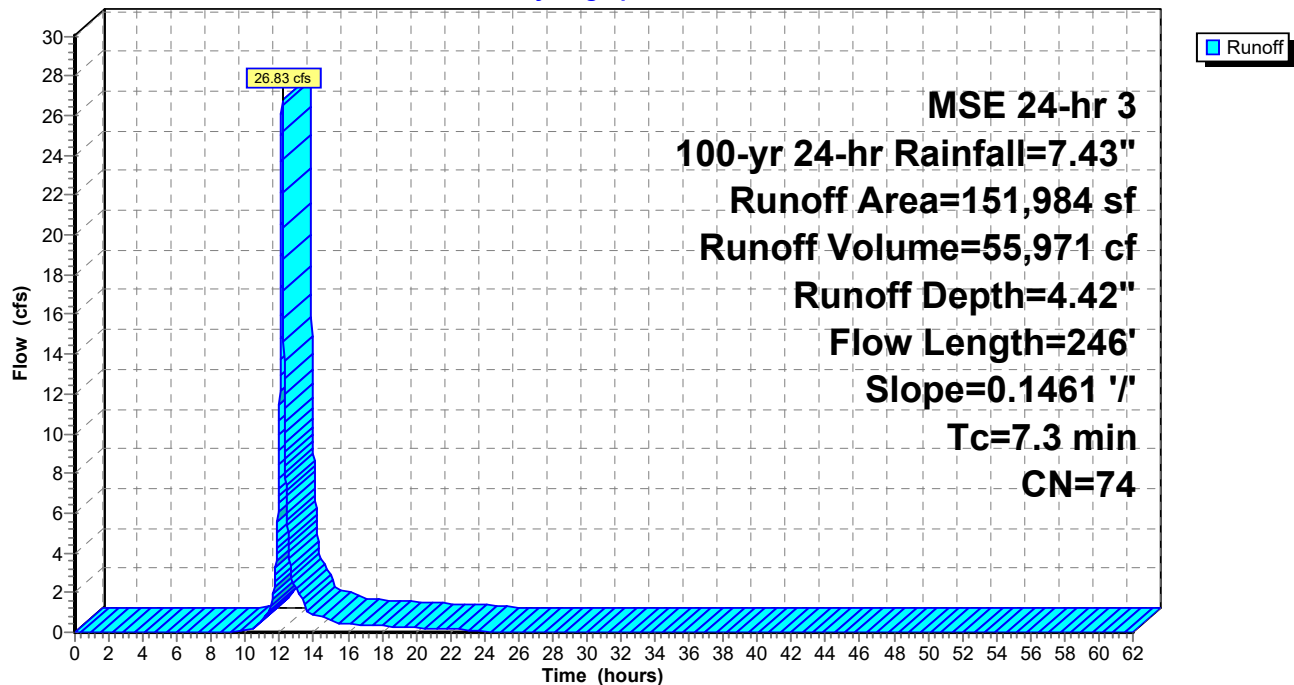
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	151,984	74	
	151,984		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	100	0.1461	0.24		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.4	146	0.1461	5.73		Shallow Concentrated Flow,
					Kv= 15.0 fps
7.3	246	Total			

Subcatchment A6: A6

Hydrograph



Summary for Subcatchment A7: A7

Runoff = 11.55 cfs @ 12.16 hrs, Volume= 24,963 cf, Depth= 4.42"

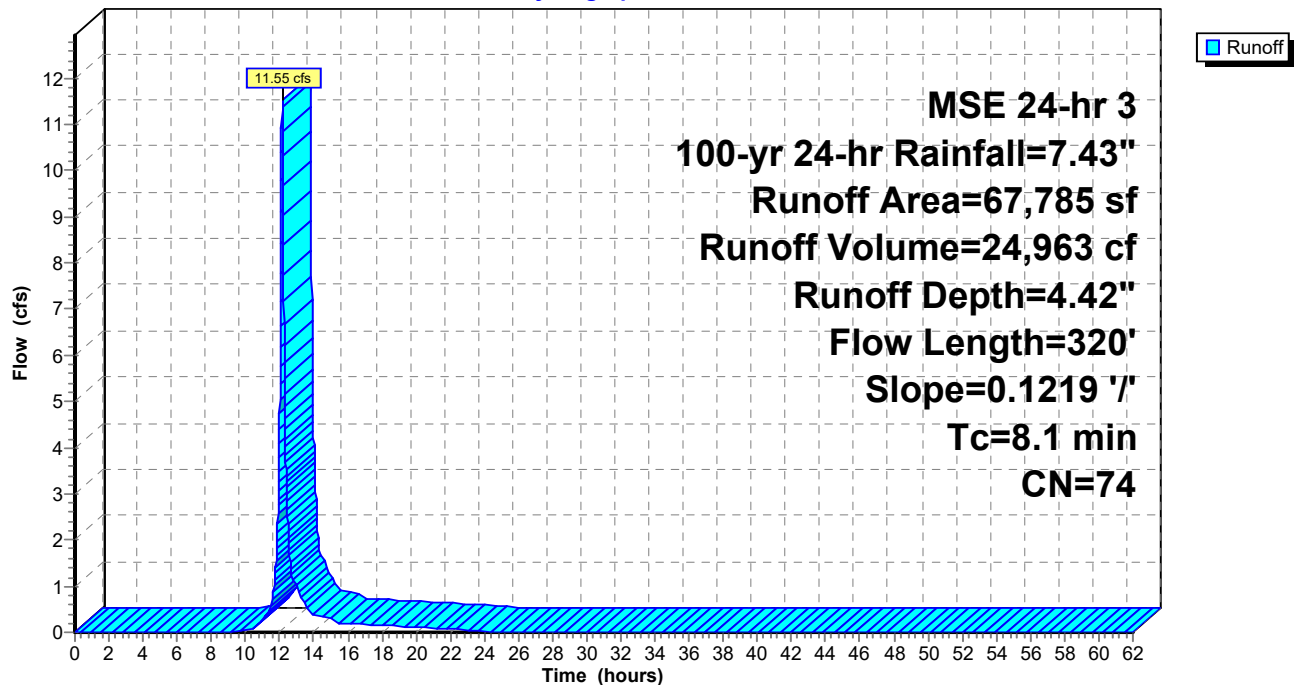
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 67,785	74	
67,785		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.1219	0.23		Sheet Flow, n= 0.240 P2= 2.80"
0.7	220	0.1219	5.24		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
8.1	320	Total			

Subcatchment A7: A7

Hydrograph



Summary for Subcatchment A8: A8

Runoff = 13.12 cfs @ 12.14 hrs, Volume= 27,245 cf, Depth= 4.42"

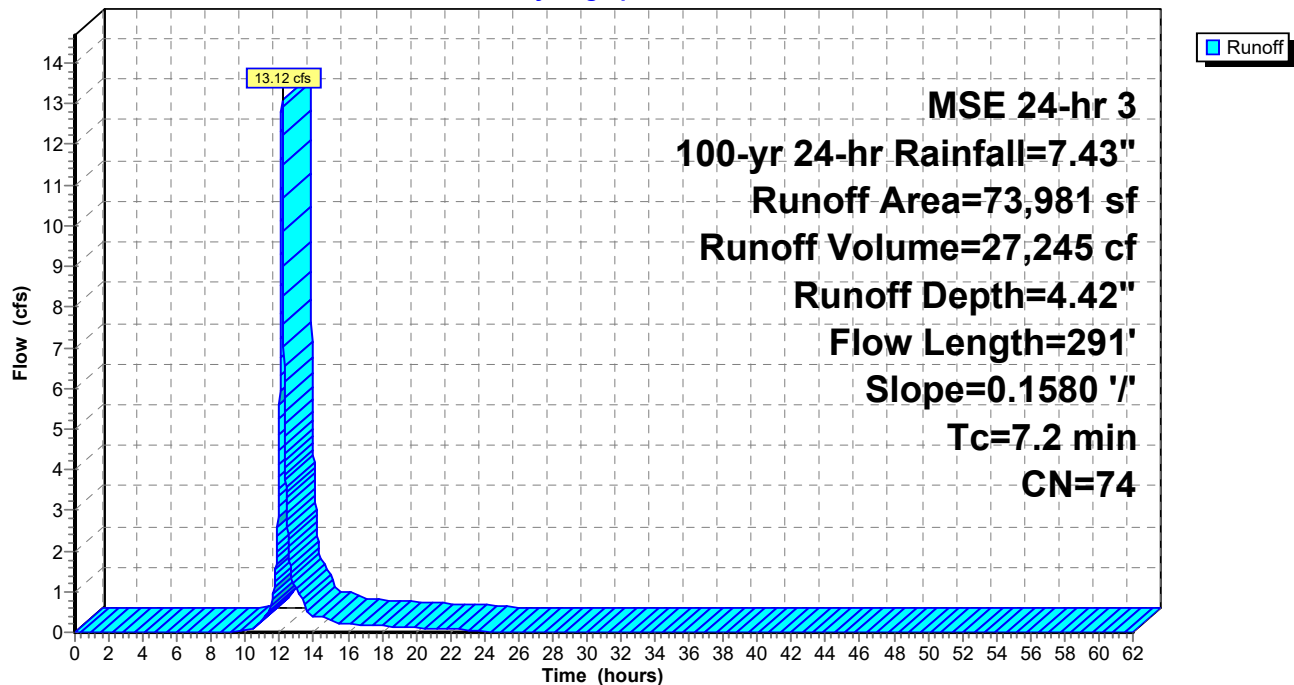
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 73,981	74	
73,981		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	100	0.1580	0.25		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.5	191	0.1580	5.96		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
7.2	291	Total			

Subcatchment A8: A8

Hydrograph



Summary for Subcatchment A9: A9

Runoff = 27.98 cfs @ 12.13 hrs, Volume= 53,605 cf, Depth= 4.42"

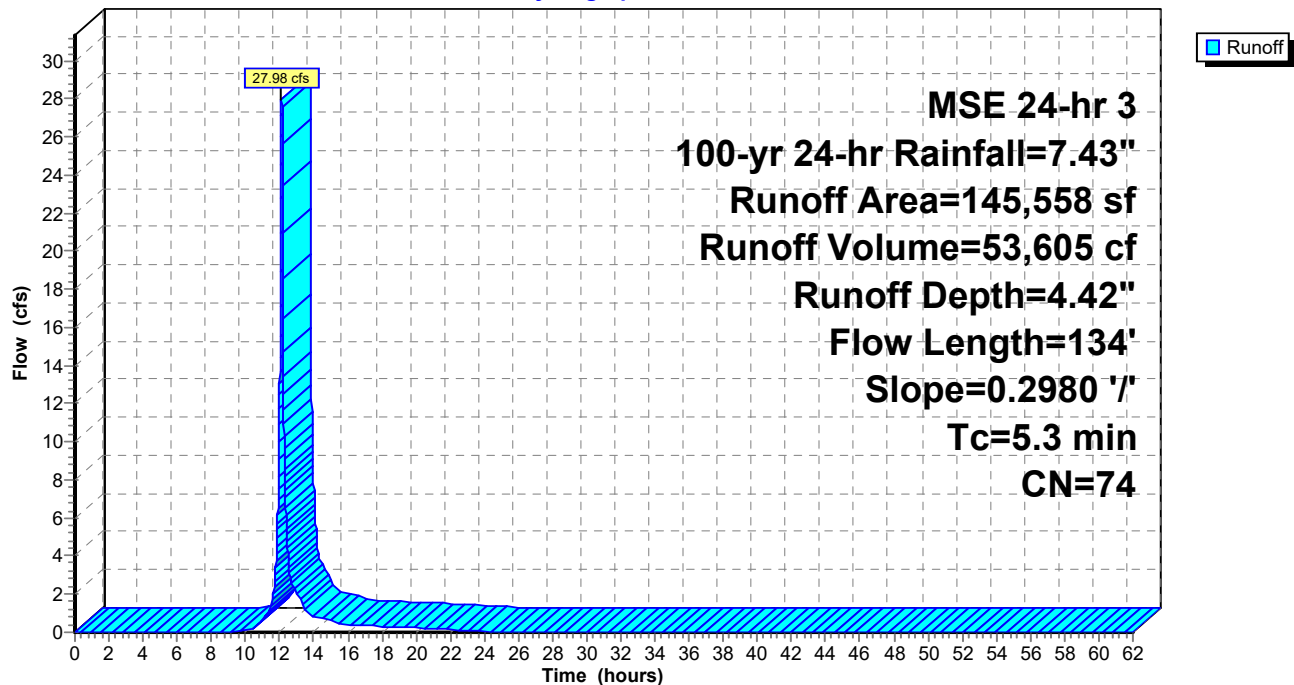
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	145,558	74	
	145,558		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2980	0.32		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.1	34	0.2980	8.19		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
5.3	134	Total			

Subcatchment A9: A9

Hydrograph



Summary for Subcatchment AA2: AA2

Runoff = 21.58 cfs @ 12.12 hrs, Volume= 39,852 cf, Depth= 4.42"

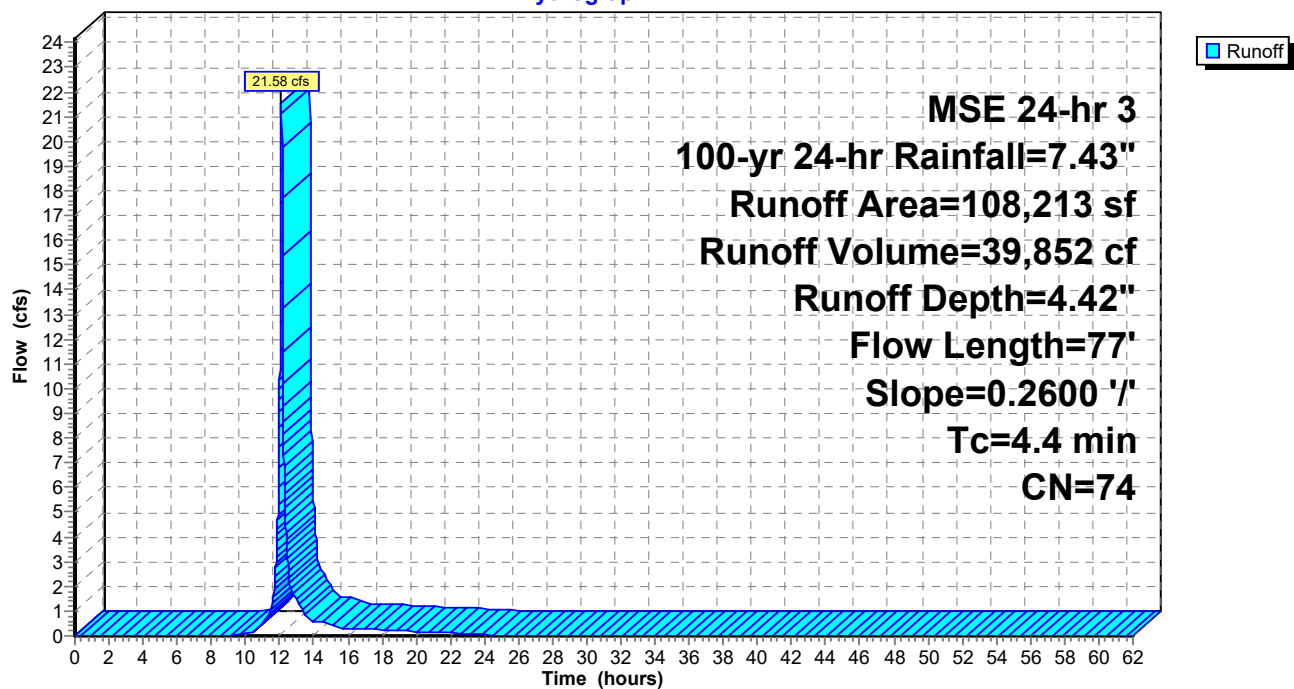
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 108,213	74	
108,213		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	77	0.2600	0.29		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"

Subcatchment AA2: AA2

Hydrograph



Summary for Subcatchment AA4: AA4

Runoff = 21.42 cfs @ 12.13 hrs, Volume= 41,726 cf, Depth= 4.42"

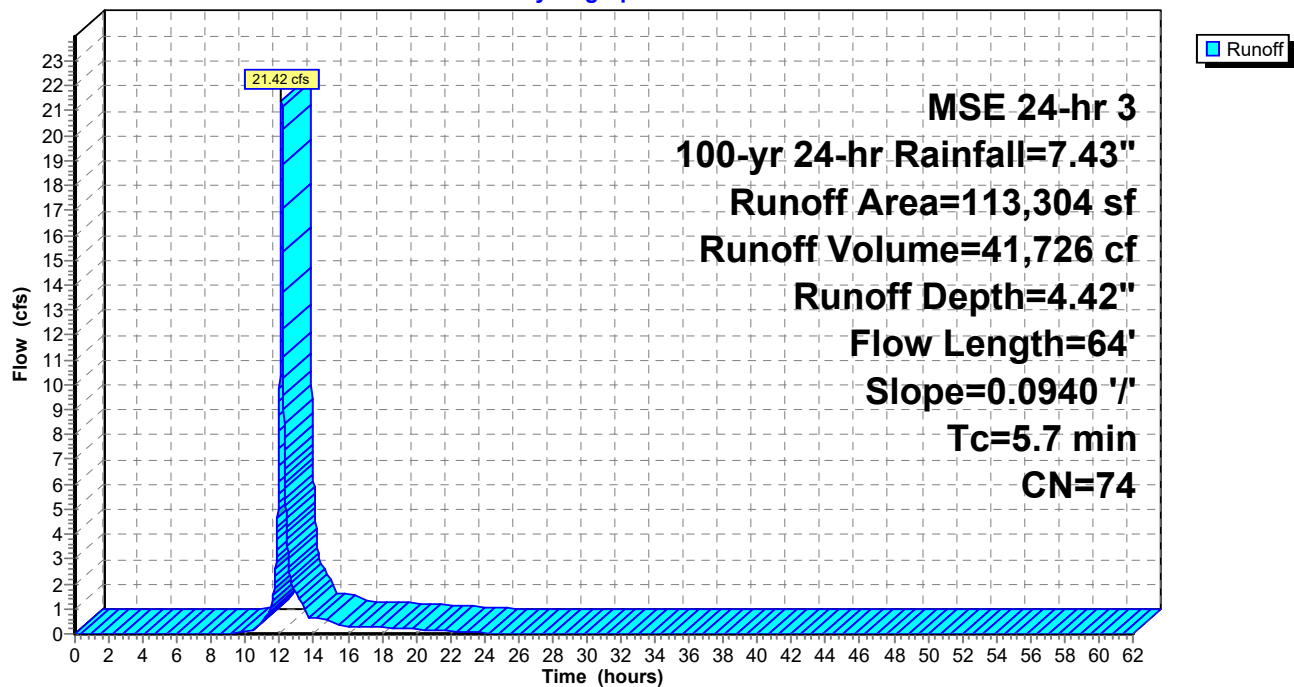
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 113,304	74	
113,304		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	64	0.0940	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"

Subcatchment AA4: AA4

Hydrograph



Summary for Subcatchment B1: B1

Runoff = 23.23 cfs @ 12.35 hrs, Volume= 82,215 cf, Depth= 4.42"

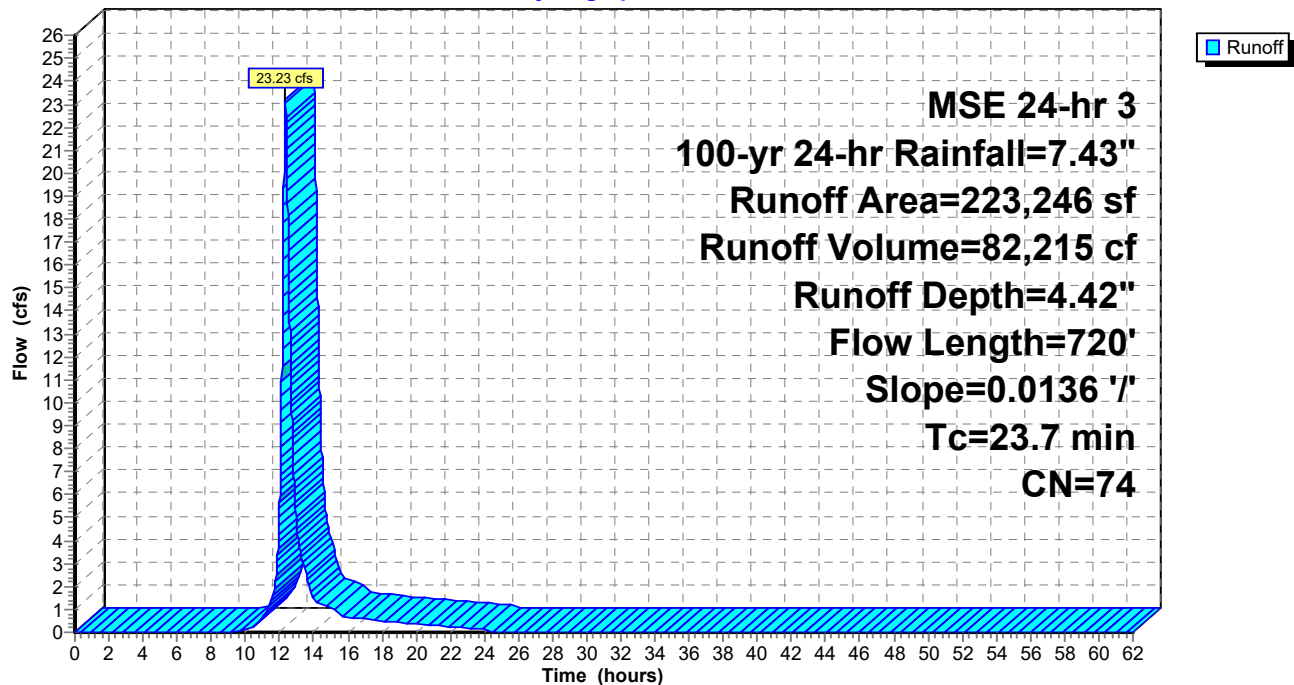
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	223,246	74	
	223,246		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	100	0.0136	0.09		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
5.9	620	0.0136	1.75		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
23.7	720	Total			

Subcatchment B1: B1

Hydrograph



Summary for Subcatchment B3: B3

Runoff = 21.36 cfs @ 12.16 hrs, Volume= 47,093 cf, Depth= 4.42"

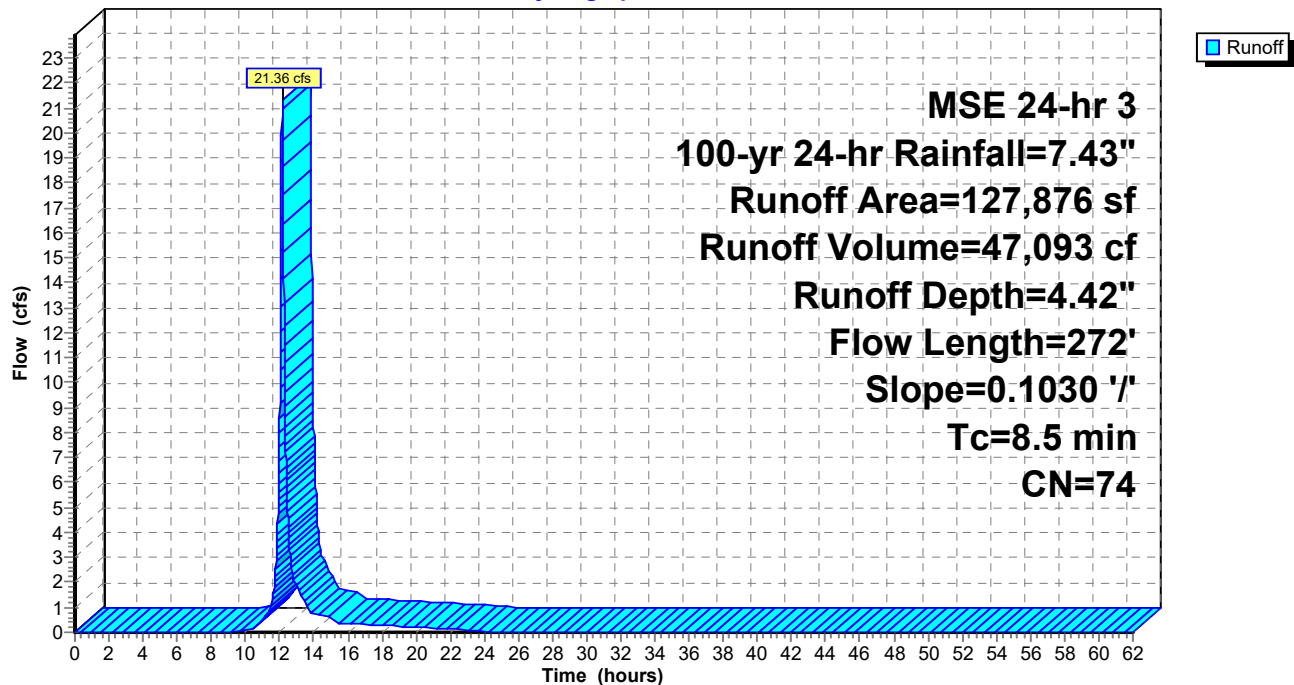
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	127,876	74	
	127,876		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	100	0.1030	0.21		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.6	172	0.1030	4.81		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
8.5	272	Total			

Subcatchment B3: B3

Hydrograph



Summary for Subcatchment B5: B5

Runoff = 30.58 cfs @ 12.13 hrs, Volume= 59,592 cf, Depth= 4.42"

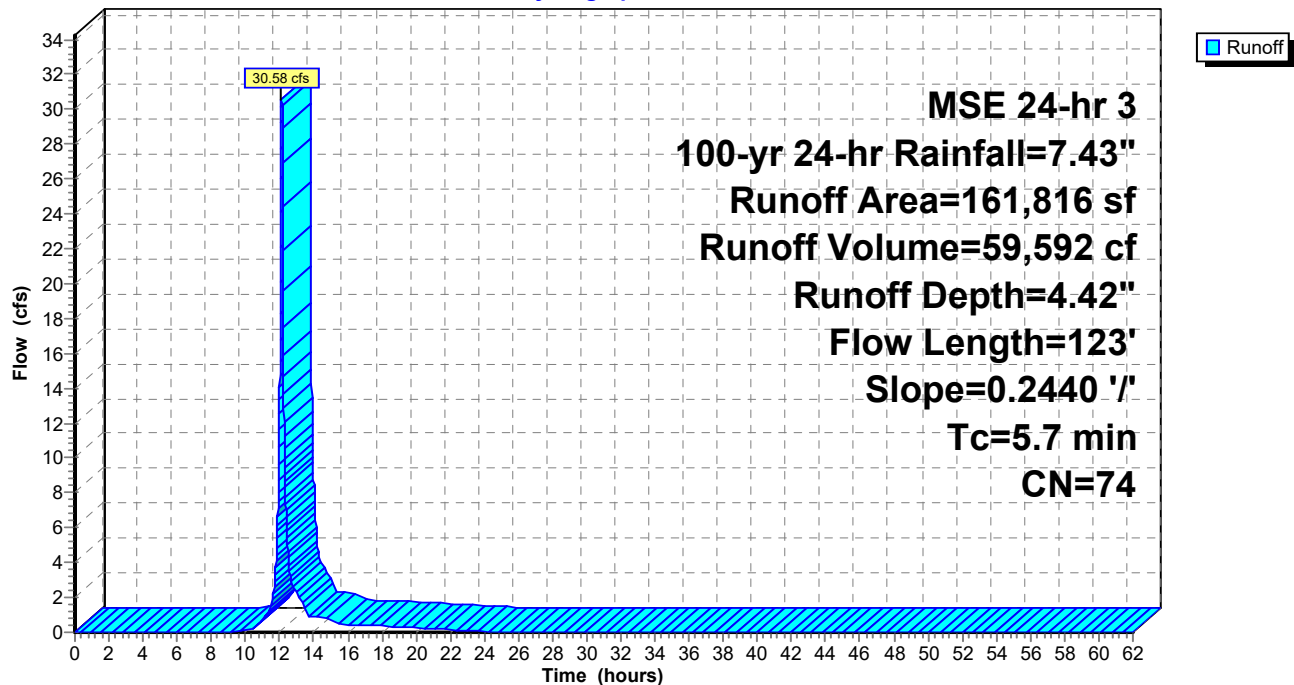
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	161,816	74	
	161,816		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.2440	0.30		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	23	0.2440	7.41		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.7	123	Total			

Subcatchment B5: B5

Hydrograph



Summary for Subcatchment B7: B7

Runoff = 35.45 cfs @ 12.12 hrs, Volume= 66,881 cf, Depth= 4.42"

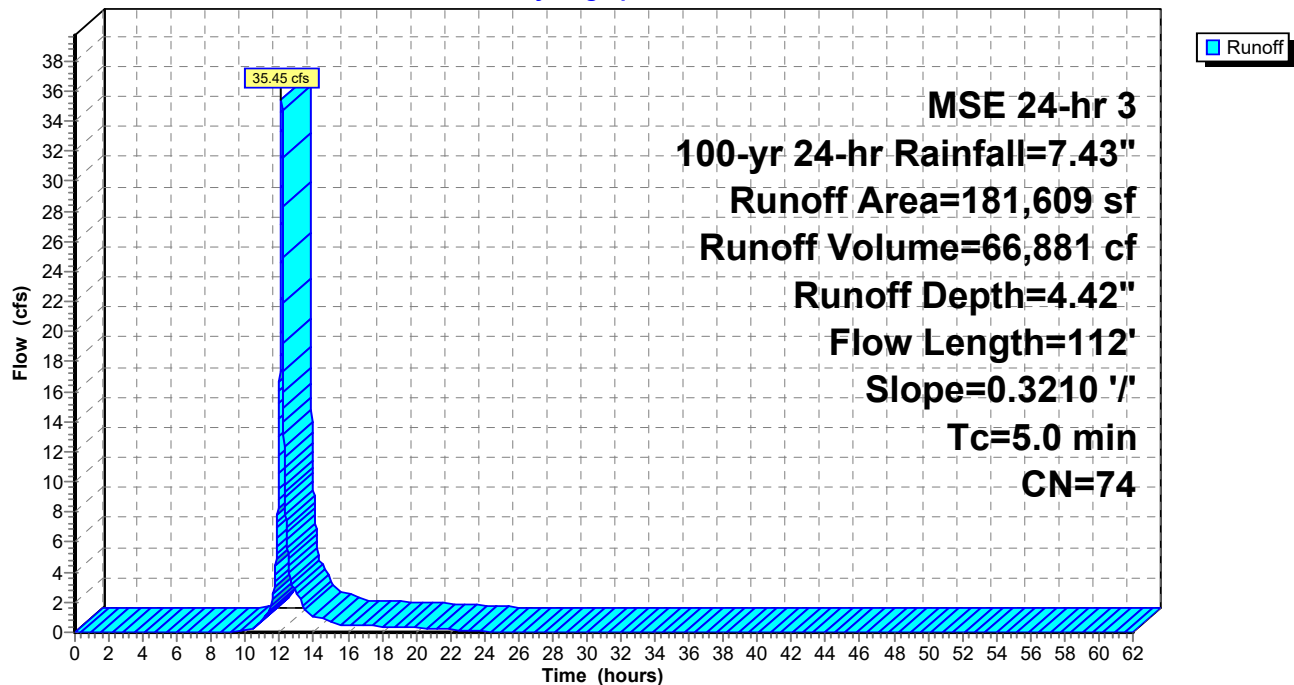
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 181,609	74	
181,609		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	100	0.3210	0.33		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.0	12	0.3210	8.50		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.0	112	Total			

Subcatchment B7: B7

Hydrograph



Summary for Subcatchment B9: B9

Runoff = 42.91 cfs @ 12.16 hrs, Volume= 93,255 cf, Depth= 4.42"

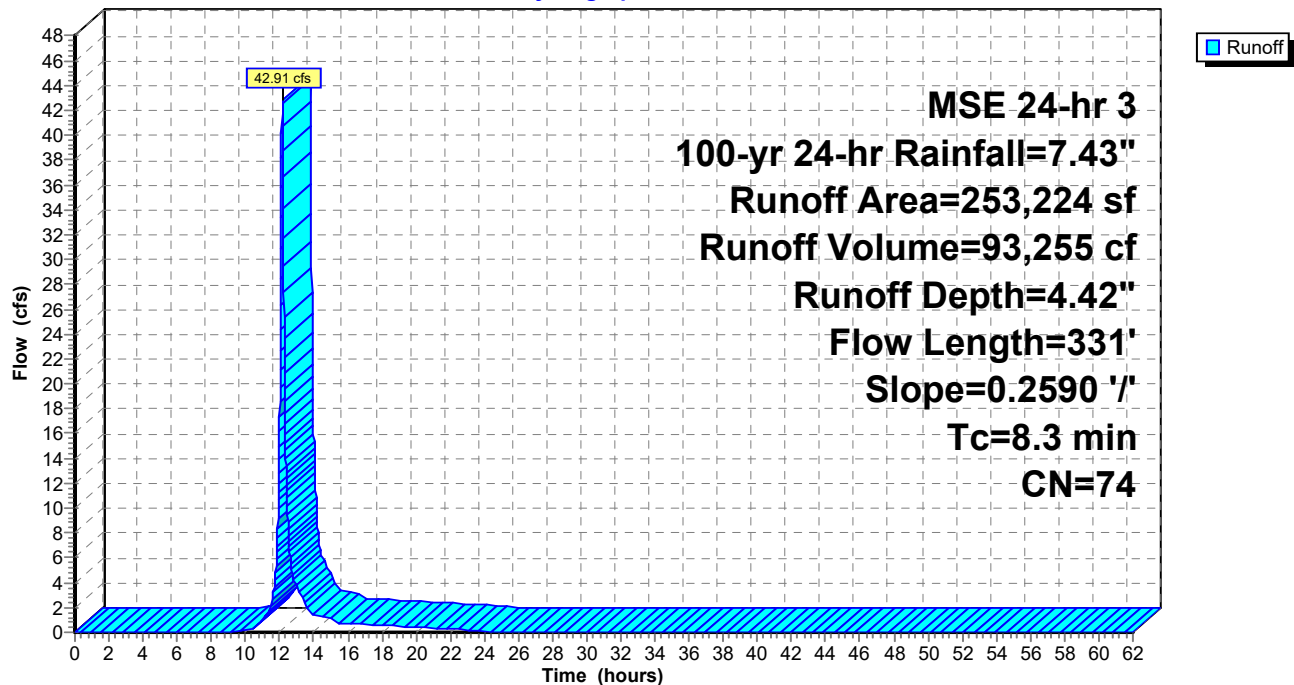
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	253,224	74	
	253,224		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	159	0.2590	0.33		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.4	172	0.2590	7.63		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
8.3	331	Total			

Subcatchment B9: B9

Hydrograph



Summary for Subcatchment BB1: BB1

Runoff = 19.05 cfs @ 12.13 hrs, Volume= 36,966 cf, Depth= 4.42"

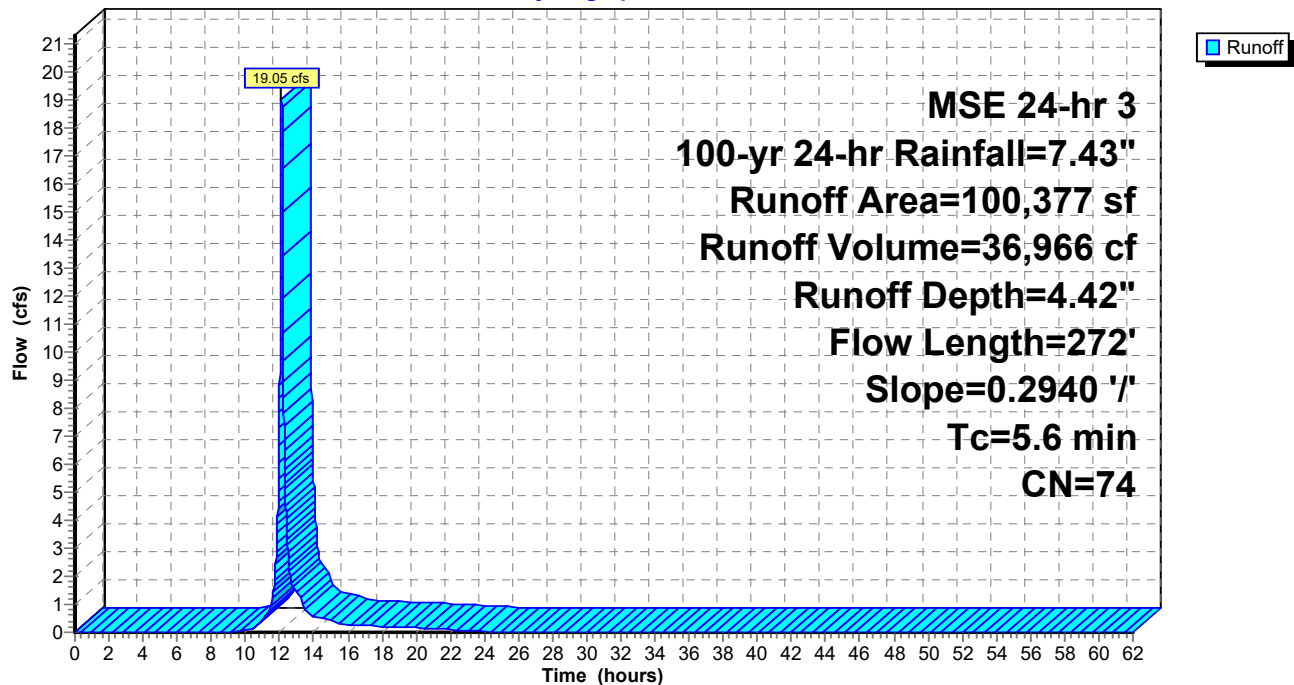
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	100,377	74	
	100,377		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2940	0.32		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.4	172	0.2940	8.13		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.6	272	Total			

Subcatchment BB1: BB1

Hydrograph



Summary for Subcatchment BB3: BB3

Runoff = 23.28 cfs @ 12.13 hrs, Volume= 44,589 cf, Depth= 4.42"

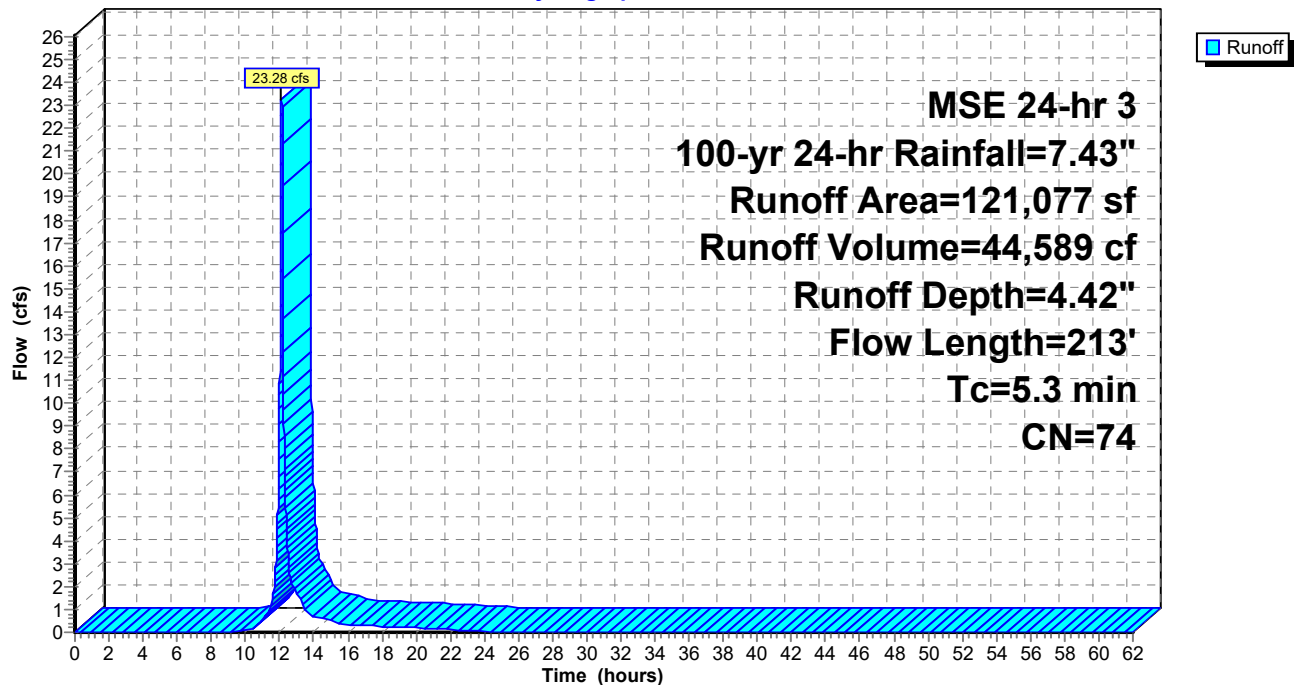
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	121,077	74	
	121,077		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	100	0.3310	0.34		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.3	113	0.2060	7.31		Shallow Concentrated Flow,
					Unpaved Kv= 16.1 fps
5.3	213	Total			

Subcatchment BB3: BB3

Hydrograph



Summary for Subcatchment BBB1: BBB1

Runoff = 37.13 cfs @ 12.15 hrs, Volume= 77,457 cf, Depth= 4.42"

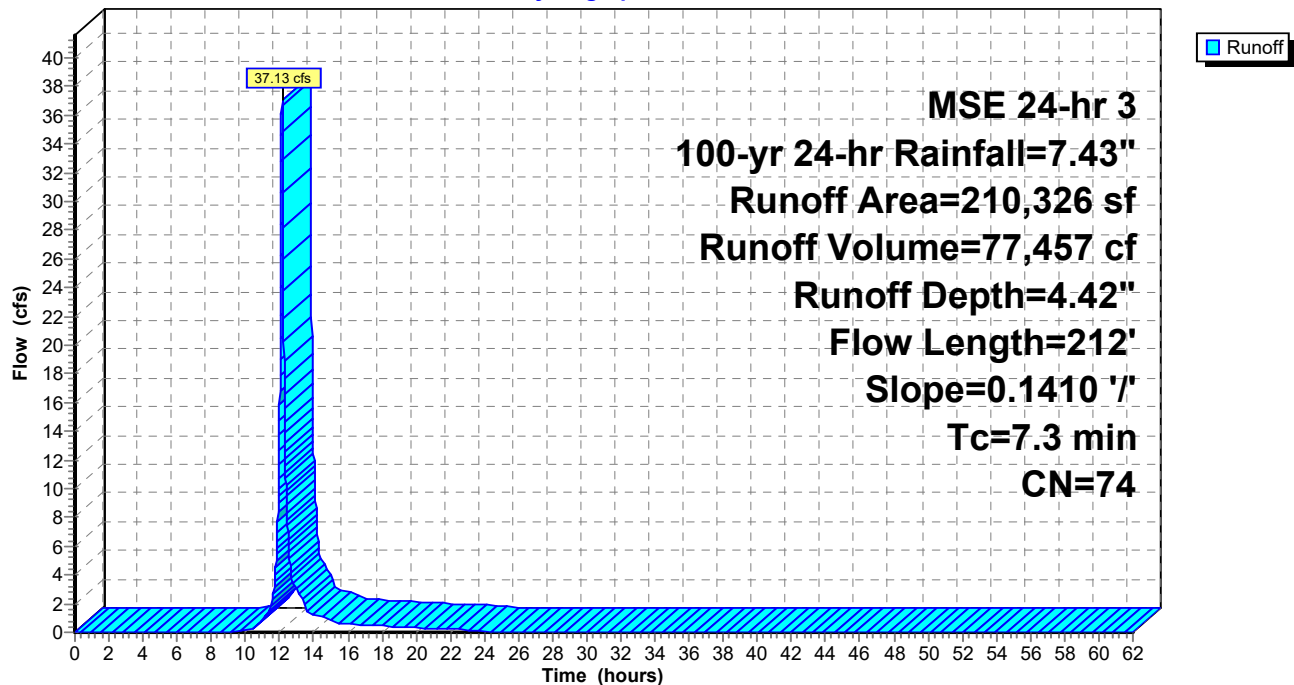
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	210,326	74	
	210,326		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	100	0.1410	0.24		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.3	112	0.1410	5.63		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
7.3	212	Total			

Subcatchment BBB1: BBB1

Hydrograph



Summary for Subcatchment BBB3: BBB3

Runoff = 12.45 cfs @ 12.12 hrs, Volume= 22,514 cf, Depth= 4.42"

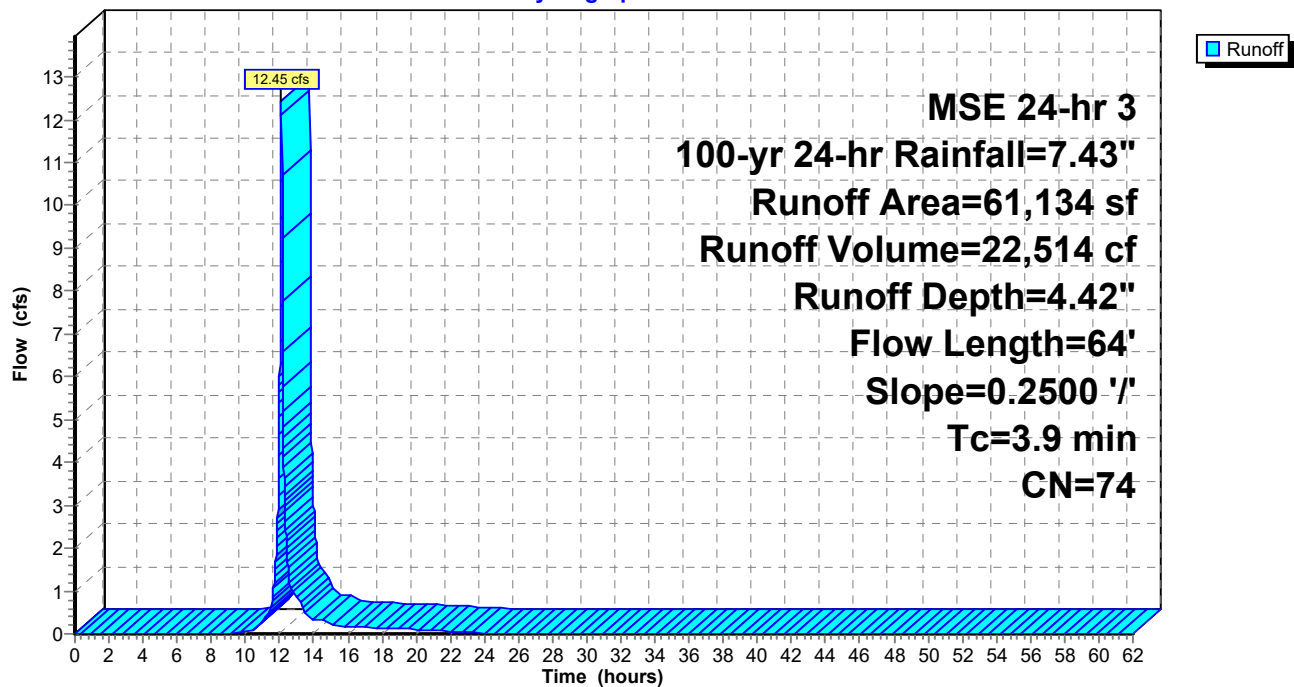
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	61,134	74	
	61,134		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	64	0.2500	0.27		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"

Subcatchment BBB3: BBB3

Hydrograph



Summary for Subcatchment C0: C0

Runoff = 4.83 cfs @ 12.19 hrs, Volume= 11,884 cf, Depth= 4.42"

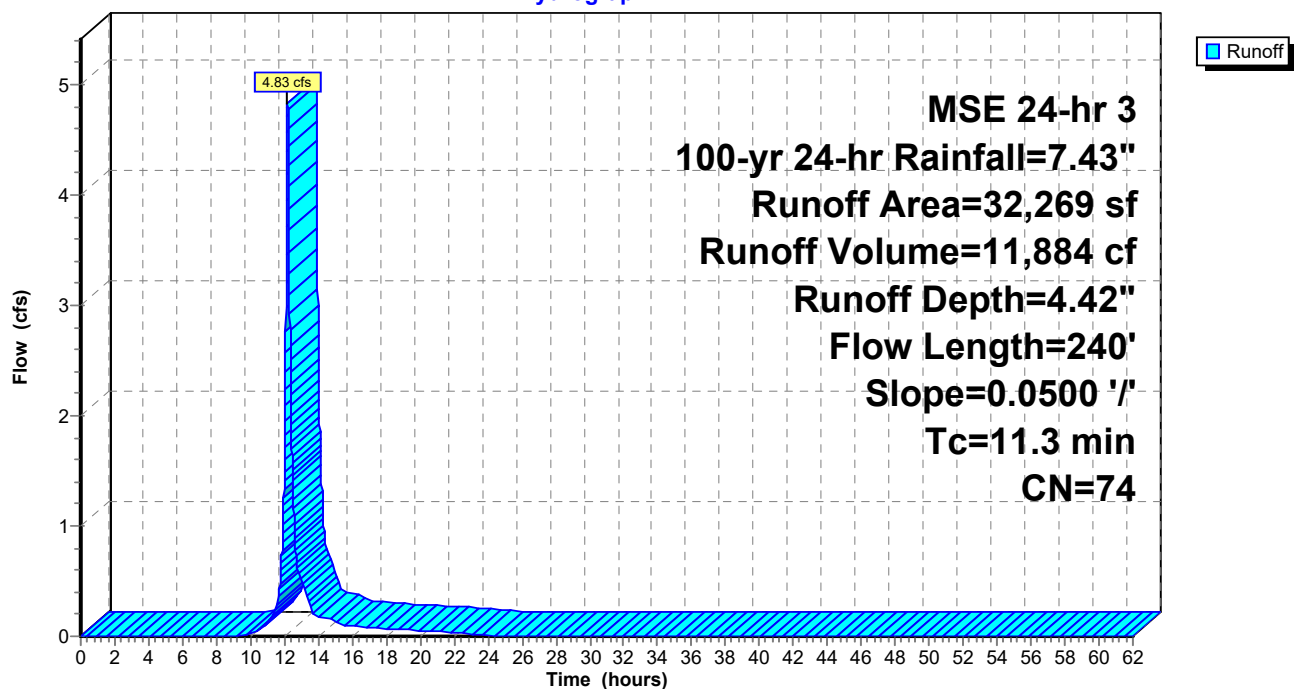
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	32,269	74	
	32,269		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	100	0.0500	0.16		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.7	140	0.0500	3.35		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
11.3	240	Total			

Subcatchment C0: C0

Hydrograph



Summary for Subcatchment C1: C1

Runoff = 74.30 cfs @ 12.22 hrs, Volume= 202,491 cf, Depth= 4.42"

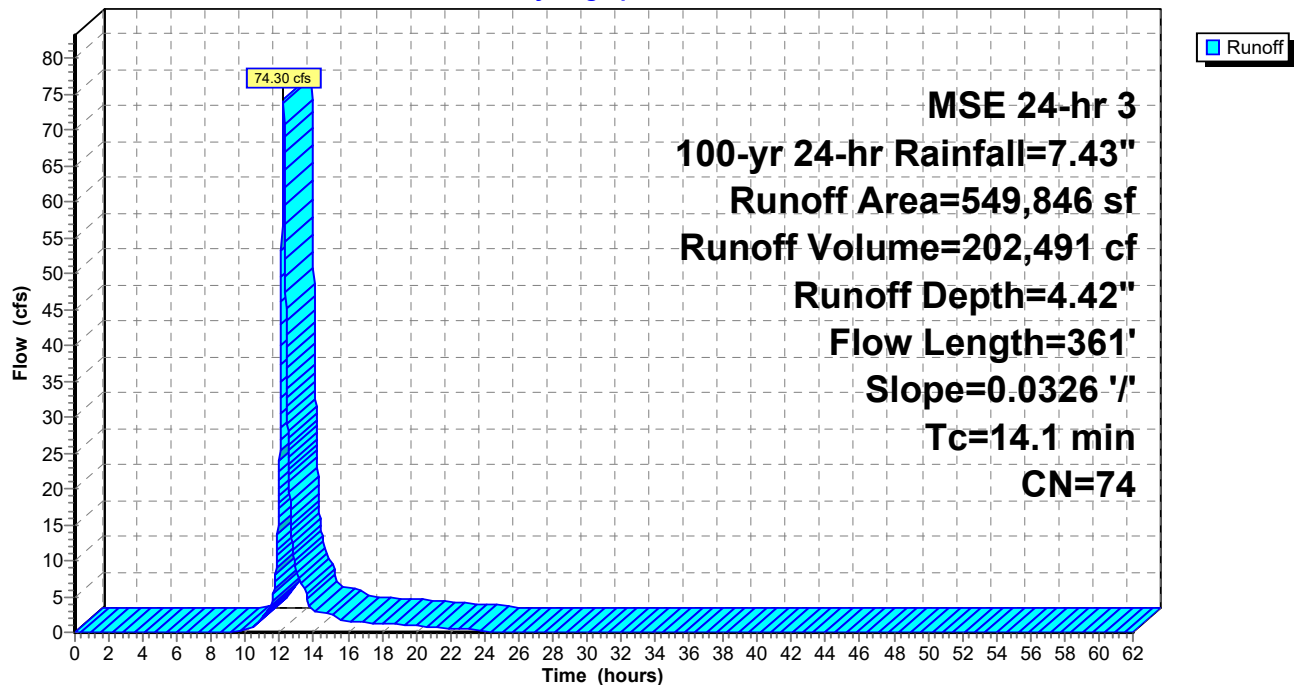
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	549,846	74	
	549,846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0326	0.13		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
1.6	261	0.0326	2.71		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
14.1	361	Total			

Subcatchment C1: C1

Hydrograph



Summary for Subcatchment C10: C10

Runoff = 44.26 cfs @ 12.12 hrs, Volume= 83,078 cf, Depth= 4.42"

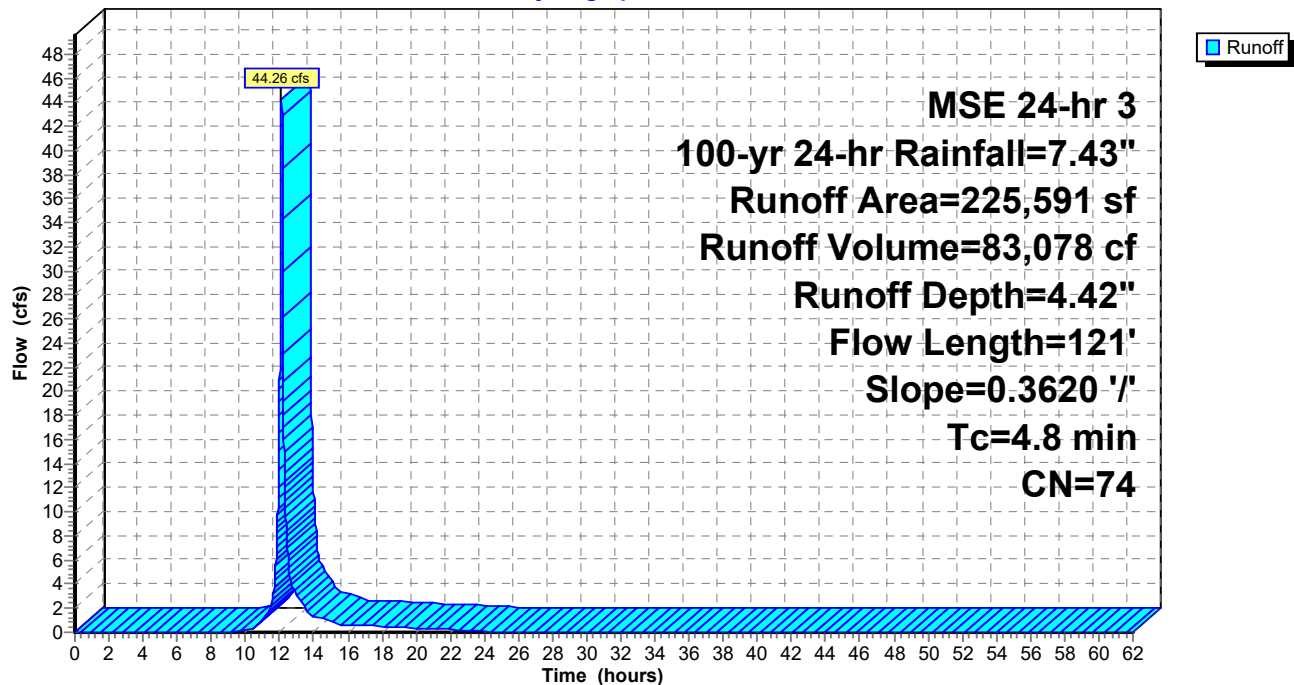
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	225,591	74	
	225,591		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	100	0.3620	0.35		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.0	21	0.3620	9.02		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
4.8	121	Total			

Subcatchment C10: C10

Hydrograph



Summary for Subcatchment C2: C2

Runoff = 30.18 cfs @ 12.22 hrs, Volume= 82,799 cf, Depth= 4.42"

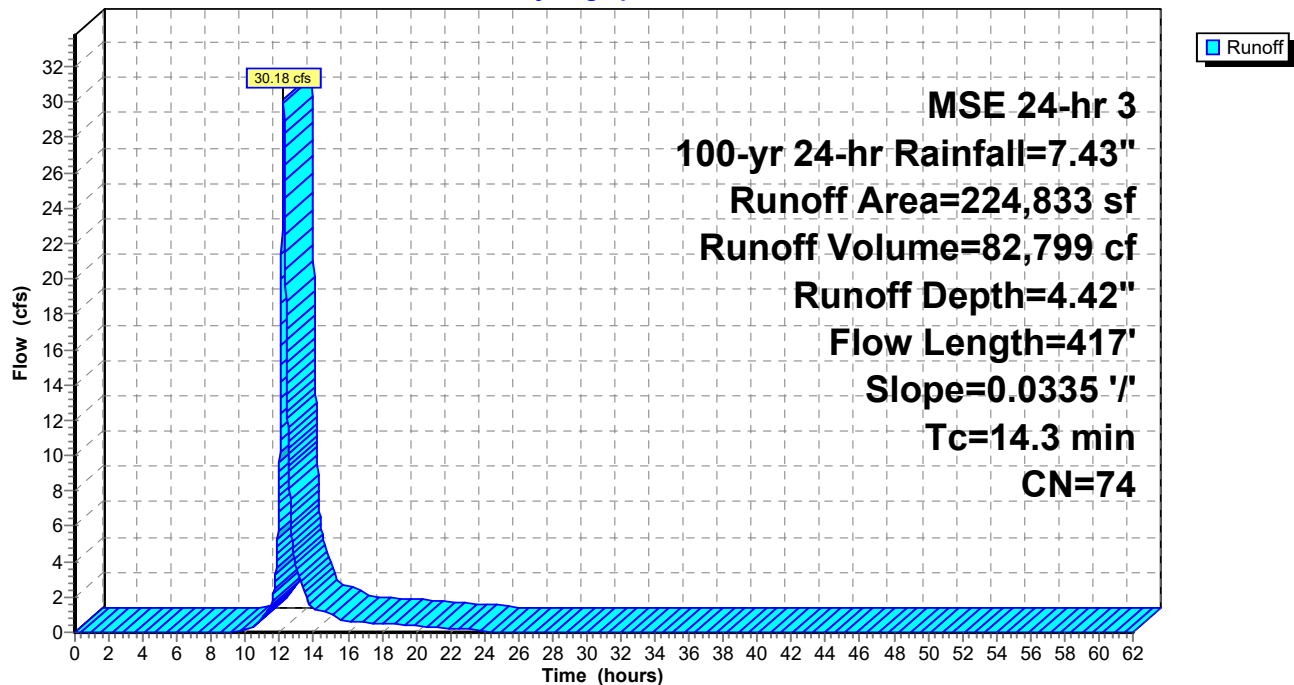
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	224,833	74	
	224,833		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	100	0.0335	0.13		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
1.9	317	0.0335	2.75		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
14.3	417	Total			

Subcatchment C2: C2

Hydrograph



Summary for Subcatchment C3: C3

Runoff = 45.49 cfs @ 12.13 hrs, Volume= 86,608 cf, Depth= 4.42"

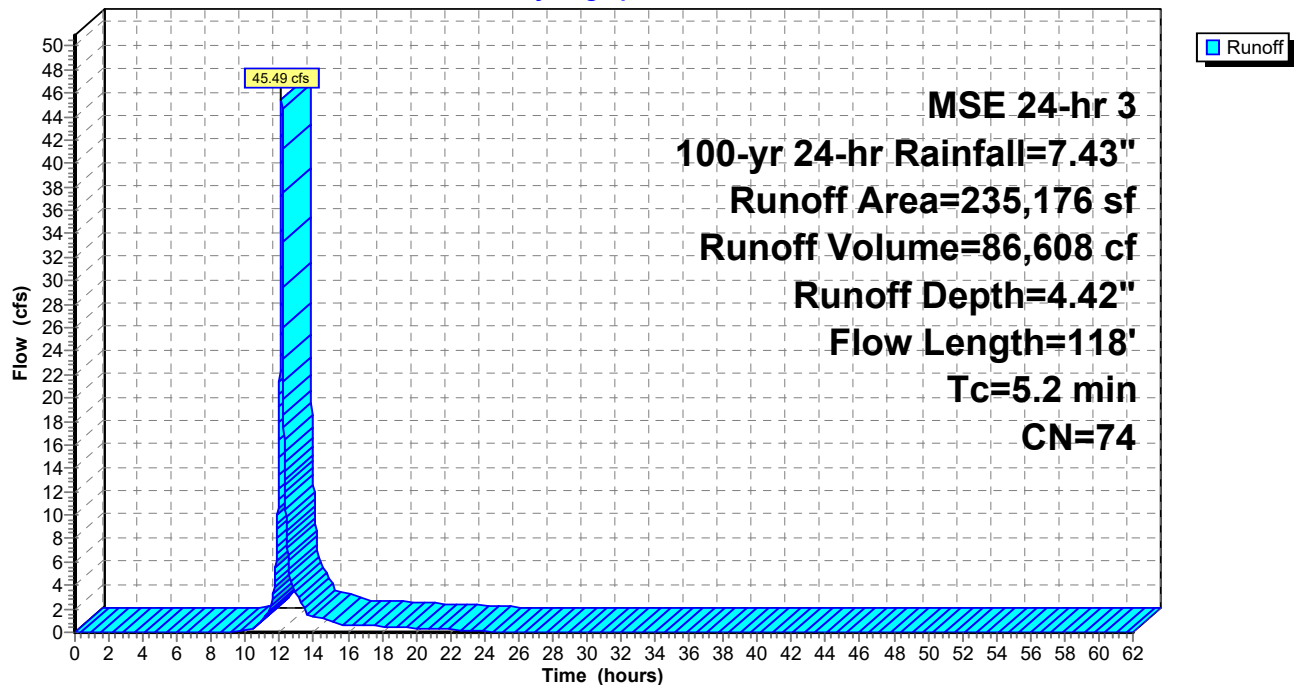
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	235,176	74	
	235,176		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	100	0.3040	0.32		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	18	0.0304	2.62		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.2	118	Total			

Subcatchment C3: C3

Hydrograph



Summary for Subcatchment C4: C4

Runoff = 28.89 cfs @ 12.13 hrs, Volume= 54,995 cf, Depth= 4.42"

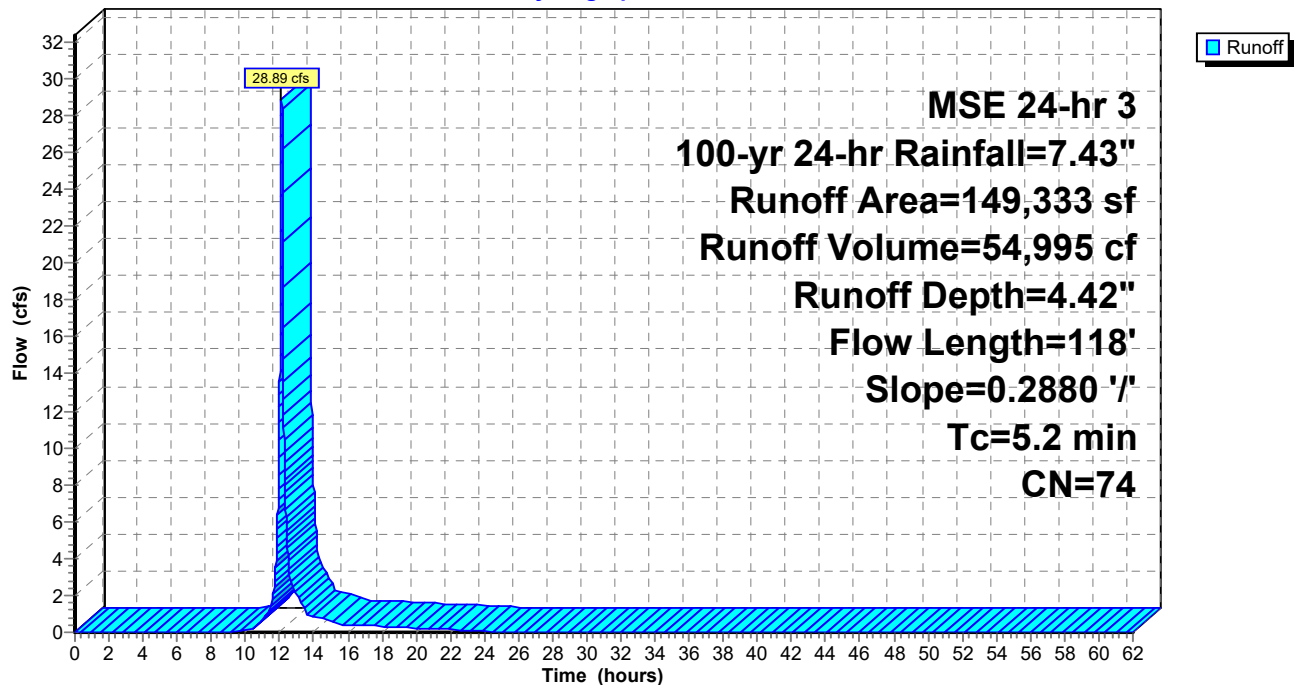
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	149,333	74	
	149,333		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2880	0.32		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.0	18	0.2880	8.05		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.2	118	Total			

Subcatchment C4: C4

Hydrograph



Summary for Subcatchment C5: C5

Runoff = 46.32 cfs @ 12.13 hrs, Volume= 88,194 cf, Depth= 4.42"

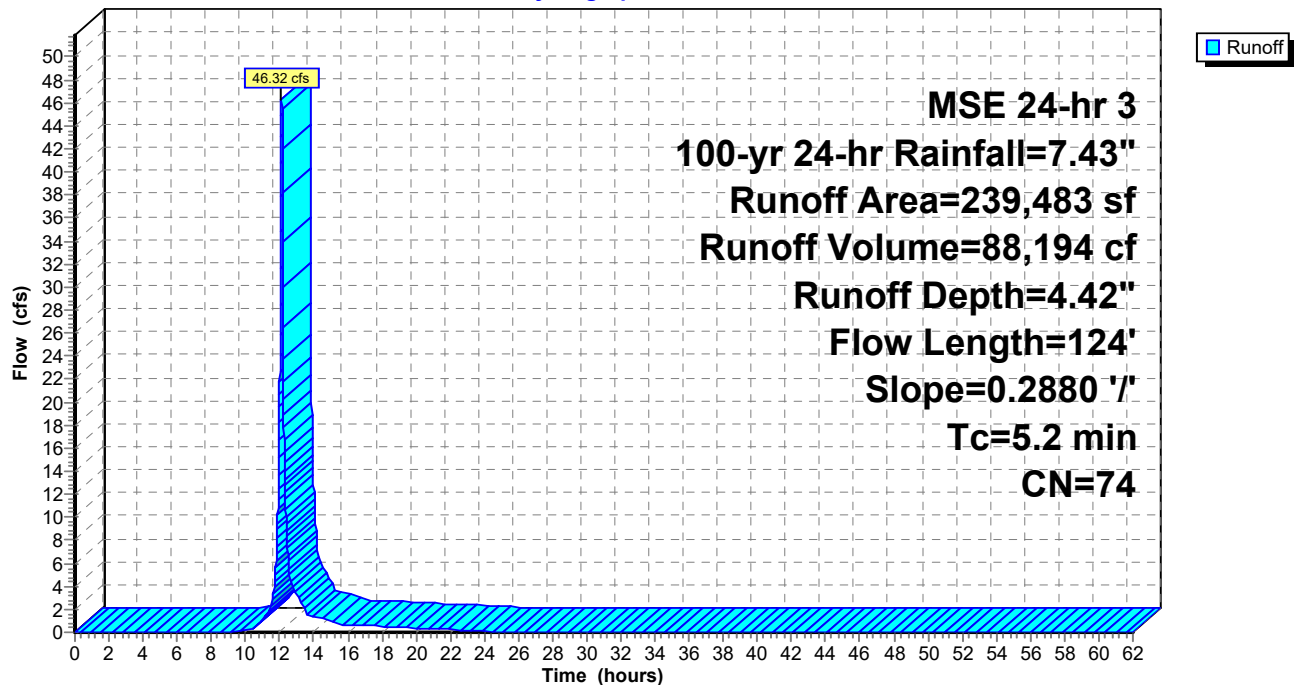
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	239,483	74	
	239,483		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2880	0.32		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.0	24	0.2880	8.05		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.2	124	Total			

Subcatchment C5: C5

Hydrograph



Summary for Subcatchment C6: C6

Runoff = 34.21 cfs @ 12.14 hrs, Volume= 69,603 cf, Depth= 4.42"

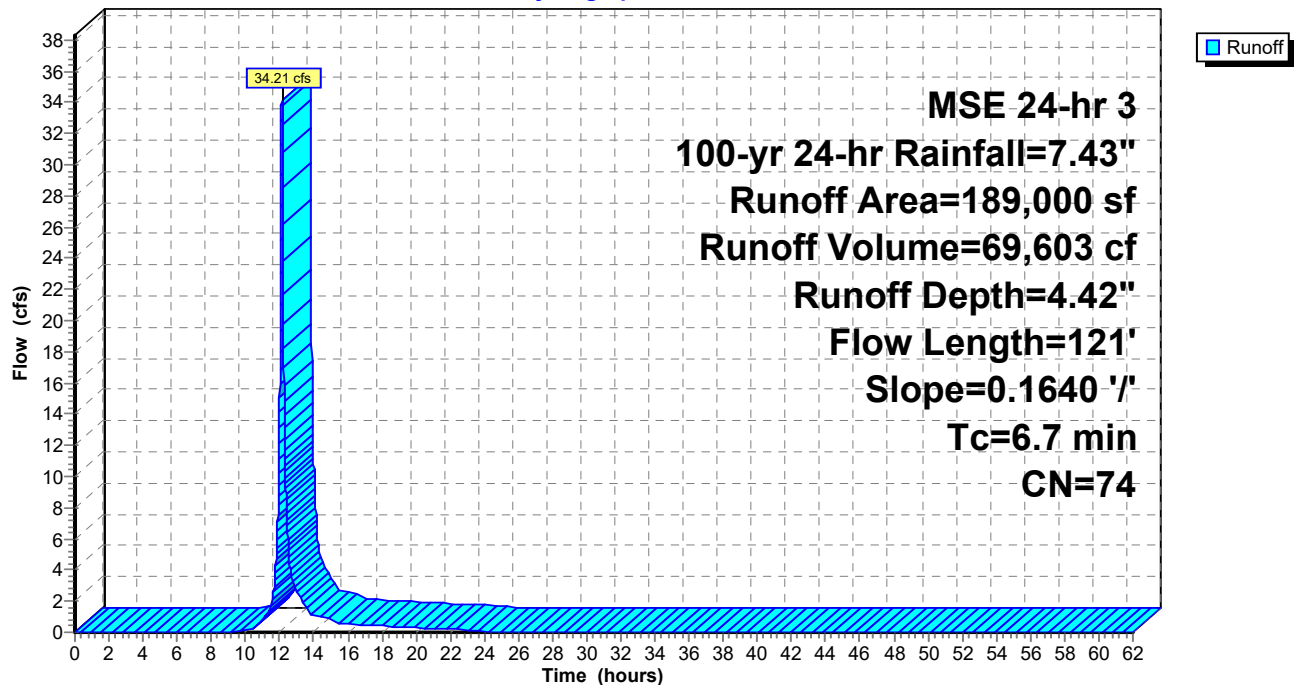
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	189,000	74	
	189,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.1640	0.25		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.1	21	0.1640	6.07		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
6.7	121	Total			

Subcatchment C6: C6

Hydrograph



Summary for Subcatchment C7: C7

Runoff = 48.41 cfs @ 12.12 hrs, Volume= 92,060 cf, Depth= 4.42"

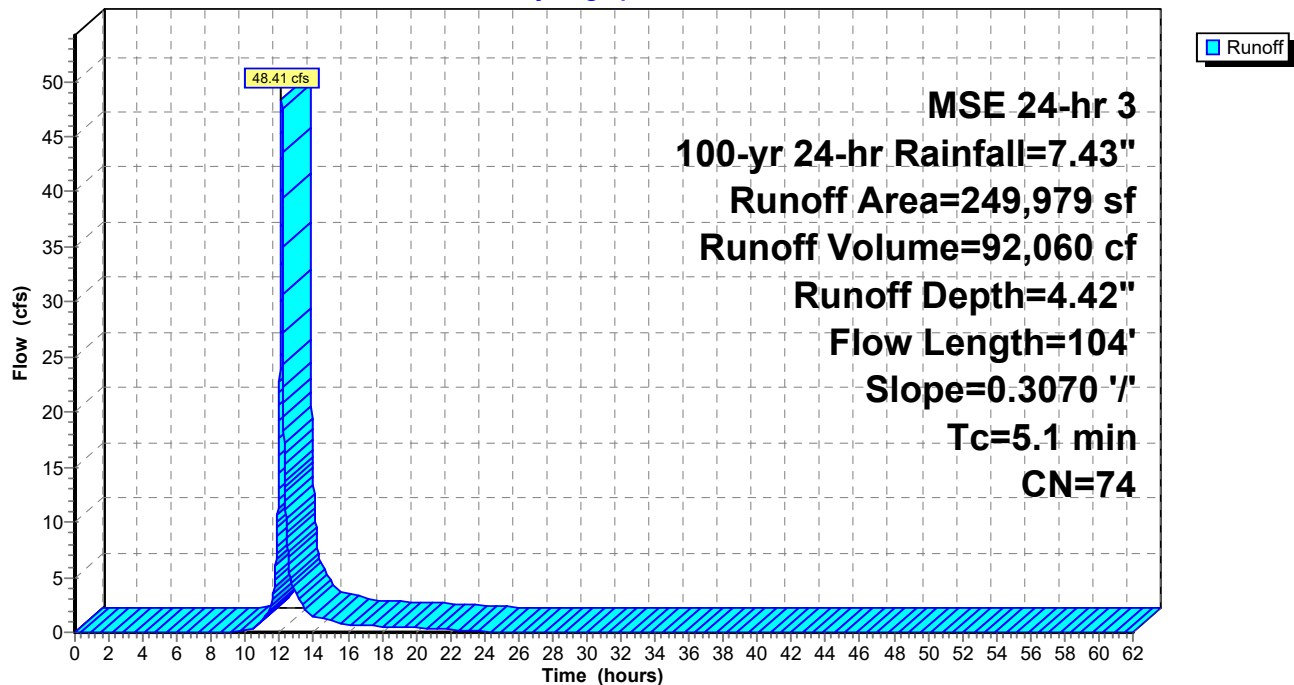
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	249,979	74	
	249,979		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	100	0.3070	0.33		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.0	4	0.3070	8.31		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
5.1	104	Total			

Subcatchment C7: C7

Hydrograph



Summary for Subcatchment C8: C8

Runoff = 41.39 cfs @ 12.13 hrs, Volume= 81,284 cf, Depth= 4.42"

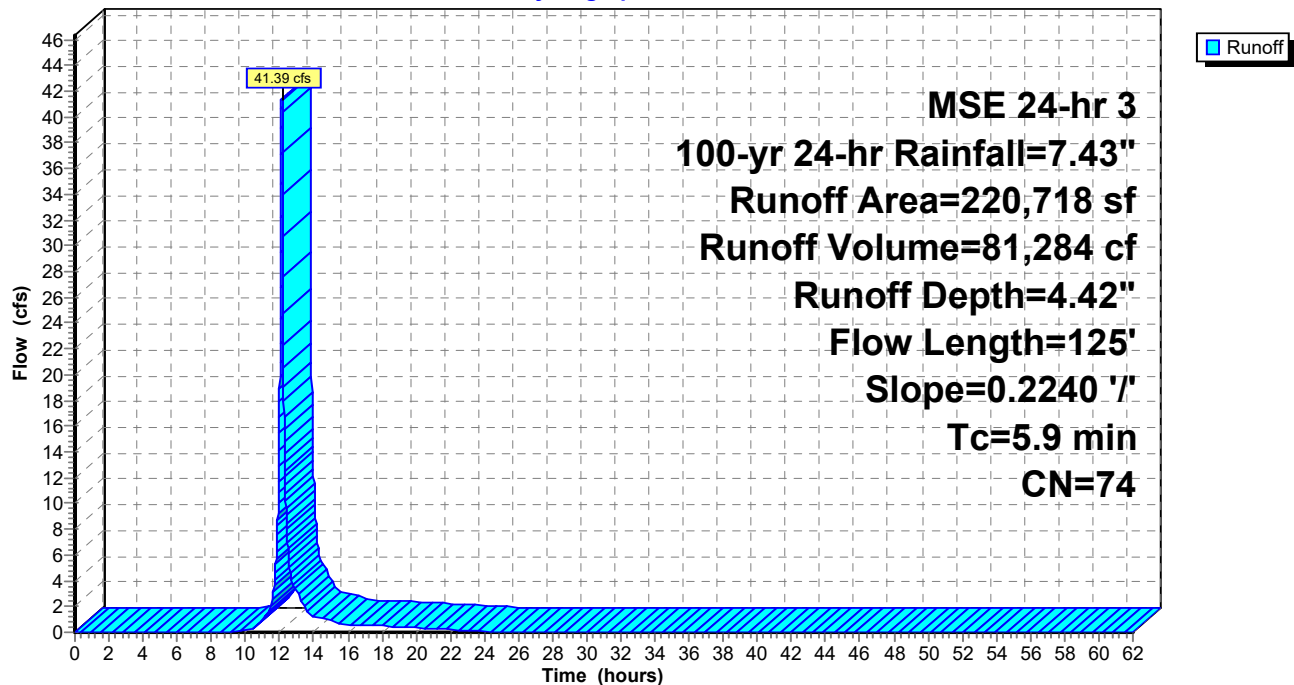
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	220,718	74	
	220,718		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.2240	0.29		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	25	0.2240	7.10		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.9	125	Total			

Subcatchment C8: C8

Hydrograph



Summary for Subcatchment C9: C9

Runoff = 79.02 cfs @ 12.13 hrs, Volume= 162,798 cf, Depth= 5.43"

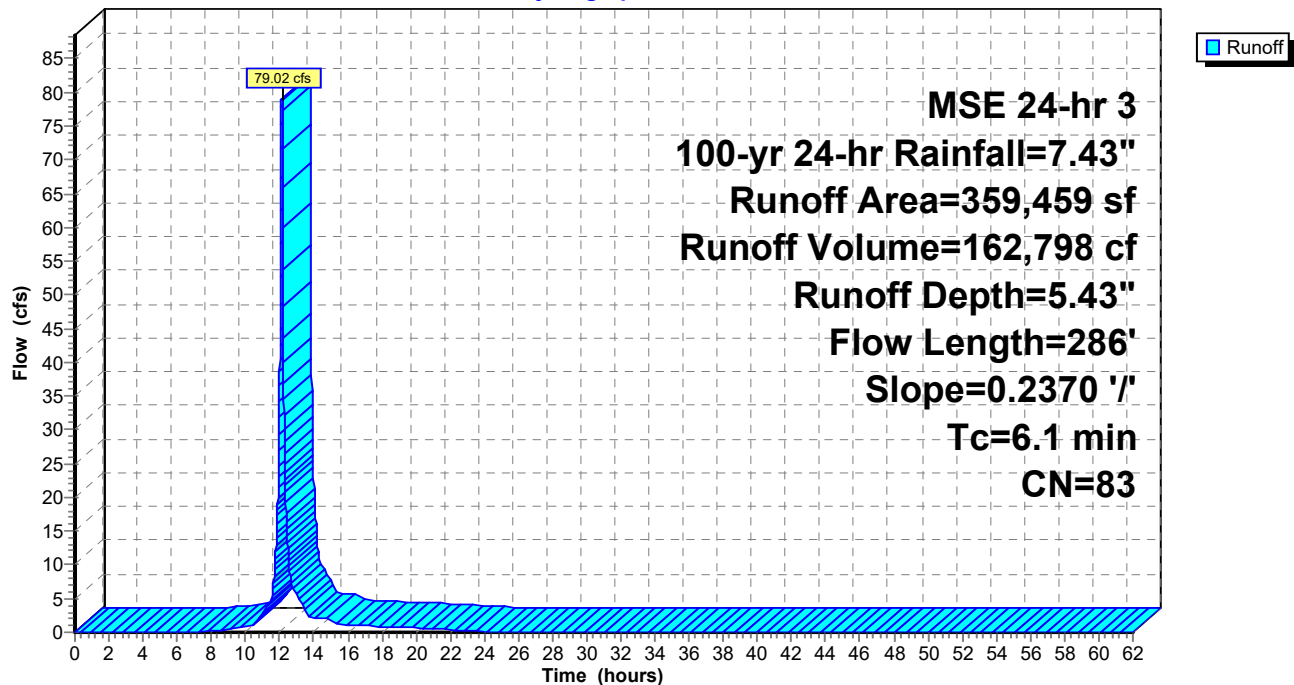
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	359,459	83	
	359,459		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	100	0.2370	0.29		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.4	186	0.2370	7.30		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
6.1	286	Total			

Subcatchment C9: C9

Hydrograph



Summary for Subcatchment CC2: CC2

Runoff = 16.49 cfs @ 12.13 hrs, Volume= 32,392 cf, Depth= 4.42"

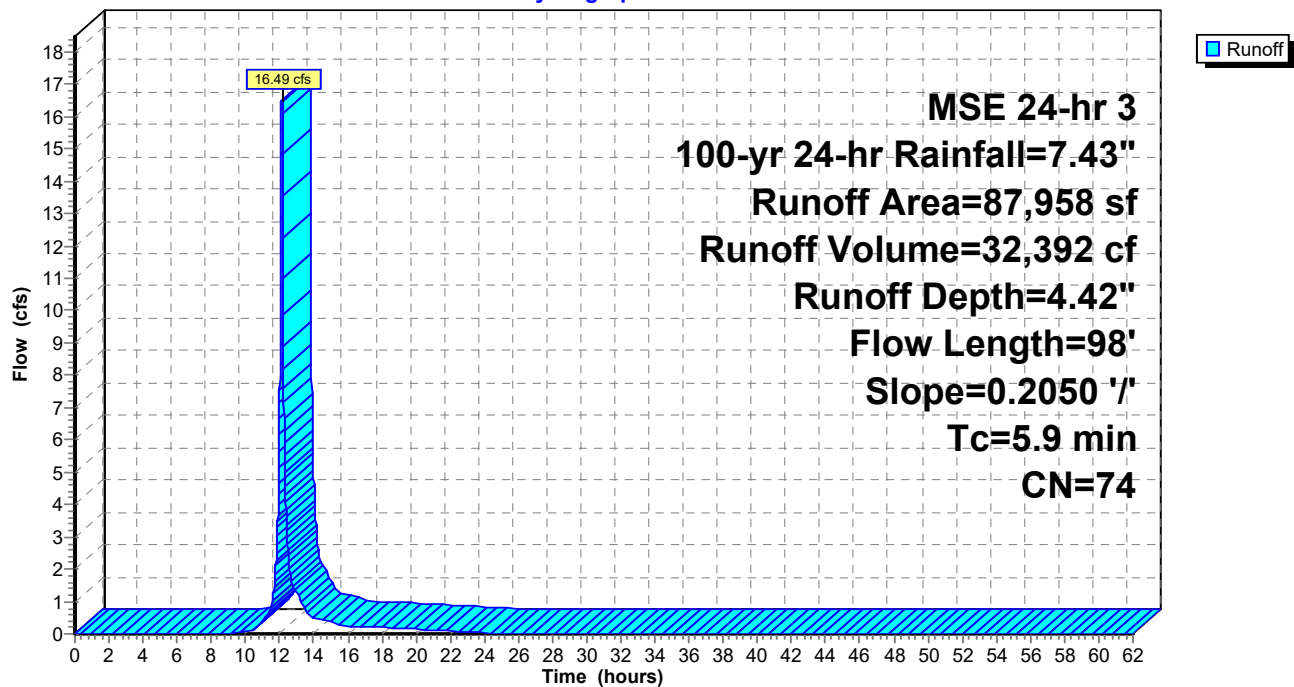
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 87,958	74	
87,958		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	98	0.2050	0.28		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"

Subcatchment CC2: CC2

Hydrograph



Summary for Subcatchment CC4: CC4

Runoff = 40.36 cfs @ 12.13 hrs, Volume= 78,322 cf, Depth= 4.42"

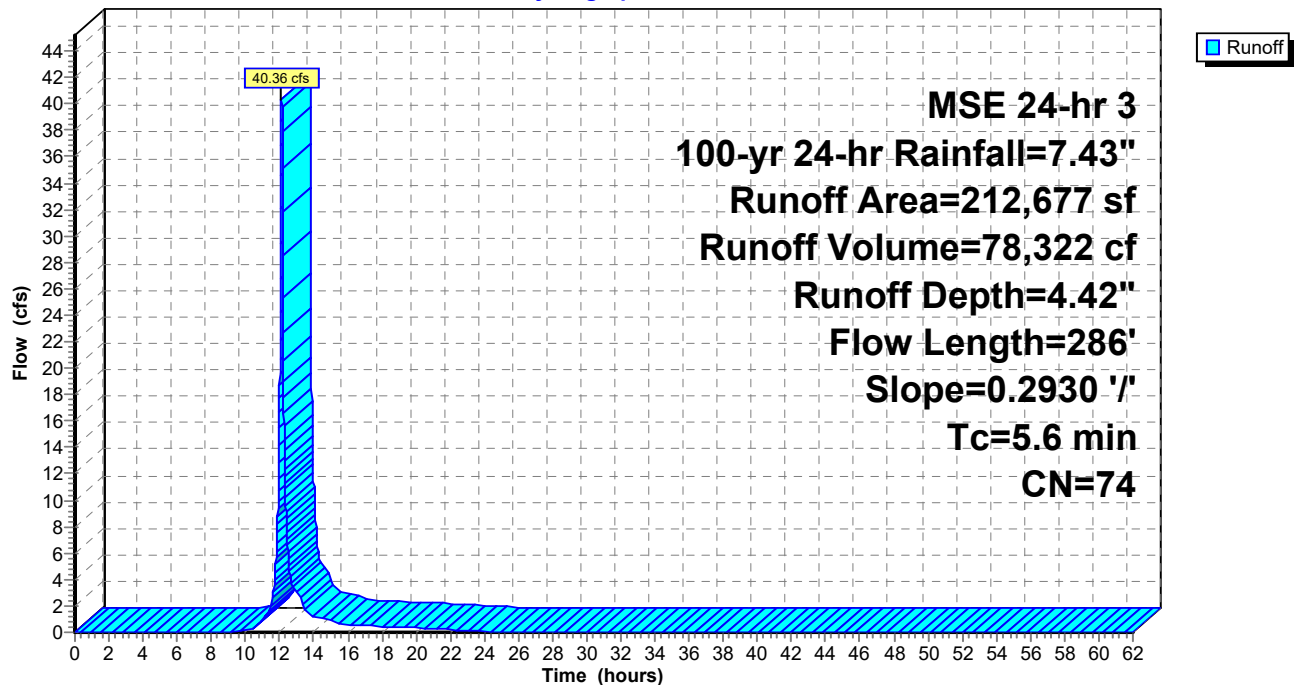
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	212,677	74	
	212,677		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2930	0.32		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.4	186	0.2930	8.12		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
5.6	286	Total			

Subcatchment CC4: CC4

Hydrograph



Summary for Subcatchment D1: D1

Runoff = 4.53 cfs @ 12.17 hrs, Volume= 10,526 cf, Depth= 4.42"

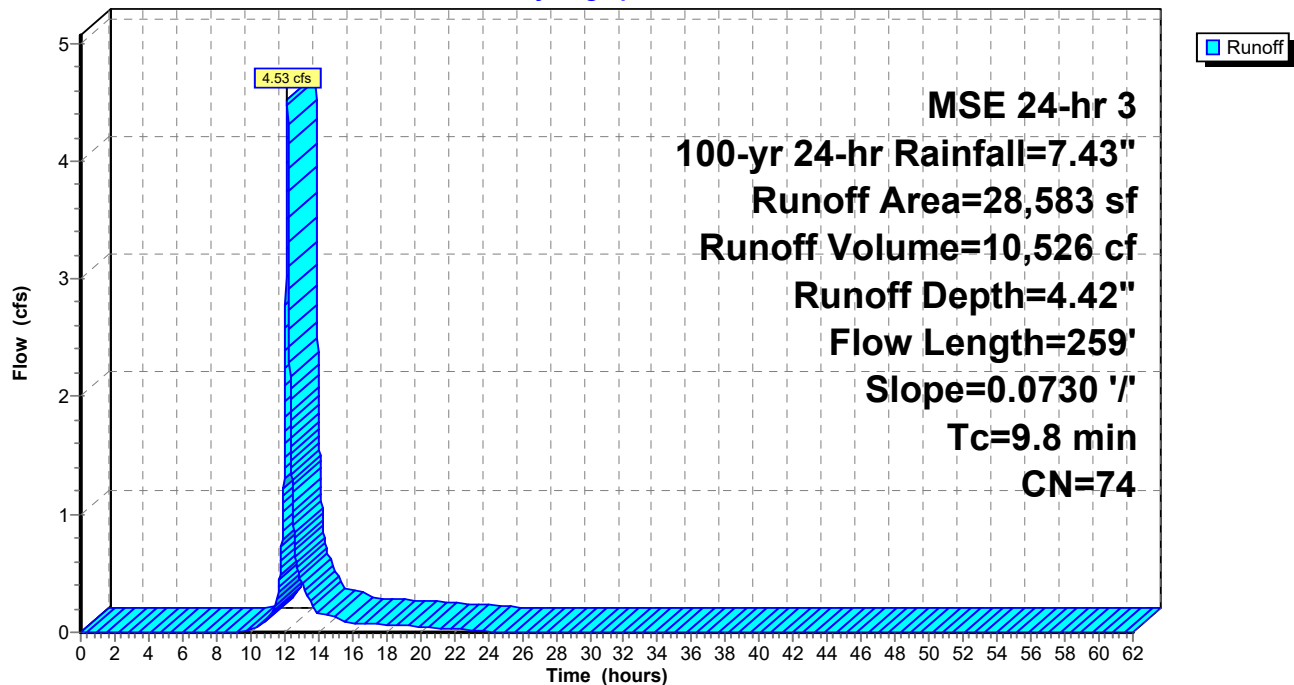
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 28,583	74	
28,583		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0730	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.7	159	0.0730	4.05		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
9.8	259	Total			

Subcatchment D1: D1

Hydrograph



Summary for Subcatchment D10: D10

Runoff = 12.76 cfs @ 12.13 hrs, Volume= 24,972 cf, Depth= 4.42"

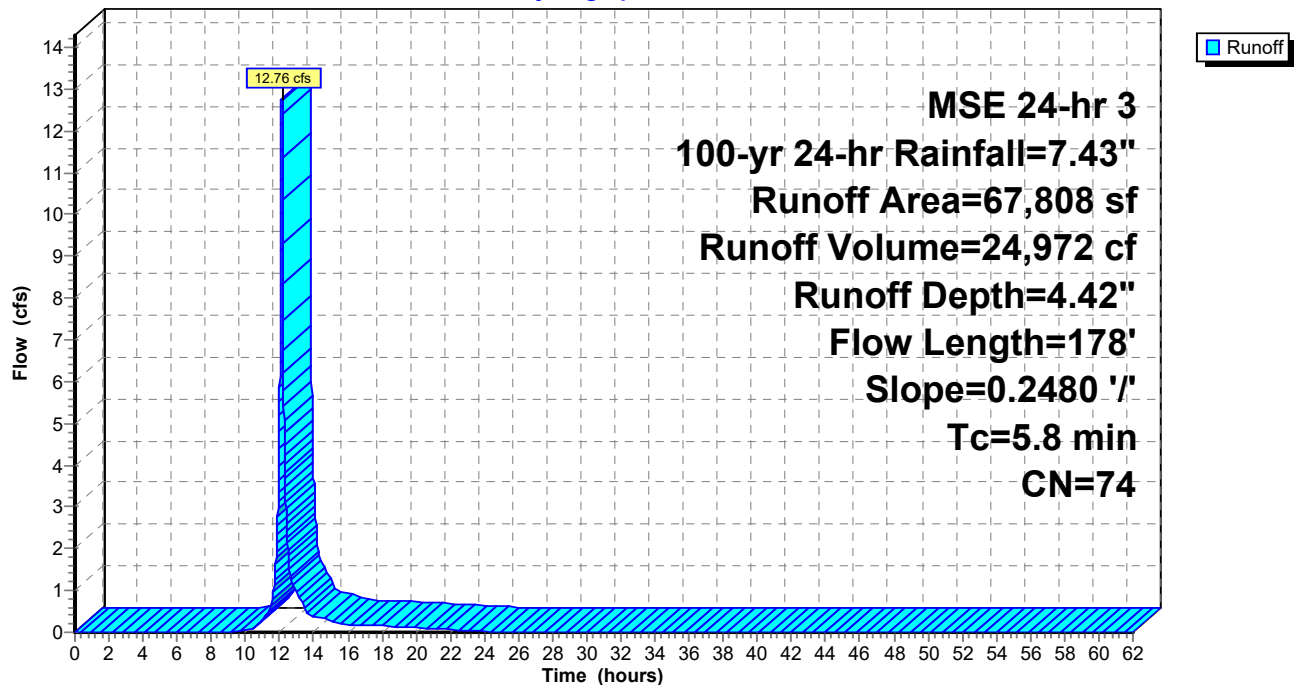
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 67,808	74	
67,808		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.2480	0.30		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.2	78	0.2480	7.47		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
5.8	178	Total			

Subcatchment D10: D10

Hydrograph



Summary for Subcatchment D11: D11

Runoff = 16.31 cfs @ 12.13 hrs, Volume= 31,247 cf, Depth= 4.42"

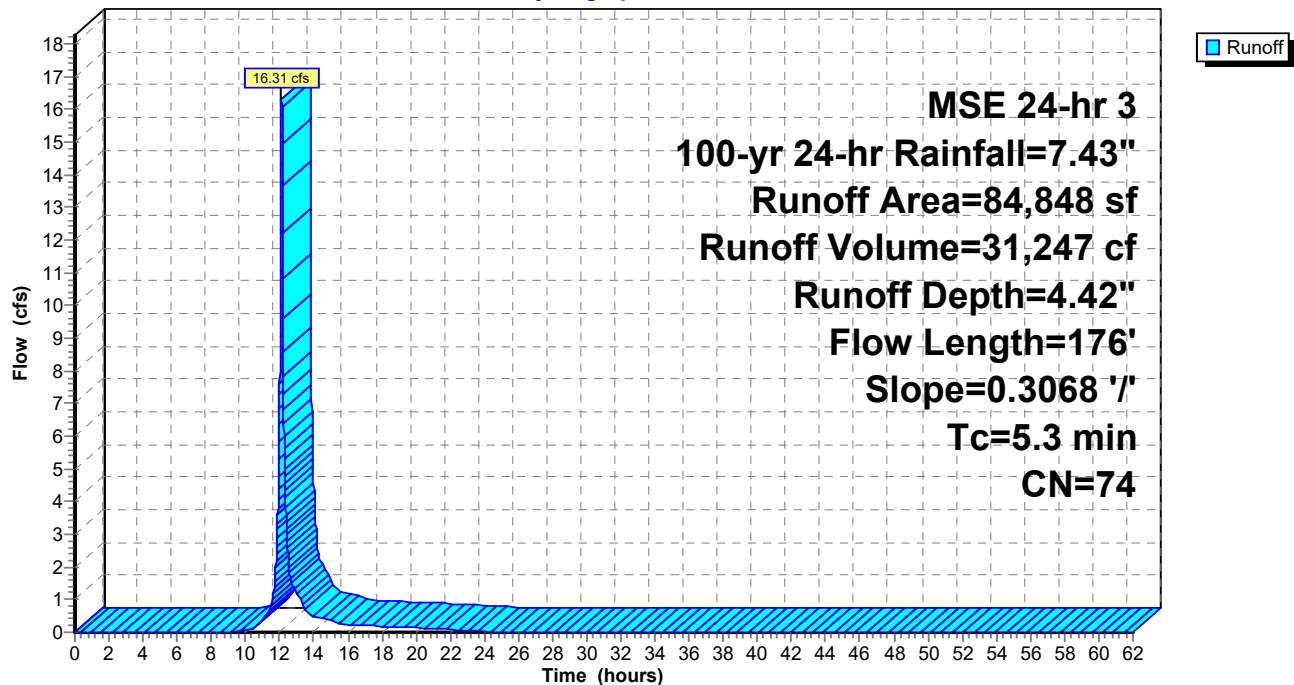
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	84,848	74	
	84,848		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	100	0.3068	0.33		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.2	76	0.3068	8.31		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.3	176	Total			

Subcatchment D11: D11

Hydrograph



Summary for Subcatchment D12: D12

Runoff = 8.78 cfs @ 12.13 hrs, Volume= 17,242 cf, Depth= 4.42"

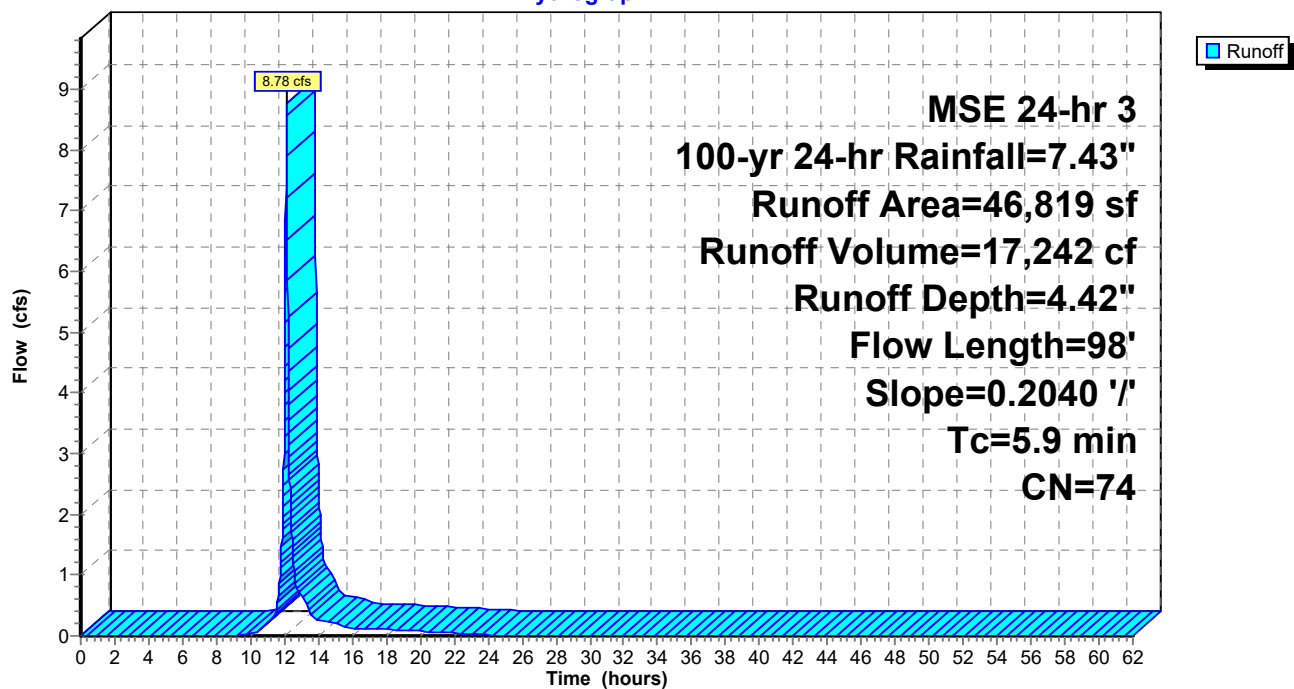
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 46,819	74	
46,819		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	98	0.2040	0.28		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"

Subcatchment D12: D12

Hydrograph



Summary for Subcatchment D2: D2

Runoff = 35.57 cfs @ 12.22 hrs, Volume= 96,111 cf, Depth= 4.42"

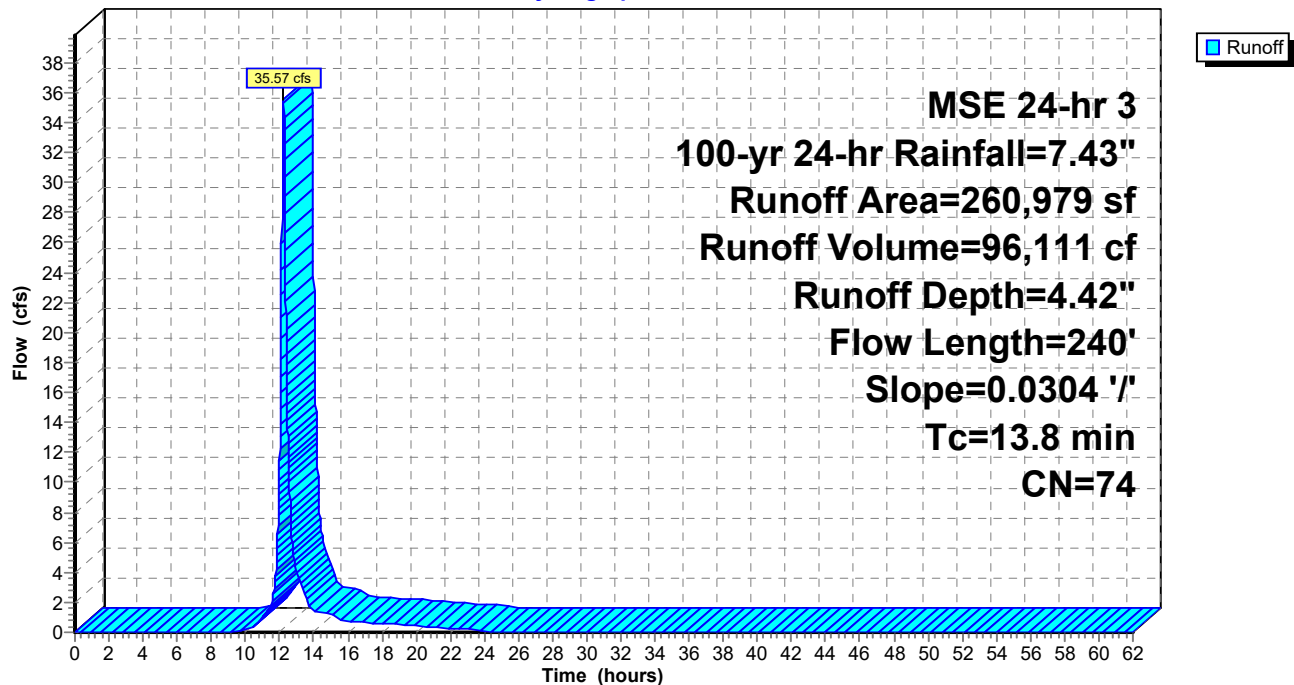
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 260,979	74	
260,979		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.9	100	0.0304	0.13		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.9	140	0.0304	2.62		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
13.8	240	Total			

Subcatchment D2: D2

Hydrograph



Summary for Subcatchment D3: D3

Runoff = 7.21 cfs @ 12.13 hrs, Volume= 14,441 cf, Depth= 5.43"

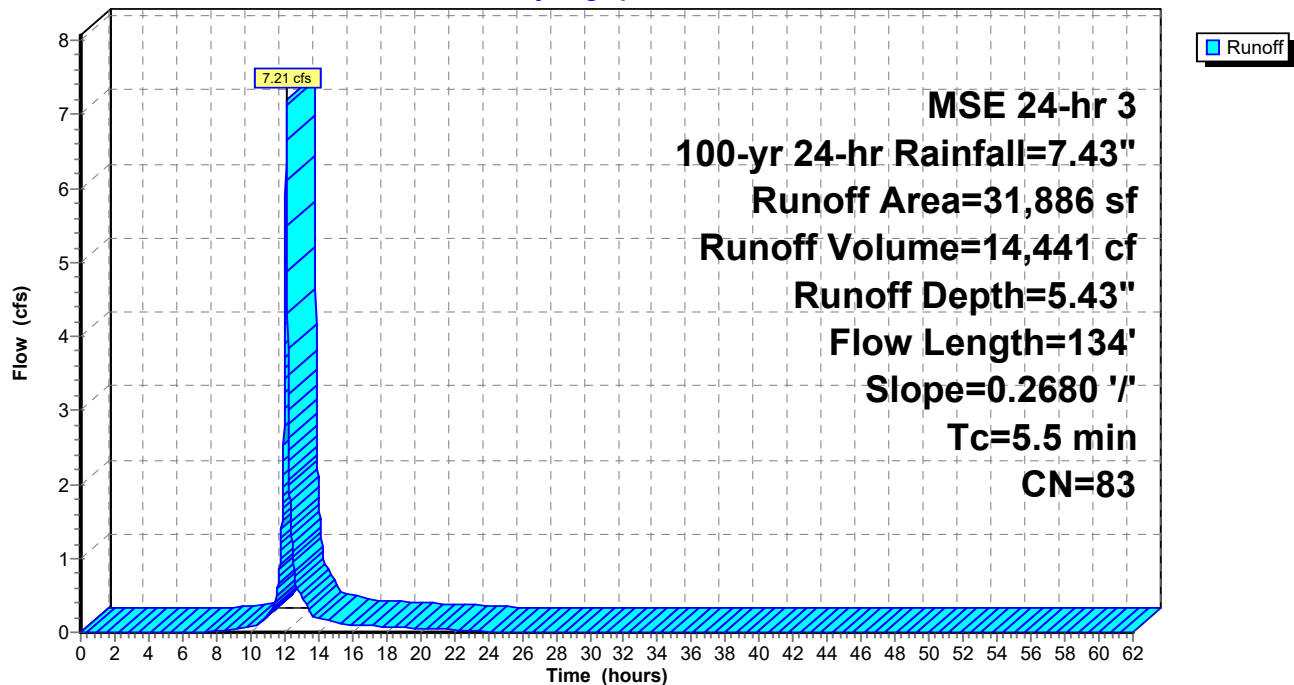
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	31,886	83	
	31,886		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2680	0.31		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	34	0.2680	7.77		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.5	134	Total			

Subcatchment D3: D3

Hydrograph



Summary for Subcatchment D4: D4

Runoff = 17.89 cfs @ 12.13 hrs, Volume= 34,407 cf, Depth= 4.42"

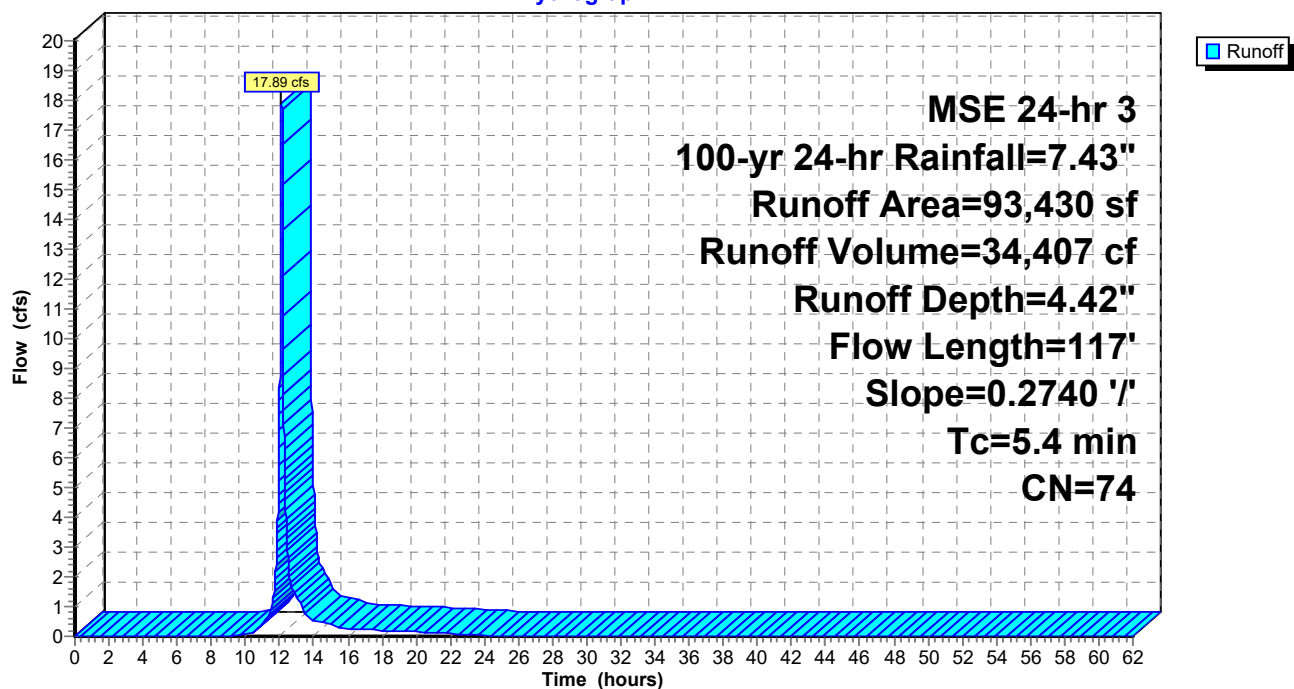
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	93,430	74	
	93,430		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2740	0.31		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.0	17	0.2740	7.85		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.4	117	Total			

Subcatchment D4: D4

Hydrograph



Summary for Subcatchment D5: D5

Runoff = 7.85 cfs @ 12.14 hrs, Volume= 16,238 cf, Depth= 4.42"

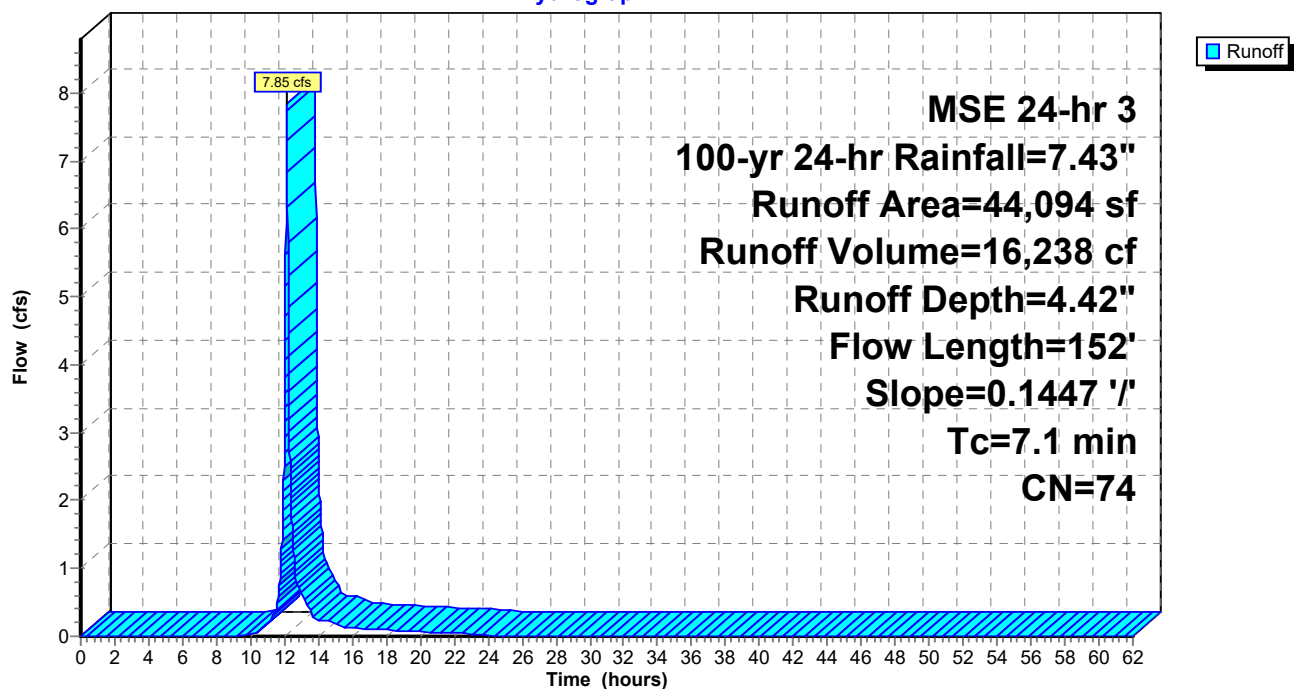
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	44,094	74	
	44,094		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	100	0.1447	0.24		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.2	52	0.1447	5.71		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
7.1	152	Total			

Subcatchment D5: D5

Hydrograph



Summary for Subcatchment D6: D6

Runoff = 17.65 cfs @ 12.13 hrs, Volume= 33,975 cf, Depth= 4.42"

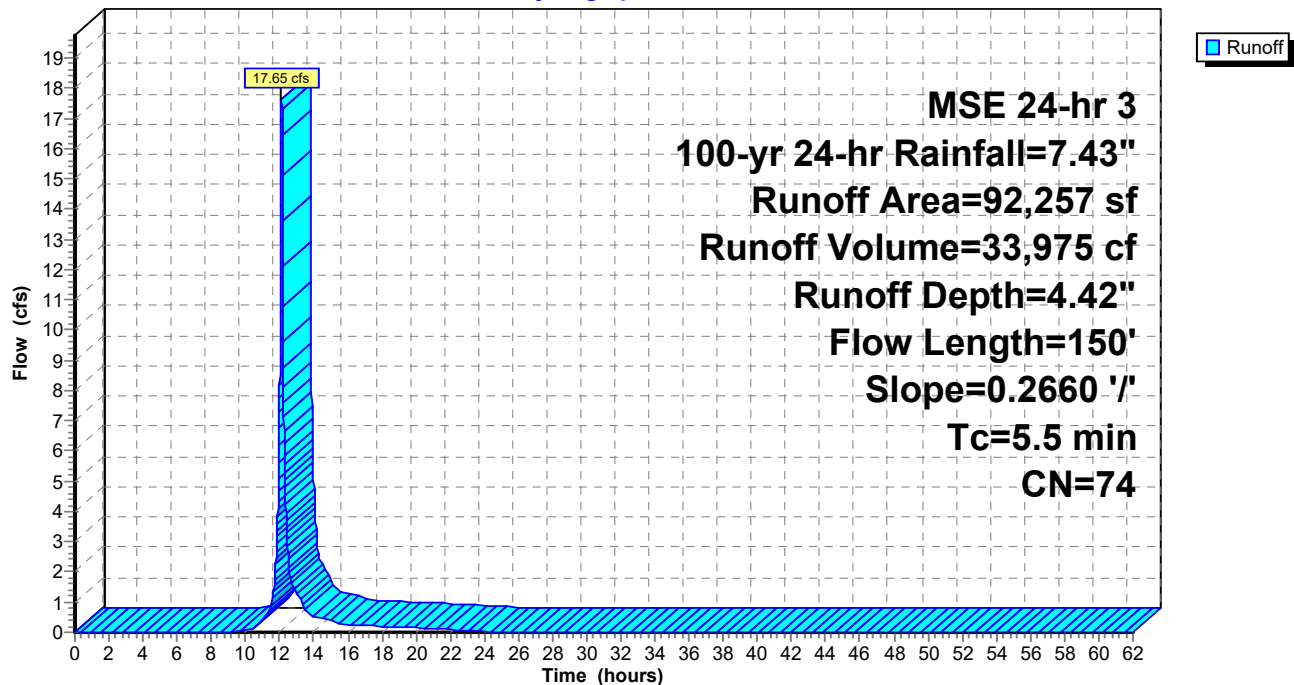
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	92,257	74	
	92,257		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2660	0.31		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	50	0.2660	7.74		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.5	150	Total			

Subcatchment D6: D6

Hydrograph



Summary for Subcatchment D7: D7

Runoff = 10.40 cfs @ 12.13 hrs, Volume= 20,186 cf, Depth= 4.42"

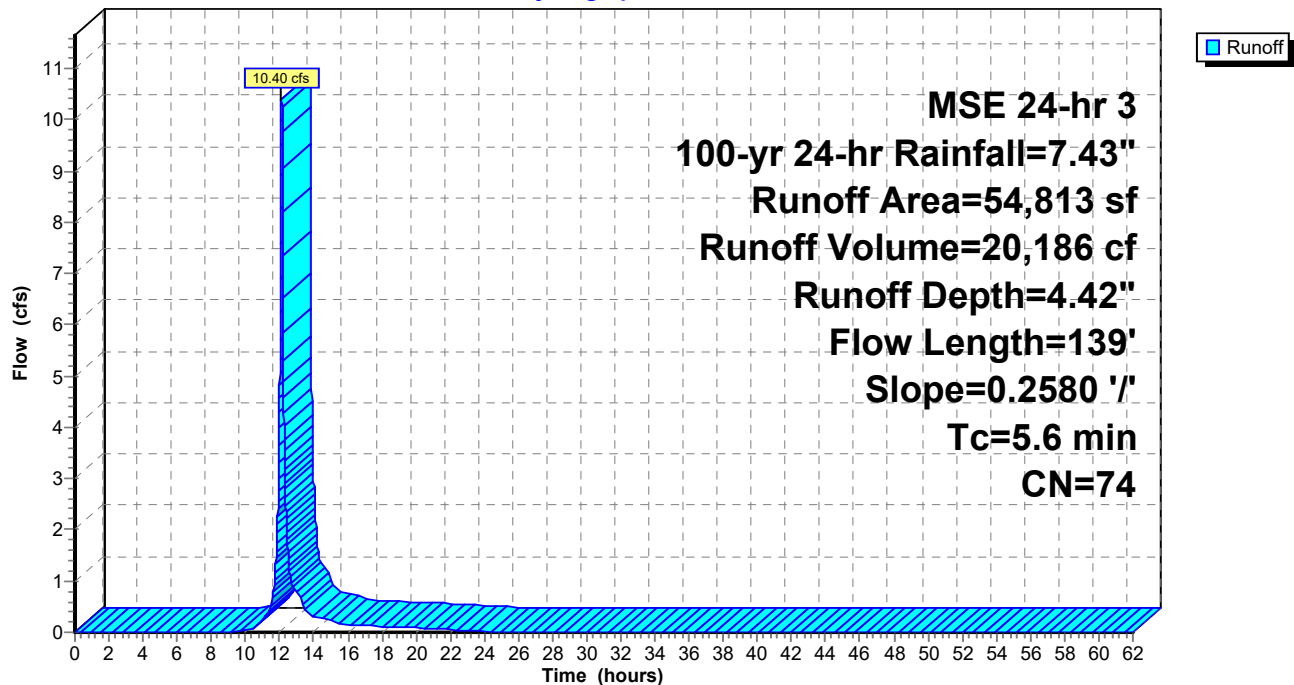
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 54,813	74	
54,813		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.2580	0.30		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.1	39	0.2580	7.62		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
5.6	139	Total			

Subcatchment D7: D7

Hydrograph



Summary for Subcatchment D8: D8

Runoff = 15.26 cfs @ 12.13 hrs, Volume= 29,616 cf, Depth= 4.42"

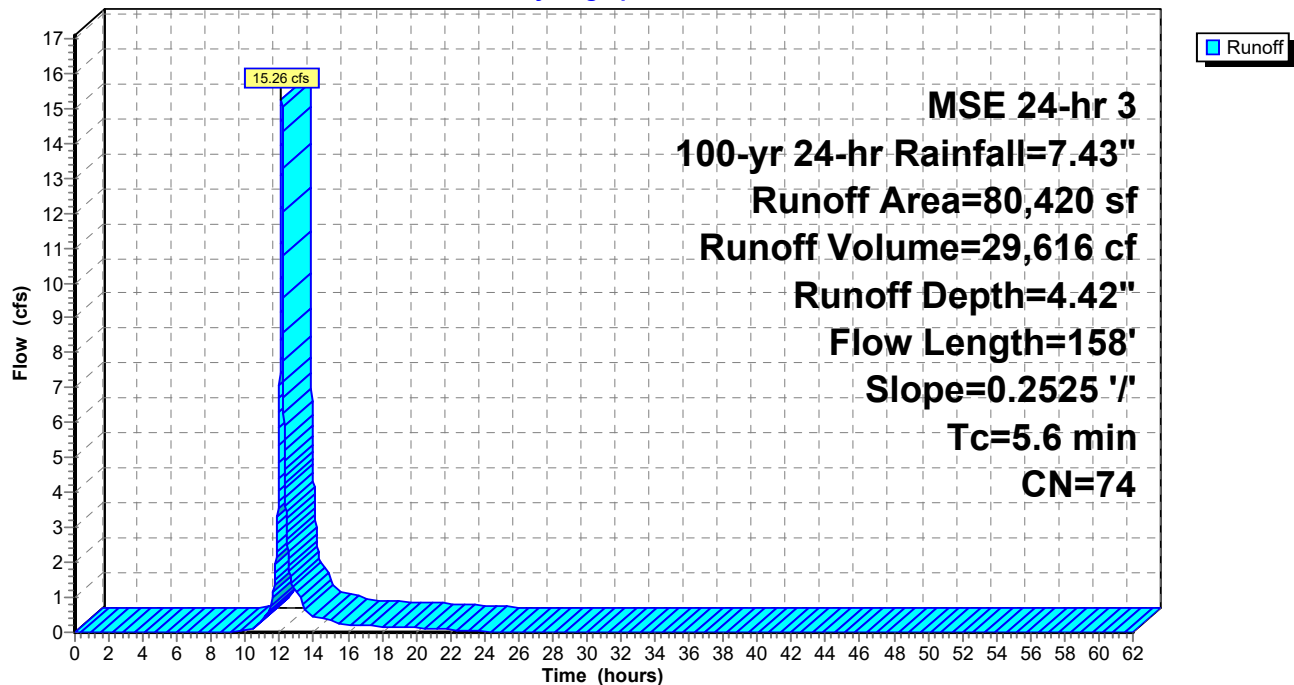
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	80,420	74	
	80,420		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.2525	0.30		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.1	58	0.2525	7.54		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
5.6	158	Total			

Subcatchment D8: D8

Hydrograph



Summary for Subcatchment D9: D9

Runoff = 12.38 cfs @ 12.13 hrs, Volume= 24,031 cf, Depth= 4.42"

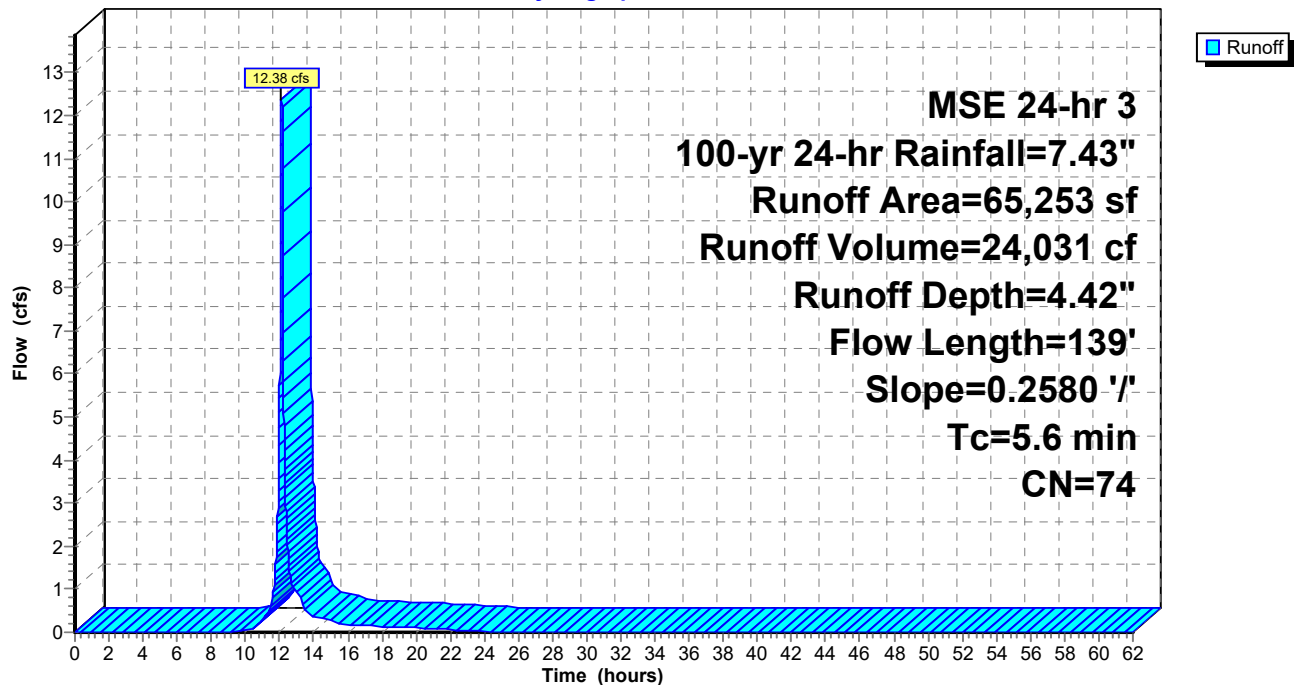
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 65,253	74	
65,253		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.2580	0.30		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	39	0.2580	7.62		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.6	139	Total			

Subcatchment D9: D9

Hydrograph



Summary for Subcatchment E1: E1

Runoff = 24.72 cfs @ 12.22 hrs, Volume= 66,978 cf, Depth= 4.42"

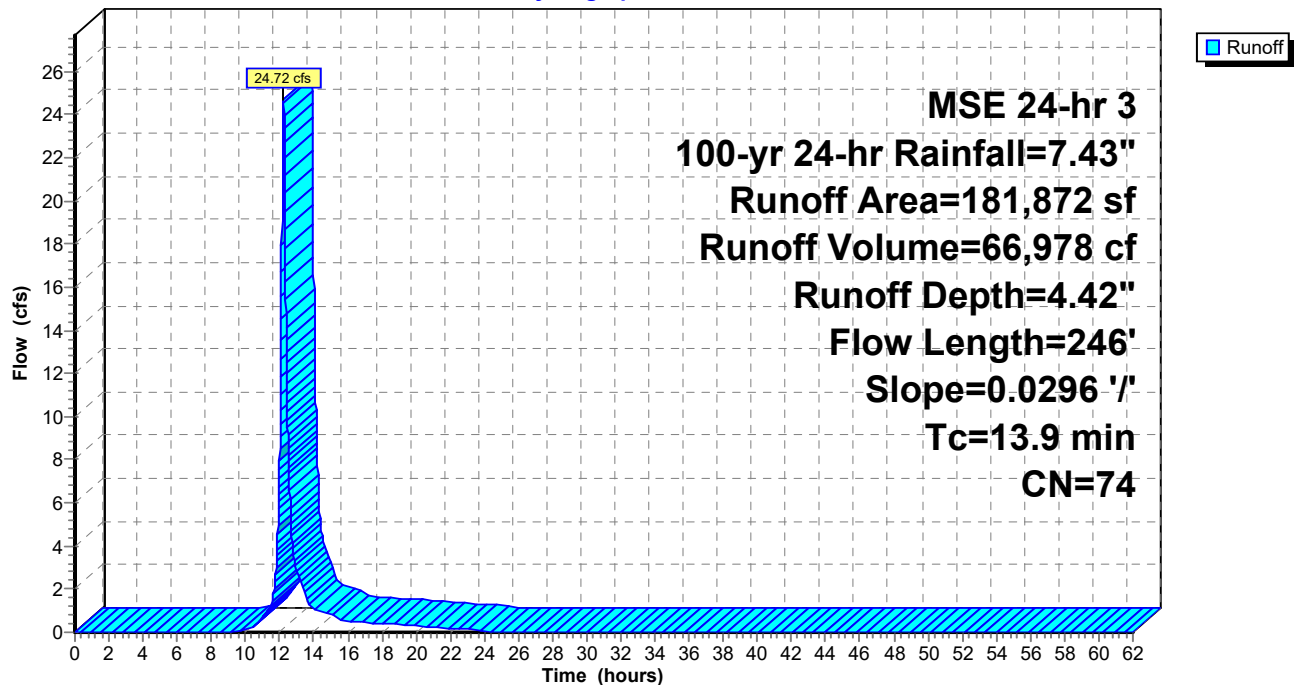
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 181,872	74	
181,872		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	100	0.0296	0.13		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.9	146	0.0296	2.58		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
13.9	246	Total			

Subcatchment E1: E1

Hydrograph



Summary for Subcatchment E10: E10

Runoff = 36.56 cfs @ 12.15 hrs, Volume= 77,895 cf, Depth= 4.42"

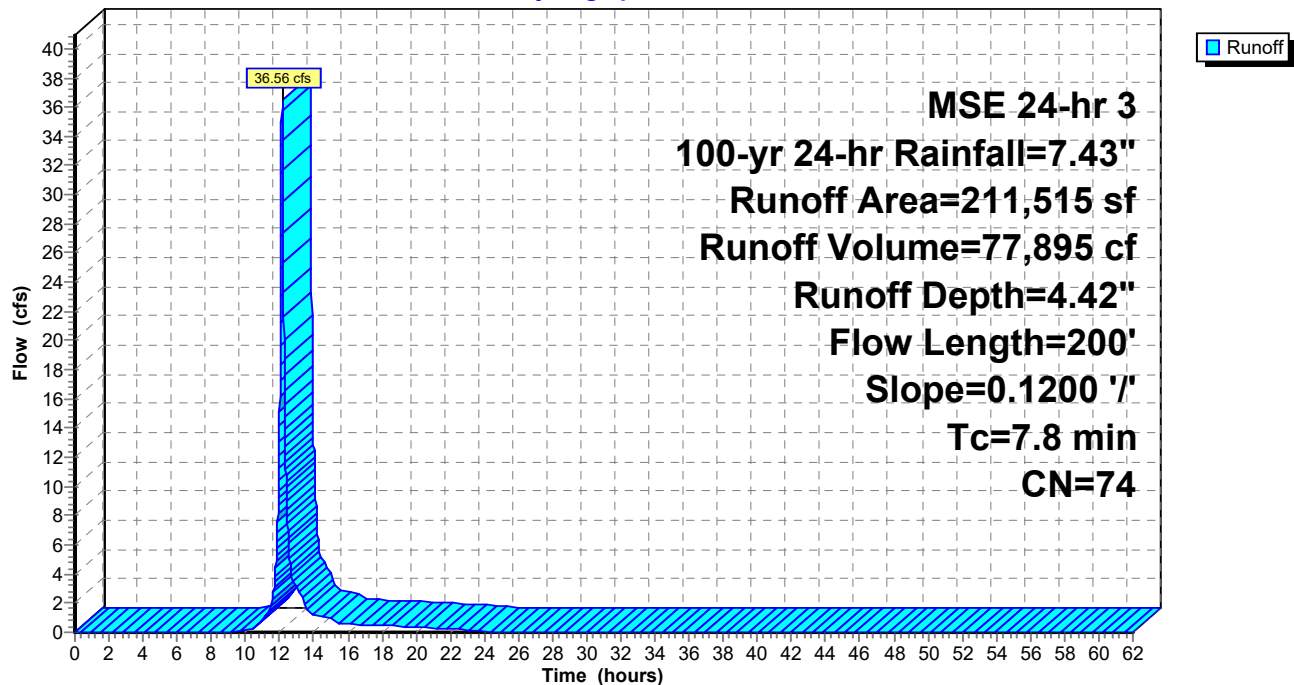
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	211,515	74	
	211,515		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	100	0.1200	0.22		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.3	100	0.1200	5.20		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
7.8	200	Total			

Subcatchment E10: E10

Hydrograph



Summary for Subcatchment E11: E11

Runoff = 14.81 cfs @ 12.14 hrs, Volume= 29,884 cf, Depth= 4.42"

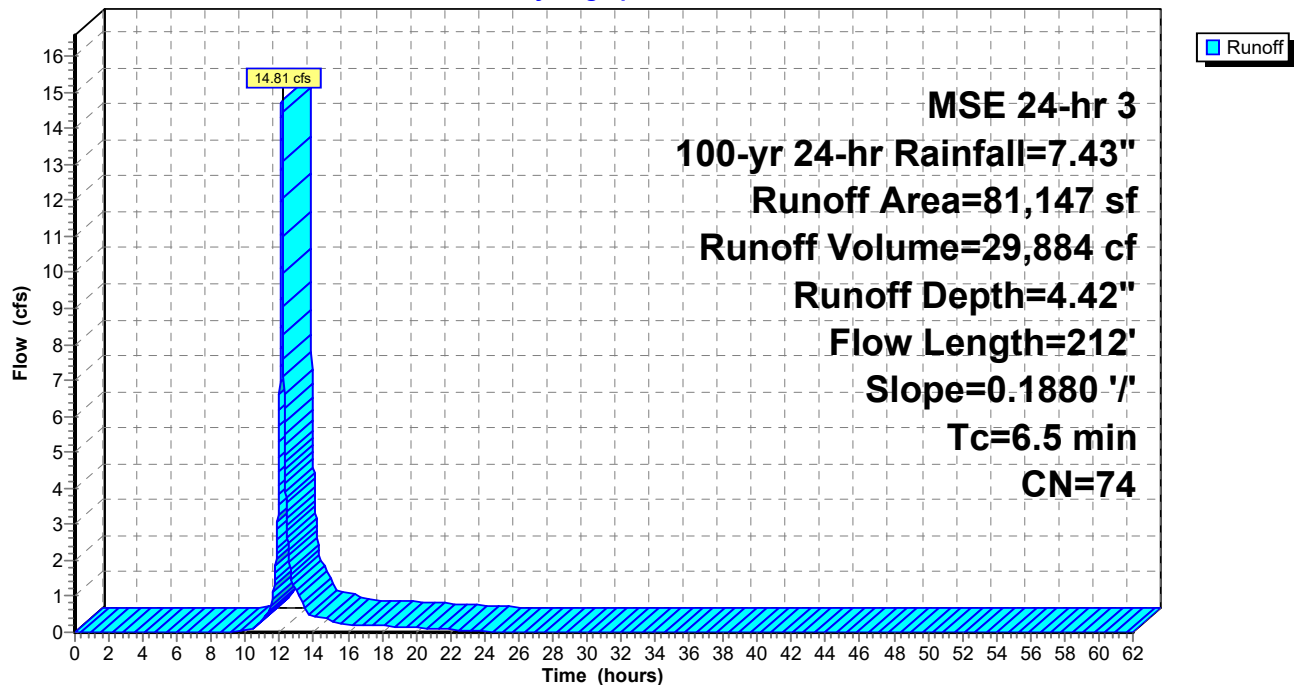
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	81,147	74	
	81,147		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	100	0.1880	0.27		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.3	112	0.1880	6.50		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
6.5	212	Total			

Subcatchment E11: E11

Hydrograph



Summary for Subcatchment E12: E12

Runoff = 41.99 cfs @ 12.15 hrs, Volume= 90,409 cf, Depth= 4.42"

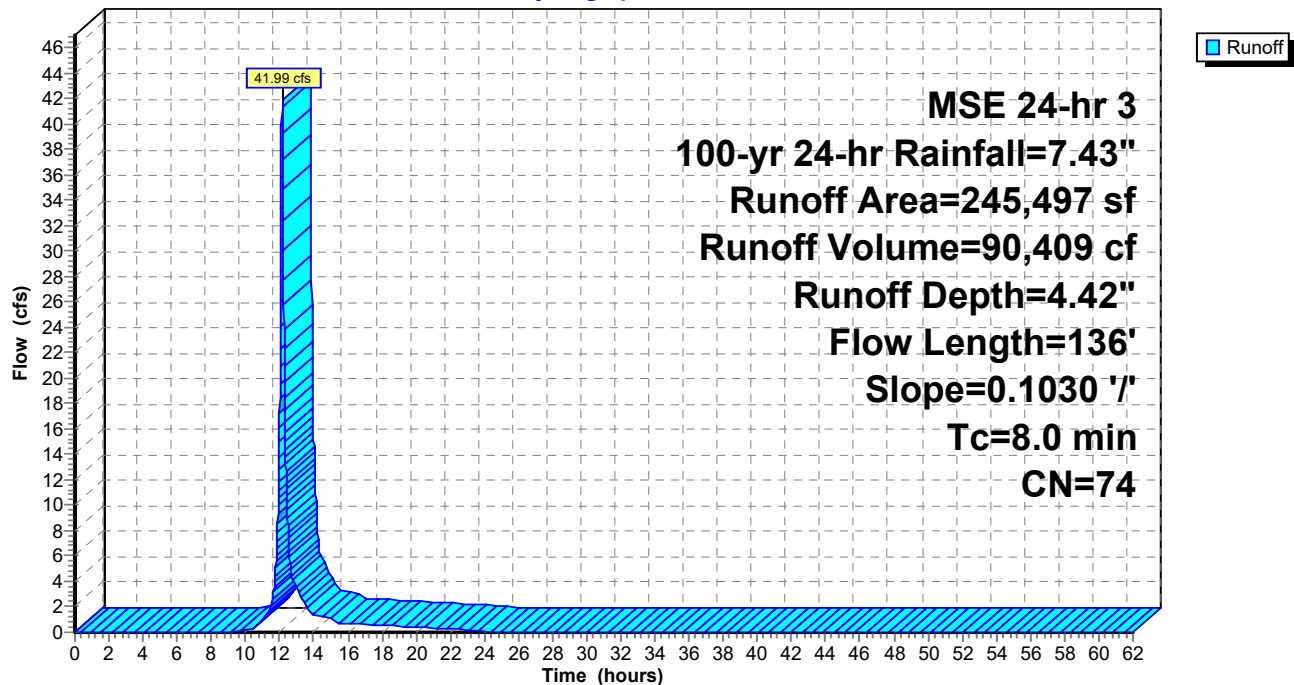
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	245,497	74	
	245,497		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	100	0.1030	0.21		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	36	0.1030	4.81		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
8.0	136	Total			

Subcatchment E12: E12

Hydrograph



Summary for Subcatchment E14: E14

Runoff = 2.00 cfs @ 12.10 hrs, Volume= 3,391 cf, Depth= 4.42"

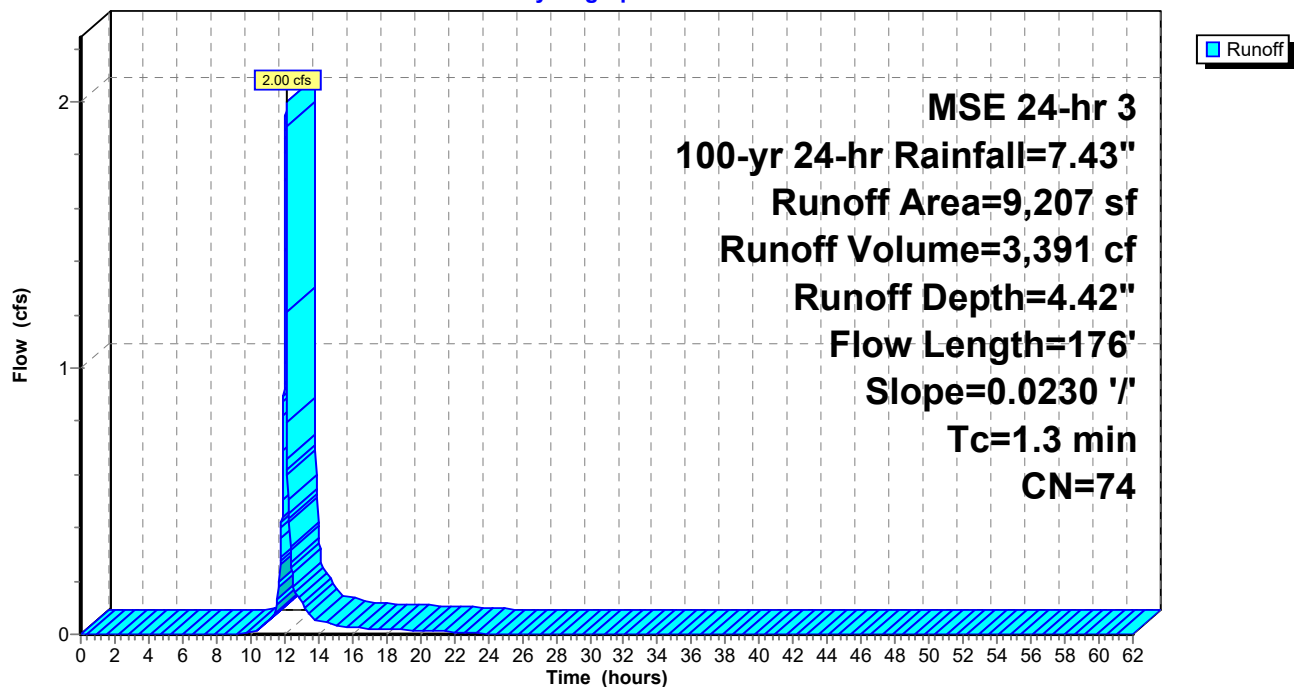
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	9,207	74	
	9,207		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	100	0.0230	2.27		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
0.6	76	0.0230	2.27		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.3	176	Total			

Subcatchment E14: E14

Hydrograph



Summary for Subcatchment E2: E2

Runoff = 13.95 cfs @ 12.23 hrs, Volume= 38,542 cf, Depth= 4.42"

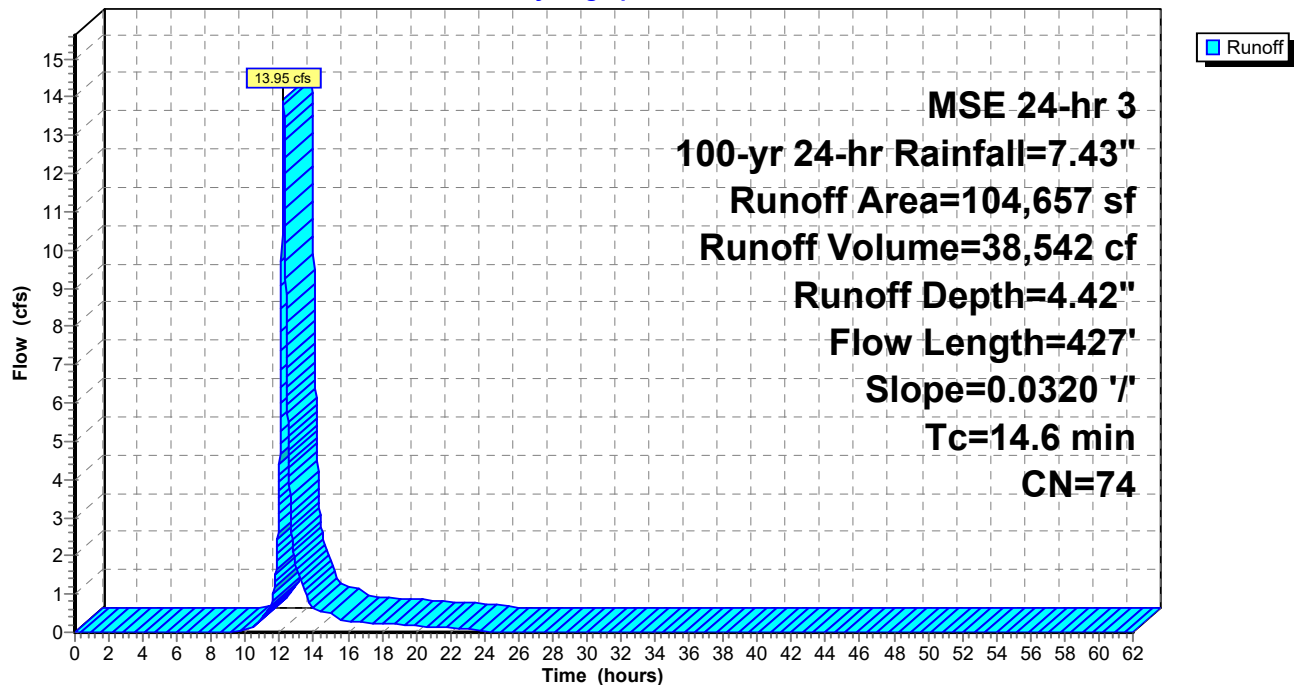
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	104,657	74	
	104,657		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.6	100	0.0320	0.13		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
2.0	327	0.0320	2.68		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
14.6	427	Total			

Subcatchment E2: E2

Hydrograph



Summary for Subcatchment E3: E3

Runoff = 14.02 cfs @ 12.13 hrs, Volume= 26,993 cf, Depth= 4.42"

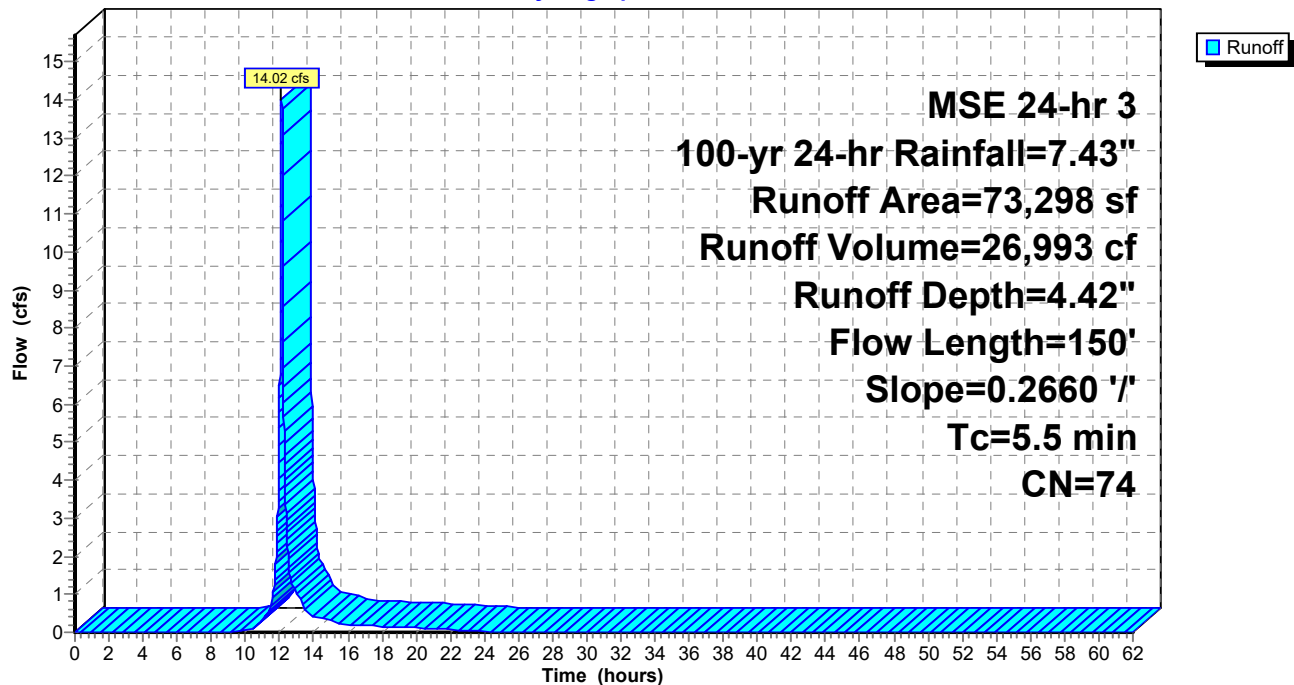
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	73,298	74	
	73,298		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2660	0.31		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	50	0.2660	7.74		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.5	150	Total			

Subcatchment E3: E3

Hydrograph



Summary for Subcatchment E4: E4

Runoff = 12.91 cfs @ 12.13 hrs, Volume= 24,834 cf, Depth= 4.42"

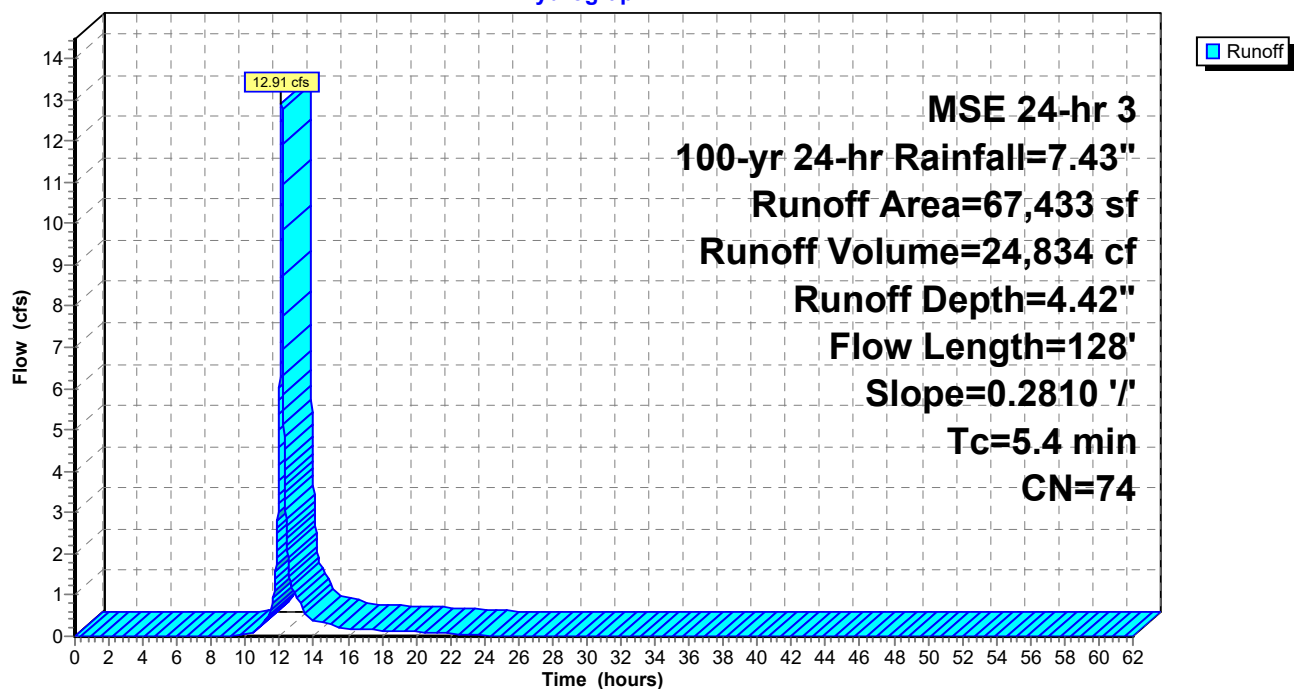
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 67,433	74	
67,433		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	100	0.2810	0.31		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	28	0.2810	7.95		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.4	128	Total			

Subcatchment E4: E4

Hydrograph



Summary for Subcatchment E5: E5

Runoff = 16.40 cfs @ 12.13 hrs, Volume= 33,205 cf, Depth= 5.43"

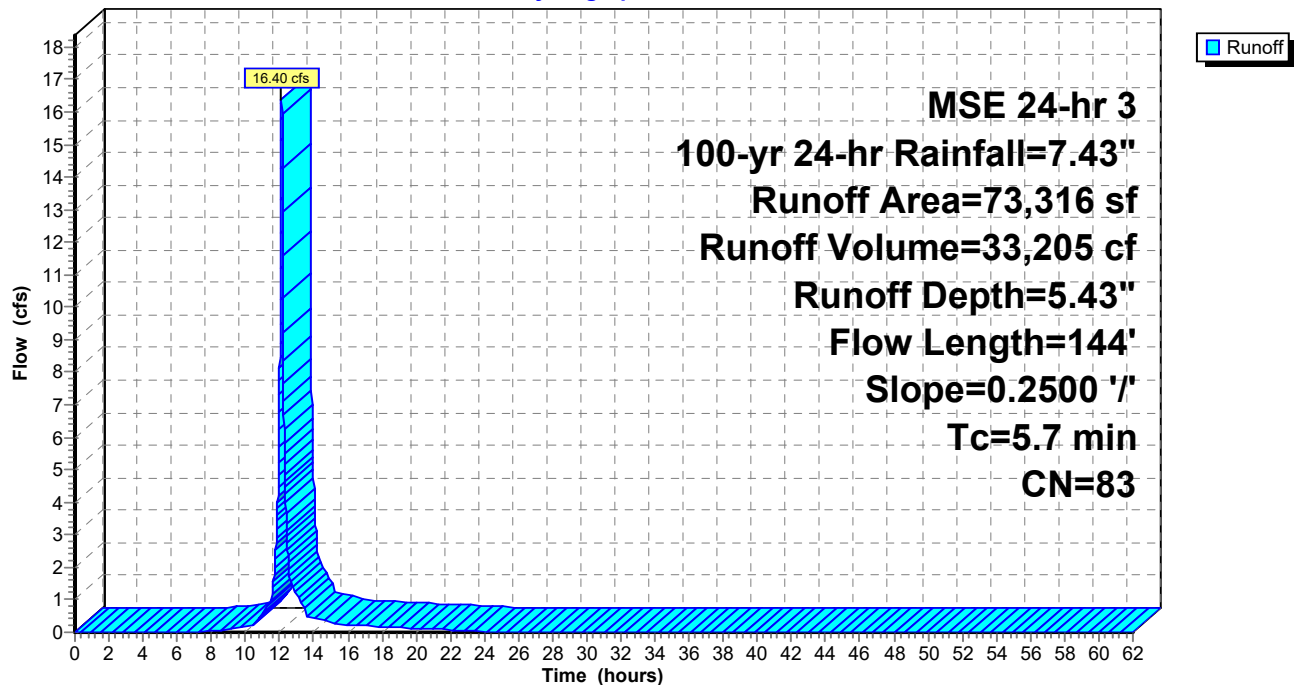
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 73,316	83	
73,316		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.2500	0.30		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.1	44	0.2500	7.50		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
5.7	144	Total			

Subcatchment E5: E5

Hydrograph



Summary for Subcatchment E6: E6

Runoff = 14.82 cfs @ 12.13 hrs, Volume= 28,386 cf, Depth= 4.42"

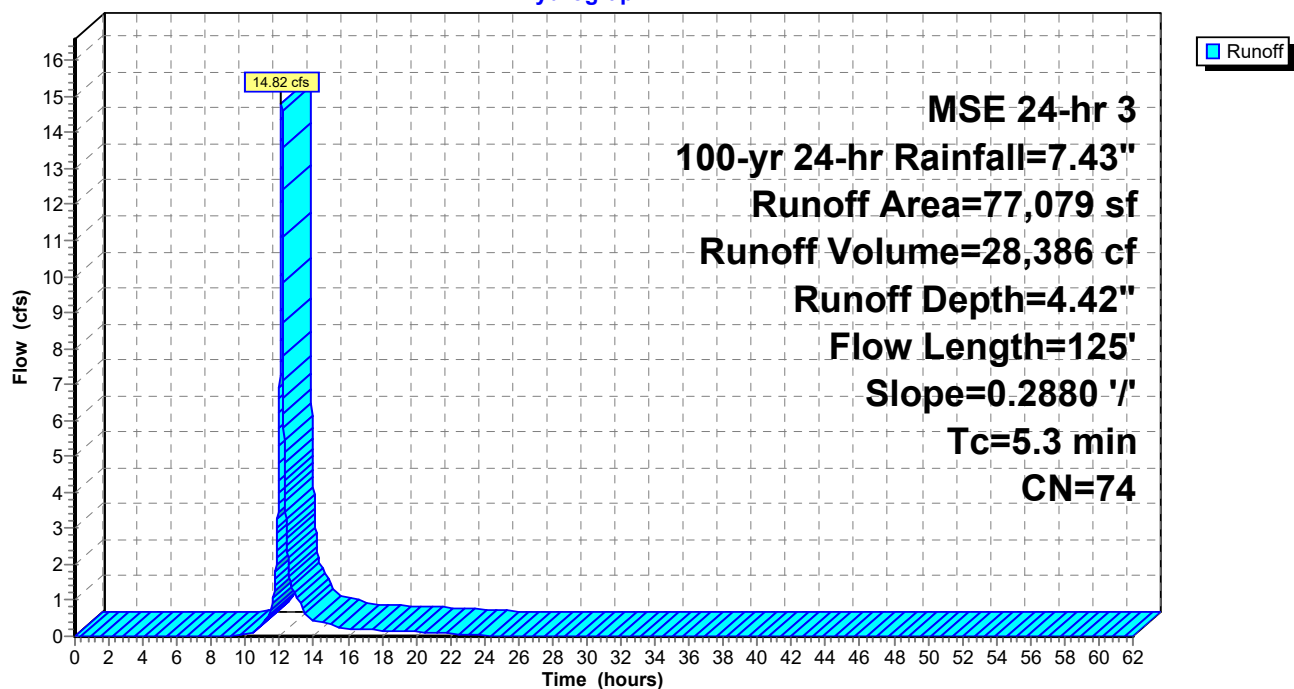
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 77,079	74	
77,079		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2880	0.32		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	25	0.2880	8.05		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.3	125	Total			

Subcatchment E6: E6

Hydrograph



Summary for Subcatchment E7: E7

Runoff = 21.55 cfs @ 12.13 hrs, Volume= 41,985 cf, Depth= 4.42"

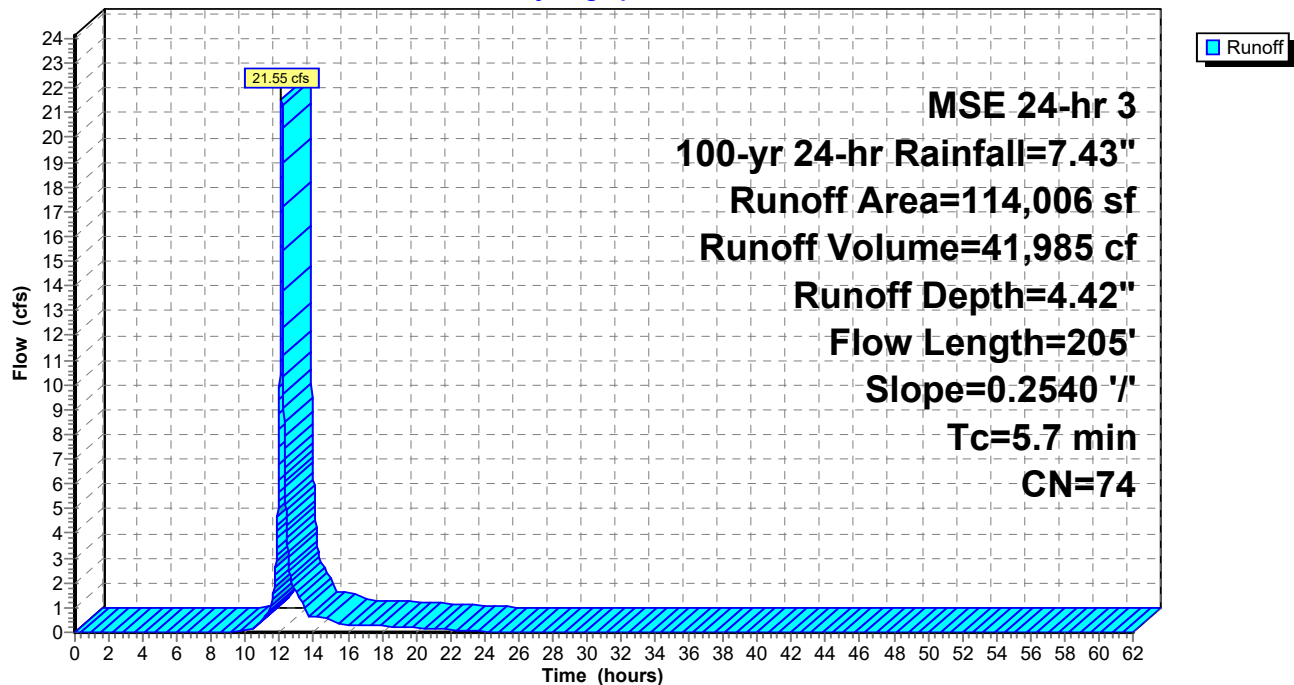
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

	Area (sf)	CN	Description
*	114,006	74	
	114,006		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.2540	0.30		Sheet Flow,
					Grass: Dense n= 0.240 P2= 2.80"
0.2	105	0.2540	7.56		Shallow Concentrated Flow,
					Grassed Waterway Kv= 15.0 fps
5.7	205	Total			

Subcatchment E7: E7

Hydrograph



Summary for Subcatchment E8: E8

Runoff = 26.38 cfs @ 12.17 hrs, Volume= 61,327 cf, Depth= 4.42"

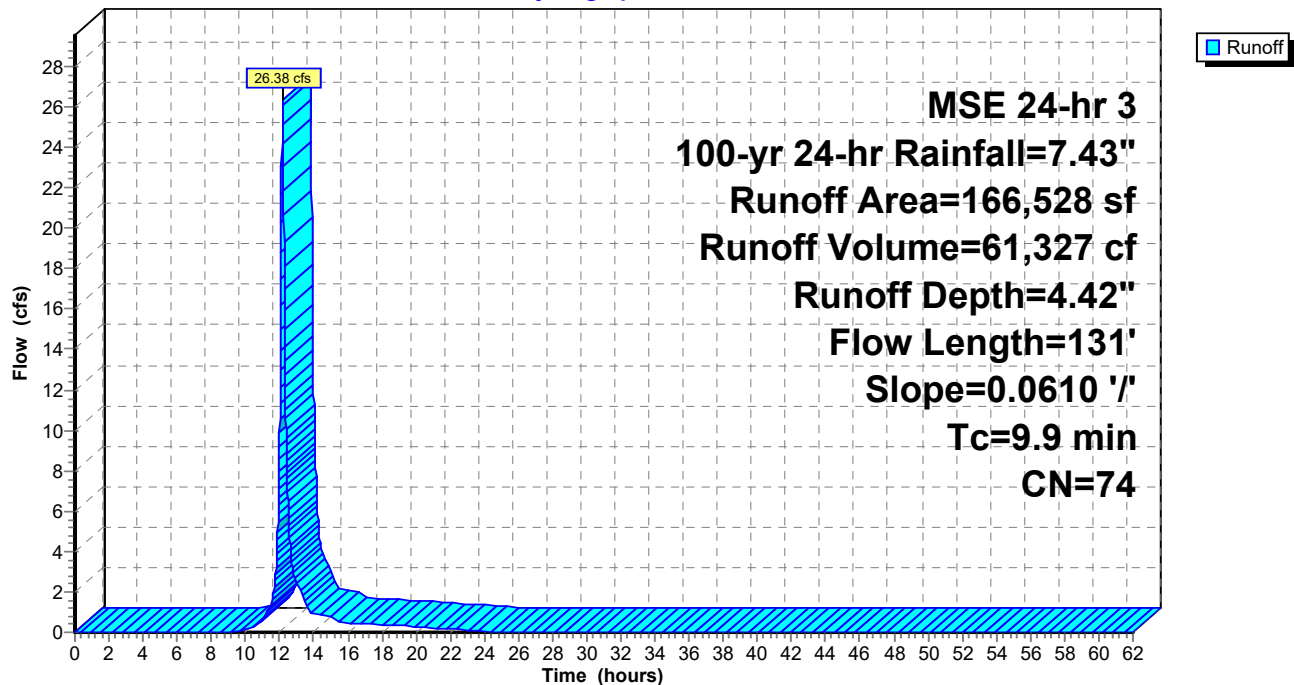
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 166,528	74	
166,528		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	100	0.0610	0.17		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.1	31	0.0610	3.70		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
9.9	131	Total			

Subcatchment E8: E8

Hydrograph



Summary for Subcatchment E9: E9

Runoff = 12.76 cfs @ 12.13 hrs, Volume= 24,863 cf, Depth= 4.42"

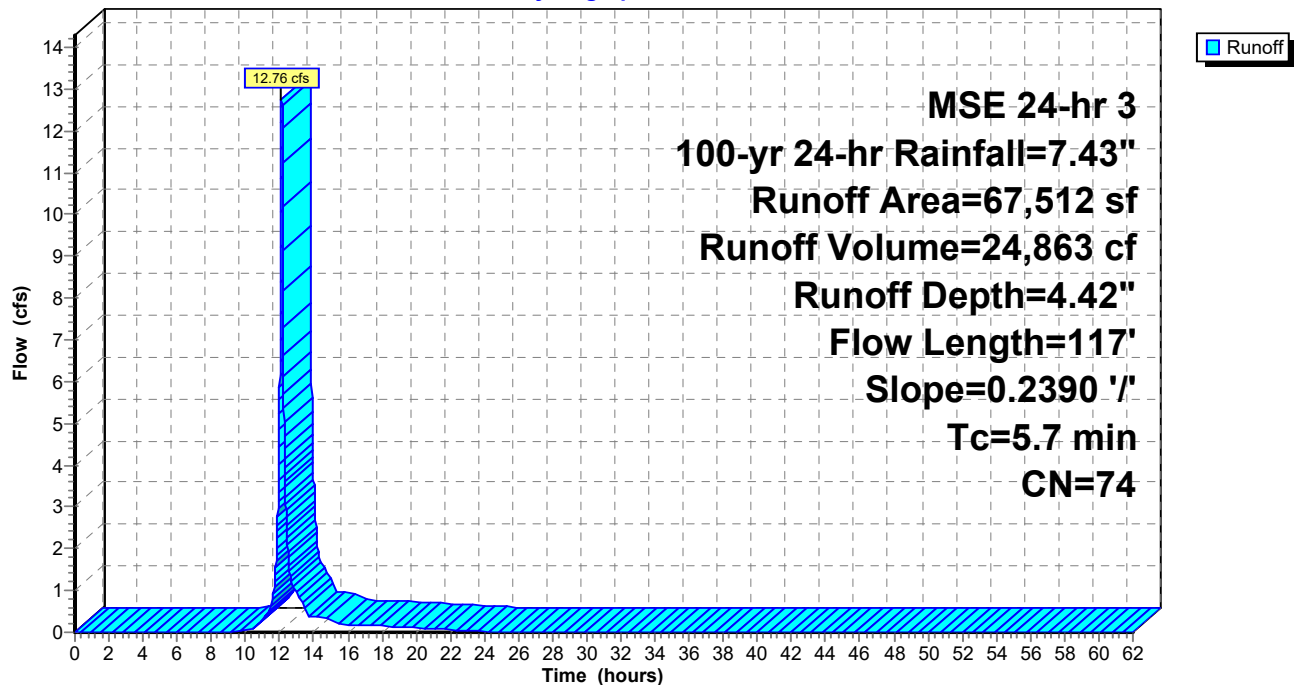
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr 24-hr Rainfall=7.43"

Area (sf)	CN	Description
* 67,512	74	
67,512		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	100	0.2390	0.29		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
0.0	17	0.2390	7.33		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.7	117	Total			

Subcatchment E9: E9

Hydrograph



Summary for Reach A10T: A10 Terrace

[62] Hint: Exceeded Reach AA4T OUTLET depth by 0.40' @ 12.26 hrs

Inflow Area = 317,575 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 46.40 cfs @ 12.13 hrs, Volume= 116,953 cf
 Outflow = 43.24 cfs @ 12.21 hrs, Volume= 116,953 cf, Atten= 7%, Lag= 5.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 5.03 fps, Min. Travel Time= 2.6 min

Avg. Velocity= 1.51 fps, Avg. Travel Time= 8.6 min

Peak Storage= 6,684 cf @ 12.17 hrs

Average Depth at Peak Storage= 1.25'

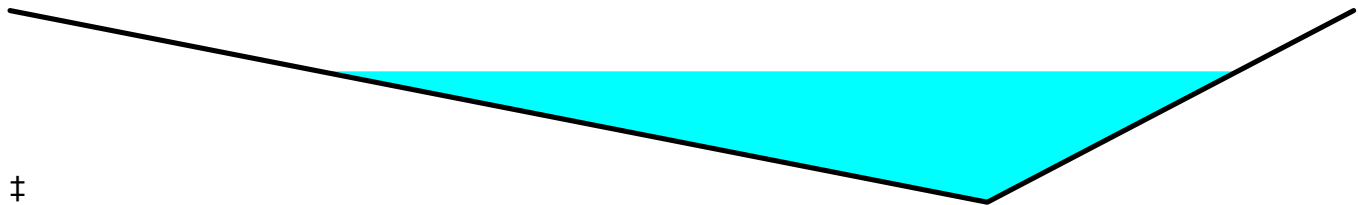
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 119.50 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'

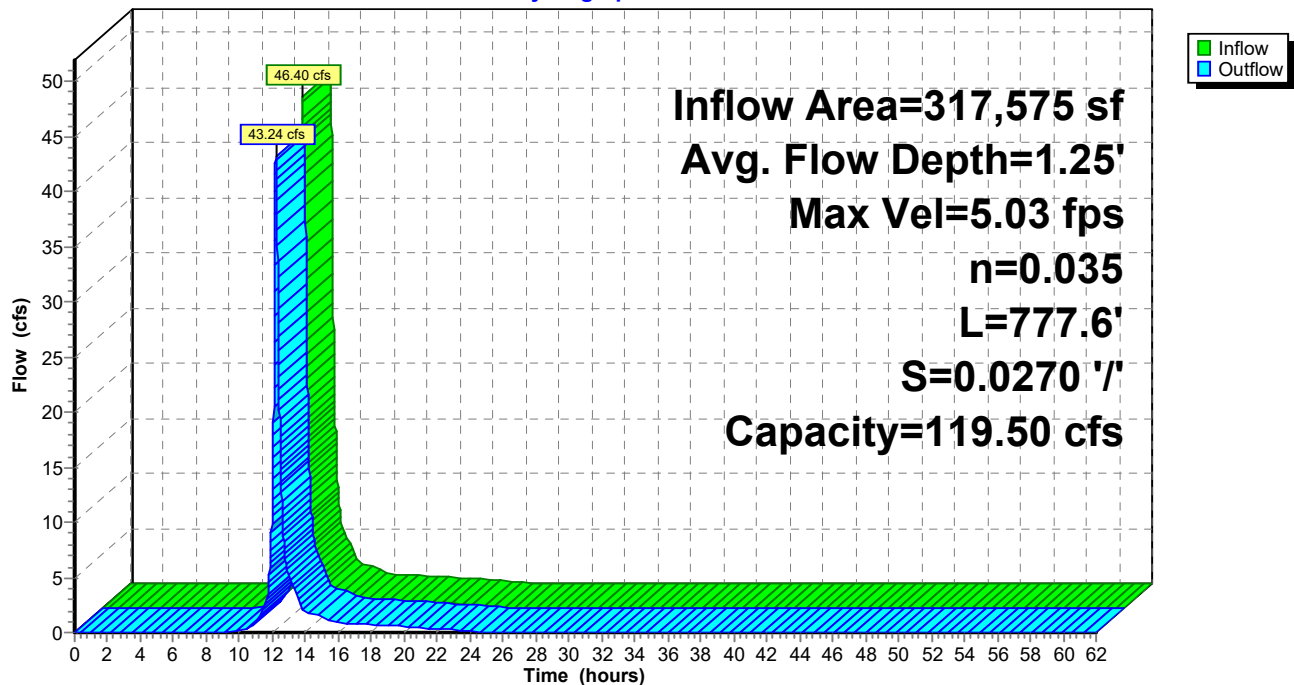
Length= 777.6' Slope= 0.0270 ' /'

Inlet Invert= 886.00', Outlet Invert= 865.00'



Reach A10T: A10 Terrace

Hydrograph



Summary for Reach A11T: A11 Terrace

Inflow Area = 245,226 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 43.06 cfs @ 12.15 hrs, Volume= 90,309 cf
 Outflow = 32.76 cfs @ 12.32 hrs, Volume= 90,309 cf, Atten= 24%, Lag= 10.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 3.65 fps, Min. Travel Time= 7.0 min

Avg. Velocity= 0.96 fps, Avg. Travel Time= 26.6 min

Peak Storage= 13,710 cf @ 12.20 hrs

Average Depth at Peak Storage= 1.28'

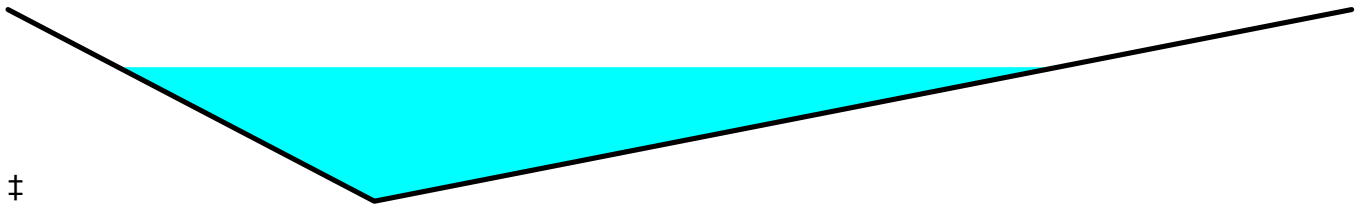
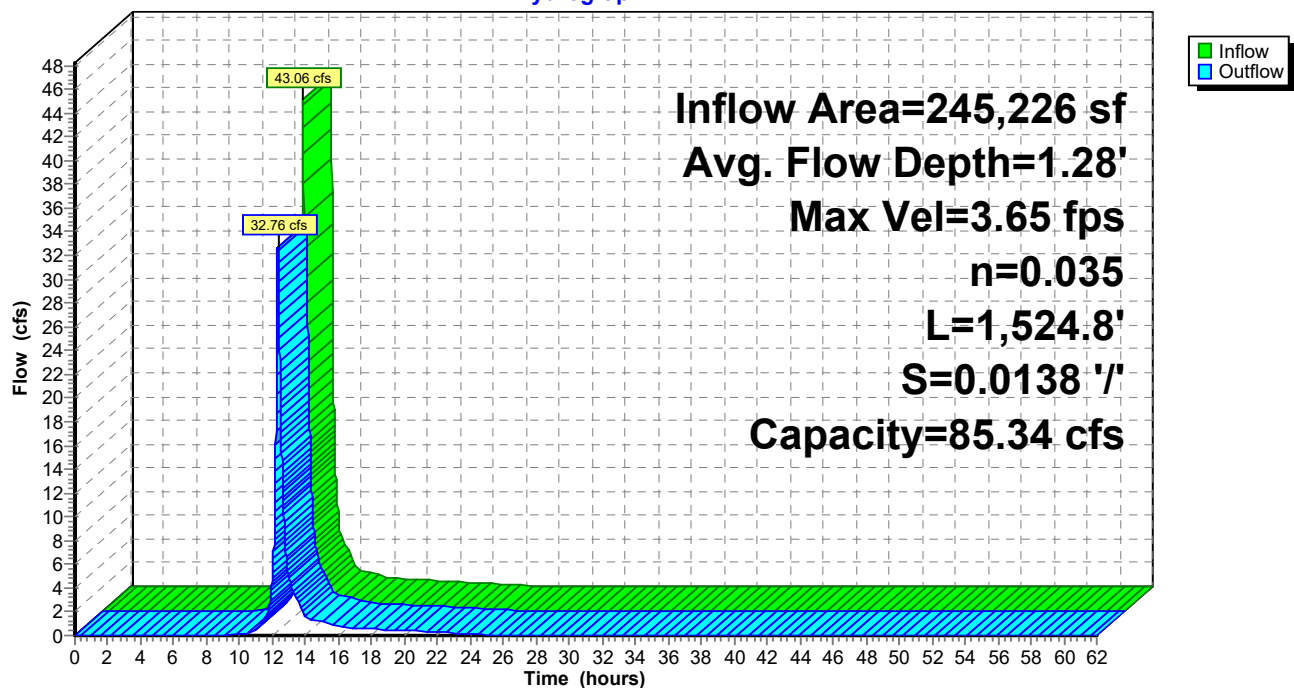
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 85.34 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 3.0 8.0 ' Top Width= 20.13'

Length= 1,524.8' Slope= 0.0138 '/'

Inlet Invert= 886.00', Outlet Invert= 865.00'

**Reach A11T: A11 Terrace****Hydrograph**

Summary for Reach A1T: A1 Terracce

Inflow Area = 86,877 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 11.31 cfs @ 12.24 hrs, Volume= 31,994 cf
 Outflow = 11.17 cfs @ 12.28 hrs, Volume= 31,994 cf, Atten= 1%, Lag= 2.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 3.23 fps, Min. Travel Time= 1.5 min

Avg. Velocity = 1.16 fps, Avg. Travel Time= 4.2 min

Peak Storage= 1,017 cf @ 12.25 hrs

Average Depth at Peak Storage= 0.79'

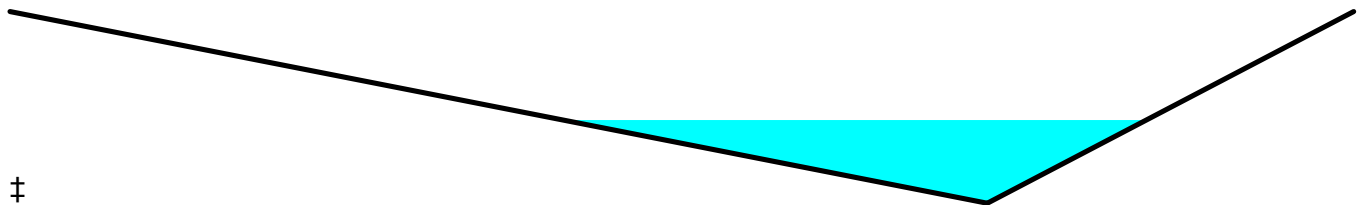
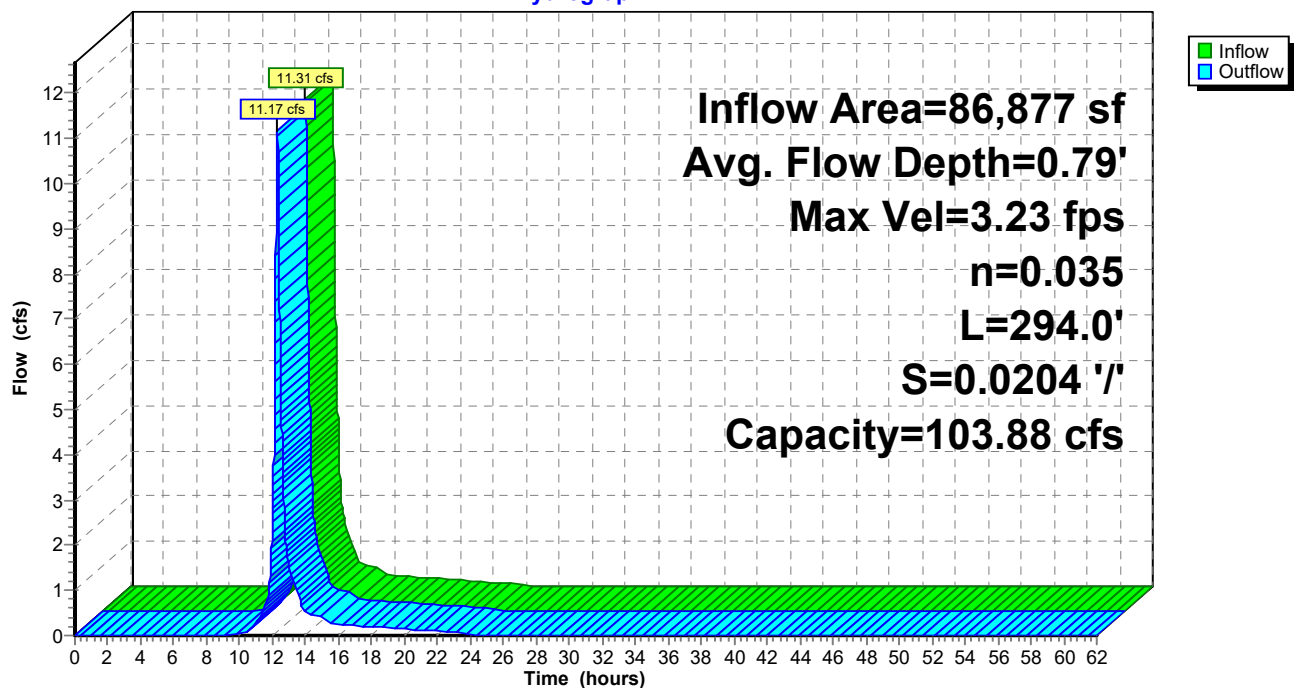
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 103.88 cfs

0.00' x 1.83' deep channel, n= 0.035 Earth, dense weeds

Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'

Length= 294.0' Slope= 0.0204 '/'

Inlet Invert= 1,092.00', Outlet Invert= 1,086.00'

**Reach A1T: A1 Terracce****Hydrograph**

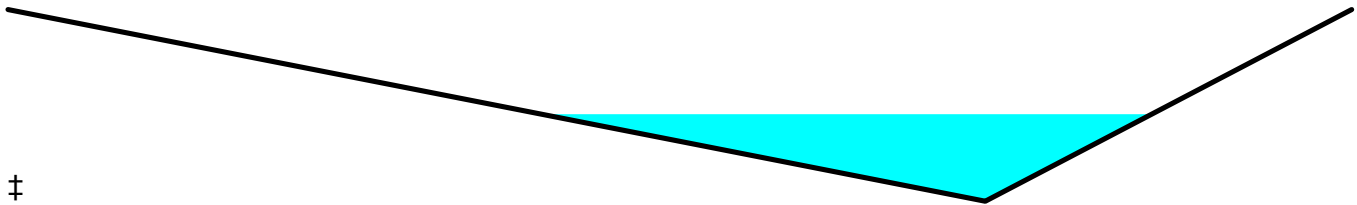
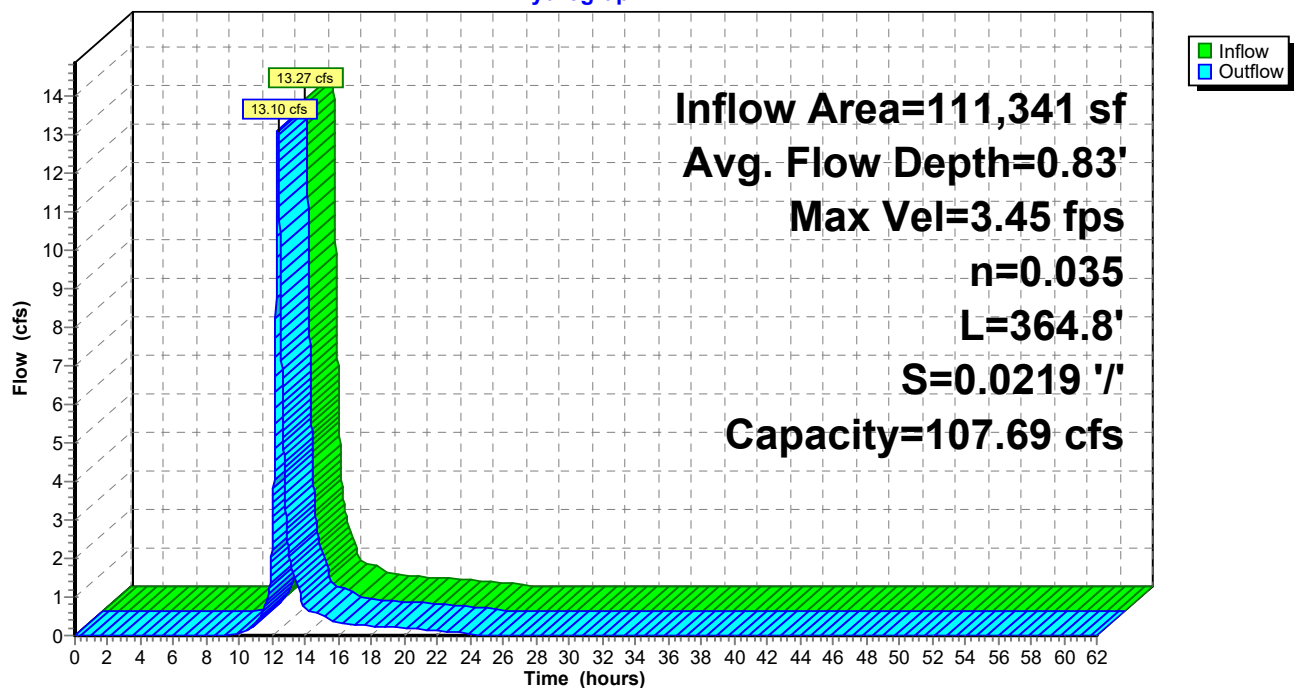
Summary for Reach A2T: A2 Terrace

Inflow Area = 111,341 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 13.27 cfs @ 12.27 hrs, Volume= 41,003 cf
 Outflow = 13.10 cfs @ 12.32 hrs, Volume= 41,003 cf, Atten= 1%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 3.45 fps, Min. Travel Time= 1.8 min
 Avg. Velocity = 1.24 fps, Avg. Travel Time= 4.9 min

Peak Storage= 1,384 cf @ 12.29 hrs
 Average Depth at Peak Storage= 0.83'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 107.69 cfs

0.00' x 1.83' deep channel, n= 0.035 Earth, dense weeds
 Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
 Length= 364.8' Slope= 0.0219 '/'
 Inlet Invert= 1,094.00', Outlet Invert= 1,086.00'

**Reach A2T: A2 Terrace****Hydrograph**

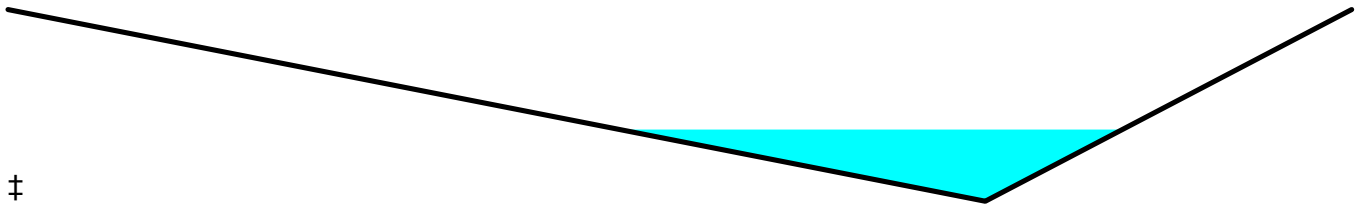
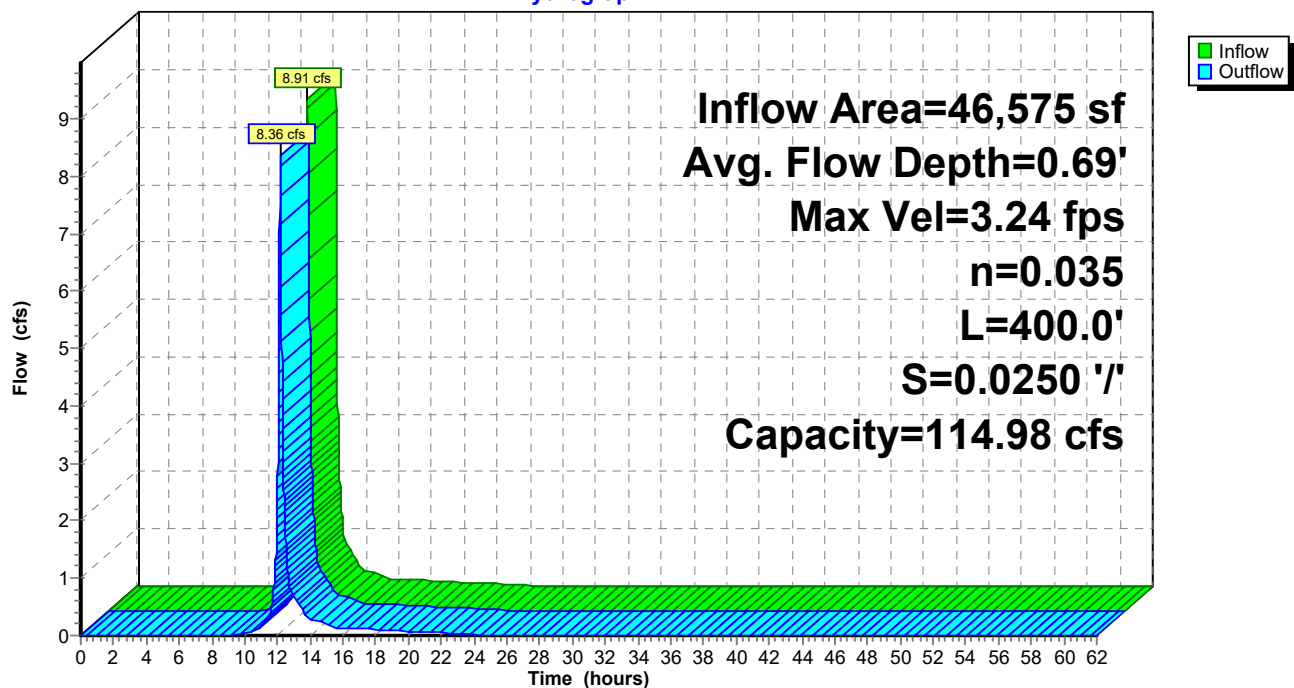
Summary for Reach A3T: A3 Terrace

Inflow Area = 46,575 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 8.91 cfs @ 12.13 hrs, Volume= 17,152 cf
 Outflow = 8.36 cfs @ 12.18 hrs, Volume= 17,152 cf, Atten= 6%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 3.24 fps, Min. Travel Time= 2.1 min
 Avg. Velocity = 1.06 fps, Avg. Travel Time= 6.3 min

Peak Storage= 1,034 cf @ 12.15 hrs
 Average Depth at Peak Storage= 0.69'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 114.98 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
 Length= 400.0' Slope= 0.0250 '/'
 Inlet Invert= 1,056.00', Outlet Invert= 1,046.00'

**Reach A3T: A3 Terrace****Hydrograph**

Summary for Reach A4T: A4 Terrace

Inflow Area = 139,986 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 21.25 cfs @ 12.19 hrs, Volume= 51,553 cf
 Outflow = 19.38 cfs @ 12.29 hrs, Volume= 51,553 cf, Atten= 9%, Lag= 6.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.09 fps, Min. Travel Time= 3.7 min

Avg. Velocity = 1.30 fps, Avg. Travel Time= 11.7 min

Peak Storage= 4,294 cf @ 12.23 hrs

Average Depth at Peak Storage= 0.93'

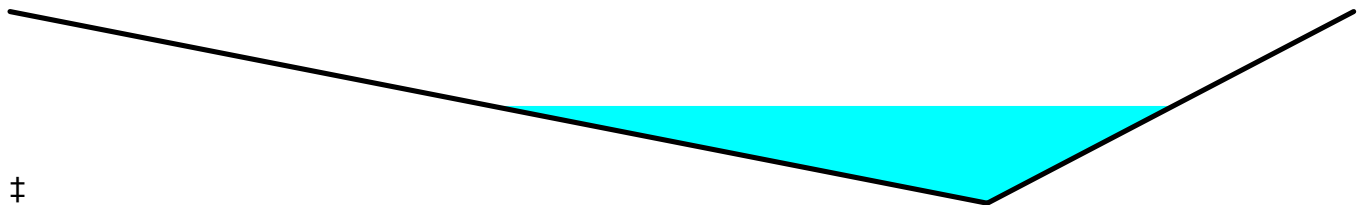
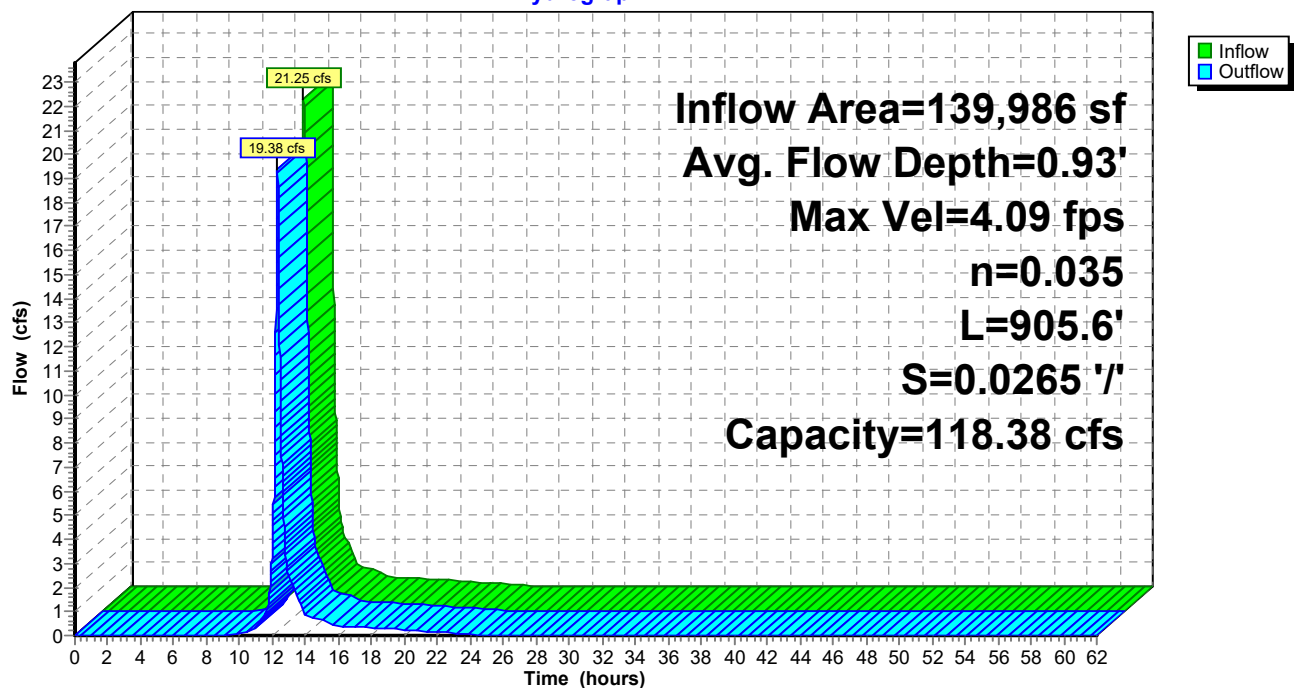
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 118.38 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'

Length= 905.6' Slope= 0.0265 '/'

Inlet Invert= 1,070.00', Outlet Invert= 1,046.00'

**Reach A4T: A4 Terrace****Hydrograph**

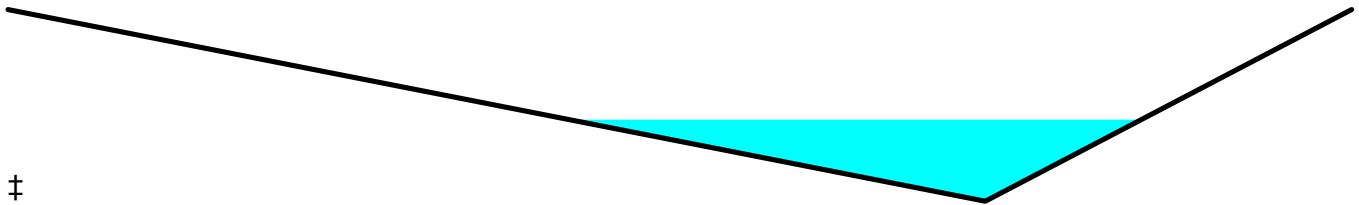
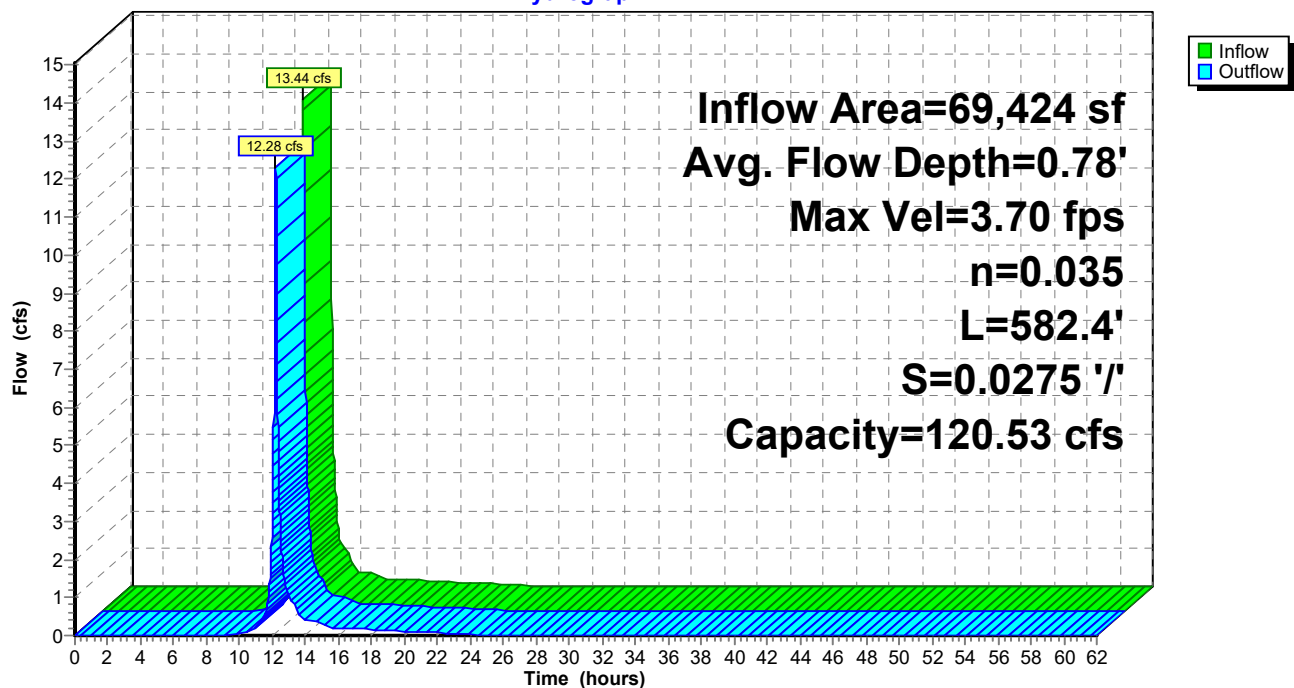
Summary for Reach A5T: A5 Terrace

Inflow Area = 69,424 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 13.44 cfs @ 12.12 hrs, Volume= 25,567 cf
 Outflow = 12.28 cfs @ 12.19 hrs, Volume= 25,567 cf, Atten= 9%, Lag= 4.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 3.70 fps, Min. Travel Time= 2.6 min
 Avg. Velocity = 1.18 fps, Avg. Travel Time= 8.2 min

Peak Storage= 1,939 cf @ 12.15 hrs
 Average Depth at Peak Storage= 0.78'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 120.53 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
 Length= 582.4' Slope= 0.0275 '/'
 Inlet Invert= 1,018.00', Outlet Invert= 1,002.00'

**Reach A5T: A5 Terrace****Hydrograph**

Summary for Reach A6T: A5 Terrace

Inflow Area = 151,984 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 26.83 cfs @ 12.15 hrs, Volume= 55,971 cf
Outflow = 23.05 cfs @ 12.26 hrs, Volume= 55,971 cf, Atten= 14%, Lag= 6.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.32 fps, Min. Travel Time= 4.2 min

Avg. Velocity= 1.30 fps, Avg. Travel Time= 14.1 min

Peak Storage= 5,872 cf @ 12.18 hrs

Average Depth at Peak Storage= 0.99'

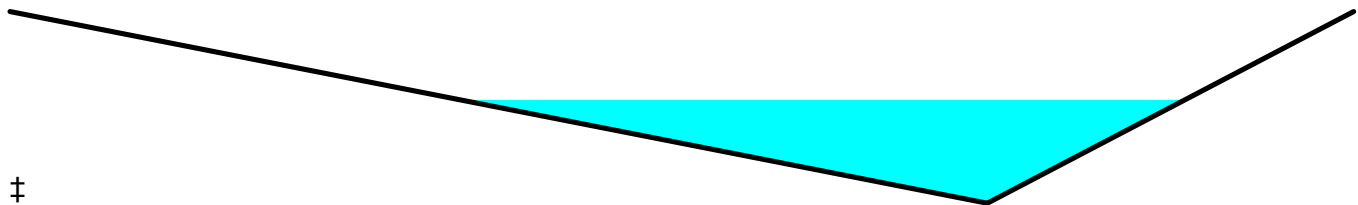
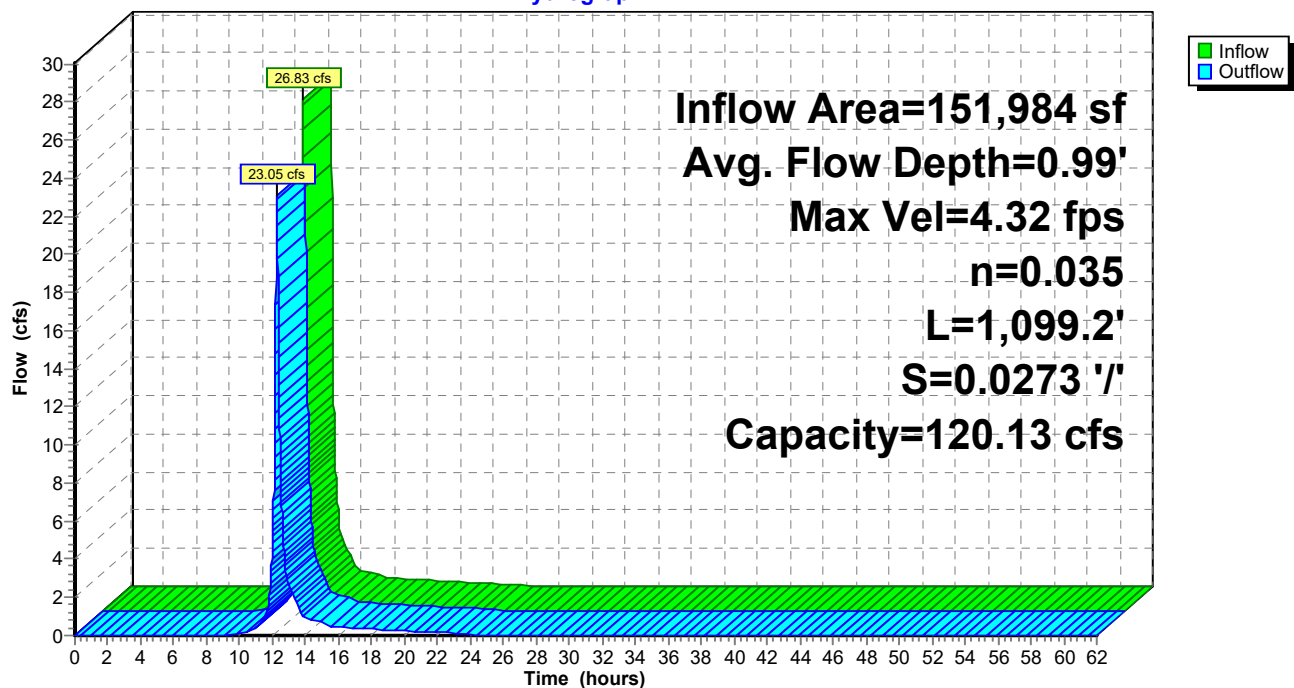
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 120.13 cfs

0.00' x 1.83' deep channel, n= 0.035 Earth, dense weeds

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 1,099.2' Slope= 0.0273 '/'

Inlet Invert= 1,032.00', Outlet Invert= 1,002.00'

**Reach A6T: A5 Terrace****Hydrograph**

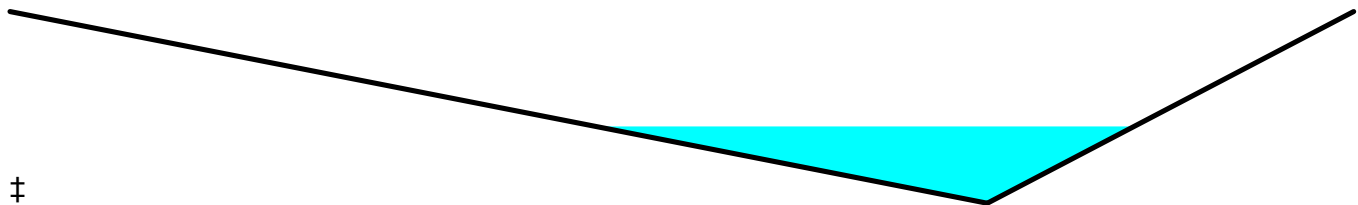
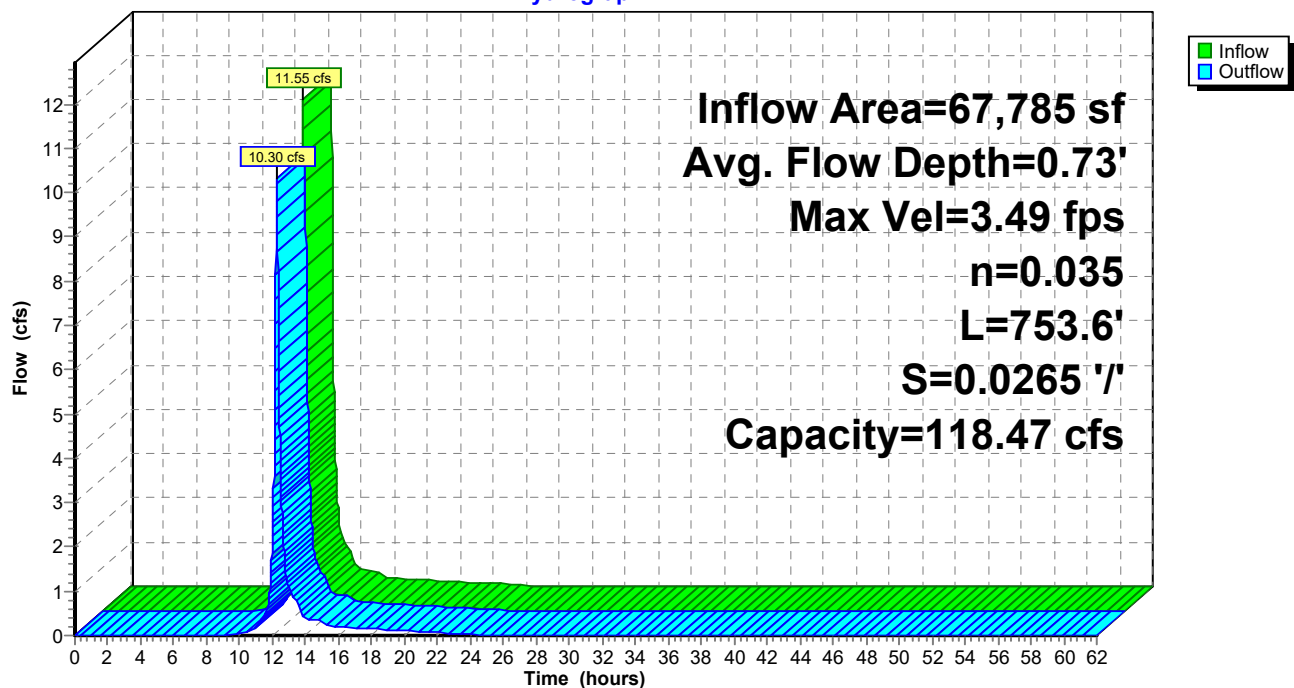
Summary for Reach A7T: A7 Terrace

Inflow Area = 67,785 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 11.55 cfs @ 12.16 hrs, Volume= 24,963 cf
Outflow = 10.30 cfs @ 12.25 hrs, Volume= 24,963 cf, Atten= 11%, Lag= 5.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.49 fps, Min. Travel Time= 3.6 min
Avg. Velocity = 1.12 fps, Avg. Travel Time= 11.2 min

Peak Storage= 2,223 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 118.47 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 753.6' Slope= 0.0265 '/'
Inlet Invert= 920.00', Outlet Invert= 900.00'

**Reach A7T: A7 Terrace****Hydrograph**

Summary for Reach A8T: A8 Terrace

Inflow Area = 73,981 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 13.12 cfs @ 12.14 hrs, Volume= 27,245 cf
 Outflow = 12.63 cfs @ 12.19 hrs, Volume= 27,245 cf, Atten= 4%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.24 fps, Min. Travel Time= 1.6 min

Avg. Velocity = 1.42 fps, Avg. Travel Time= 4.8 min

Peak Storage= 1,226 cf @ 12.16 hrs

Average Depth at Peak Storage= 0.74'

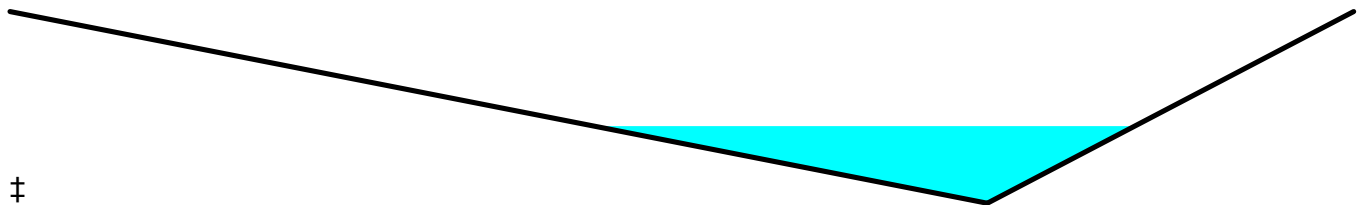
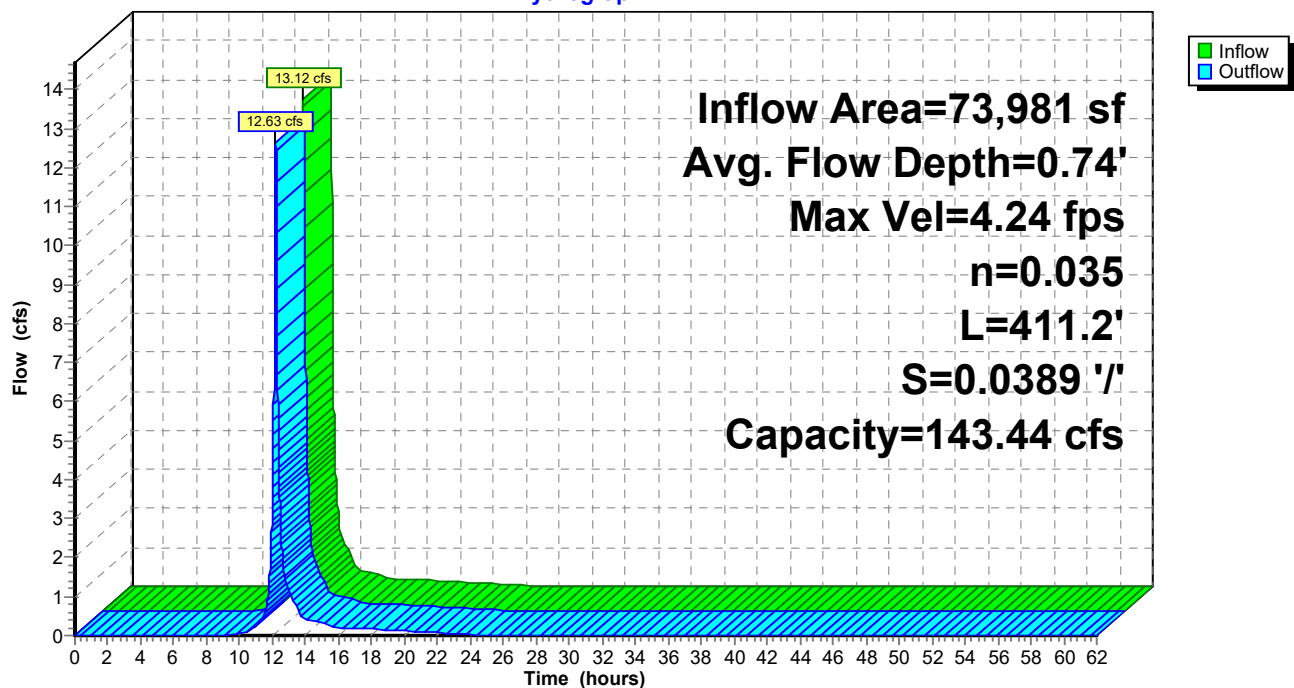
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 143.44 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 411.2' Slope= 0.0389 '/'

Inlet Invert= 916.00', Outlet Invert= 900.00'

**Reach A8T: A8 Terrace****Hydrograph**

Summary for Reach A9T: A9 Terrace

Inflow Area = 145,558 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 27.98 cfs @ 12.13 hrs, Volume= 53,605 cf
Outflow = 23.07 cfs @ 12.24 hrs, Volume= 53,605 cf, Atten= 18%, Lag= 6.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 3.12 fps, Min. Travel Time= 4.6 min

Avg. Velocity = 0.89 fps, Avg. Travel Time= 16.4 min

Peak Storage= 6,440 cf @ 12.16 hrs

Average Depth at Peak Storage= 1.16'

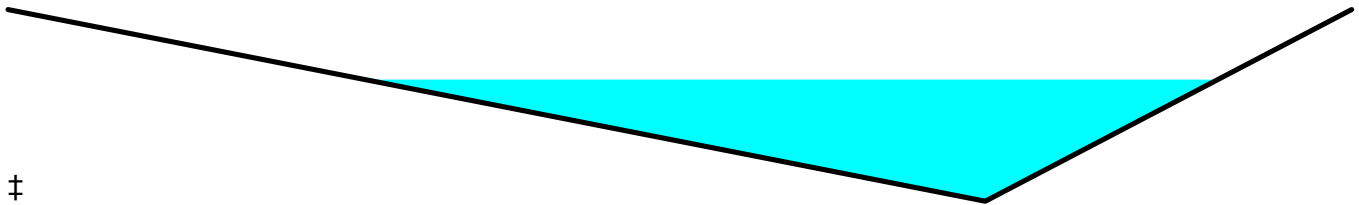
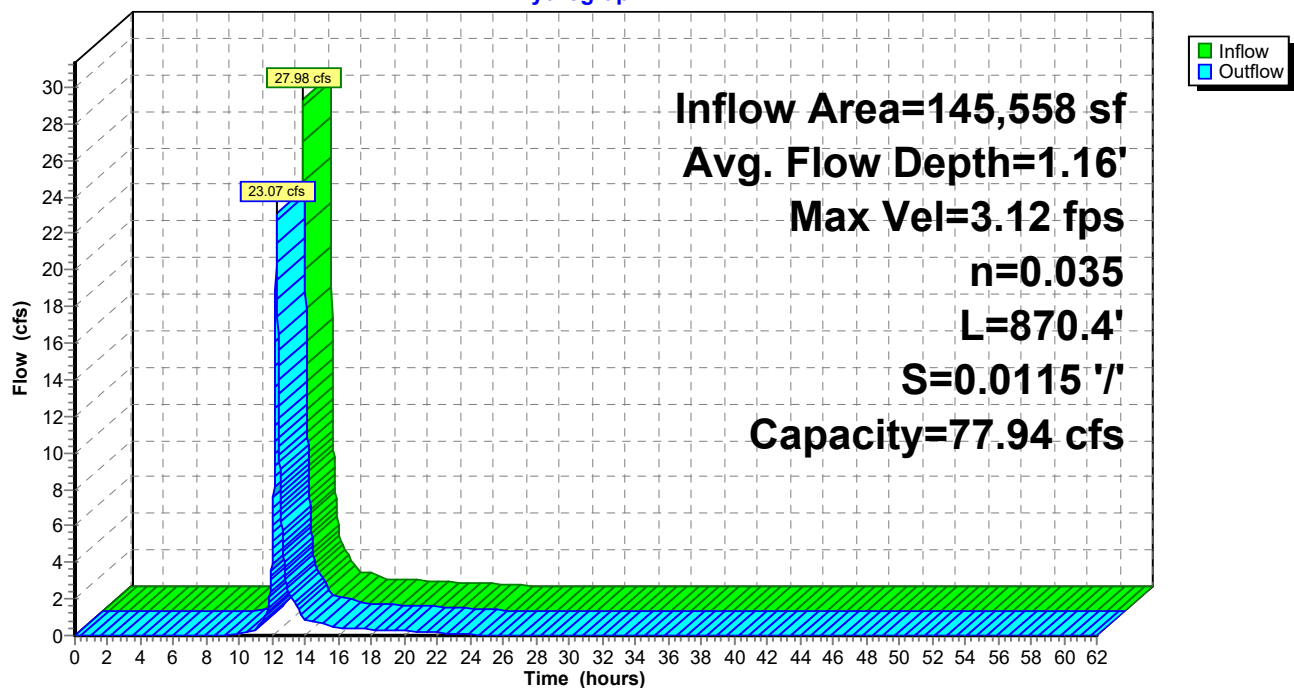
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 77.94 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'

Length= 870.4' Slope= 0.0115 '/'

Inlet Invert= 880.00', Outlet Invert= 870.00'

**Reach A9T: A9 Terrace****Hydrograph**

Summary for Reach AA2T: AA2 Terrace

Inflow Area = 108,213 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 21.58 cfs @ 12.12 hrs, Volume= 39,852 cf
 Outflow = 20.65 cfs @ 12.16 hrs, Volume= 39,852 cf, Atten= 4%, Lag= 2.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 5.53 fps, Min. Travel Time= 1.6 min

Avg. Velocity = 1.79 fps, Avg. Travel Time= 4.9 min

Peak Storage= 1,976 cf @ 12.13 hrs

Average Depth at Peak Storage= 0.82'

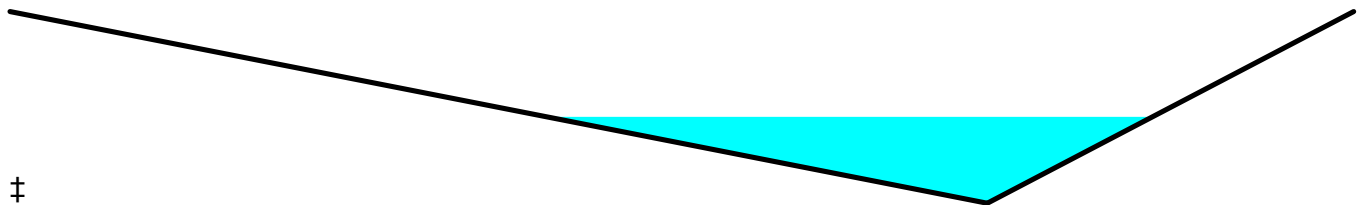
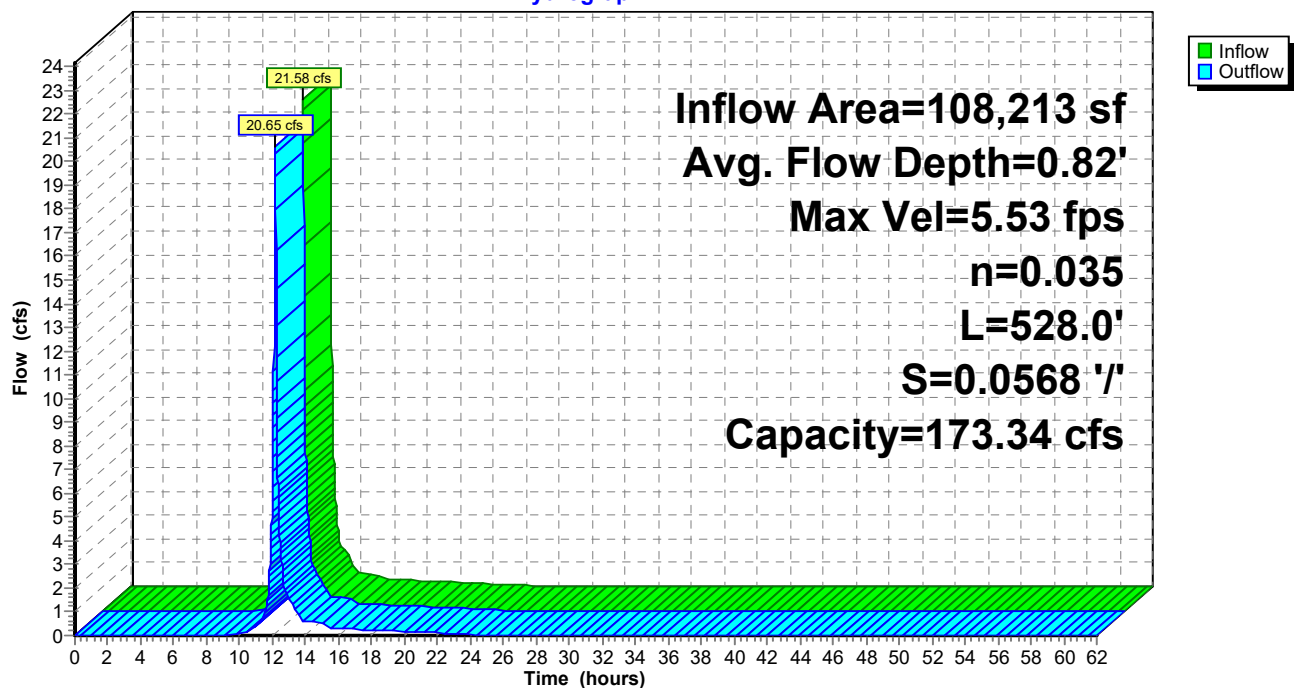
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 173.34 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'

Length= 528.0' Slope= 0.0568 '/'

Inlet Invert= 930.00', Outlet Invert= 900.00'

**Reach AA2T: AA2 Terrace****Hydrograph**

Summary for Reach AA4T: AA4 Terrace

Inflow Area = 113,304 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 21.42 cfs @ 12.13 hrs, Volume= 41,726 cf
 Outflow = 18.33 cfs @ 12.23 hrs, Volume= 41,726 cf, Atten= 14%, Lag= 5.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 3.97 fps, Min. Travel Time= 4.0 min

Avg. Velocity= 1.20 fps, Avg. Travel Time= 13.1 min

Peak Storage= 4,367 cf @ 12.16 hrs

Average Depth at Peak Storage= 0.92'

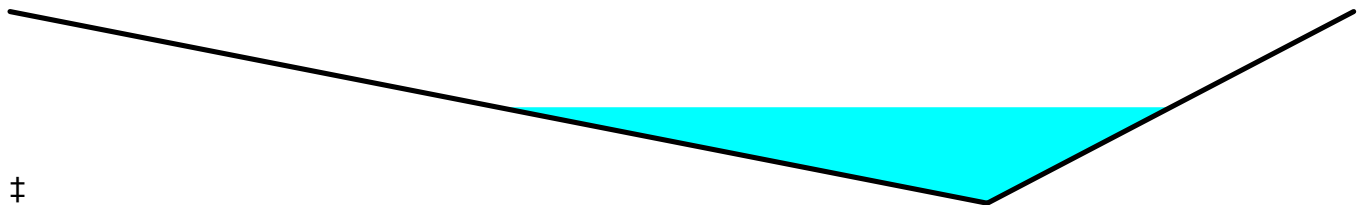
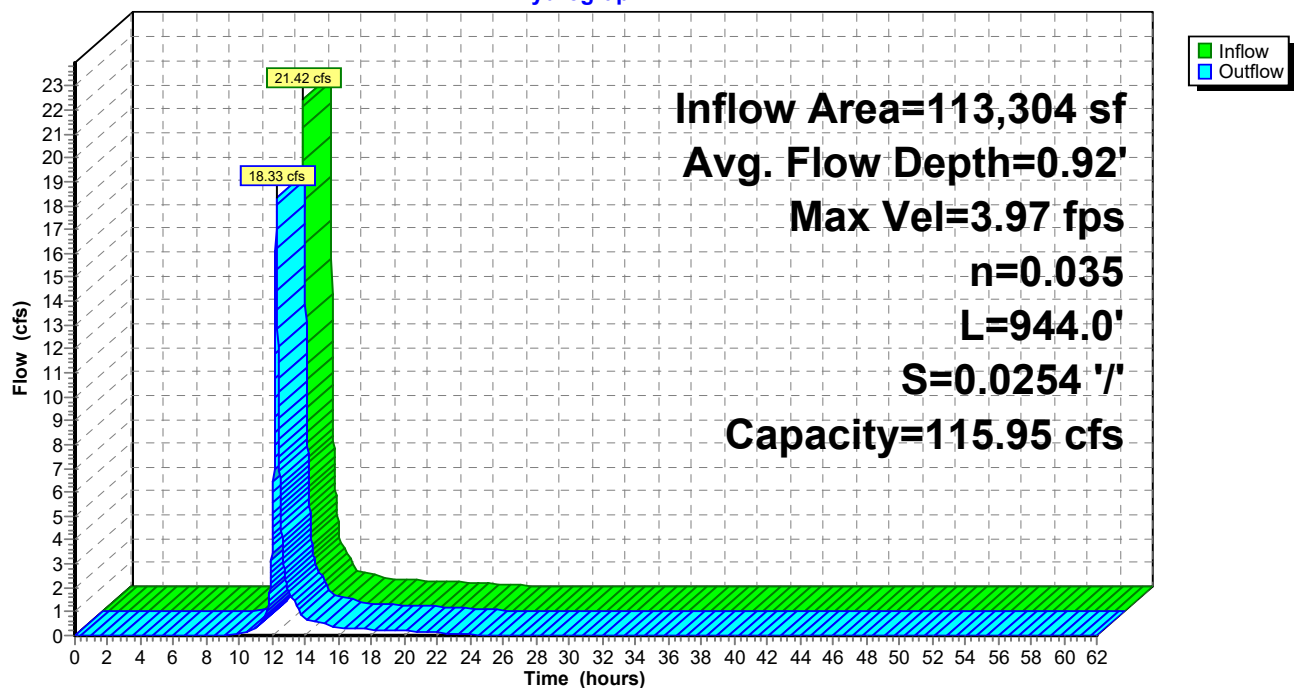
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 115.95 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 944.0' Slope= 0.0254 '/'

Inlet Invert= 910.00', Outlet Invert= 886.00'

**Reach AA4T: AA4 Terrace****Hydrograph**

Summary for Reach AADS1: AA Downslope 1

[61] Hint: Exceeded Reach AA2T outlet invert by 0.24' @ 12.16 hrs

Inflow Area = 108,213 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 20.65 cfs @ 12.16 hrs, Volume= 39,852 cf
Outflow = 20.60 cfs @ 12.16 hrs, Volume= 39,852 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 8.92 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 2.17 fps, Avg. Travel Time= 0.4 min

Peak Storage= 119 cf @ 12.16 hrs

Average Depth at Peak Storage= 0.24'

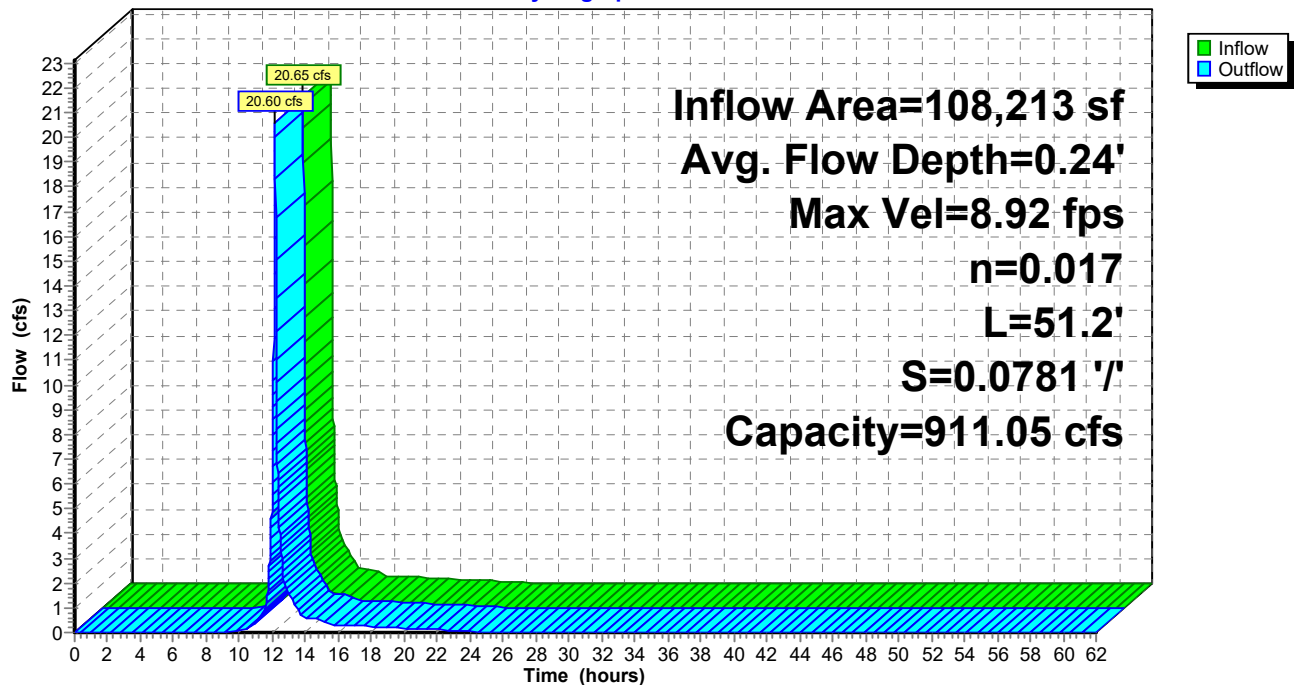
Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 911.05 cfs

9.00' x 2.00' deep channel, n= 0.017

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

Length= 51.2' Slope= 0.0781 '/'

Inlet Invert= 900.00', Outlet Invert= 896.00'

**Reach AADS1: AA Downslope 1****Hydrograph**

Summary for Reach ADS1: A Downslope 1

[61] Hint: Exceeded Reach A1T outlet invert by 0.32' @ 12.31 hrs

[61] Hint: Exceeded Reach A2T outlet invert by 0.32' @ 12.31 hrs

Inflow Area = 198,218 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 23.96 cfs @ 12.30 hrs, Volume= 72,998 cf
 Outflow = 23.94 cfs @ 12.31 hrs, Volume= 72,998 cf, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 7.45 fps, Min. Travel Time= 0.4 min

Avg. Velocity= 1.91 fps, Avg. Travel Time= 1.7 min

Peak Storage= 617 cf @ 12.31 hrs

Average Depth at Peak Storage= 0.32'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 632.29 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 ' ' Top Width= 21.00'

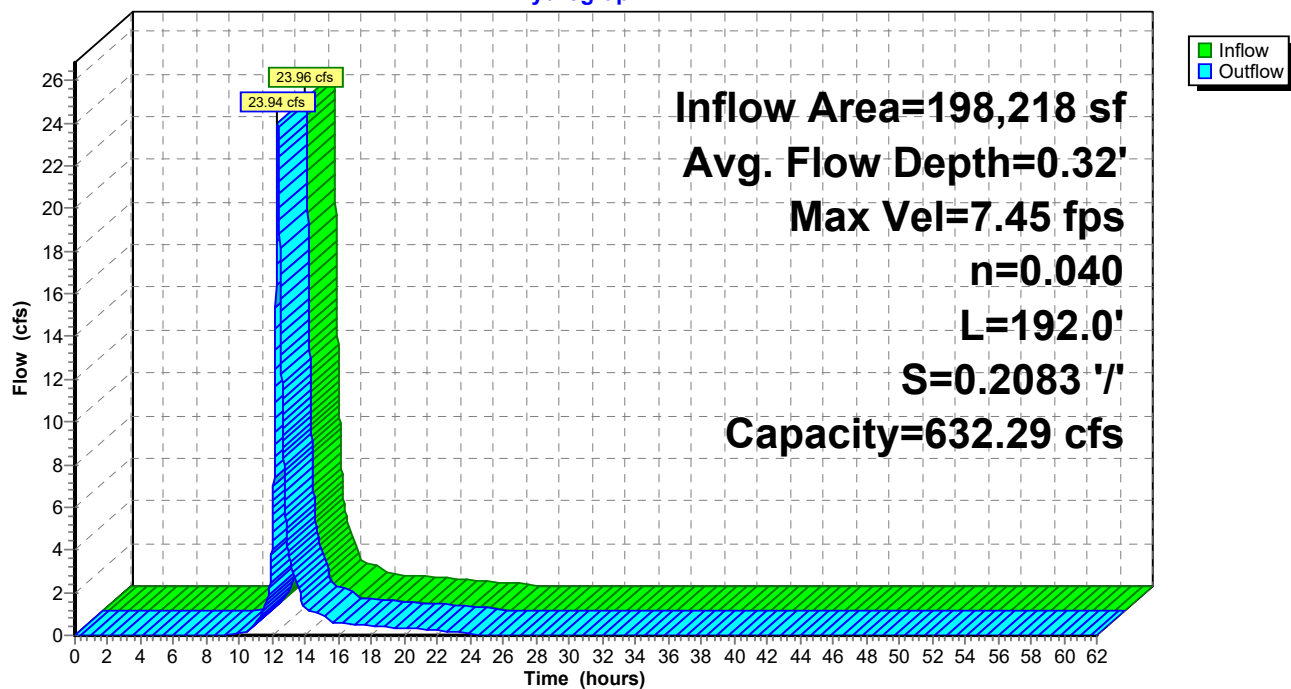
Length= 192.0' Slope= 0.2083 ' '

Inlet Invert= 1,086.00', Outlet Invert= 1,046.00'



Reach ADS1: A Downslope 1

Hydrograph



Summary for Reach ADS2: A Downslope 2

[62] Hint: Exceeded Reach A3T OUTLET depth by 0.03' @ 12.34 hrs

[61] Hint: Exceeded Reach A4T outlet invert by 0.49' @ 12.30 hrs

[62] Hint: Exceeded Reach ADS1 OUTLET depth by 0.17' @ 12.27 hrs

Inflow Area = 384,779 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 47.05 cfs @ 12.29 hrs, Volume= 141,702 cf
 Outflow = 47.00 cfs @ 12.30 hrs, Volume= 141,702 cf, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 9.16 fps, Min. Travel Time= 0.4 min
 Avg. Velocity = 2.21 fps, Avg. Travel Time= 1.7 min

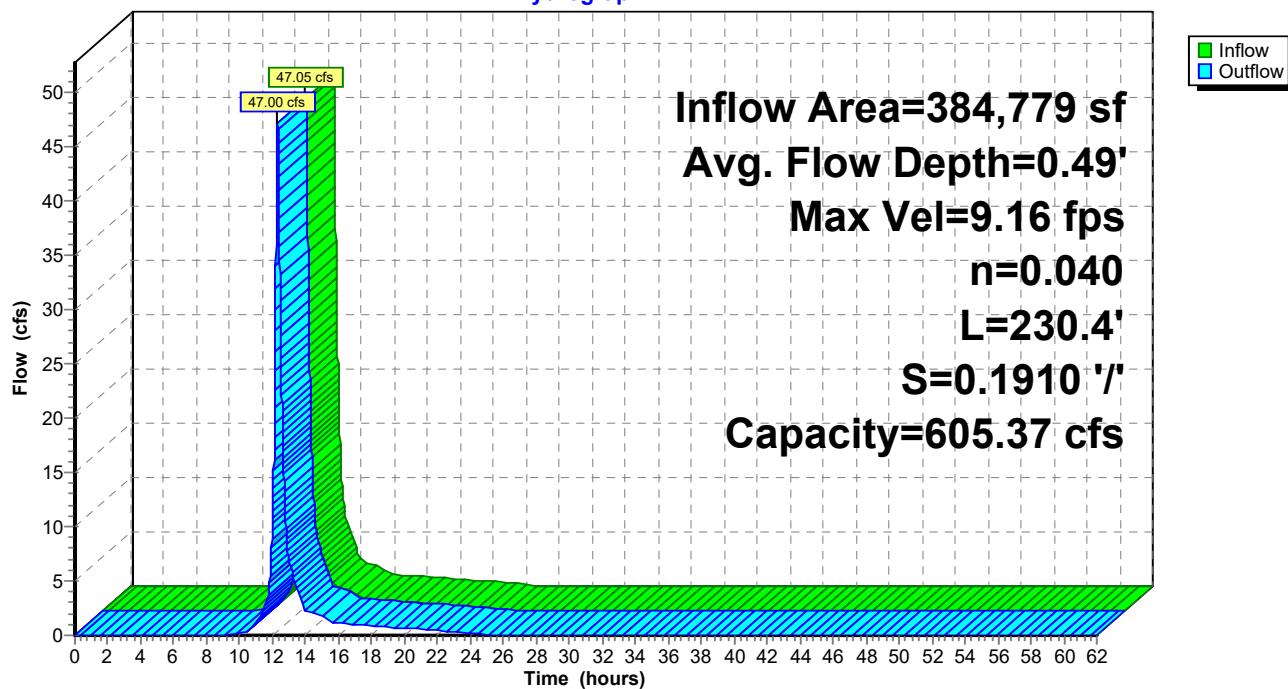
Peak Storage= 1,182 cf @ 12.30 hrs
 Average Depth at Peak Storage= 0.49'
 Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 605.37 cfs

9.00' x 2.00' deep channel, n= 0.040
 Side Slope Z-value= 3.0 '/' Top Width= 21.00'
 Length= 230.4' Slope= 0.1910 '/'
 Inlet Invert= 1,046.00', Outlet Invert= 1,002.00'



Reach ADS2: A Downslope 2

Hydrograph



Summary for Reach ADS3: A Downslope 3

[62] Hint: Exceeded Reach A5T OUTLET depth by 0.14' @ 12.33 hrs

[61] Hint: Exceeded Reach A6T outlet invert by 0.68' @ 12.28 hrs

[62] Hint: Exceeded Reach ADS2 OUTLET depth by 0.20' @ 12.25 hrs

Inflow Area = 606,187 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 76.06 cfs @ 12.27 hrs, Volume= 223,240 cf
Outflow = 75.72 cfs @ 12.30 hrs, Volume= 223,240 cf, Atten= 0%, Lag= 1.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 10.02 fps, Min. Travel Time= 1.1 min

Avg. Velocity = 2.32 fps, Avg. Travel Time= 4.7 min

Peak Storage= 4,985 cf @ 12.28 hrs

Average Depth at Peak Storage= 0.68'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 544.91 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 ' ' Top Width= 21.00'

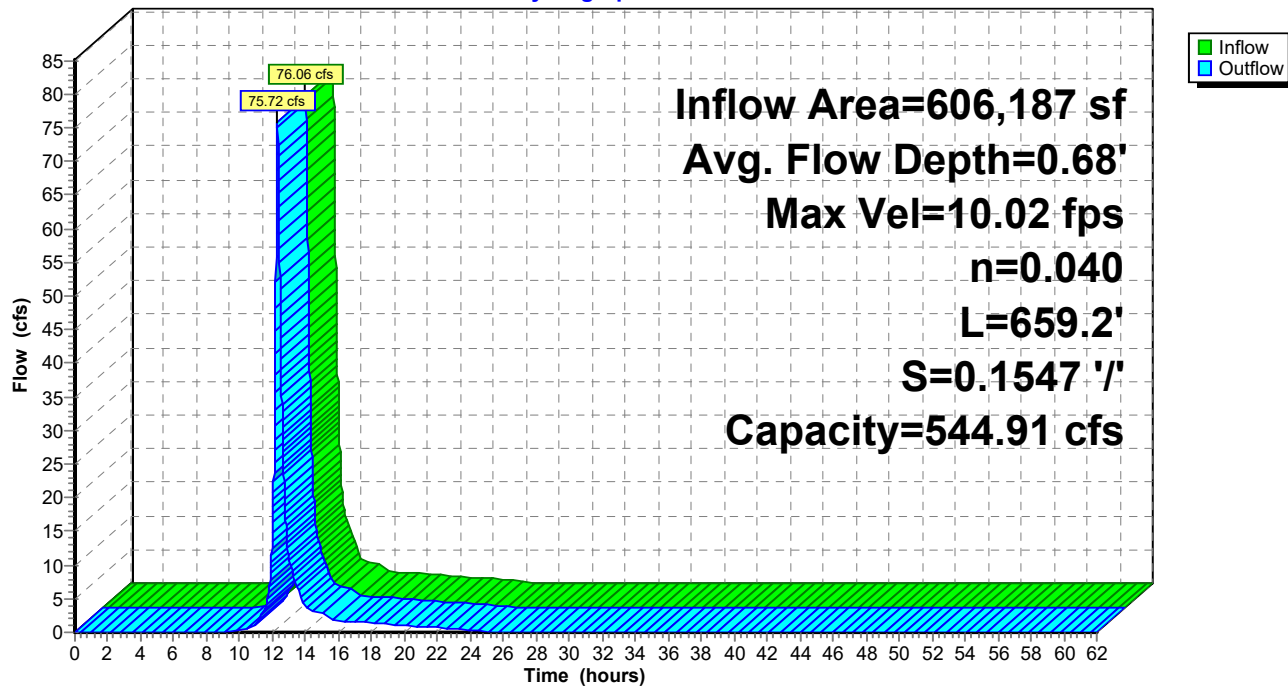
Length= 659.2' Slope= 0.1547 ' '

Inlet Invert= 1,002.00', Outlet Invert= 900.00'



Reach ADS3: A Downslope 3

Hydrograph



Summary for Reach ADS4: A Downslope 4

[62] Hint: Exceeded Reach A7T OUTLET depth by 0.15' @ 12.35 hrs

[62] Hint: Exceeded Reach A8T OUTLET depth by 0.22' @ 12.33 hrs

[62] Hint: Exceeded Reach ADS3 OUTLET depth by 0.07' @ 12.33 hrs

Inflow Area = 747,953 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 92.63 cfs @ 12.28 hrs, Volume= 275,448 cf
 Outflow = 92.55 cfs @ 12.28 hrs, Volume= 275,448 cf, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 10.88 fps, Min. Travel Time= 0.3 min
 Avg. Velocity = 2.52 fps, Avg. Travel Time= 1.2 min

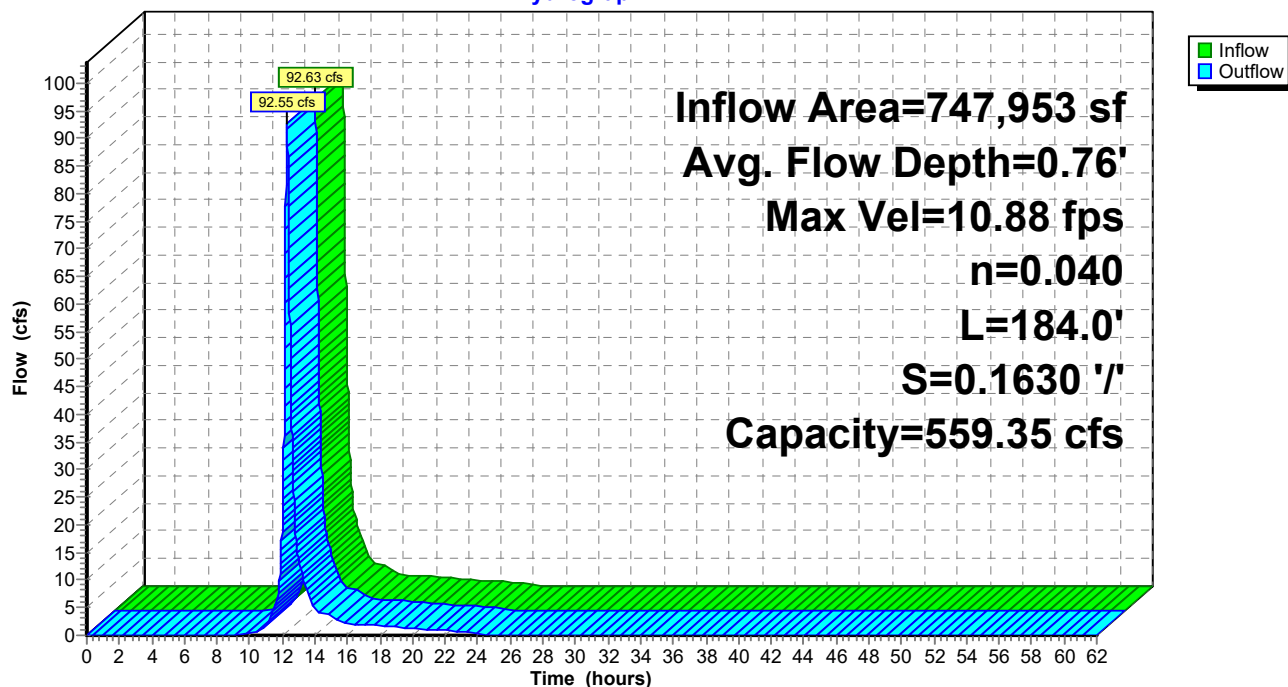
Peak Storage= 1,566 cf @ 12.28 hrs
 Average Depth at Peak Storage= 0.76'
 Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 559.35 cfs

9.00' x 2.00' deep channel, n= 0.040
 Side Slope Z-value= 3.0 '/' Top Width= 21.00'
 Length= 184.0' Slope= 0.1630 '/'
 Inlet Invert= 900.00', Outlet Invert= 870.00'



Reach ADS4: A Downslope 4

Hydrograph



Summary for Reach ADS5: A Downslope 5

[62] Hint: Exceeded Reach A9T OUTLET depth by 0.12' @ 12.34 hrs

[62] Hint: Exceeded Reach ADS4 OUTLET depth by 0.28' @ 12.25 hrs

Inflow Area = 893,511 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 113.53 cfs @ 12.27 hrs, Volume= 329,053 cf
Outflow = 113.45 cfs @ 12.27 hrs, Volume= 329,053 cf, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 9.11 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 2.05 fps, Avg. Travel Time= 0.8 min

Peak Storage= 1,236 cf @ 12.27 hrs

Average Depth at Peak Storage= 1.03'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 393.39 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

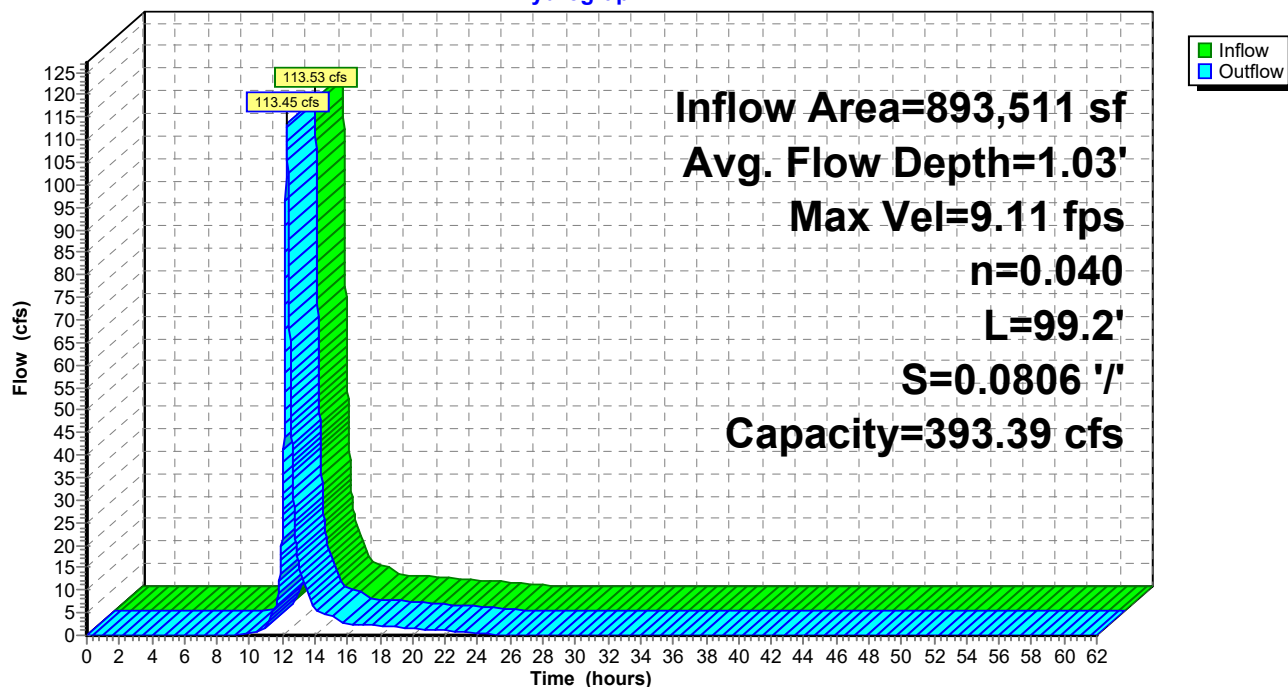
Length= 99.2' Slope= 0.0806 '/'

Inlet Invert= 870.00', Outlet Invert= 862.00'



Reach ADS5: A Downslope 5

Hydrograph



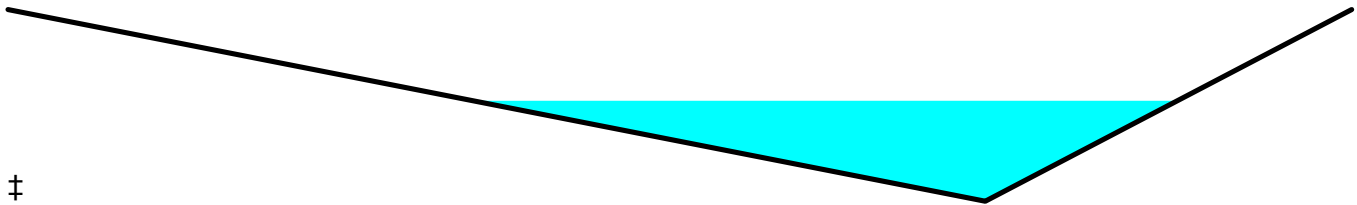
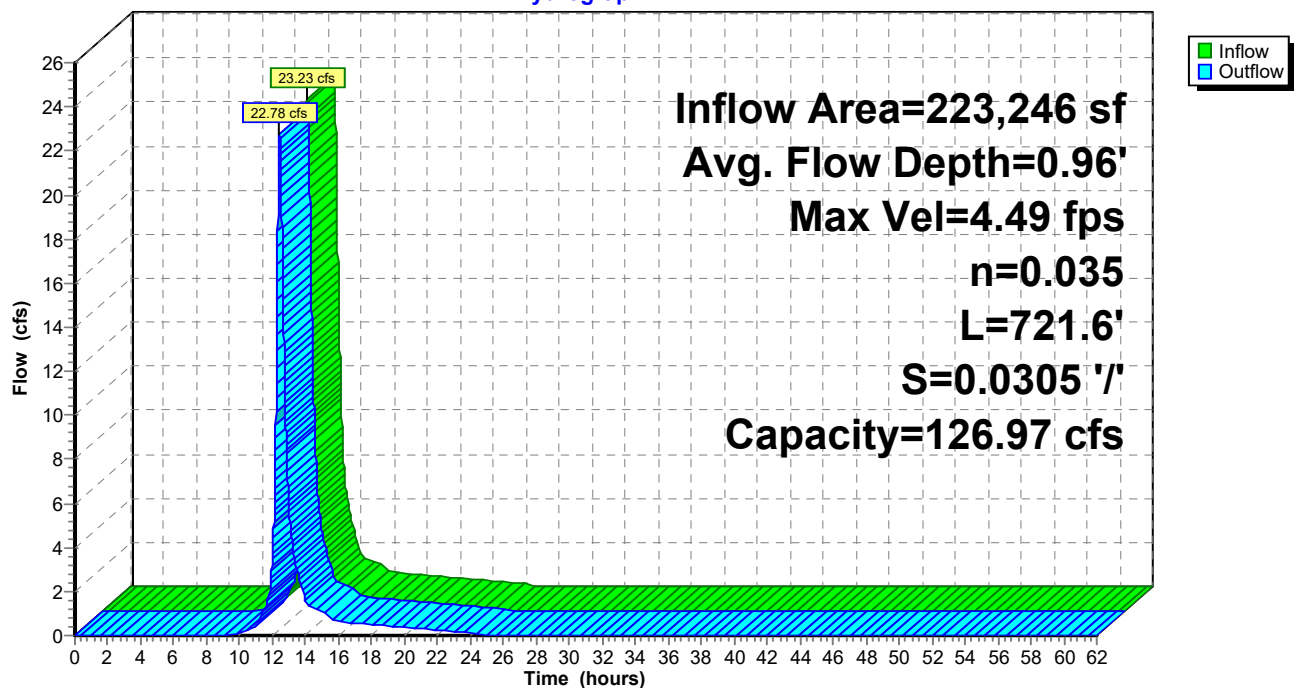
Summary for Reach B1T: B1 Terrace

Inflow Area = 223,246 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 23.23 cfs @ 12.35 hrs, Volume= 82,215 cf
 Outflow = 22.78 cfs @ 12.42 hrs, Volume= 82,215 cf, Atten= 2%, Lag= 4.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 4.49 fps, Min. Travel Time= 2.7 min
 Avg. Velocity = 1.58 fps, Avg. Travel Time= 7.6 min

Peak Storage= 3,664 cf @ 12.38 hrs
 Average Depth at Peak Storage= 0.96'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 126.97 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'
 Length= 721.6' Slope= 0.0305 ' / '
 Inlet Invert= 1,080.00', Outlet Invert= 1,058.00'

**Reach B1T: B1 Terrace****Hydrograph**

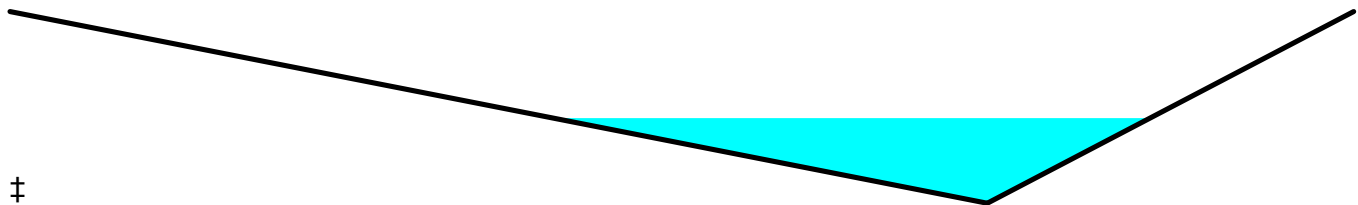
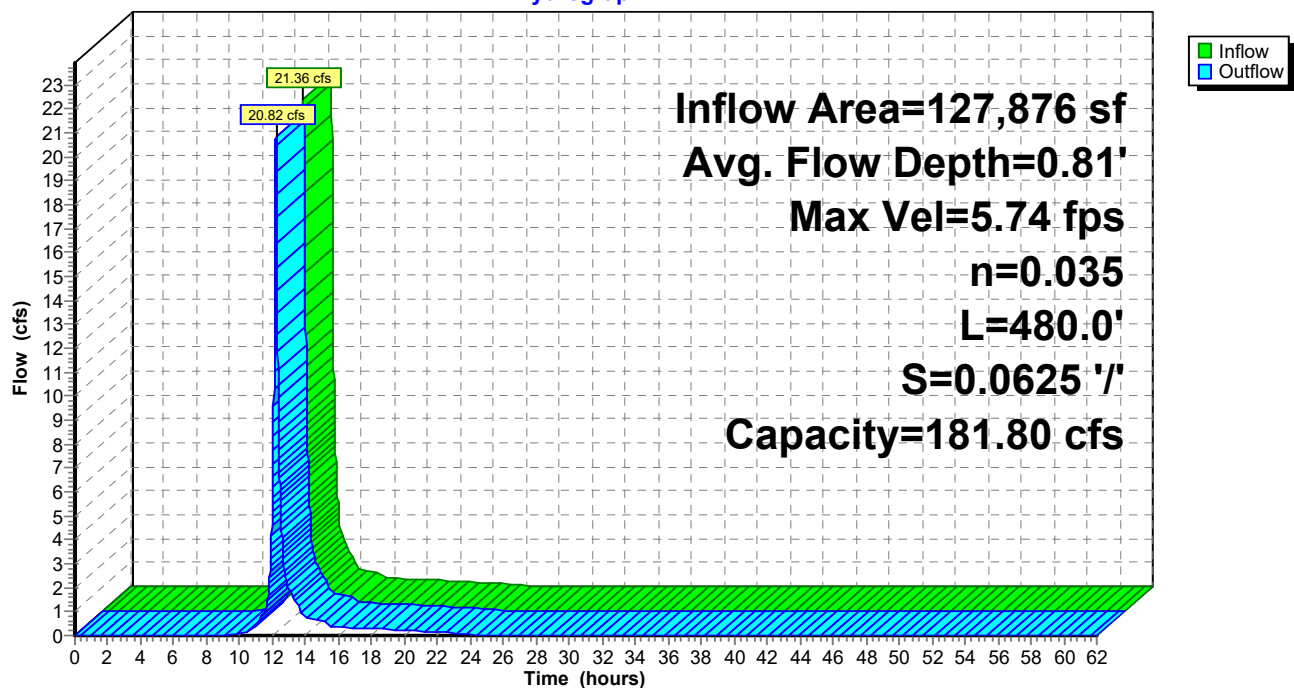
Summary for Reach B3T: B3 Terrace

Inflow Area = 127,876 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 21.36 cfs @ 12.16 hrs, Volume= 47,093 cf
Outflow = 20.82 cfs @ 12.20 hrs, Volume= 47,093 cf, Atten= 3%, Lag= 2.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.74 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 1.95 fps, Avg. Travel Time= 4.1 min

Peak Storage= 1,743 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.81'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 181.80 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 480.0' Slope= 0.0625 '/'
Inlet Invert= 1,050.00', Outlet Invert= 1,020.00'

**Reach B3T: B3 Terrace****Hydrograph**

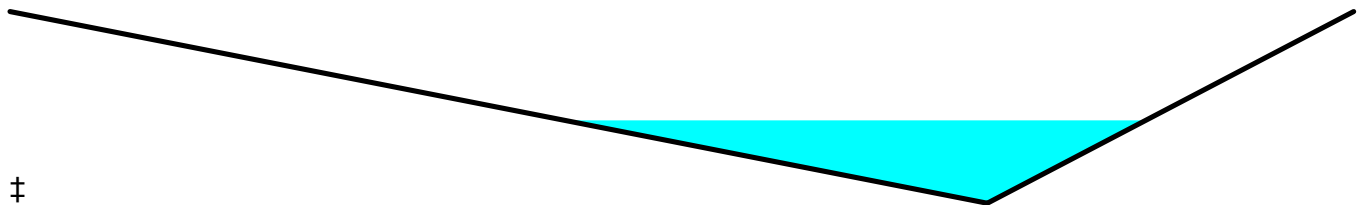
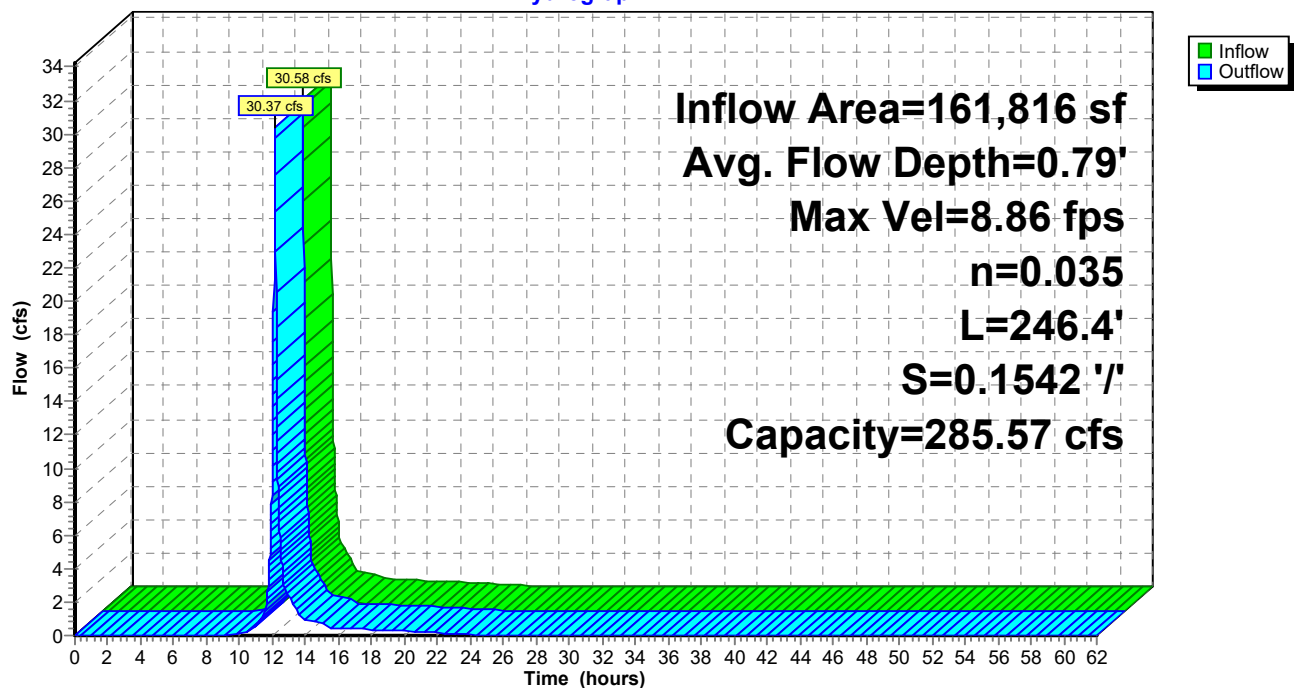
Summary for Reach B5T: B5 Terrace

Inflow Area = 161,816 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 30.58 cfs @ 12.13 hrs, Volume= 59,592 cf
Outflow = 30.37 cfs @ 12.14 hrs, Volume= 59,592 cf, Atten= 1%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.86 fps, Min. Travel Time= 0.5 min
Avg. Velocity= 3.03 fps, Avg. Travel Time= 1.4 min

Peak Storage= 847 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 285.57 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 246.4' Slope= 0.1542 '/'
Inlet Invert= 1,018.00', Outlet Invert= 980.00'

**Reach B5T: B5 Terrace****Hydrograph**

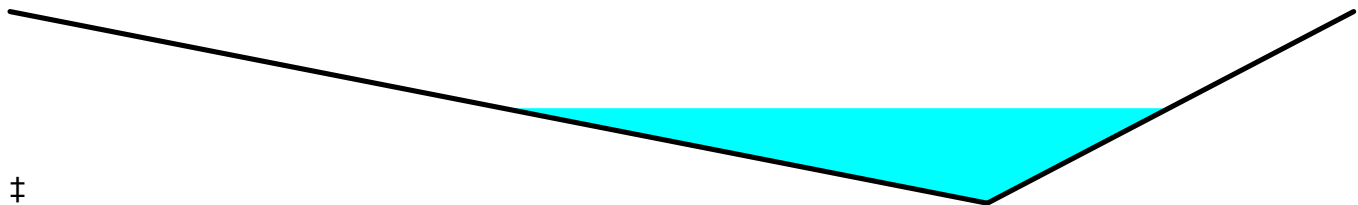
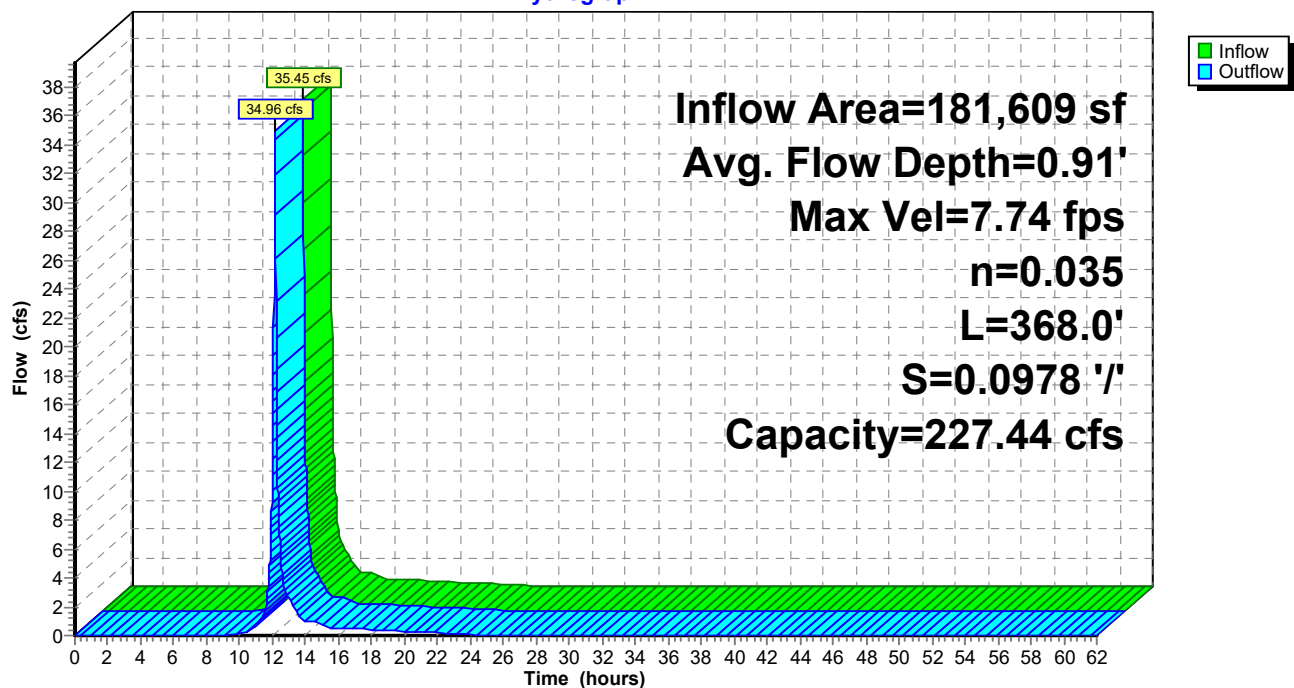
Summary for Reach B7T: B7 Terrace

Inflow Area = 181,609 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 35.45 cfs @ 12.12 hrs, Volume= 66,881 cf
Outflow = 34.96 cfs @ 12.15 hrs, Volume= 66,881 cf, Atten= 1%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.74 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 2.58 fps, Avg. Travel Time= 2.4 min

Peak Storage= 1,667 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.91'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 227.44 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 368.0' Slope= 0.0978 '/'
Inlet Invert= 978.00', Outlet Invert= 942.00'

**Reach B7T: B7 Terrace****Hydrograph**

Summary for Reach B9T: B9 Terrace

[62] Hint: Exceeded Reach BB3T OUTLET depth by 0.86' @ 12.33 hrs

[62] Hint: Exceeded Reach BBDS1 OUTLET depth by 1.16' @ 12.23 hrs

Inflow Area = 746,138 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 93.08 cfs @ 12.20 hrs, Volume= 274,780 cf
Outflow = 89.45 cfs @ 12.28 hrs, Volume= 274,780 cf, Atten= 4%, Lag= 5.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.14 fps, Min. Travel Time= 2.7 min

Avg. Velocity = 1.08 fps, Avg. Travel Time= 10.6 min

Peak Storage= 14,752 cf @ 12.24 hrs

Average Depth at Peak Storage= 1.51'

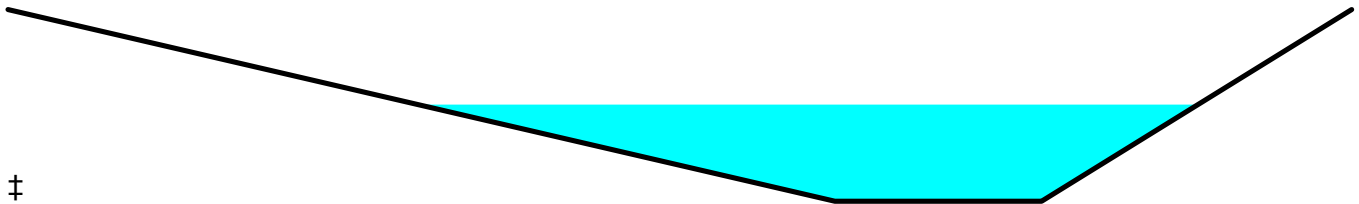
Bank-Full Depth= 3.00' Flow Area= 67.5 sf, Capacity= 413.91 cfs

6.00' x 3.00' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 39.00'

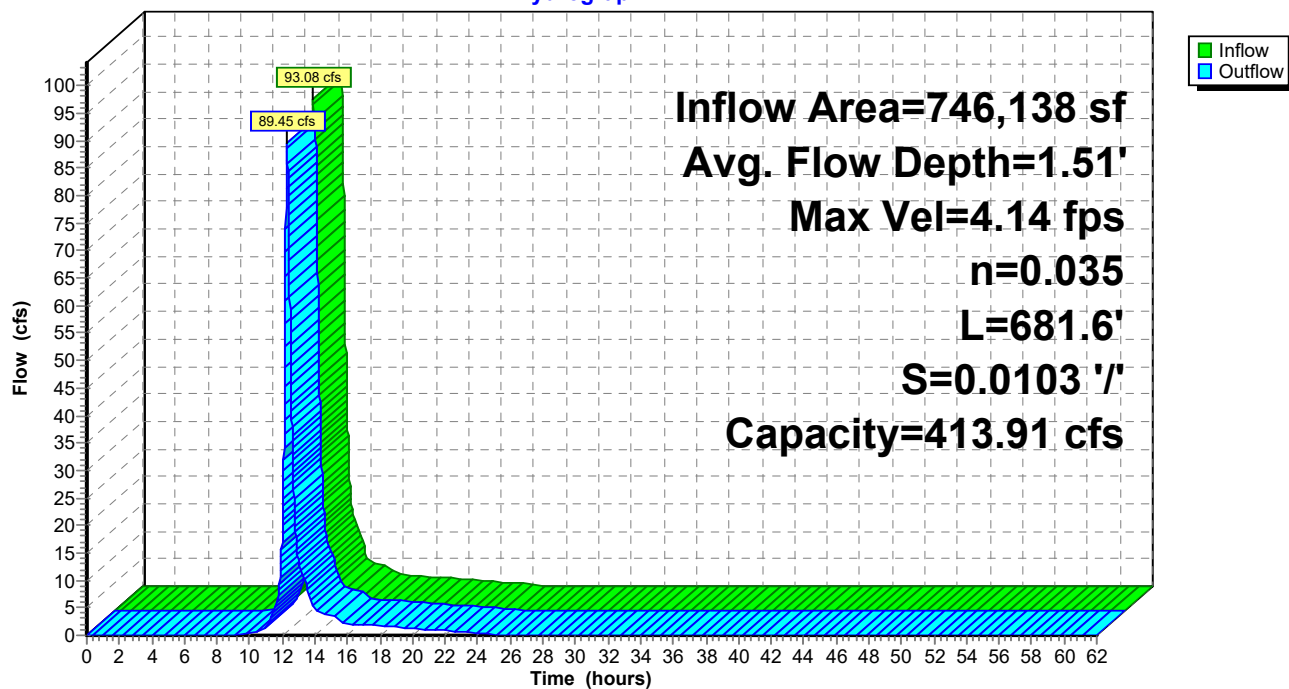
Length= 681.6' Slope= 0.0103 '/'

Inlet Invert= 908.00', Outlet Invert= 901.00'



Reach B9T: B9 Terrace

Hydrograph



Summary for Reach BB1T: BB1 Terrace

[62] Hint: Exceeded Reach BBB1T OUTLET depth by 0.25' @ 12.35 hrs

Inflow Area = 310,703 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 38.59 cfs @ 12.25 hrs, Volume= 114,422 cf
 Outflow = 37.58 cfs @ 12.31 hrs, Volume= 114,422 cf, Atten= 3%, Lag= 3.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.27 fps, Min. Travel Time= 2.4 min

Avg. Velocity= 1.25 fps, Avg. Travel Time= 8.4 min

Peak Storage= 5,522 cf @ 12.27 hrs

Average Depth at Peak Storage= 1.27'

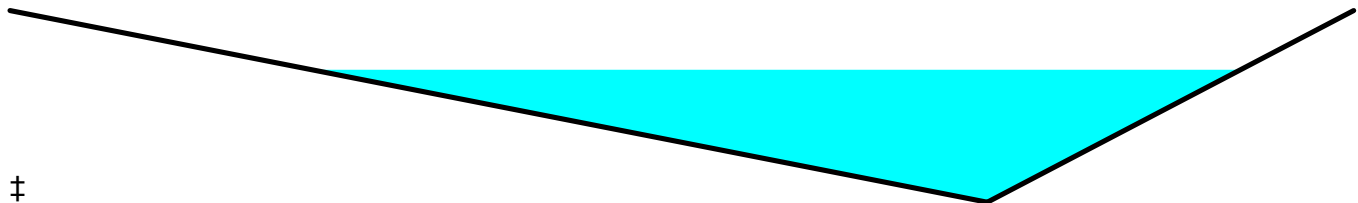
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 100.59 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

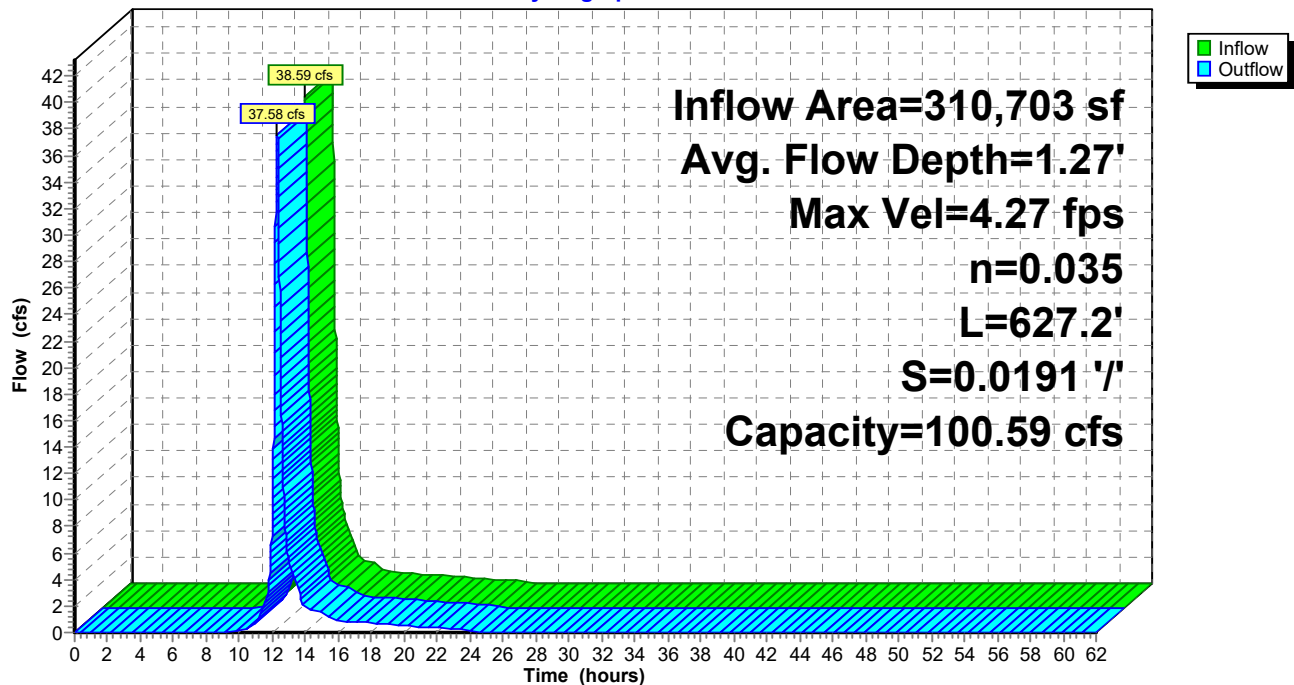
Length= 627.2' Slope= 0.0191 '/'

Inlet Invert= 950.00', Outlet Invert= 938.00'



Reach BB1T: BB1 Terrace

Hydrograph



Summary for Reach BB3T: BB3 Terrace

[62] Hint: Exceeded Reach BBB3T OUTLET depth by 0.17' @ 12.22 hrs

Inflow Area = 182,211 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 32.28 cfs @ 12.14 hrs, Volume= 67,103 cf
 Outflow = 28.13 cfs @ 12.24 hrs, Volume= 67,103 cf, Atten= 13%, Lag= 6.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 3.28 fps, Min. Travel Time= 4.0 min

Avg. Velocity= 0.79 fps, Avg. Travel Time= 16.5 min

Peak Storage= 6,697 cf @ 12.17 hrs

Average Depth at Peak Storage= 0.82'

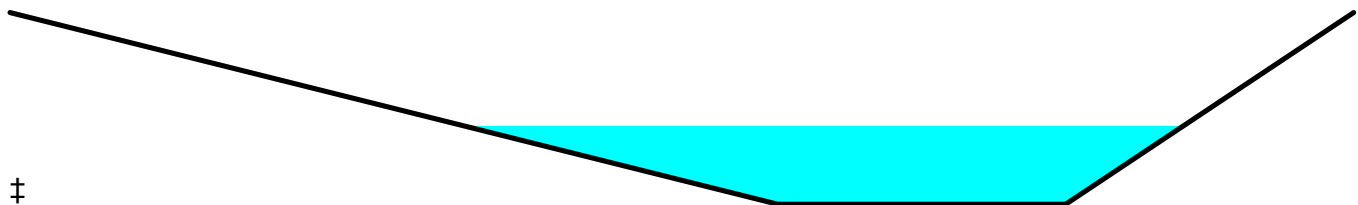
Bank-Full Depth= 2.00' Flow Area= 34.0 sf, Capacity= 183.98 cfs

6.00' x 2.00' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 28.00'

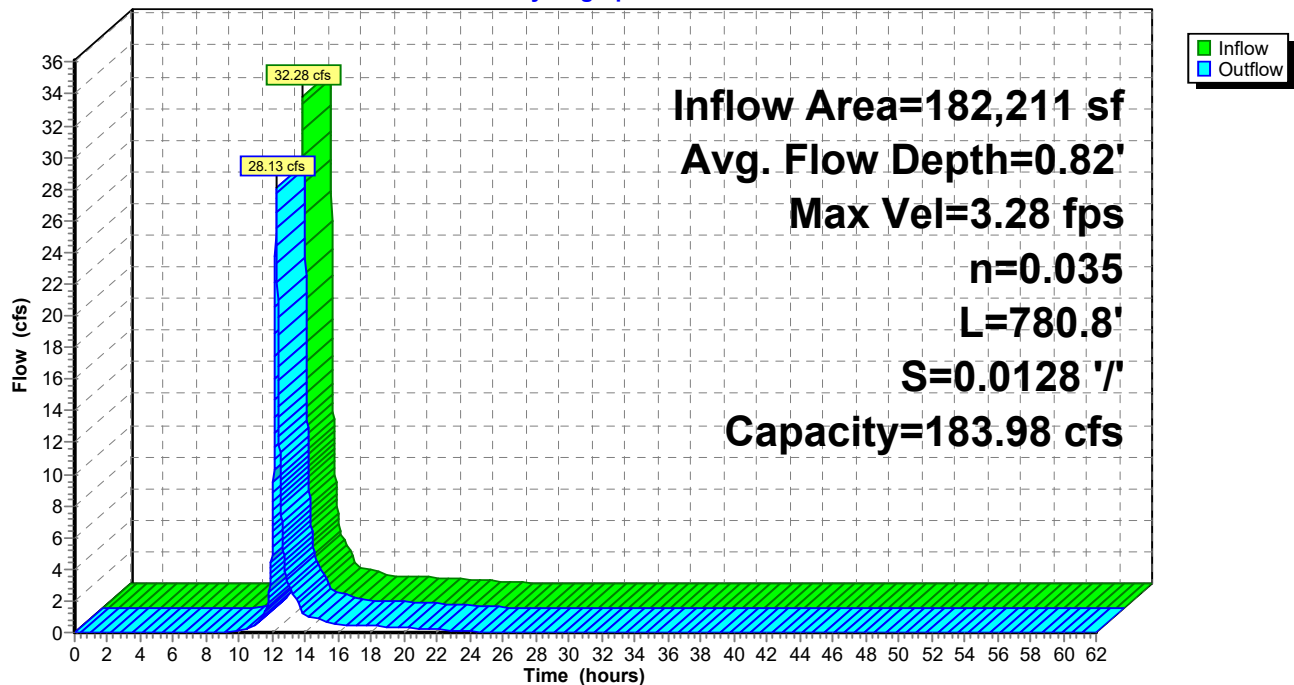
Length= 780.8' Slope= 0.0128 '/'

Inlet Invert= 918.00', Outlet Invert= 908.00'



Reach BB3T: BB3 Terrace

Hydrograph



Summary for Reach BBB1T: BBB1 Terrace

Inflow Area = 210,326 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 37.13 cfs @ 12.15 hrs, Volume= 77,457 cf
 Outflow = 31.49 cfs @ 12.26 hrs, Volume= 77,457 cf, Atten= 15%, Lag= 6.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 3.91 fps, Min. Travel Time= 4.5 min

Avg. Velocity= 1.12 fps, Avg. Travel Time= 15.7 min

Peak Storage= 8,511 cf @ 12.19 hrs

Average Depth at Peak Storage= 1.21'

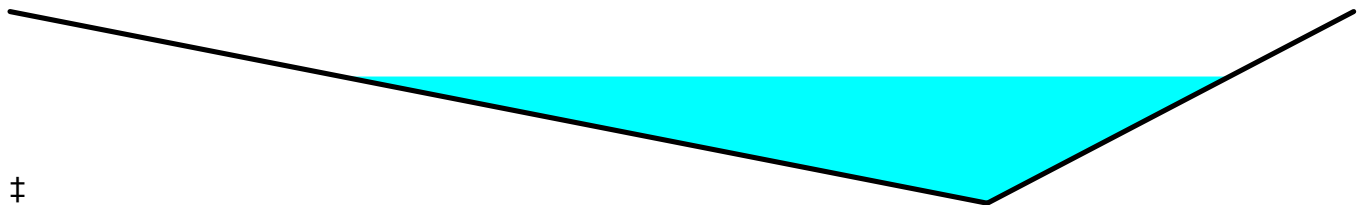
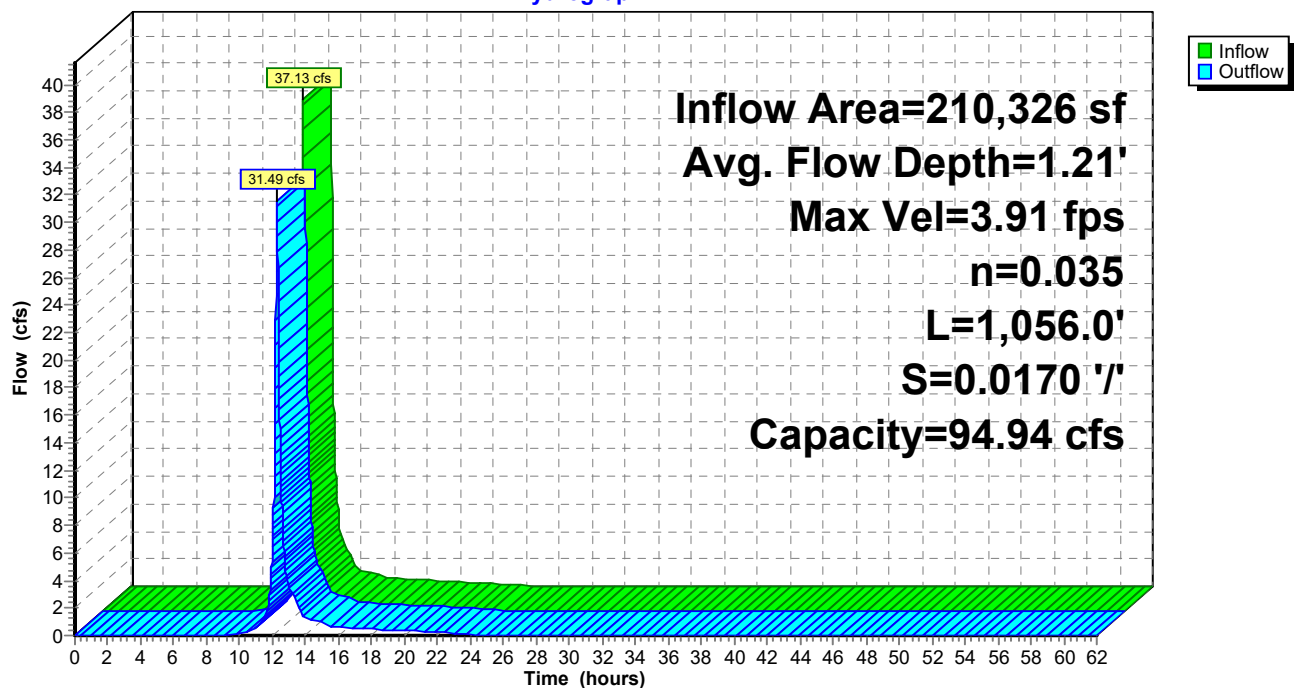
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 94.94 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'

Length= 1,056.0' Slope= 0.0170 '/'

Inlet Invert= 968.00', Outlet Invert= 950.00'

**Reach BBB1T: BBB1 Terrace****Hydrograph**

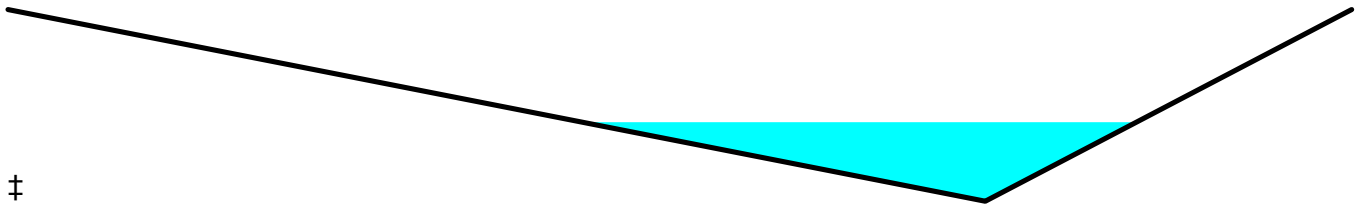
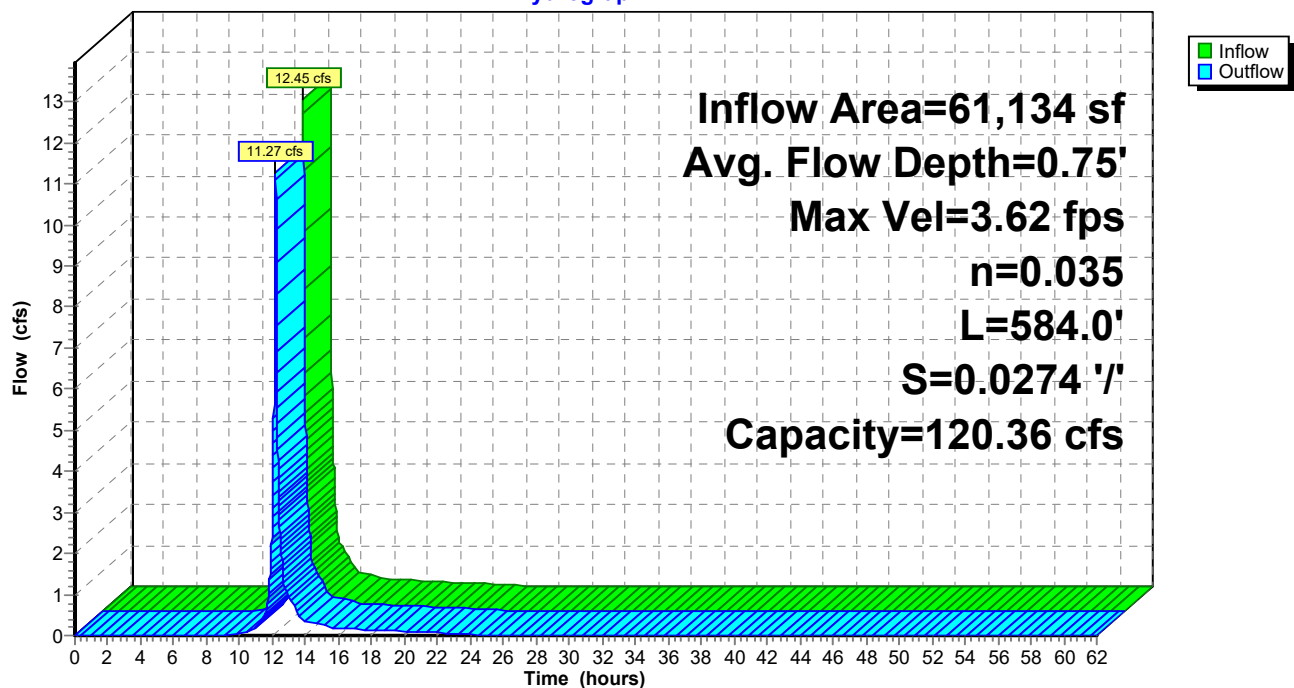
Summary for Reach BBB3T: BBB3 Terrace

Inflow Area = 61,134 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 12.45 cfs @ 12.12 hrs, Volume= 22,514 cf
 Outflow = 11.27 cfs @ 12.18 hrs, Volume= 22,514 cf, Atten= 9%, Lag= 3.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 3.62 fps, Min. Travel Time= 2.7 min
 Avg. Velocity = 1.14 fps, Avg. Travel Time= 8.5 min

Peak Storage= 1,826 cf @ 12.14 hrs
 Average Depth at Peak Storage= 0.75'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 120.36 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
 Length= 584.0' Slope= 0.0274 '/'
 Inlet Invert= 934.00', Outlet Invert= 918.00'

**Reach BBB3T: BBB3 Terrace****Hydrograph**

Summary for Reach BBDS1: BB Downslope 1

[61] Hint: Exceeded Reach BB1T outlet invert by 0.38' @ 12.32 hrs

Inflow Area = 310,703 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 37.58 cfs @ 12.31 hrs, Volume= 114,422 cf
 Outflow = 37.55 cfs @ 12.32 hrs, Volume= 114,422 cf, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 9.85 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 2.34 fps, Avg. Travel Time= 0.7 min

Peak Storage= 378 cf @ 12.32 hrs

Average Depth at Peak Storage= 0.38'

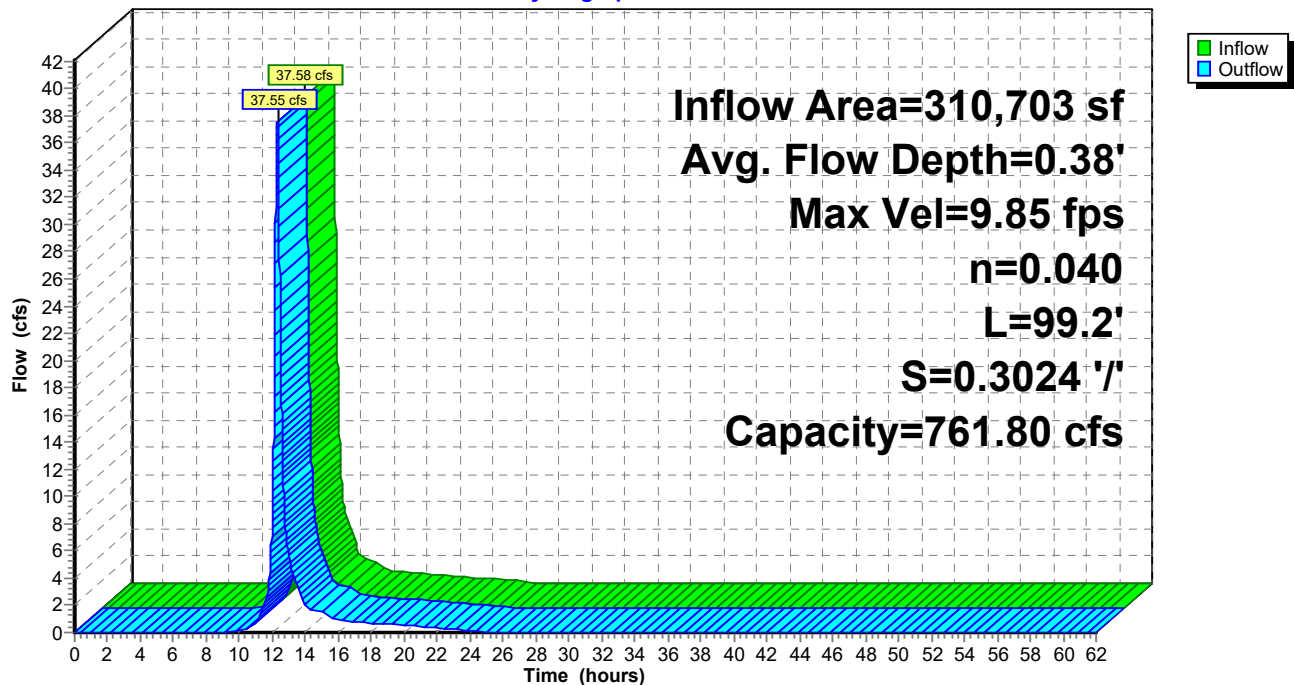
Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 761.80 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

Length= 99.2' Slope= 0.3024 '/'

Inlet Invert= 938.00', Outlet Invert= 908.00'

**Reach BBDS1: BB Downslope 1****Hydrograph**

Summary for Reach BDS1: B Downslope 1

[61] Hint: Exceeded Reach B1T outlet invert by 0.30' @ 12.43 hrs

Inflow Area = 223,246 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 22.78 cfs @ 12.42 hrs, Volume= 82,215 cf
 Outflow = 22.76 cfs @ 12.43 hrs, Volume= 82,215 cf, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 7.63 fps, Min. Travel Time= 0.3 min

Avg. Velocity= 2.02 fps, Avg. Travel Time= 1.3 min

Peak Storage= 477 cf @ 12.43 hrs

Average Depth at Peak Storage= 0.30'

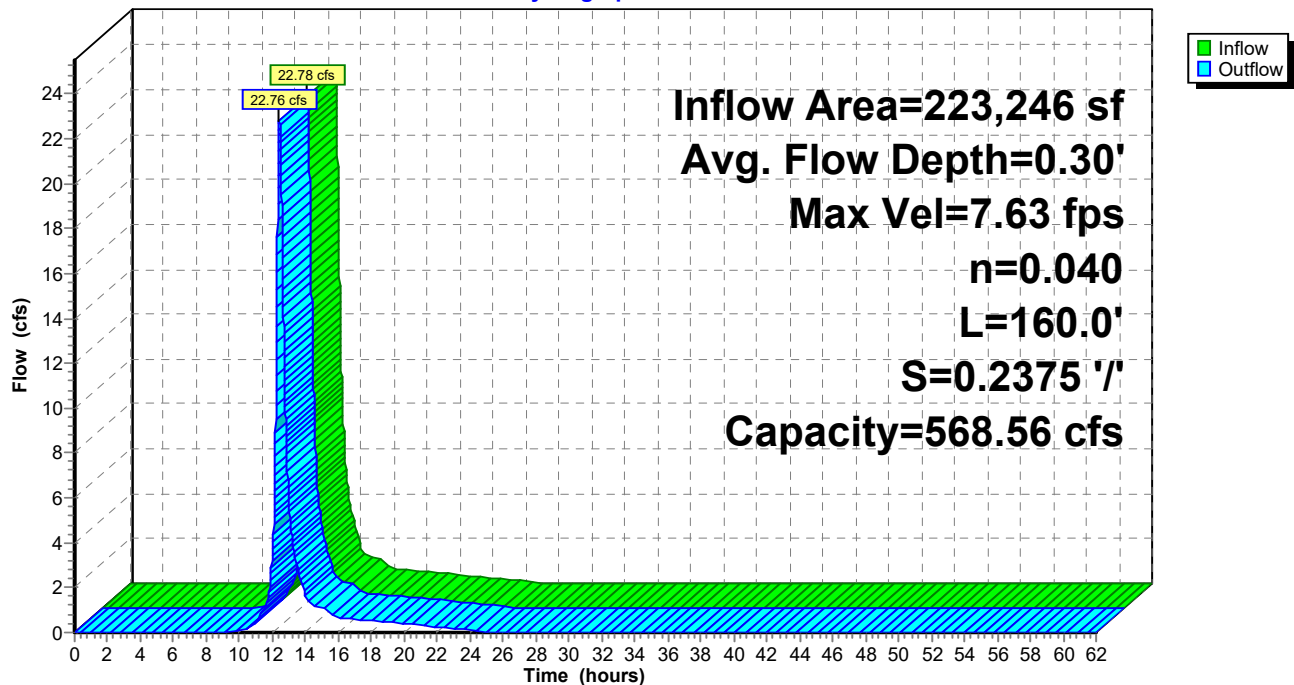
Bank-Full Depth= 1.83' Flow Area= 26.5 sf, Capacity= 568.56 cfs

9.00' x 1.83' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 19.98'

Length= 160.0' Slope= 0.2375 '/'

Inlet Invert= 1,058.00', Outlet Invert= 1,020.00'

**Reach BDS1: B Downslope 1****Hydrograph**

Summary for Reach BDS2: B Downslope 2

[61] Hint: Exceeded Reach B3T outlet invert by 0.33' @ 12.22 hrs

[62] Hint: Exceeded Reach BDS1 OUTLET depth by 0.14' @ 12.19 hrs

Inflow Area = 351,122 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 30.87 cfs @ 12.22 hrs, Volume= 129,307 cf
 Outflow = 30.84 cfs @ 12.23 hrs, Volume= 129,307 cf, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 9.49 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 2.64 fps, Avg. Travel Time= 0.8 min

Peak Storage= 390 cf @ 12.22 hrs

Average Depth at Peak Storage= 0.33'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 799.79 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 ' Top Width= 21.00'

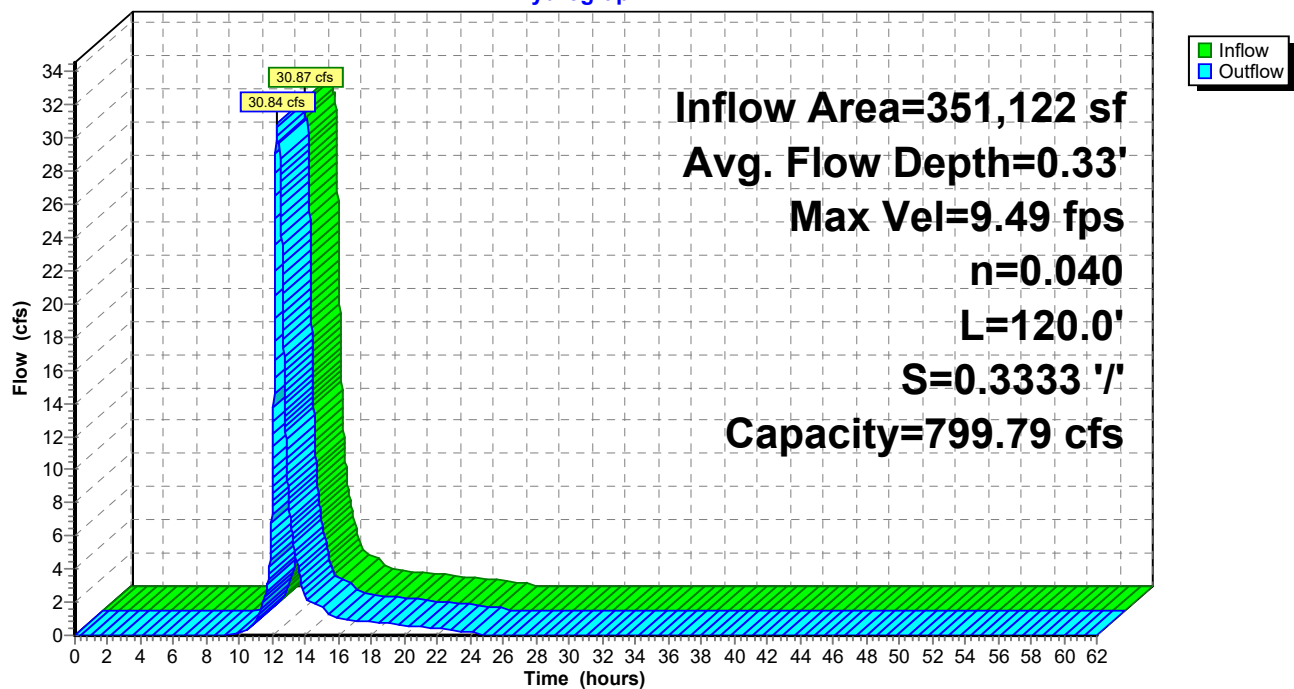
Length= 120.0' Slope= 0.3333 ' '

Inlet Invert= 1,020.00', Outlet Invert= 980.00'



Reach BDS2: B Downslope 2

Hydrograph



Summary for Reach BDS3: B Downslope 3

[61] Hint: Exceeded Reach B5T outlet invert by 0.47' @ 12.16 hrs

[62] Hint: Exceeded Reach BDS2 OUTLET depth by 0.19' @ 12.14 hrs

Inflow Area = 512,938 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 54.40 cfs @ 12.16 hrs, Volume= 188,899 cf
Outflow = 54.28 cfs @ 12.17 hrs, Volume= 188,899 cf, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 11.13 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 2.87 fps, Avg. Travel Time= 0.7 min

Peak Storage= 625 cf @ 12.16 hrs

Average Depth at Peak Storage= 0.47'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 754.78 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

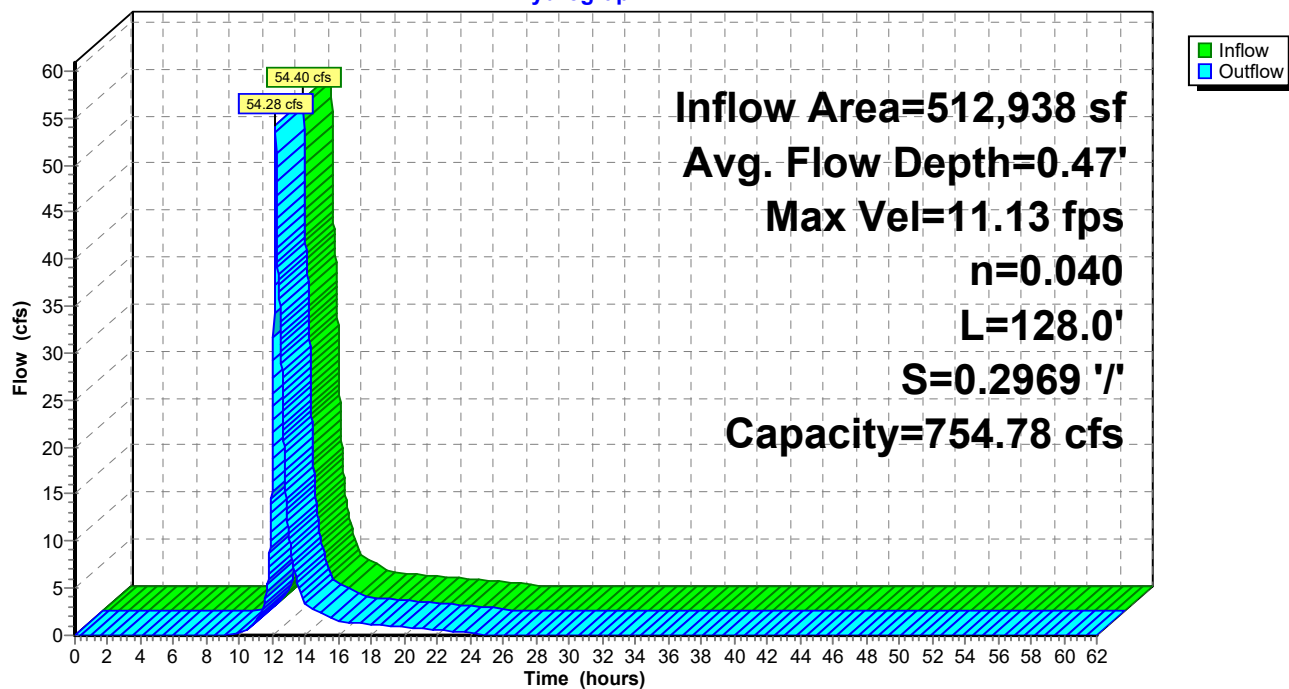
Length= 128.0' Slope= 0.2969 '/'

Inlet Invert= 980.00', Outlet Invert= 942.00'



Reach BDS3: B Downslope 3

Hydrograph



Summary for Reach BDS4: B Downslope 4

[61] Hint: Exceeded Reach B7T outlet invert by 0.69' @ 12.16 hrs

[62] Hint: Exceeded Reach BDS3 OUTLET depth by 0.23' @ 12.15 hrs

Inflow Area = 694,547 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 88.16 cfs @ 12.16 hrs, Volume= 255,780 cf
Outflow = 87.87 cfs @ 12.16 hrs, Volume= 255,780 cf, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 11.47 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 2.77 fps, Avg. Travel Time= 1.0 min

Peak Storage= 1,229 cf @ 12.16 hrs

Average Depth at Peak Storage= 0.69'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 619.51 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

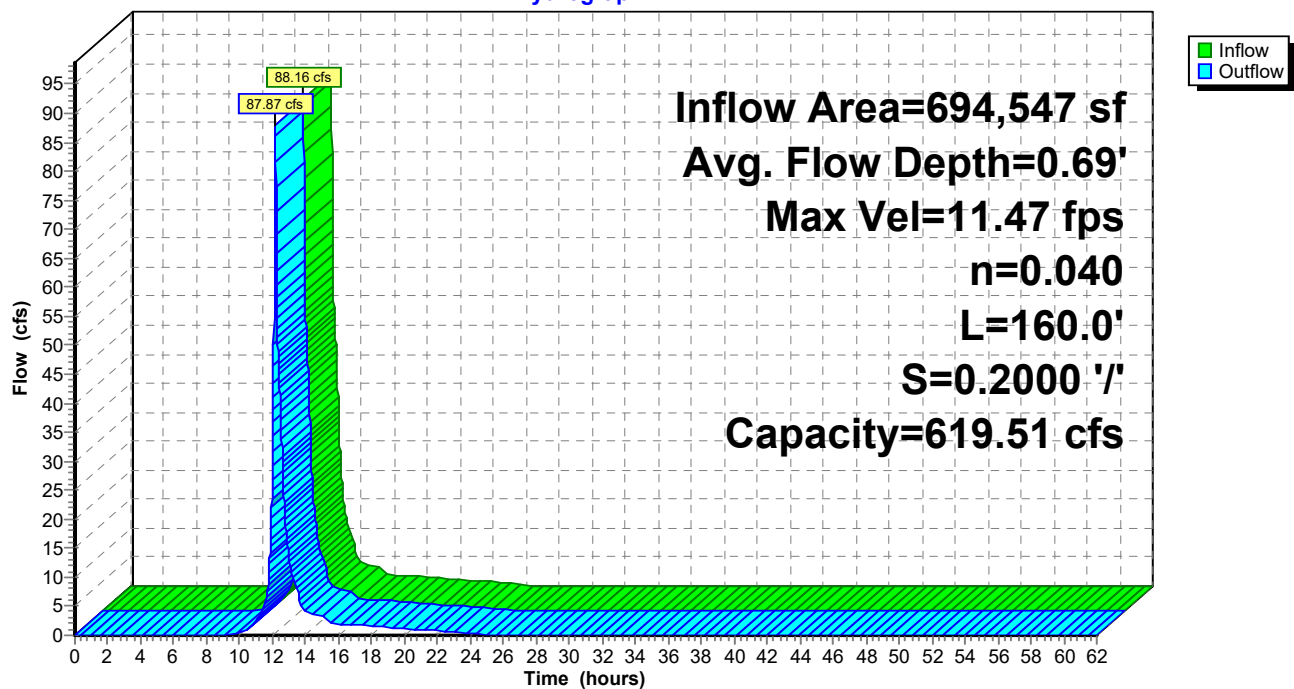
Length= 160.0' Slope= 0.2000 '/'

Inlet Invert= 942.00', Outlet Invert= 910.00'



Reach BDS4: B Downslope 4

Hydrograph



Summary for Reach C0T: C0 Terrace

Inflow Area = 32,269 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 4.83 cfs @ 12.19 hrs, Volume= 11,884 cf
 Outflow = 4.78 cfs @ 12.22 hrs, Volume= 11,884 cf, Atten= 1%, Lag= 1.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 3.17 fps, Min. Travel Time= 0.9 min

Avg. Velocity = 1.14 fps, Avg. Travel Time= 2.6 min

Peak Storage= 266 cf @ 12.20 hrs

Average Depth at Peak Storage= 0.52'

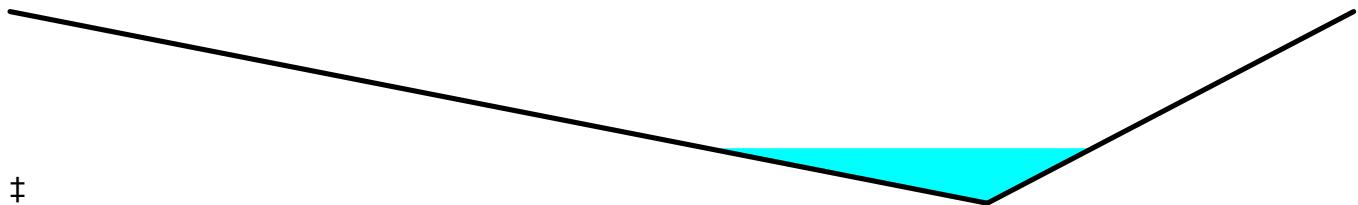
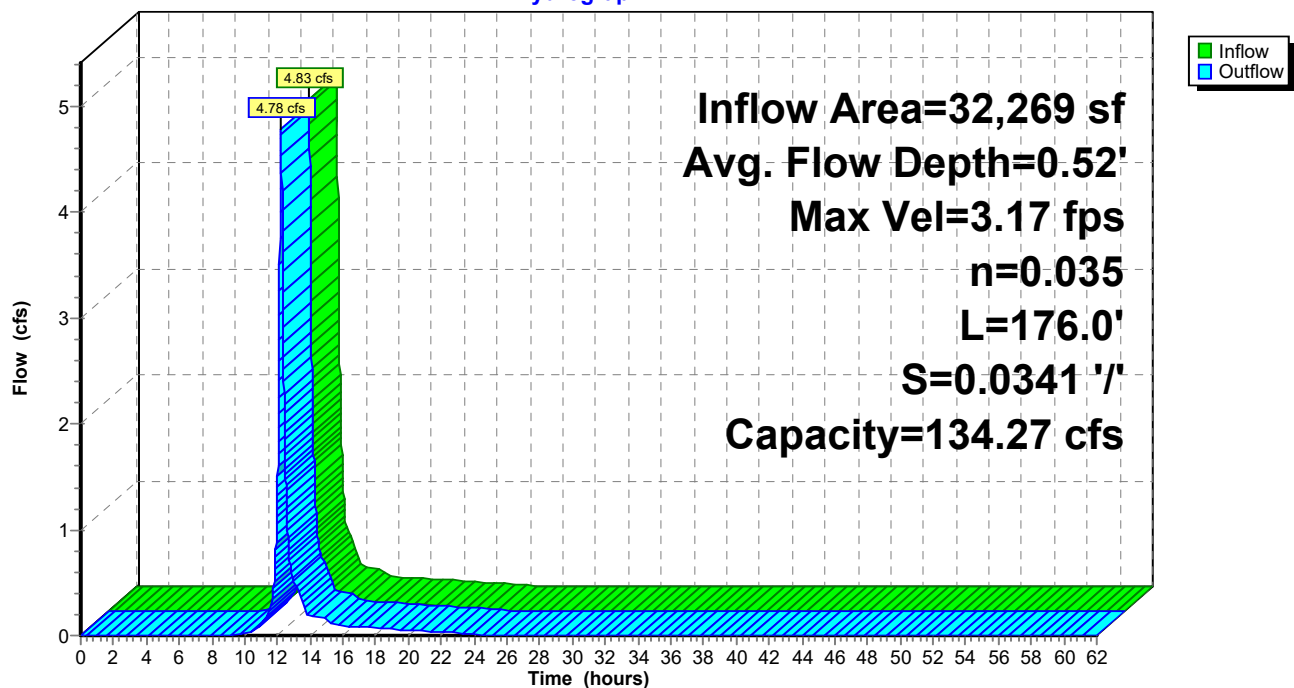
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 134.27 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 176.0' Slope= 0.0341 '/'

Inlet Invert= 1,096.00', Outlet Invert= 1,090.00'

**Reach C0T: C0 Terrace****Hydrograph**

Summary for Reach C10T: C10 Terrace

[62] Hint: Exceeded Reach CCDS1 OUTLET depth by 1.14' @ 12.15 hrs

Inflow Area = 313,549 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 51.96 cfs @ 12.13 hrs, Volume= 115,471 cf
 Outflow = 42.89 cfs @ 12.25 hrs, Volume= 115,471 cf, Atten= 17%, Lag= 7.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.39 fps, Min. Travel Time= 4.8 min

Avg. Velocity= 1.23 fps, Avg. Travel Time= 17.3 min

Peak Storage= 12,445 cf @ 12.17 hrs

Average Depth at Peak Storage= 1.33'

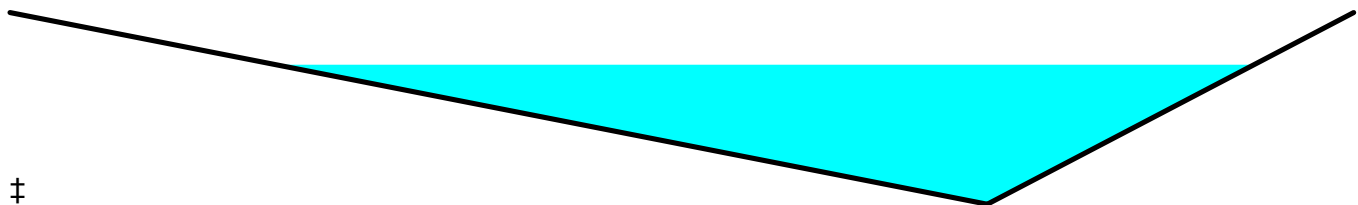
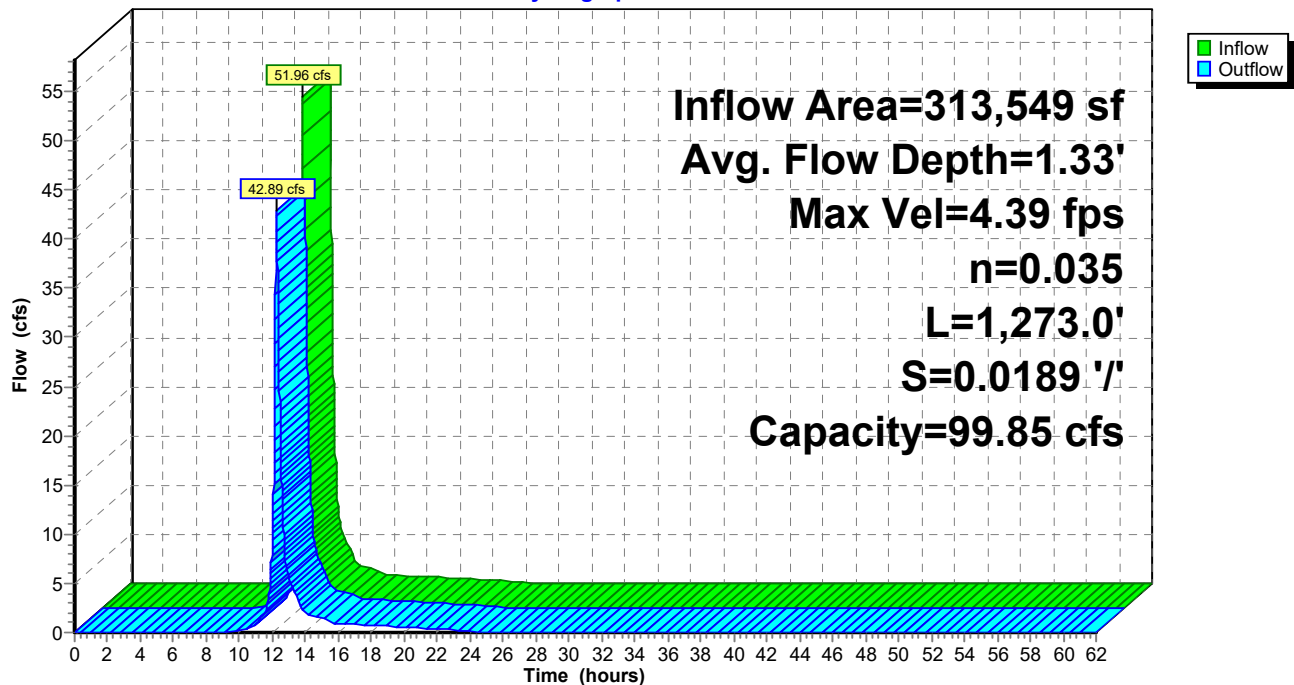
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 99.85 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 1,273.0' Slope= 0.0189 '/'

Inlet Invert= 924.00', Outlet Invert= 900.00'

**Reach C10T: C10 Terrace****Hydrograph**

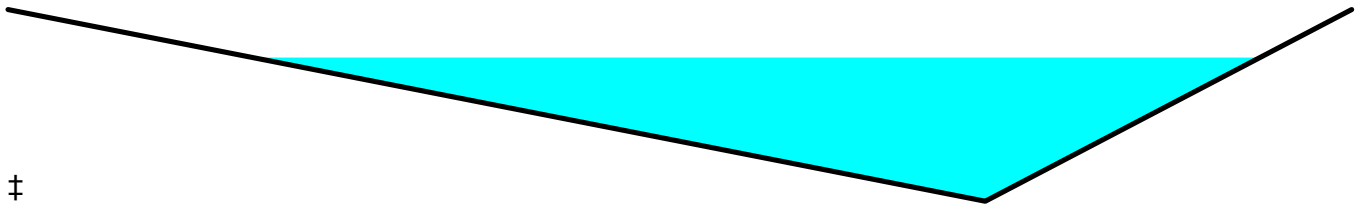
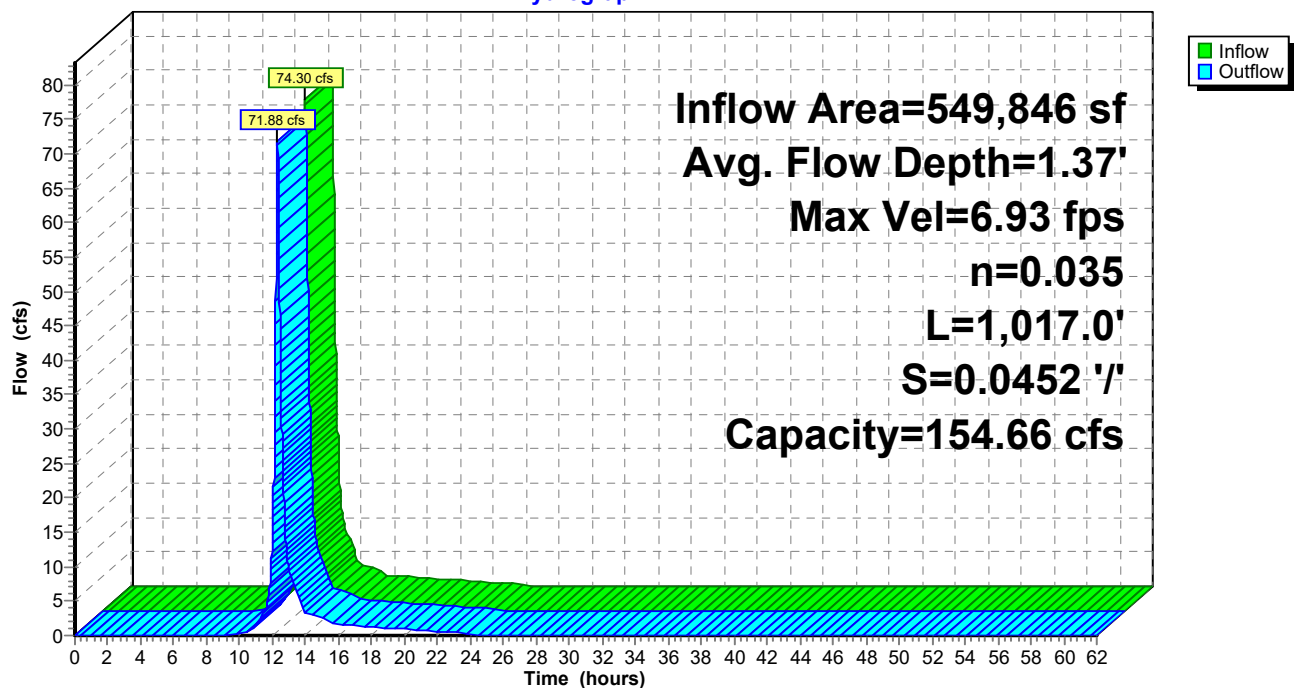
Summary for Reach C1T: C1 Terrace

Inflow Area = 549,846 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 74.30 cfs @ 12.22 hrs, Volume= 202,491 cf
Outflow = 71.88 cfs @ 12.29 hrs, Volume= 202,491 cf, Atten= 3%, Lag= 4.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.93 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 2.23 fps, Avg. Travel Time= 7.6 min

Peak Storage= 10,547 cf @ 12.25 hrs
Average Depth at Peak Storage= 1.37'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 154.66 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 1,017.0' Slope= 0.0452 '/'
Inlet Invert= 1,094.00', Outlet Invert= 1,048.00'

**Reach C1T: C1 Terrace****Hydrograph**

Summary for Reach C2T: C2 Terrace

Inflow Area = 224,833 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 30.18 cfs @ 12.22 hrs, Volume= 82,799 cf
Outflow = 28.22 cfs @ 12.33 hrs, Volume= 82,799 cf, Atten= 6%, Lag= 6.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.57 fps, Min. Travel Time= 3.7 min

Avg. Velocity = 1.45 fps, Avg. Travel Time= 11.6 min

Peak Storage= 6,225 cf @ 12.27 hrs

Average Depth at Peak Storage= 1.06'

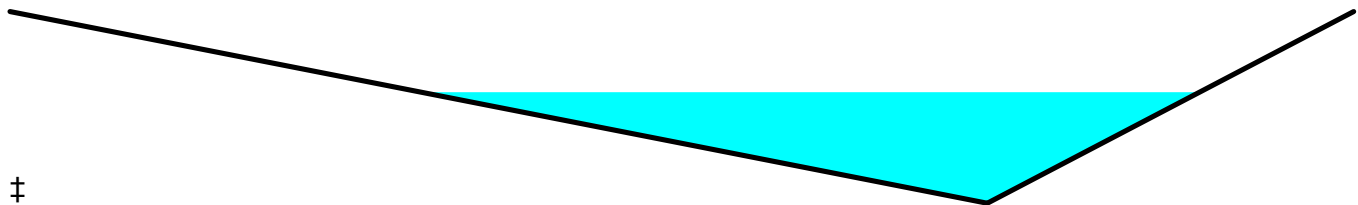
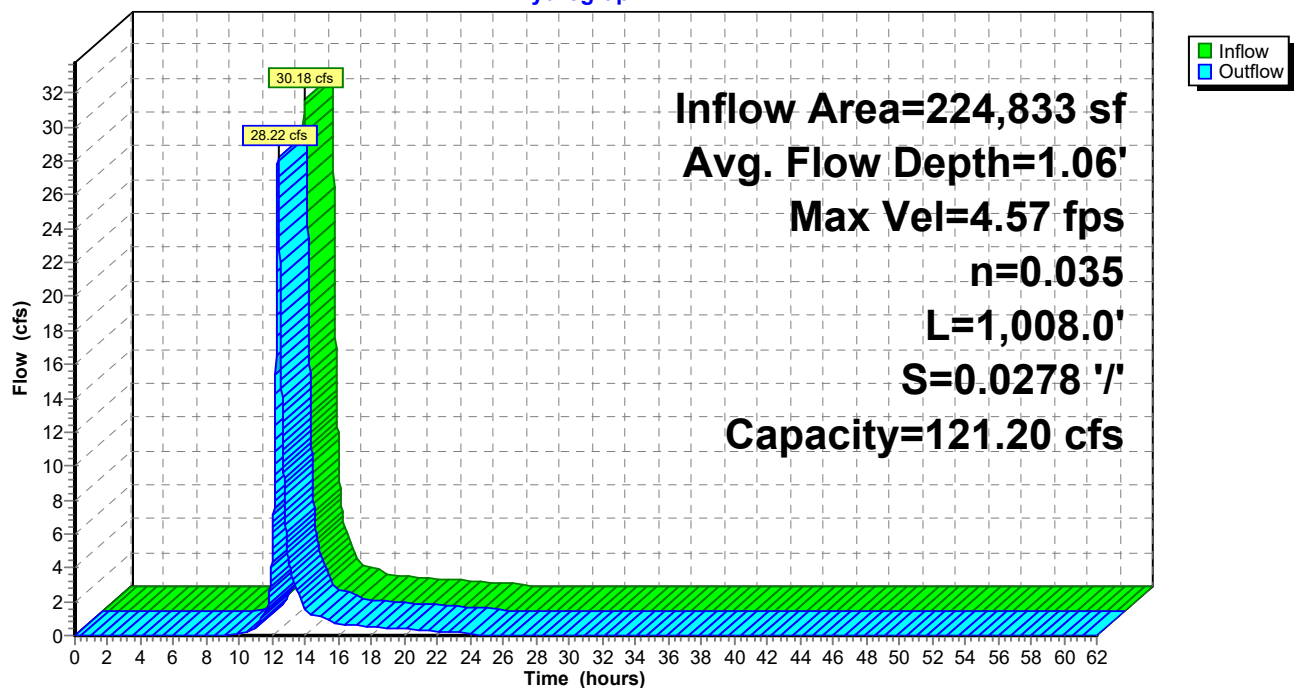
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 121.20 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 1,008.0' Slope= 0.0278 '/'

Inlet Invert= 1,090.00', Outlet Invert= 1,062.00'

**Reach C2T: C2 Terrace****Hydrograph**

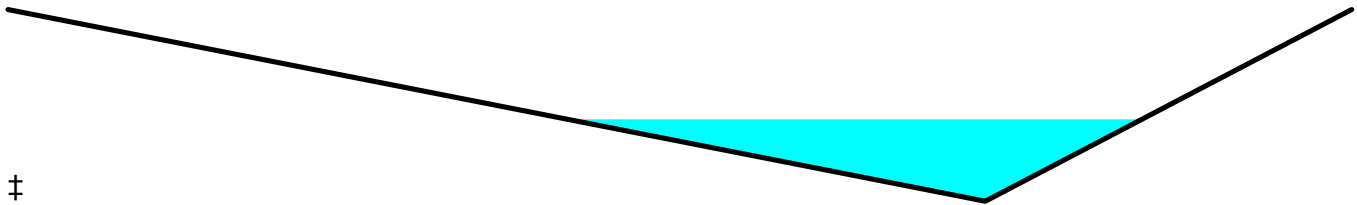
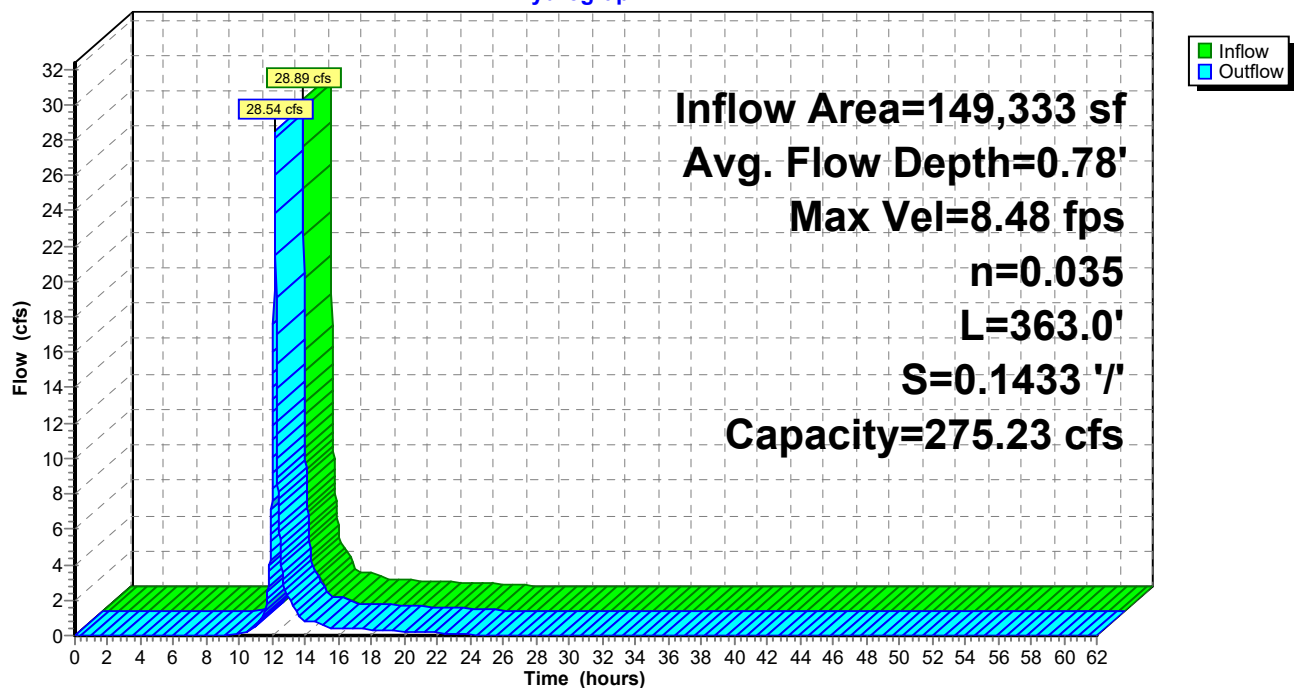
Summary for Reach C3T: C3 Terrace

Inflow Area = 149,333 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 28.89 cfs @ 12.13 hrs, Volume= 54,995 cf
 Outflow = 28.54 cfs @ 12.15 hrs, Volume= 54,995 cf, Atten= 1%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 8.48 fps, Min. Travel Time= 0.7 min
 Avg. Velocity = 2.86 fps, Avg. Travel Time= 2.1 min

Peak Storage= 1,223 cf @ 12.13 hrs
 Average Depth at Peak Storage= 0.78'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 275.23 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
 Length= 363.0' Slope= 0.1433 '/'
 Inlet Invert= 1,056.00', Outlet Invert= 1,004.00'

**Reach C3T: C3 Terrace****Hydrograph**

Summary for Reach C4T: C4 Terrace

Inflow Area = 235,176 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 45.49 cfs @ 12.13 hrs, Volume= 86,608 cf
 Outflow = 38.12 cfs @ 12.23 hrs, Volume= 86,608 cf, Atten= 16%, Lag= 6.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 5.03 fps, Min. Travel Time= 4.3 min

Avg. Velocity= 1.44 fps, Avg. Travel Time= 15.0 min

Peak Storage= 9,844 cf @ 12.16 hrs

Average Depth at Peak Storage= 1.17'

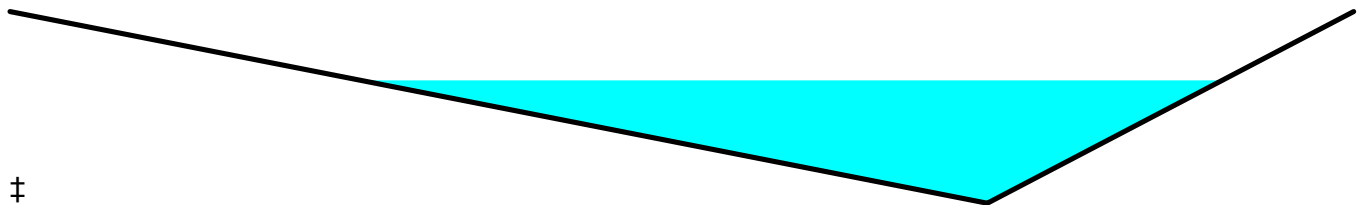
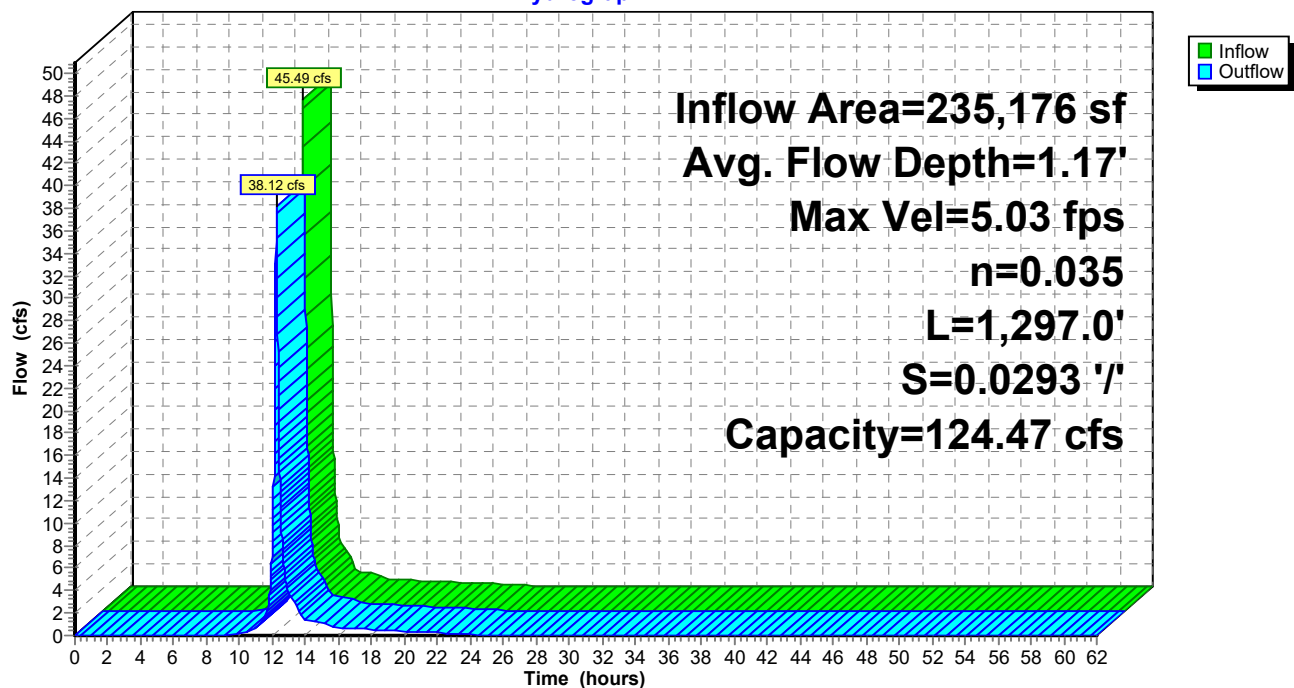
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 124.47 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 1,297.0' Slope= 0.0293 '/'

Inlet Invert= 1,058.00', Outlet Invert= 1,020.00'

**Reach C4T: C4 Terrace****Hydrograph**

Summary for Reach C5T: C5 Terrace

Inflow Area = 239,483 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 46.32 cfs @ 12.13 hrs, Volume= 88,194 cf
 Outflow = 35.26 cfs @ 12.27 hrs, Volume= 88,194 cf, Atten= 24%, Lag= 8.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.99 fps, Min. Travel Time= 6.2 min

Avg. Velocity= 1.36 fps, Avg. Travel Time= 22.7 min

Peak Storage= 13,115 cf @ 12.17 hrs

Average Depth at Peak Storage= 1.13'

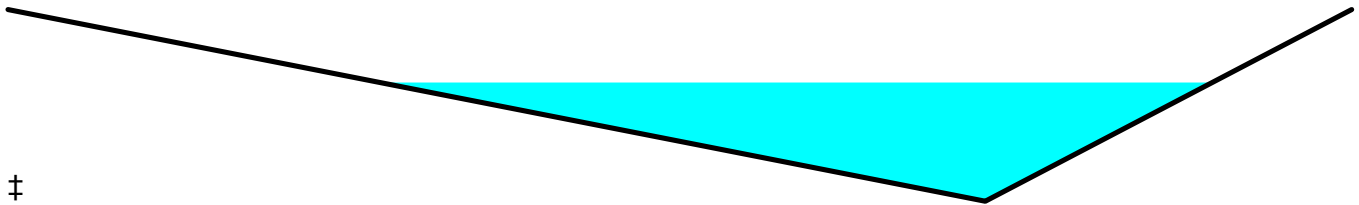
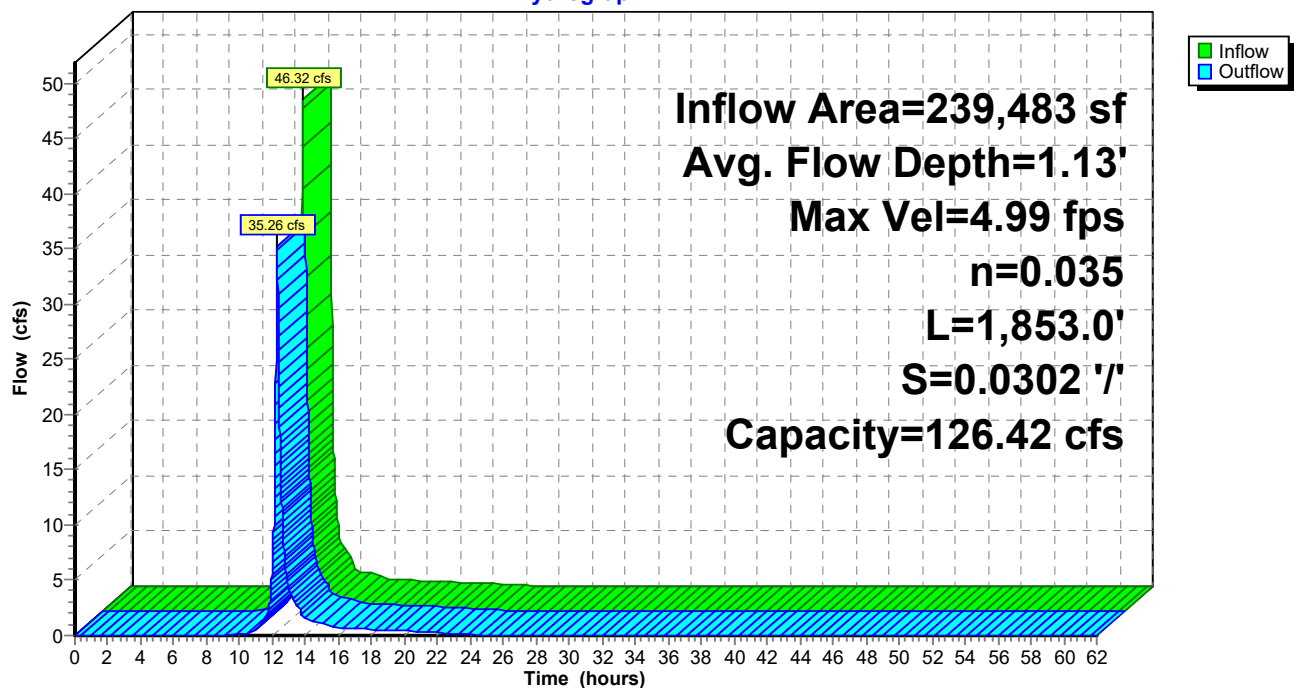
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 126.42 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 1,853.0' Slope= 0.0302 '/'

Inlet Invert= 1,018.00', Outlet Invert= 962.00'

**Reach C5T: C5 Terrace****Hydrograph**

Summary for Reach C6T: C6 Terrace

Inflow Area = 189,000 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 34.21 cfs @ 12.14 hrs, Volume= 69,603 cf
 Outflow = 33.07 cfs @ 12.18 hrs, Volume= 69,603 cf, Atten= 3%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 22.91 fps, Min. Travel Time= 1.2 min

Avg. Velocity = 22.91 fps, Avg. Travel Time= 1.2 min

Peak Storage= 2,307 cf @ 12.16 hrs

Average Depth at Peak Storage= 0.03'

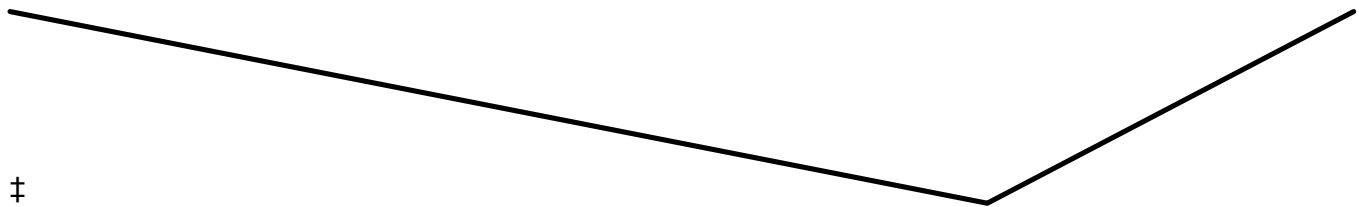
Bank-Full Depth= 998.00' Flow Area= 5,478,022.0 sf, Capacity= 2,703,331,657.33 cfs

0.00' x 998.00' deep channel, n= 0.035

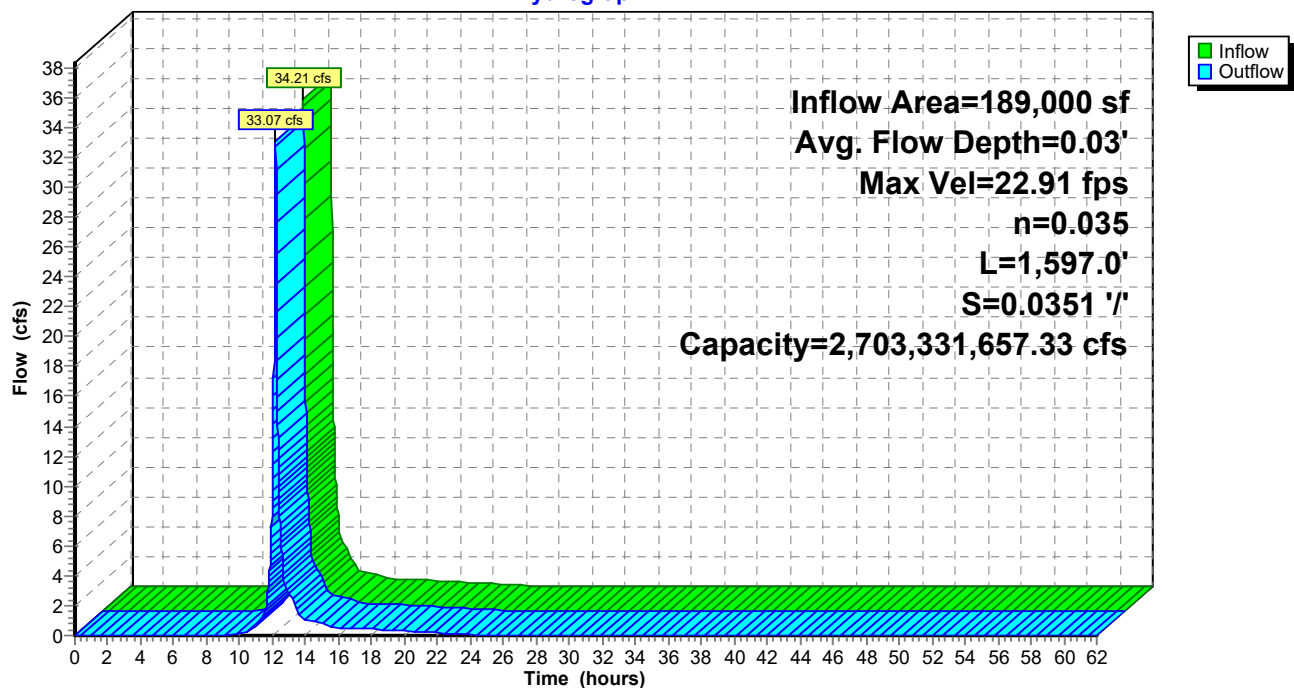
Side Slope Z-value= 8.0 3.0 ' Top Width= 10,978.00'

Length= 1,597.0' Slope= 0.0351 ' /'

Inlet Invert= 1,036.00', Outlet Invert= 980.00'

**Reach C6T: C6 Terrace**

Hydrograph



Summary for Reach C7T: C7 Terrace

Inflow Area = 249,979 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 48.41 cfs @ 12.12 hrs, Volume= 92,060 cf
 Outflow = 37.01 cfs @ 12.27 hrs, Volume= 92,060 cf, Atten= 24%, Lag= 8.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 5.14 fps, Min. Travel Time= 6.1 min

Avg. Velocity= 1.40 fps, Avg. Travel Time= 22.5 min

Peak Storage= 13,625 cf @ 12.17 hrs

Average Depth at Peak Storage= 1.14'

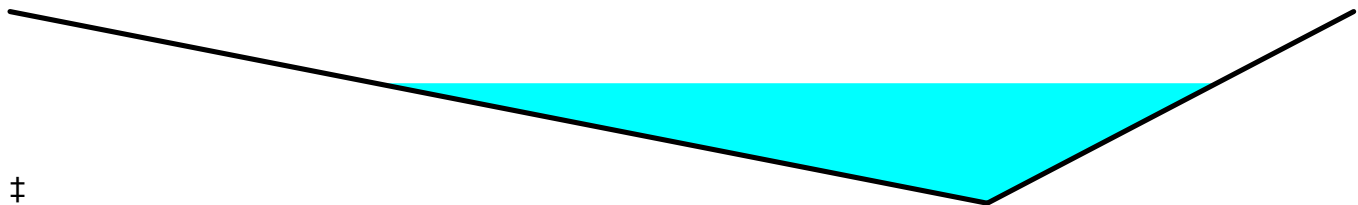
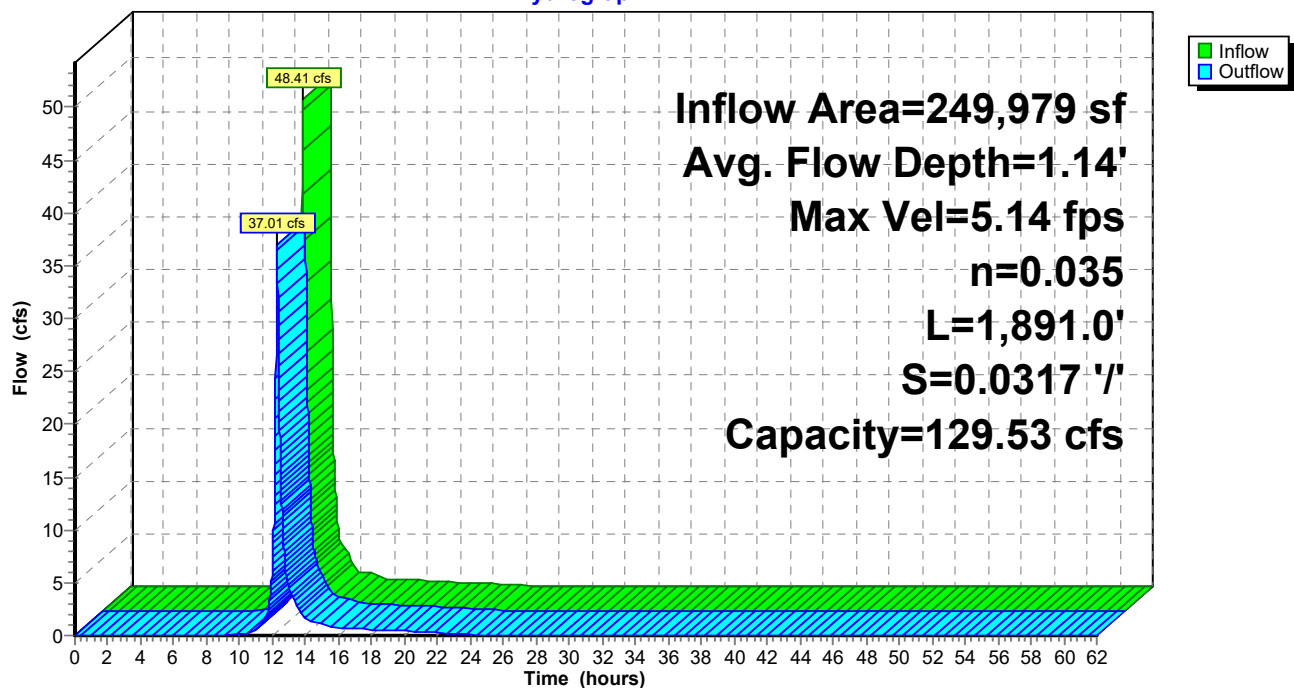
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 129.53 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'

Length= 1,891.0' Slope= 0.0317 '/'

Inlet Invert= 982.00', Outlet Invert= 922.00'

**Reach C7T: C7 Terrace****Hydrograph**

Summary for Reach C8T: C8 Terrace

Inflow Area = 220,718 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 41.39 cfs @ 12.13 hrs, Volume= 81,284 cf
 Outflow = 31.93 cfs @ 12.28 hrs, Volume= 81,284 cf, Atten= 23%, Lag= 8.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 5.14 fps, Min. Travel Time= 6.1 min

Avg. Velocity= 1.43 fps, Avg. Travel Time= 22.1 min

Peak Storage= 11,776 cf @ 12.18 hrs

Average Depth at Peak Storage= 1.06'

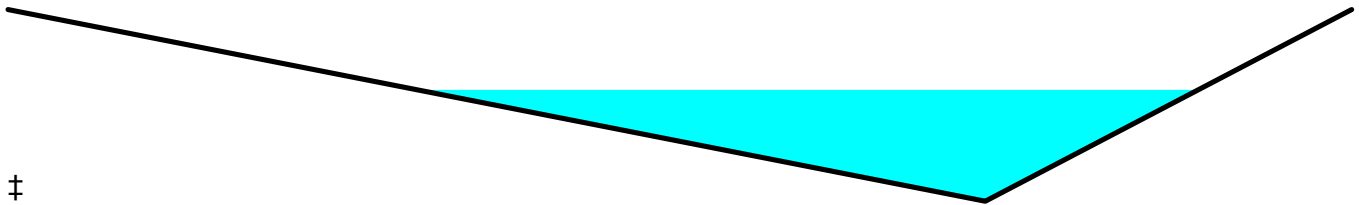
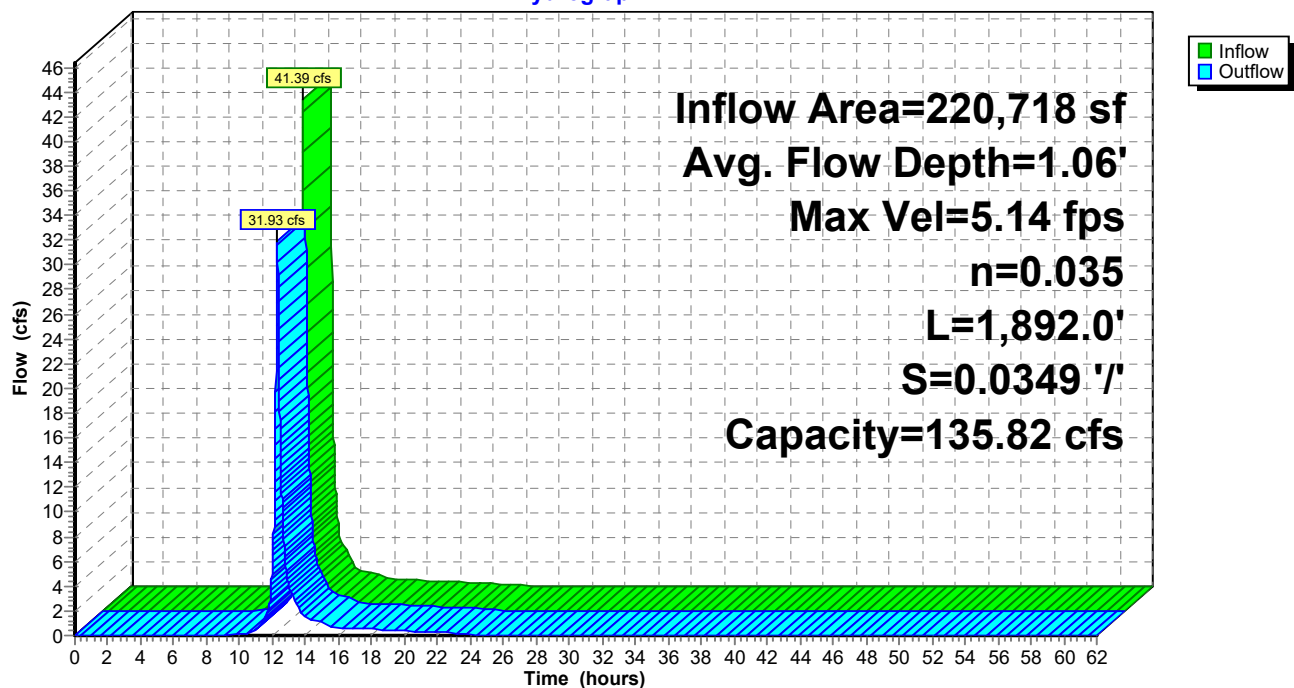
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 135.82 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'

Length= 1,892.0' Slope= 0.0349 '/'

Inlet Invert= 1,004.00', Outlet Invert= 938.00'

**Reach C8T: C8 Terrace****Hydrograph**

Summary for Reach C9T: C9 Terrace

[55] Hint: Peak inflow is 156% of Manning's capacity

Inflow Area = 359,459 sf, 0.00% Impervious, Inflow Depth = 5.43" for 100-yr 24-hr event
 Inflow = 79.02 cfs @ 12.13 hrs, Volume= 162,798 cf
 Outflow = 47.98 cfs @ 12.41 hrs, Volume= 162,798 cf, Atten= 39%, Lag= 16.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 2.71 fps, Min. Travel Time= 12.7 min

Avg. Velocity = 0.55 fps, Avg. Travel Time= 62.5 min

Peak Storage= 36,530 cf @ 12.20 hrs

Average Depth at Peak Storage= 1.79'

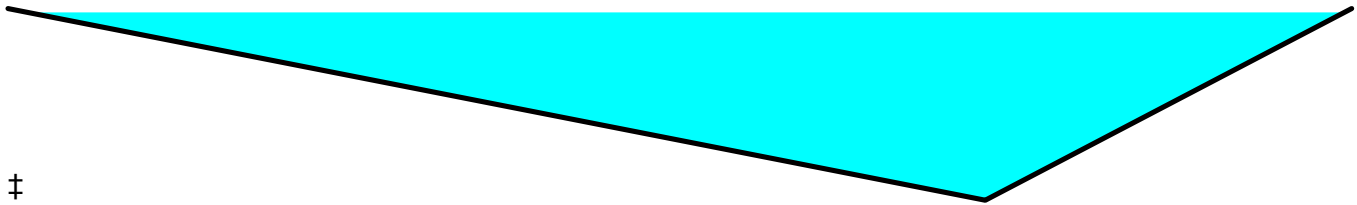
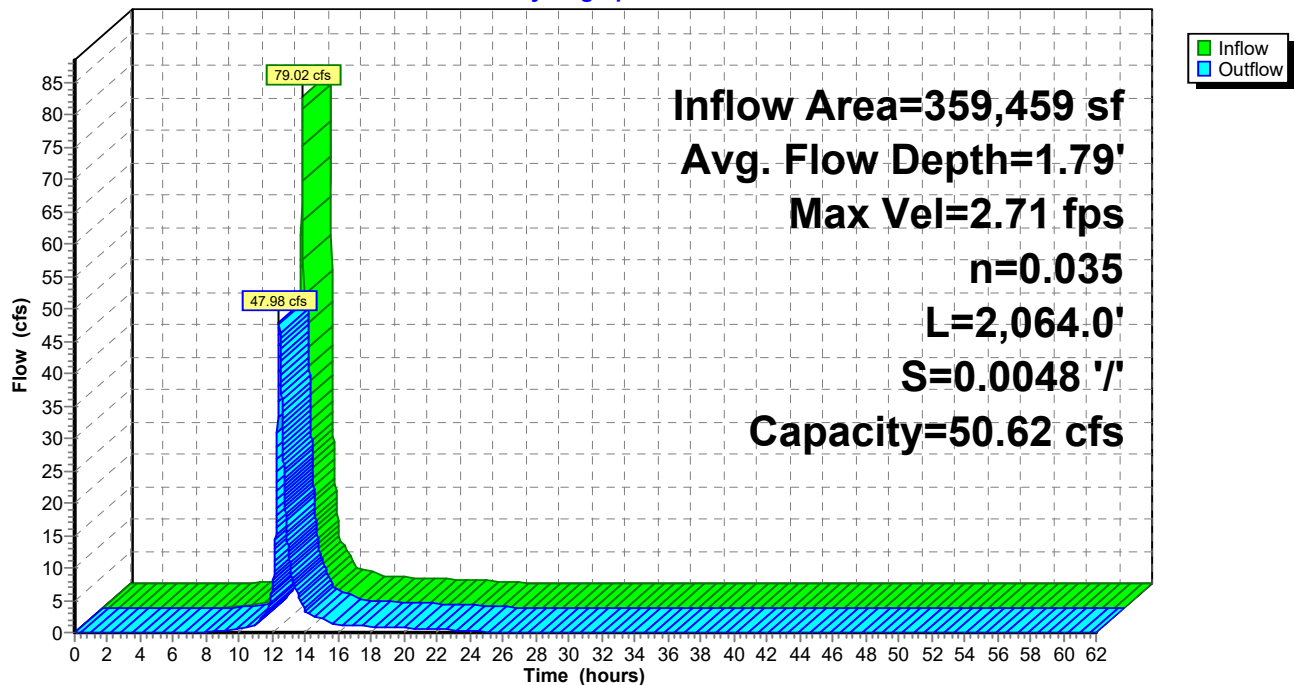
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 50.62 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 2,064.0' Slope= 0.0048 '/'

Inlet Invert= 910.00', Outlet Invert= 900.00'

**Reach C9T: C9 Terrace****Hydrograph**

Summary for Reach CC2T: CC2 Terrace

Inflow Area = 87,958 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 16.49 cfs @ 12.13 hrs, Volume= 32,392 cf
 Outflow = 14.56 cfs @ 12.22 hrs, Volume= 32,392 cf, Atten= 12%, Lag= 5.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.44 fps, Min. Travel Time= 3.4 min

Avg. Velocity = 1.40 fps, Avg. Travel Time= 10.8 min

Peak Storage= 2,973 cf @ 12.16 hrs

Average Depth at Peak Storage= 0.77'

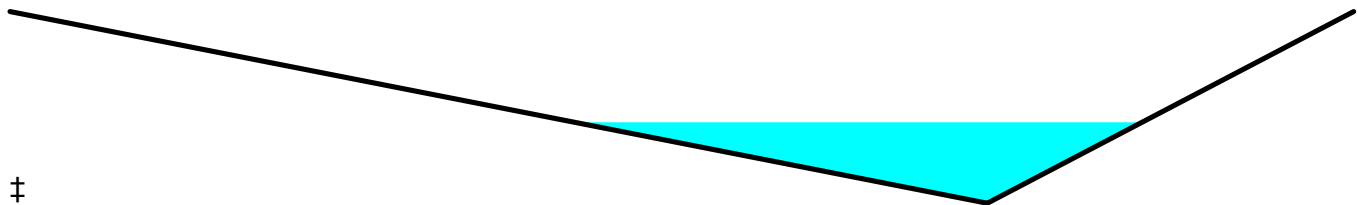
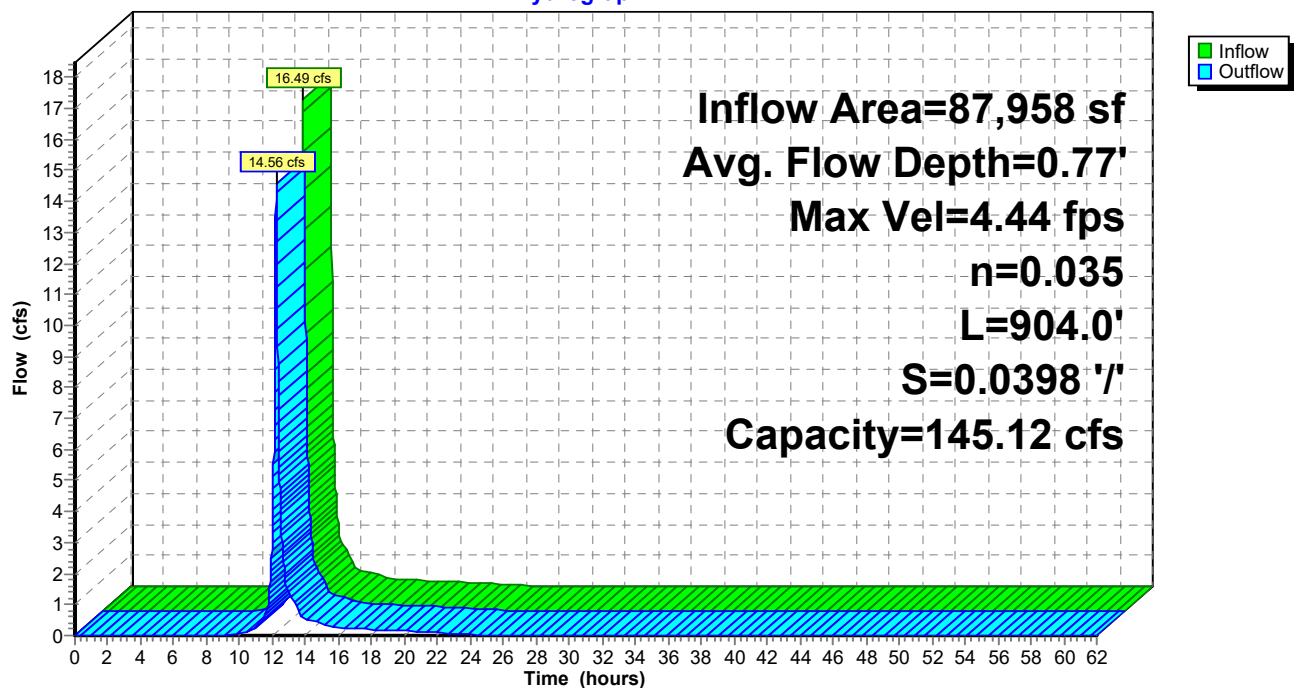
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 145.12 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 904.0' Slope= 0.0398 '/'

Inlet Invert= 980.00', Outlet Invert= 944.00'

**Reach CC2T: CC2 Terrace****Hydrograph**

Summary for Reach CC4T: CC4 Terrace

Inflow Area = 212,677 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 40.36 cfs @ 12.13 hrs, Volume= 78,322 cf
 Outflow = 23.26 cfs @ 12.42 hrs, Volume= 78,322 cf, Atten= 42%, Lag= 17.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 3.19 fps, Min. Travel Time= 13.0 min

Avg. Velocity = 0.75 fps, Avg. Travel Time= 55.6 min

Peak Storage= 18,178 cf @ 12.20 hrs

Average Depth at Peak Storage= 1.15'

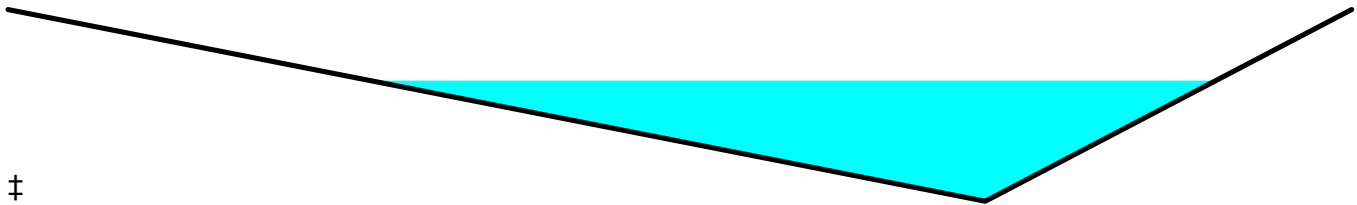
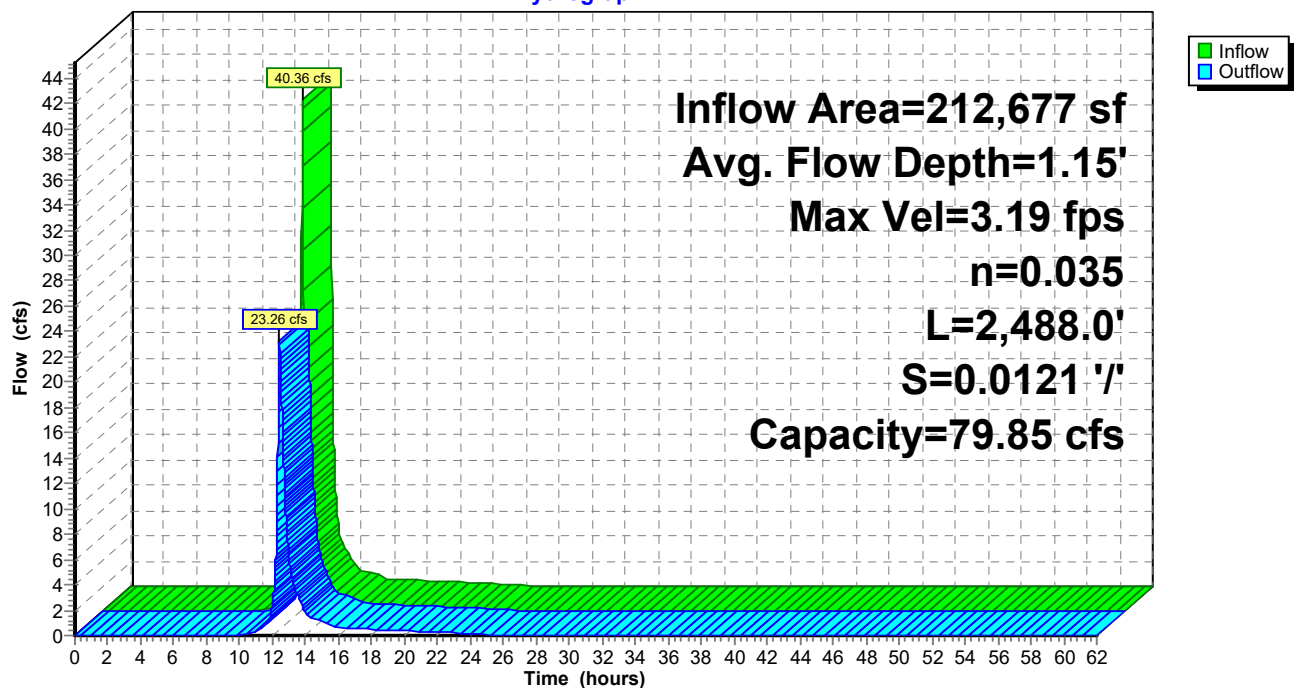
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 79.85 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 2,488.0' Slope= 0.0121 '/'

Inlet Invert= 924.00', Outlet Invert= 894.00'

**Reach CC4T: CC4 Terrace****Hydrograph**

Summary for Reach CCDS1: CC Downslope 1

[61] Hint: Exceeded Reach CC2T outlet invert by 0.23' @ 12.22 hrs

Inflow Area = 87,958 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 14.56 cfs @ 12.22 hrs, Volume= 32,392 cf
 Outflow = 14.51 cfs @ 12.23 hrs, Volume= 32,392 cf, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 6.48 fps, Min. Travel Time= 0.3 min

Avg. Velocity= 1.61 fps, Avg. Travel Time= 1.1 min

Peak Storage= 248 cf @ 12.22 hrs

Average Depth at Peak Storage= 0.23'

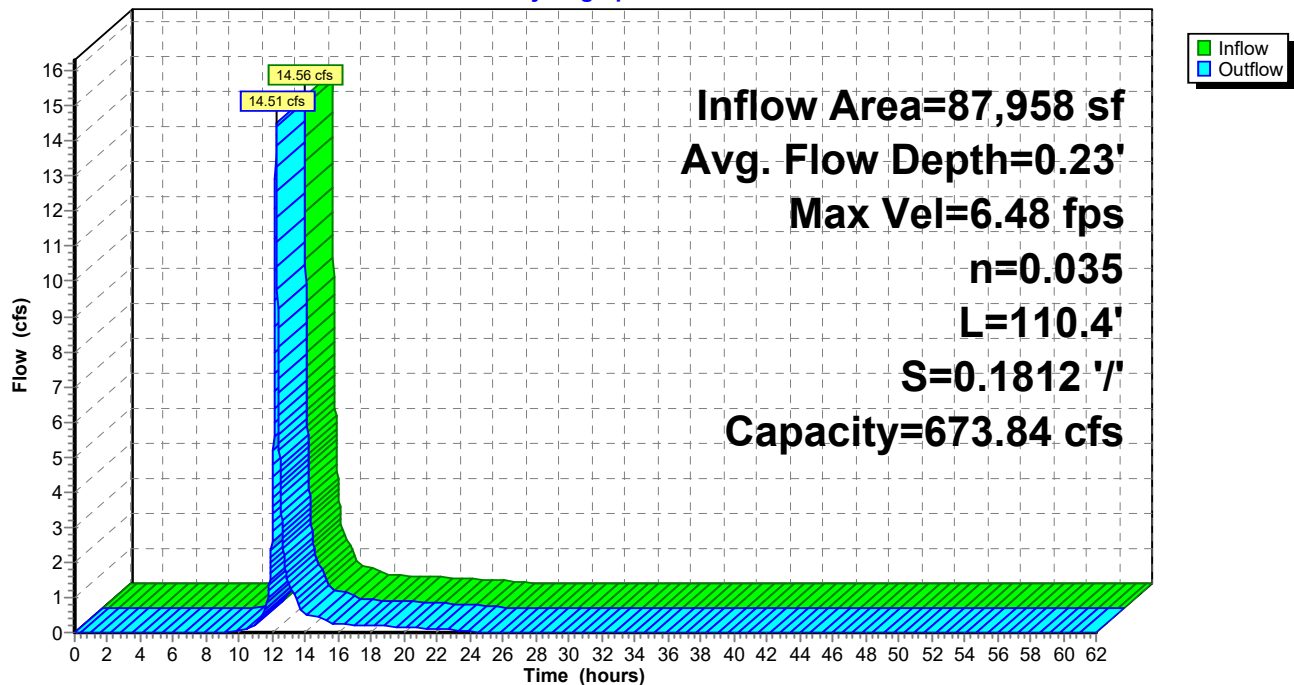
Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 673.84 cfs

9.00' x 2.00' deep channel, n= 0.035

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

Length= 110.4' Slope= 0.1812 '/'

Inlet Invert= 944.00', Outlet Invert= 924.00'

**Reach CCDS1: CC Downslope 1****Hydrograph**

Summary for Reach CDS1: C Downslope 1

[61] Hint: Exceeded Reach COT outlet invert by 0.12' @ 12.22 hrs

Inflow Area = 32,269 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 4.78 cfs @ 12.22 hrs, Volume= 11,884 cf
 Outflow = 4.77 cfs @ 12.23 hrs, Volume= 11,884 cf, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.22 fps, Min. Travel Time= 0.5 min

Avg. Velocity= 1.42 fps, Avg. Travel Time= 1.4 min

Peak Storage= 139 cf @ 12.22 hrs

Average Depth at Peak Storage= 0.12'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 660.94 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

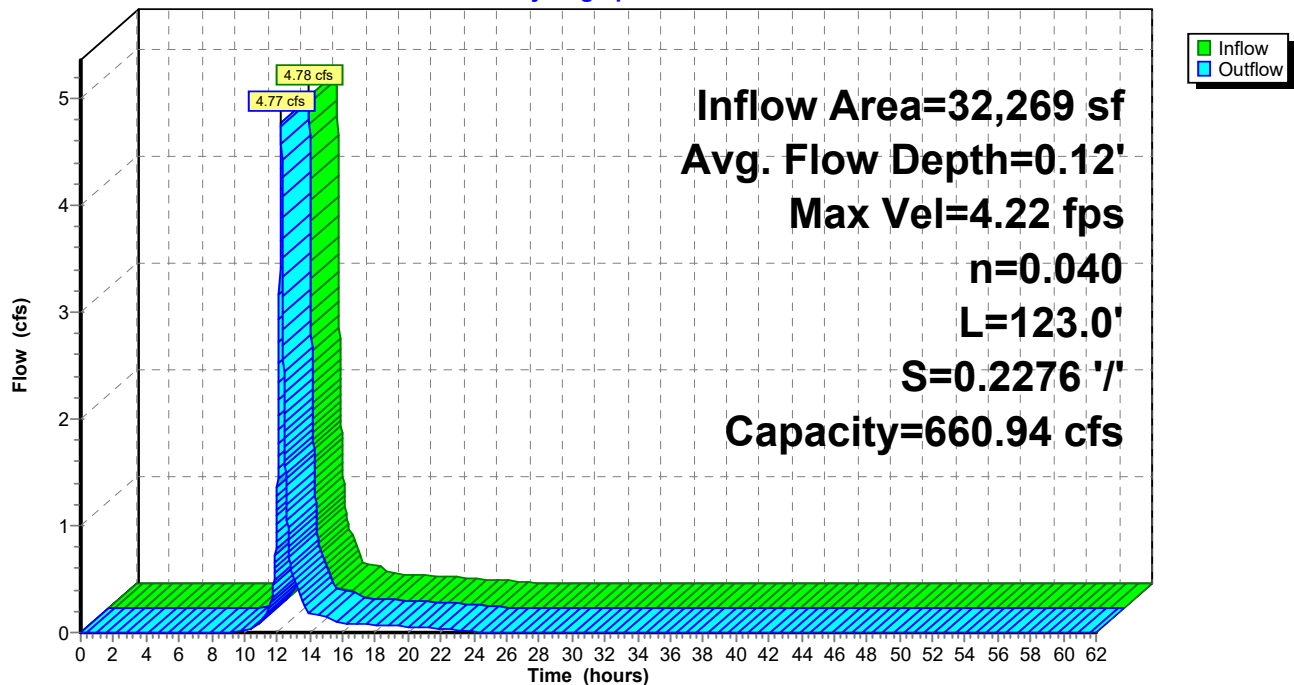
Length= 123.0' Slope= 0.2276 '/'

Inlet Invert= 1,090.00', Outlet Invert= 1,062.00'



Reach CDS1: C Downslope 1

Hydrograph



Summary for Reach CDS2: C Downslope 2

[61] Hint: Exceeded Reach C2T outlet invert by 0.37' @ 12.32 hrs

[62] Hint: Exceeded Reach CDS1 OUTLET depth by 0.28' @ 12.35 hrs

Inflow Area = 257,102 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 31.62 cfs @ 12.32 hrs, Volume= 94,683 cf
Outflow = 31.61 cfs @ 12.32 hrs, Volume= 94,683 cf, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 8.42 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 2.05 fps, Avg. Travel Time= 0.5 min

Peak Storage= 234 cf @ 12.32 hrs

Average Depth at Peak Storage= 0.37'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 656.15 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 ' ' Top Width= 21.00'

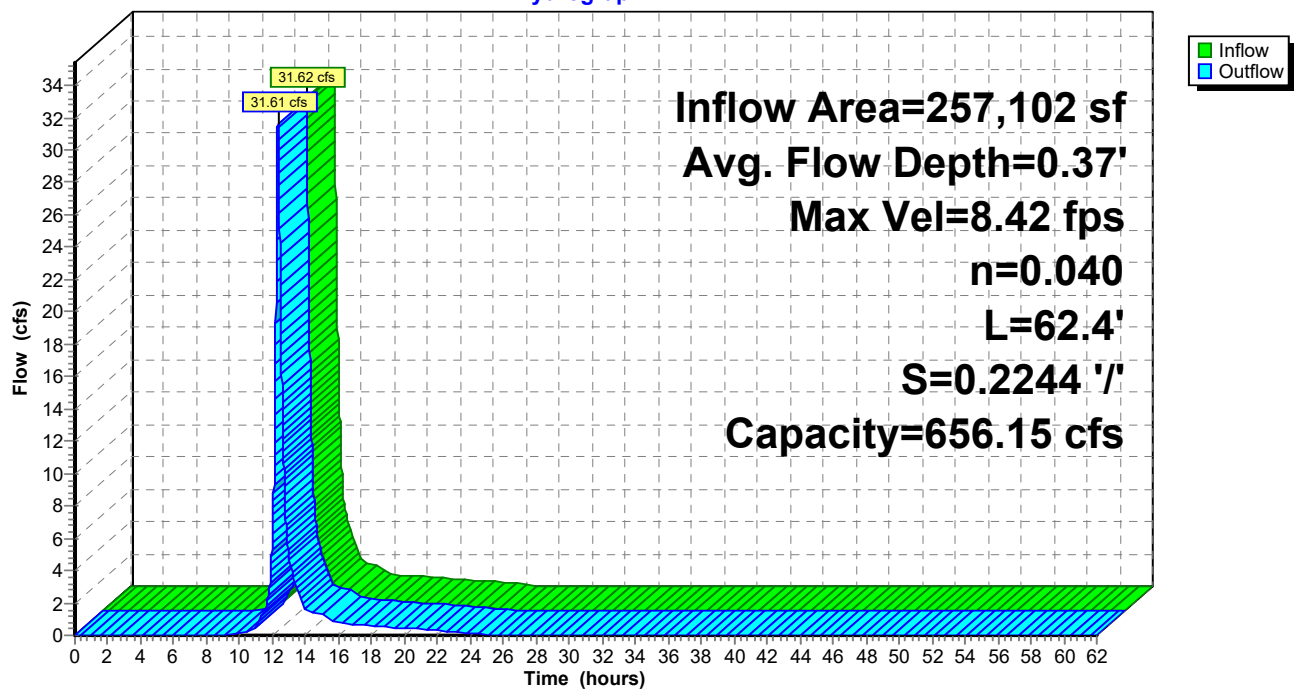
Length= 62.4' Slope= 0.2244 ' '

Inlet Invert= 1,062.00', Outlet Invert= 1,048.00'



Reach CDS2: C Downslope 2

Hydrograph



Summary for Reach CDS3: C Downslope 3

[61] Hint: Exceeded Reach C1T outlet invert by 0.72' @ 12.30 hrs

[62] Hint: Exceeded Reach CDS2 OUTLET depth by 0.35' @ 12.29 hrs

Inflow Area = 806,948 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 102.93 cfs @ 12.30 hrs, Volume= 297,174 cf
Outflow = 102.87 cfs @ 12.31 hrs, Volume= 297,174 cf, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 12.89 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 3.01 fps, Avg. Travel Time= 0.6 min

Peak Storage= 918 cf @ 12.30 hrs

Average Depth at Peak Storage= 0.72'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 683.54 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 ' ' Top Width= 21.00'

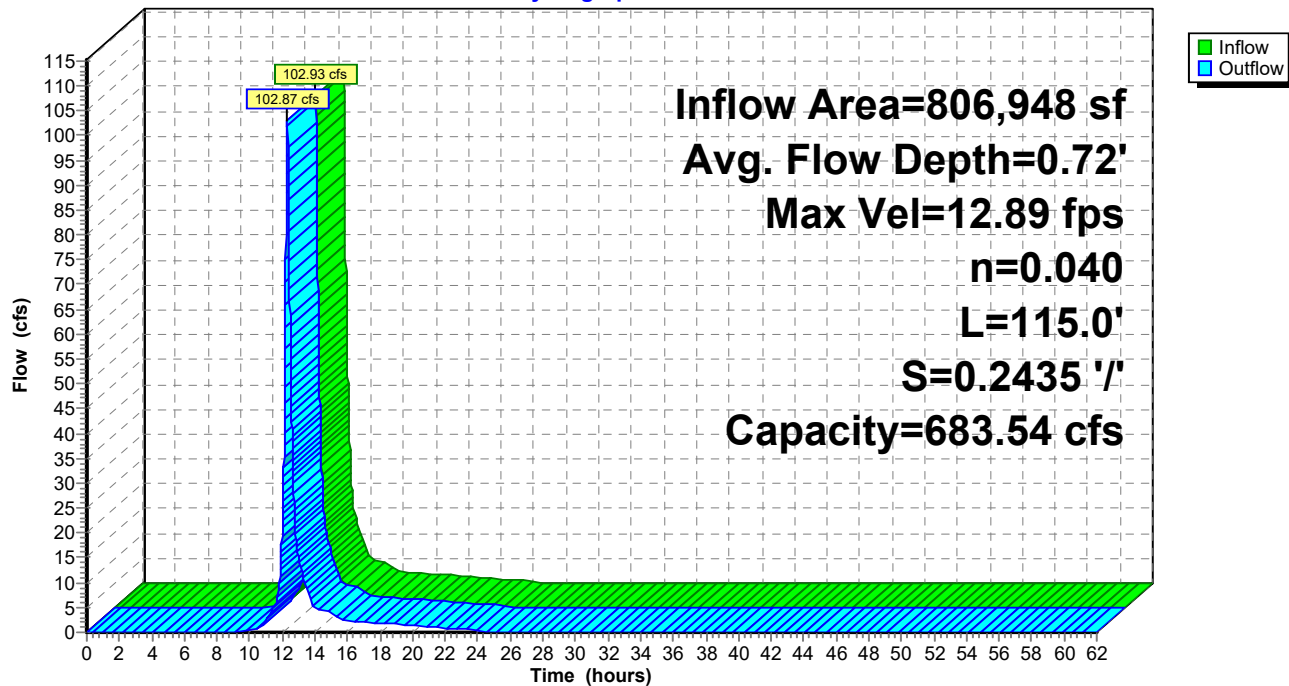
Length= 115.0' Slope= 0.2435 ' '

Inlet Invert= 1,048.00', Outlet Invert= 1,020.00'



Reach CDS3: C Downslope 3

Hydrograph



Summary for Reach CDS4: C Downslope 4

[62] Hint: Exceeded Reach C4T OUTLET depth by 0.04' @ 12.35 hrs

[62] Hint: Exceeded Reach CDS3 OUTLET depth by 0.23' @ 12.23 hrs

Inflow Area = 1,042,124 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 132.42 cfs @ 12.28 hrs, Volume= 383,782 cf
Outflow = 132.36 cfs @ 12.28 hrs, Volume= 383,782 cf, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 12.28 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 2.80 fps, Avg. Travel Time= 0.6 min

Peak Storage= 1,035 cf @ 12.28 hrs

Average Depth at Peak Storage= 0.92'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 565.53 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

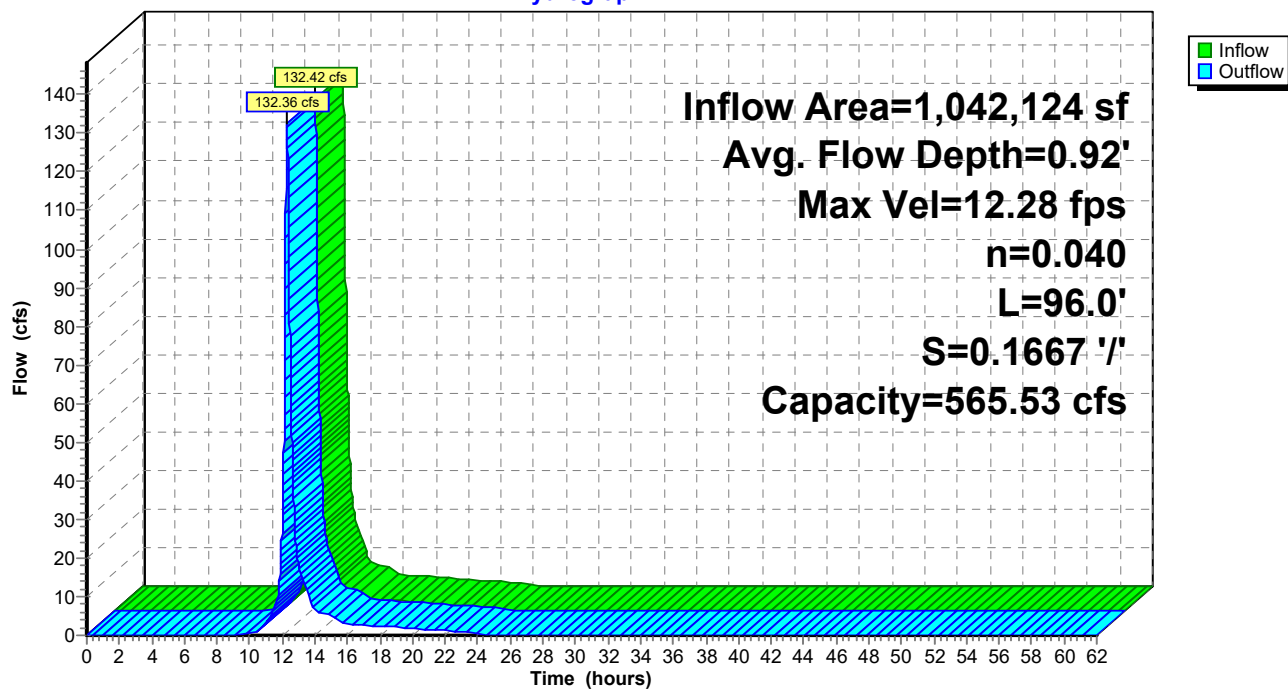
Length= 96.0' Slope= 0.1667 '/'

Inlet Invert= 1,020.00', Outlet Invert= 1,004.00'



Reach CDS4: C Downslope 4

Hydrograph



Summary for Reach CDS5: C Downslope 5

[62] Hint: Exceeded Reach C3T OUTLET depth by 0.37' @ 12.31 hrs

[62] Hint: Exceeded Reach CDS4 OUTLET depth by 0.07' @ 12.12 hrs

Inflow Area = 1,191,457 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 142.49 cfs @ 12.27 hrs, Volume= 438,777 cf
Outflow = 142.41 cfs @ 12.28 hrs, Volume= 438,777 cf, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 14.05 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 3.27 fps, Avg. Travel Time= 0.5 min

Peak Storage= 1,055 cf @ 12.28 hrs

Average Depth at Peak Storage= 0.87'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 665.46 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 ' ' Top Width= 21.00'

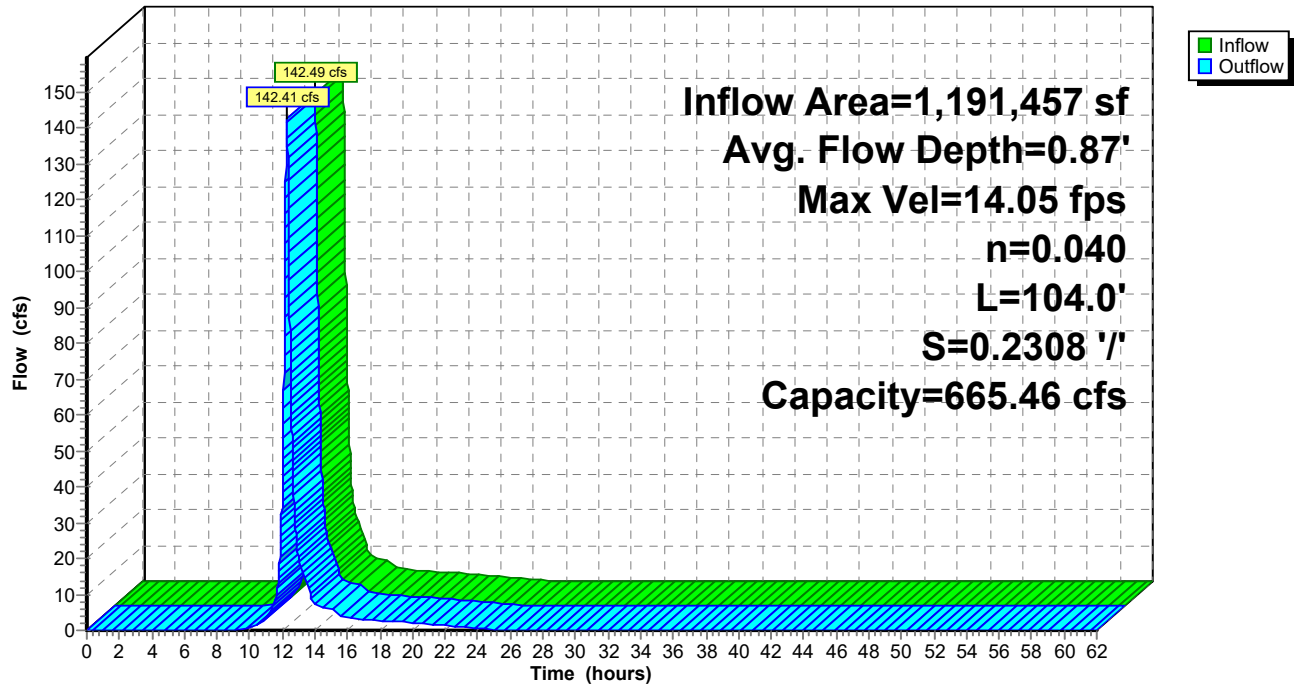
Length= 104.0' Slope= 0.2308 ' '

Inlet Invert= 1,004.00', Outlet Invert= 980.00'



Reach CDS5: C Downslope 5

Hydrograph



Summary for Reach CDS6: C Downslope 6

[62] Hint: Exceeded Reach C6T OUTLET depth by 0.99' @ 12.26 hrs

[62] Hint: Exceeded Reach CDS5 OUTLET depth by 0.17' @ 12.18 hrs

Inflow Area = 1,380,457 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 161.26 cfs @ 12.26 hrs, Volume= 508,380 cf
Outflow = 161.20 cfs @ 12.26 hrs, Volume= 508,380 cf, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 13.44 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 3.16 fps, Avg. Travel Time= 0.5 min

Peak Storage= 1,190 cf @ 12.26 hrs

Average Depth at Peak Storage= 1.00'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 590.09 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

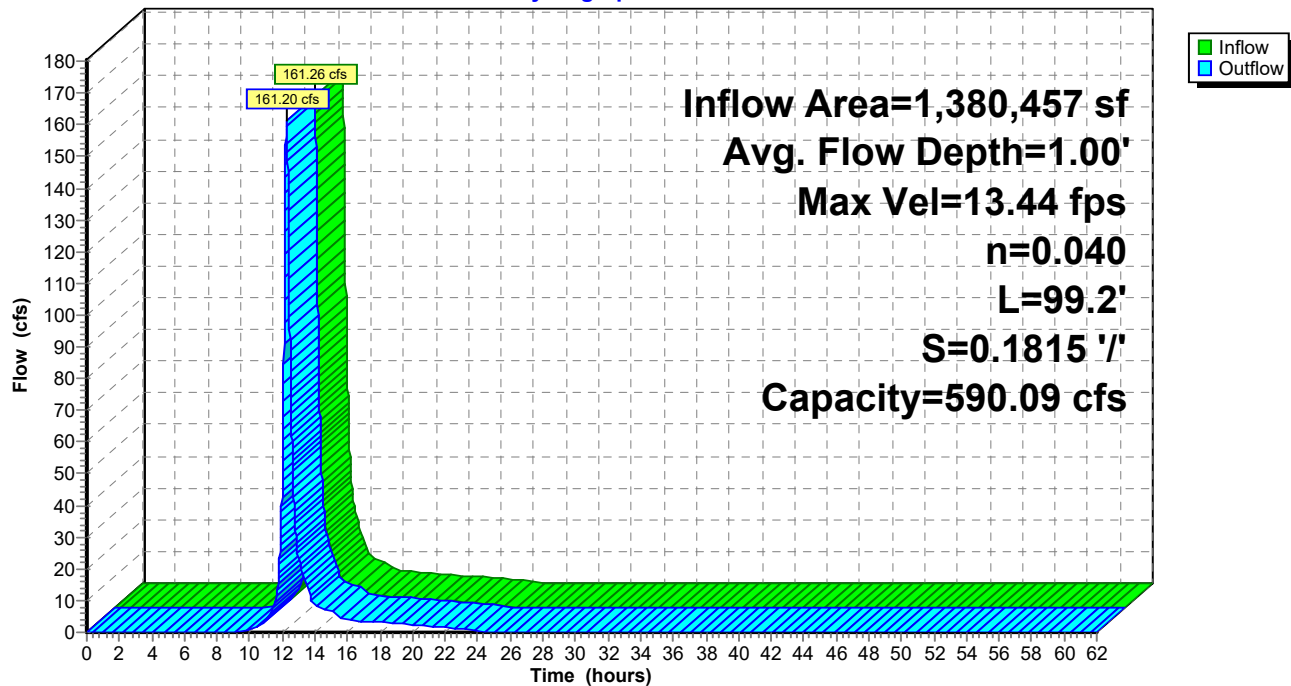
Length= 99.2' Slope= 0.1815 '/'

Inlet Invert= 980.00', Outlet Invert= 962.00'



Reach CDS6: C Downslope 6

Hydrograph



Summary for Reach CDS7: C Downslope 7

[62] Hint: Exceeded Reach C5T OUTLET depth by 0.10' @ 12.33 hrs

[62] Hint: Exceeded Reach CDS6 OUTLET depth by 0.05' @ 12.28 hrs

Inflow Area = 1,619,940 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 196.31 cfs @ 12.26 hrs, Volume= 596,574 cf
Outflow = 196.20 cfs @ 12.27 hrs, Volume= 596,574 cf, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 15.52 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 3.45 fps, Avg. Travel Time= 0.5 min

Peak Storage= 1,315 cf @ 12.27 hrs

Average Depth at Peak Storage= 1.04'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 665.46 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

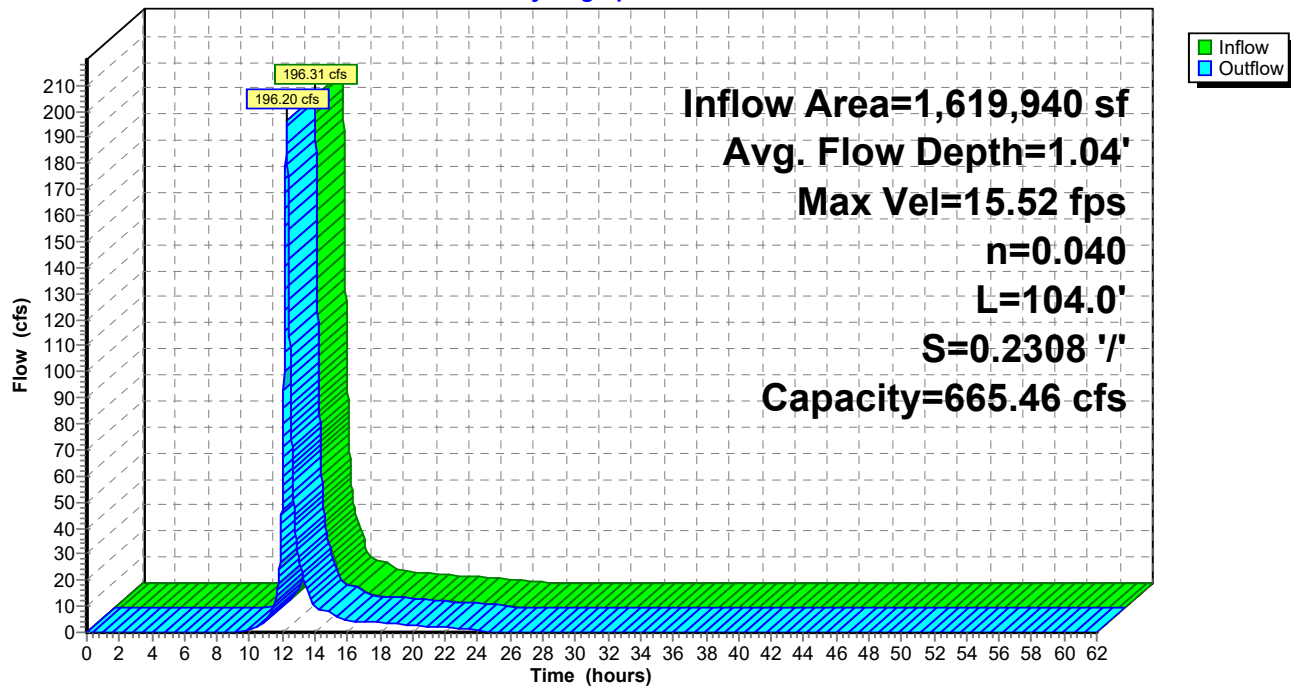
Length= 104.0' Slope= 0.2308 '/'

Inlet Invert= 962.00', Outlet Invert= 938.00'



Reach CDS7: C Downslope 7

Hydrograph



Summary for Reach CDS8: C Downslope 8

[62] Hint: Exceeded Reach C8T OUTLET depth by 0.20' @ 12.32 hrs

[62] Hint: Exceeded Reach CDS7 OUTLET depth by 0.07' @ 12.29 hrs

Inflow Area = 1,840,658 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 227.94 cfs @ 12.27 hrs, Volume= 677,858 cf
Outflow = 227.86 cfs @ 12.27 hrs, Volume= 677,858 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 16.56 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 3.60 fps, Avg. Travel Time= 0.3 min

Peak Storage= 903 cf @ 12.27 hrs

Average Depth at Peak Storage= 1.11'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 684.14 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

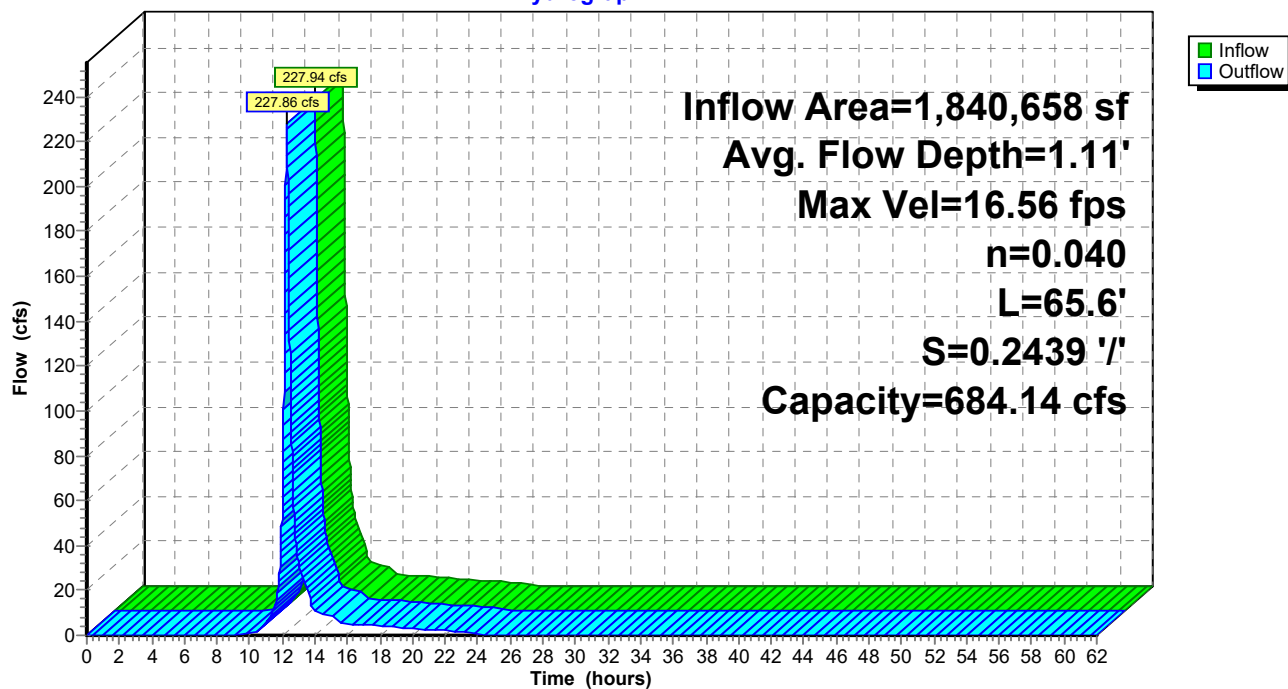
Length= 65.6' Slope= 0.2439 '/'

Inlet Invert= 938.00', Outlet Invert= 922.00'



Reach CDS8: C Downslope 8

Hydrograph



Summary for Reach CDS9: C Downslope 9

[62] Hint: Exceeded Reach C7T OUTLET depth by 0.41' @ 12.31 hrs

[62] Hint: Exceeded Reach CDS8 OUTLET depth by 0.25' @ 12.28 hrs

Inflow Area = 2,090,637 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 264.82 cfs @ 12.27 hrs, Volume= 769,918 cf
Outflow = 264.55 cfs @ 12.28 hrs, Volume= 769,918 cf, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 14.76 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 3.12 fps, Avg. Travel Time= 0.8 min

Peak Storage= 2,555 cf @ 12.27 hrs

Average Depth at Peak Storage= 1.37'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 544.49 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

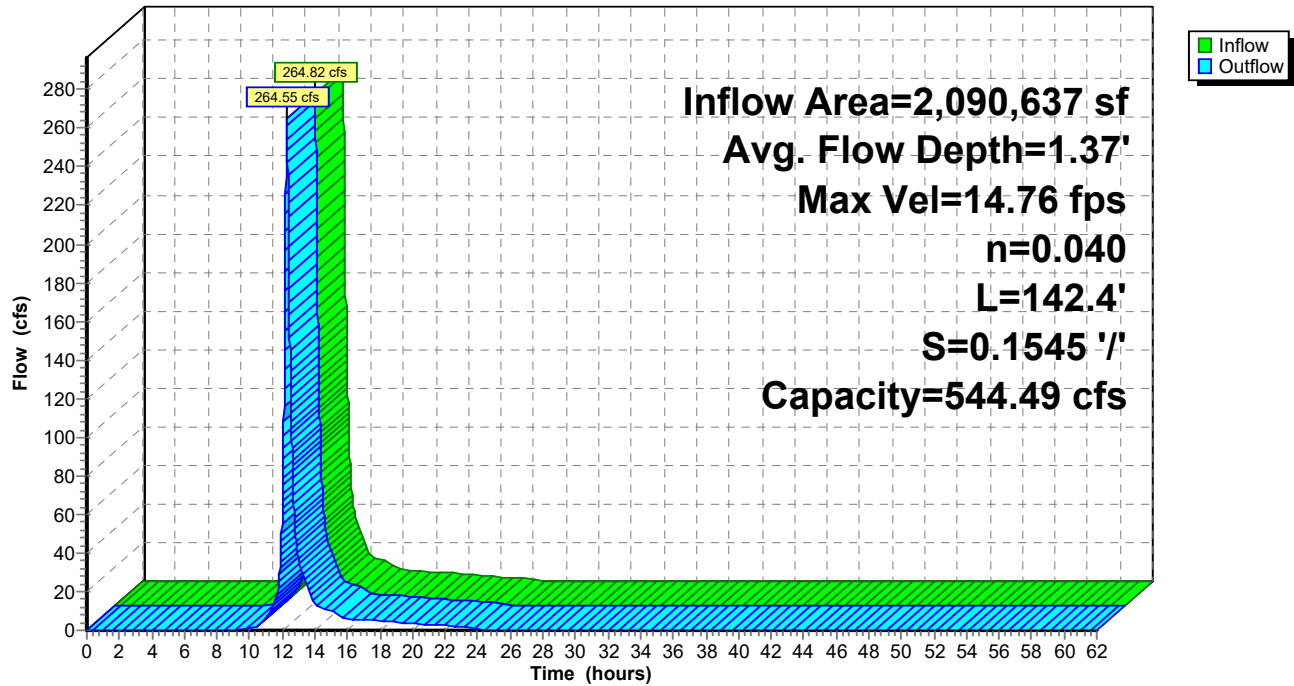
Length= 142.4' Slope= 0.1545 '/'

Inlet Invert= 922.00', Outlet Invert= 900.00'



Reach CDS9: C Downslope 9

Hydrograph



Summary for Reach D10T: D10 Terrace

Inflow Area = 67,808 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 12.76 cfs @ 12.13 hrs, Volume= 24,972 cf
 Outflow = 12.12 cfs @ 12.18 hrs, Volume= 24,972 cf, Atten= 5%, Lag= 3.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 3.56 fps, Min. Travel Time= 1.9 min

Avg. Velocity = 1.16 fps, Avg. Travel Time= 5.7 min

Peak Storage= 1,365 cf @ 12.15 hrs

Average Depth at Peak Storage= 0.79'

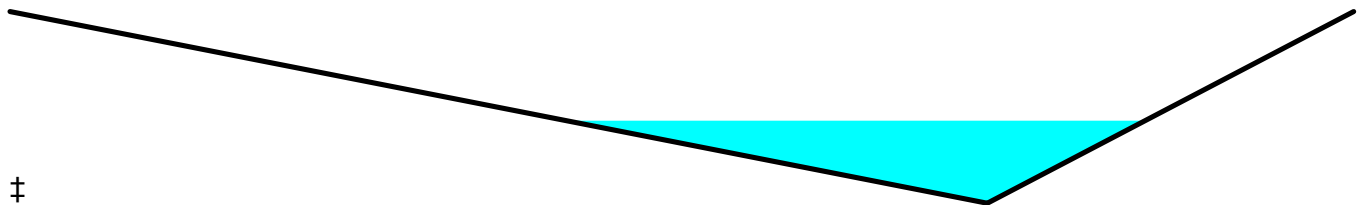
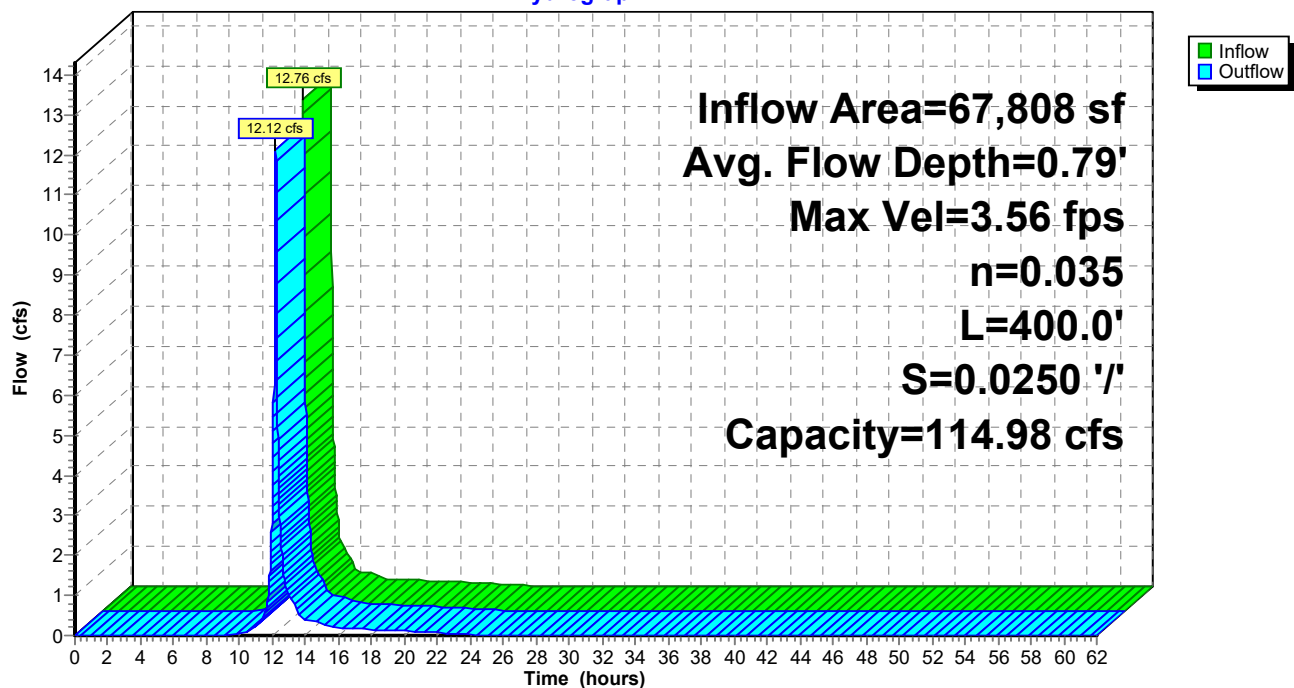
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 114.98 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 400.0' Slope= 0.0250 '/'

Inlet Invert= 932.00', Outlet Invert= 922.00'

**Reach D10T: D10 Terrace****Hydrograph**

Summary for Reach D11T: D11 Terrace

Inflow Area = 297,525 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 26.36 cfs @ 12.41 hrs, Volume= 109,569 cf
 Outflow = 24.93 cfs @ 12.53 hrs, Volume= 109,569 cf, Atten= 5%, Lag= 6.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 2.15 fps, Min. Travel Time= 3.8 min

Avg. Velocity = 0.49 fps, Avg. Travel Time= 16.8 min

Peak Storage= 5,756 cf @ 12.46 hrs

Average Depth at Peak Storage= 1.45'

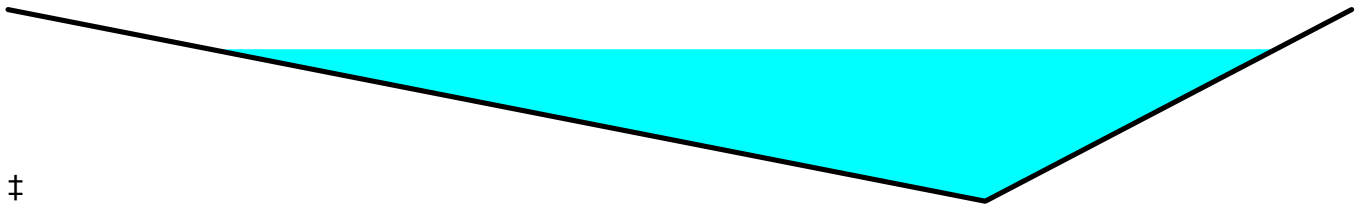
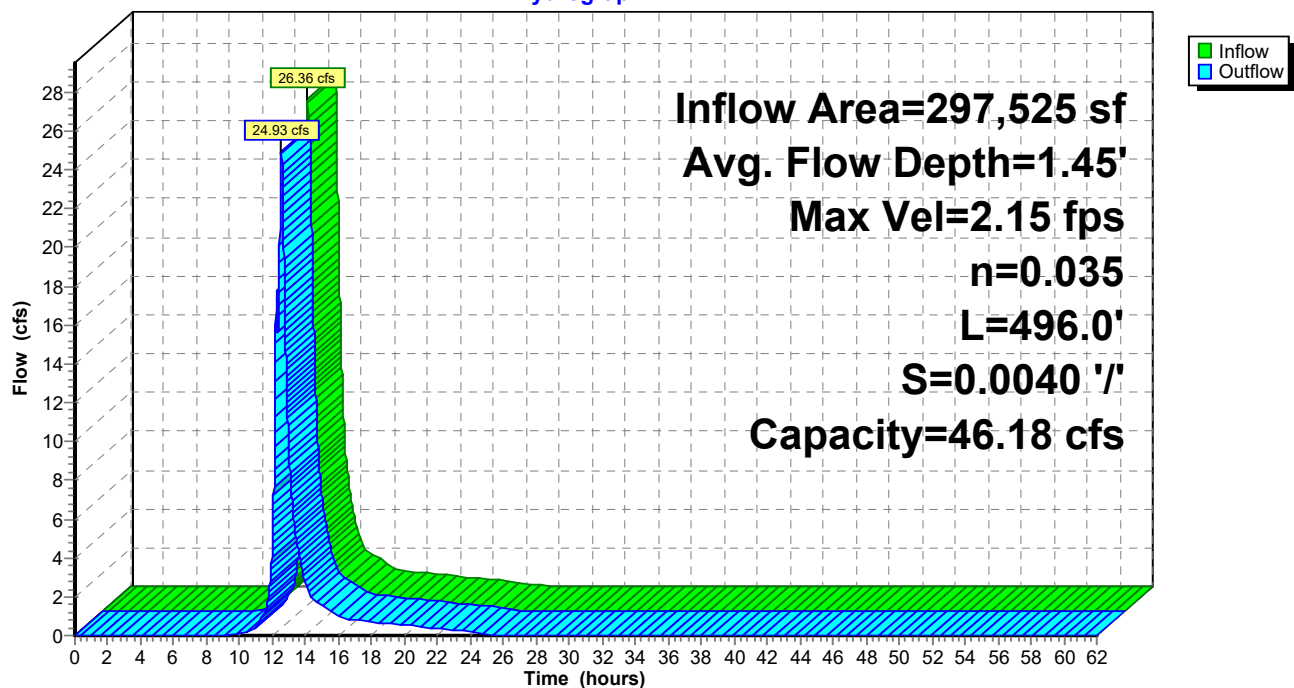
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 46.18 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 496.0' Slope= 0.0040 '/'

Inlet Invert= 890.00', Outlet Invert= 888.00'

**Reach D11T: D11 Terrace****Hydrograph**

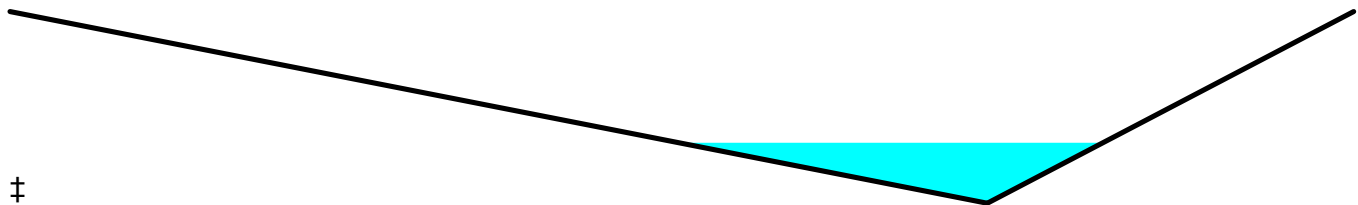
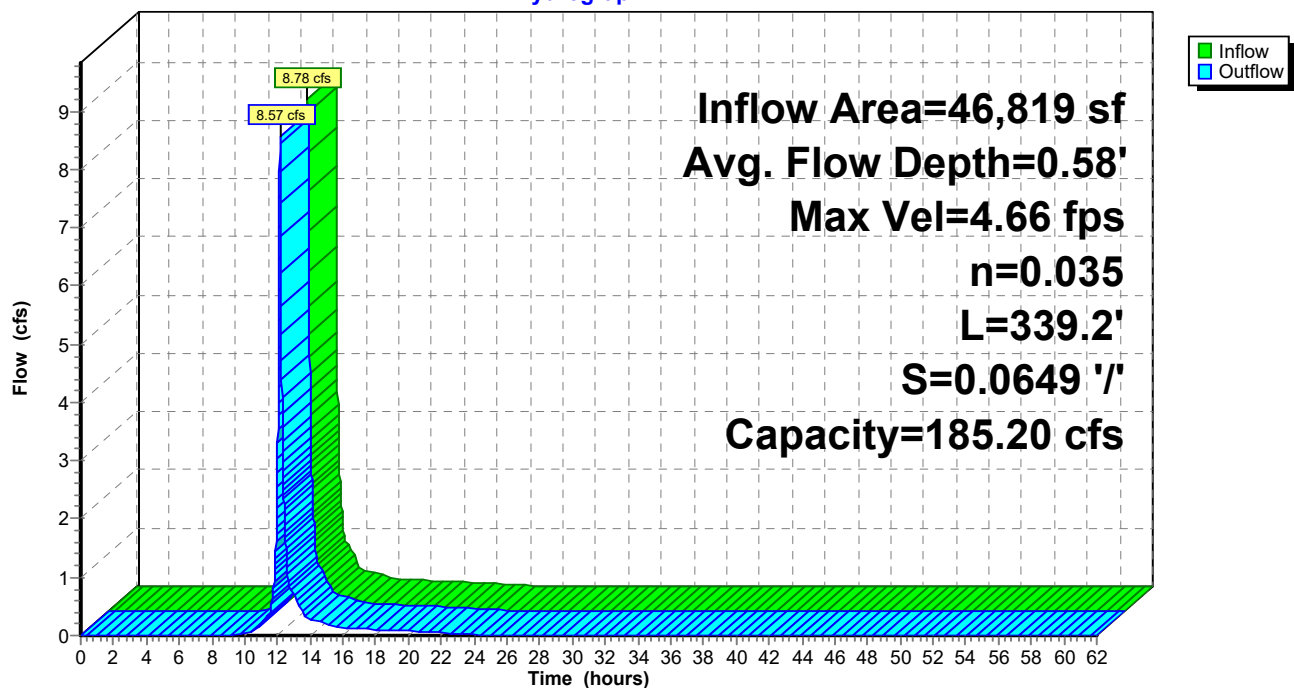
Summary for Reach D12T: D12 Terrce

Inflow Area = 46,819 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 8.78 cfs @ 12.13 hrs, Volume= 17,242 cf
Outflow = 8.57 cfs @ 12.17 hrs, Volume= 17,242 cf, Atten= 2%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.66 fps, Min. Travel Time= 1.2 min
Avg. Velocity= 1.58 fps, Avg. Travel Time= 3.6 min

Peak Storage= 624 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.58'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 185.20 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 339.2' Slope= 0.0649 '/'
Inlet Invert= 910.00', Outlet Invert= 888.00'

**Reach D12T: D12 Terrce****Hydrograph**

Summary for Reach D1T: D1 Terrace

Inflow Area = 28,583 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 4.53 cfs @ 12.17 hrs, Volume= 10,526 cf
 Outflow = 4.47 cfs @ 12.20 hrs, Volume= 10,526 cf, Atten= 1%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 2.69 fps, Min. Travel Time= 1.1 min

Avg. Velocity = 0.95 fps, Avg. Travel Time= 3.0 min

Peak Storage= 287 cf @ 12.19 hrs

Average Depth at Peak Storage= 0.55'

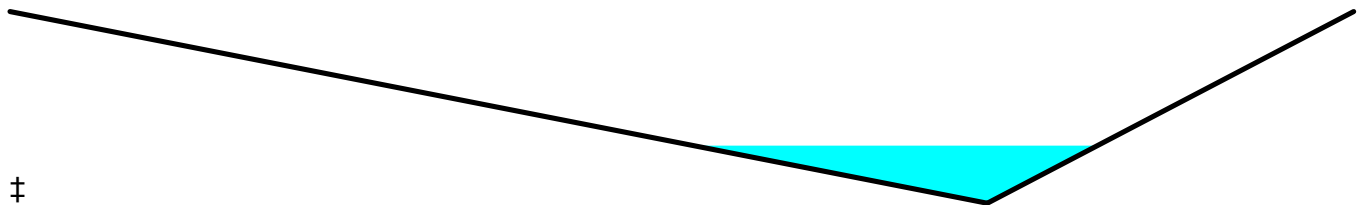
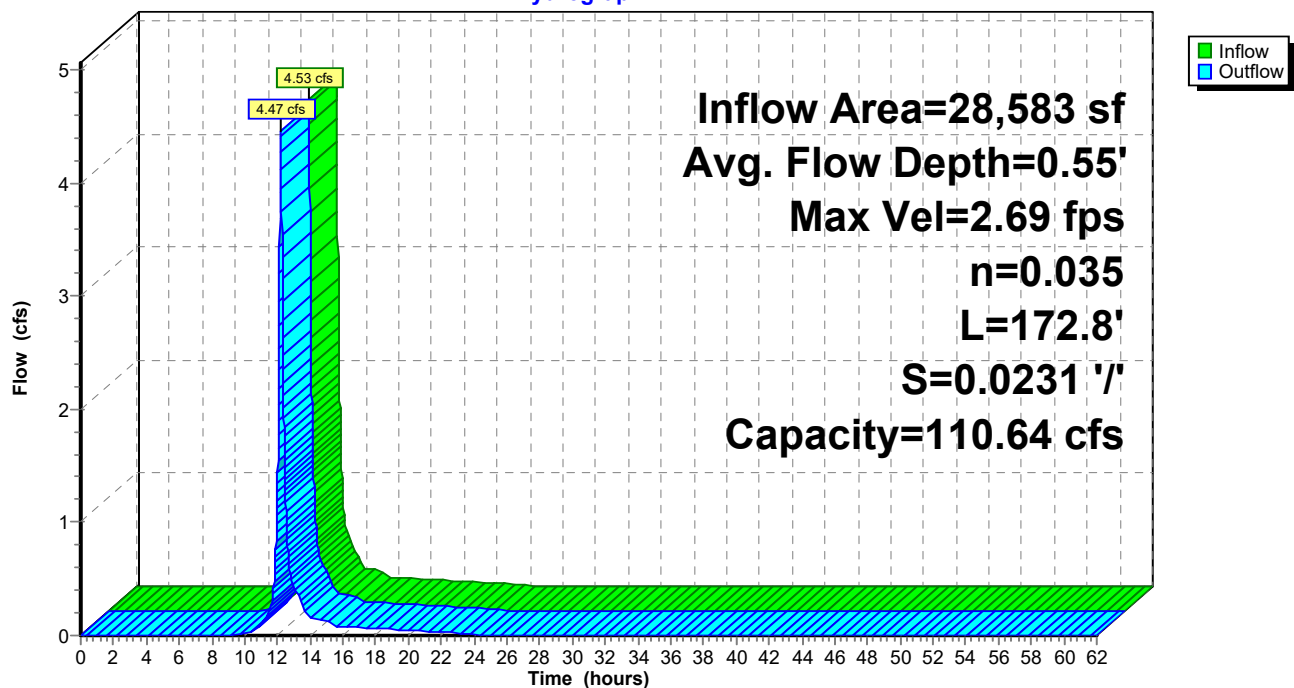
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 110.64 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 172.8' Slope= 0.0231 '/'

Inlet Invert= 1,086.00', Outlet Invert= 1,082.00'

**Reach D1T: D1 Terrace****Hydrograph**

Summary for Reach D2T: D2 Terrace

Inflow Area = 260,979 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 35.57 cfs @ 12.22 hrs, Volume= 96,111 cf
Outflow = 35.12 cfs @ 12.26 hrs, Volume= 96,111 cf, Atten= 1%, Lag= 2.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.81 fps, Min. Travel Time= 1.5 min

Avg. Velocity= 1.16 fps, Avg. Travel Time= 6.1 min

Peak Storage= 3,112 cf @ 12.24 hrs

Average Depth at Peak Storage= 0.66'

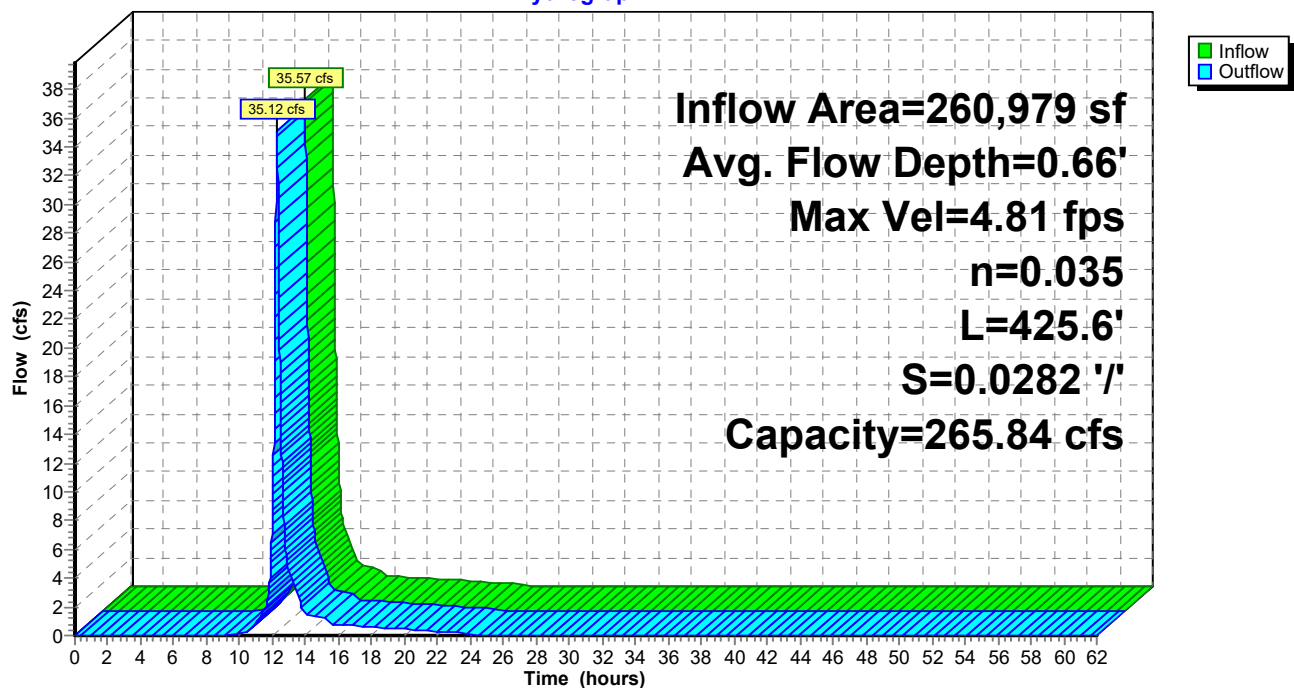
Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 265.84 cfs

9.00' x 2.00' deep channel, n= 0.035

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

Length= 425.6' Slope= 0.0282 '/'

Inlet Invert= 1,094.00', Outlet Invert= 1,082.00'

**Reach D2T: D2 Terrace****Hydrograph**

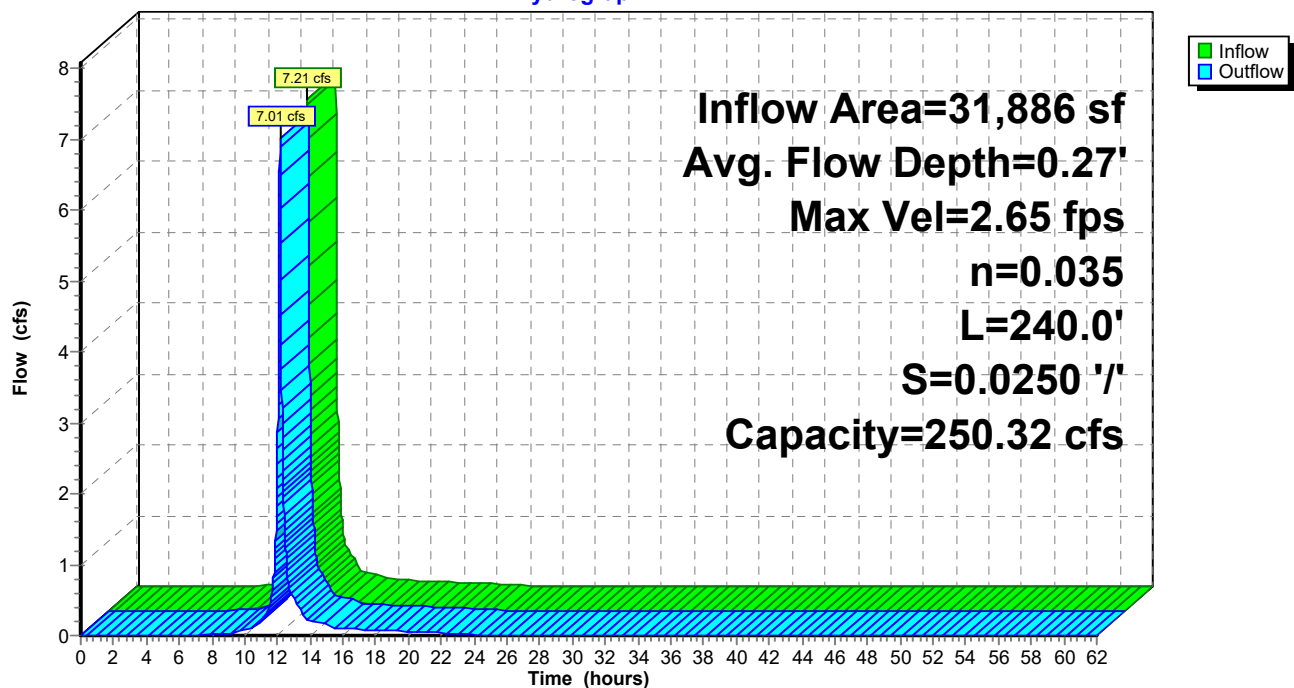
Summary for Reach D3T: D3 Terrace

Inflow Area = 31,886 sf, 0.00% Impervious, Inflow Depth = 5.43" for 100-yr 24-hr event
Inflow = 7.21 cfs @ 12.13 hrs, Volume= 14,441 cf
Outflow = 7.01 cfs @ 12.17 hrs, Volume= 14,441 cf, Atten= 3%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.65 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 6.5 min

Peak Storage= 637 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 250.32 cfs

9.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 3.0 '/' Top Width= 21.00'
Length= 240.0' Slope= 0.0250 '/'
Inlet Invert= 1,048.00', Outlet Invert= 1,042.00'

**Reach D3T: D3 Terrace****Hydrograph**

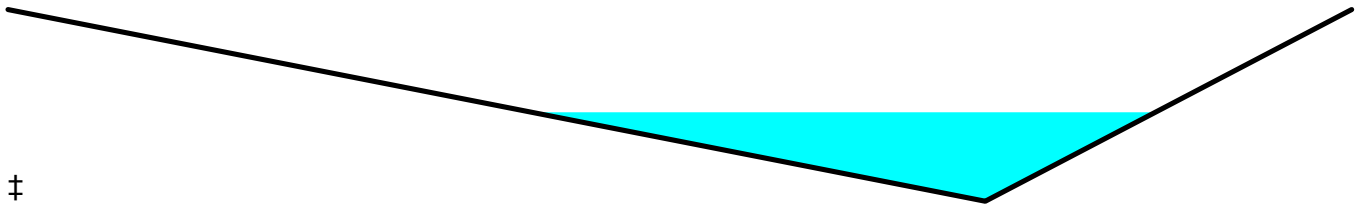
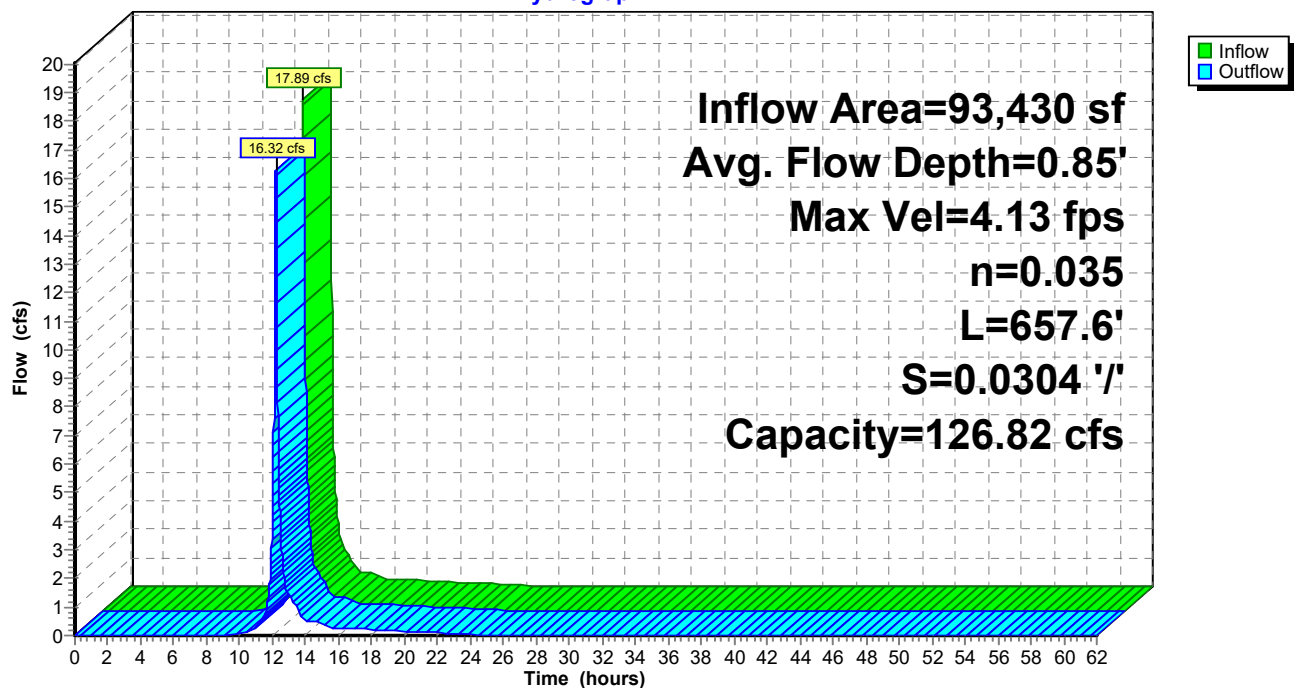
Summary for Reach D4T: D4 Terrace

Inflow Area = 93,430 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 17.89 cfs @ 12.13 hrs, Volume= 34,407 cf
 Outflow = 16.32 cfs @ 12.20 hrs, Volume= 34,407 cf, Atten= 9%, Lag= 4.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 4.13 fps, Min. Travel Time= 2.7 min
 Avg. Velocity = 1.31 fps, Avg. Travel Time= 8.4 min

Peak Storage= 2,608 cf @ 12.15 hrs
 Average Depth at Peak Storage= 0.85'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 126.82 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
 Length= 657.6' Slope= 0.0304 '/'
 Inlet Invert= 1,062.00', Outlet Invert= 1,042.00'

**Reach D4T: D4 Terrace****Hydrograph**

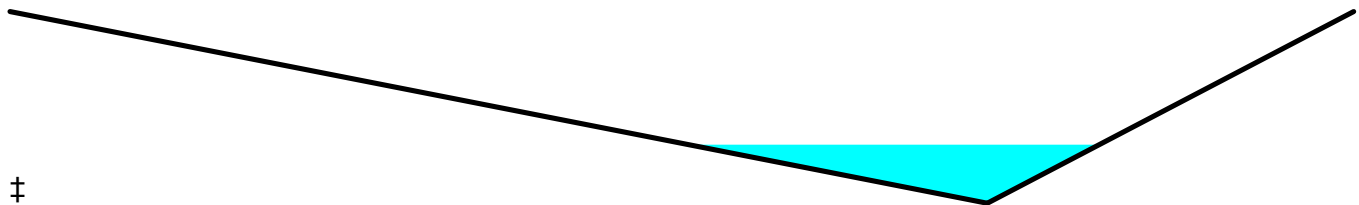
Summary for Reach D5T: D5 Terrace

Inflow Area = 44,094 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 7.85 cfs @ 12.14 hrs, Volume= 16,238 cf
 Outflow = 7.69 cfs @ 12.18 hrs, Volume= 16,238 cf, Atten= 2%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 4.48 fps, Min. Travel Time= 1.2 min
 Avg. Velocity = 1.54 fps, Avg. Travel Time= 3.5 min

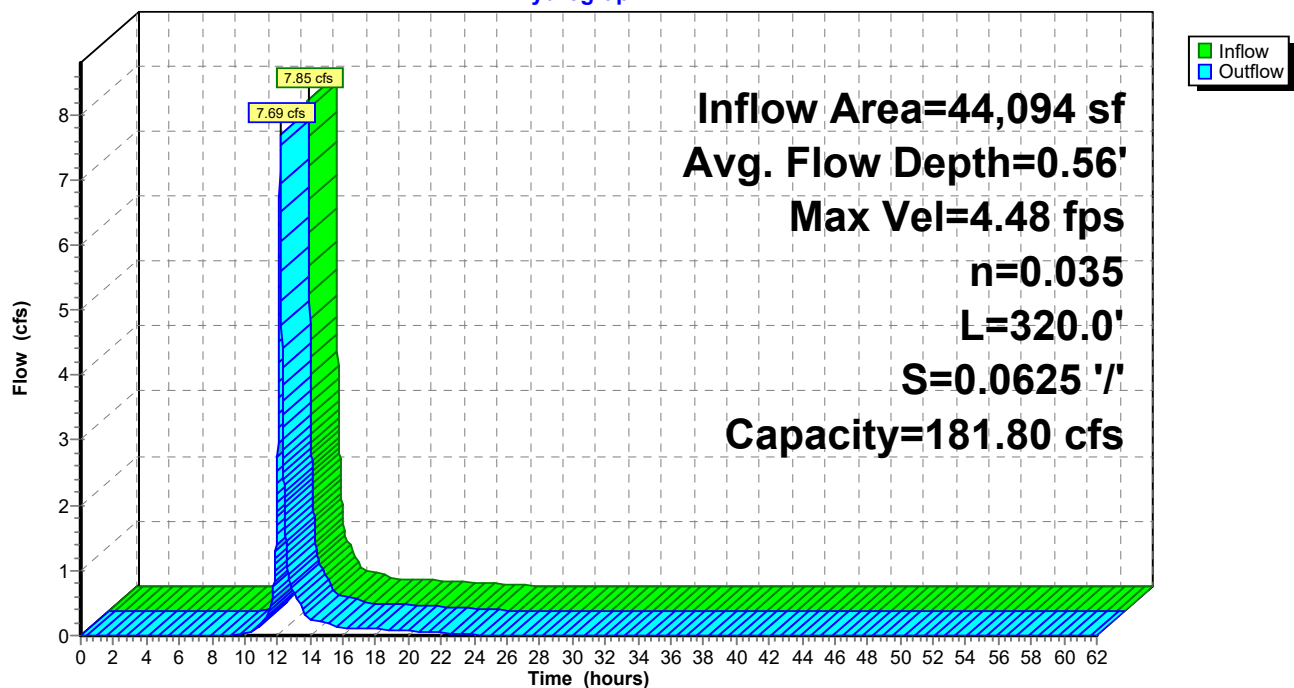
Peak Storage= 550 cf @ 12.16 hrs
 Average Depth at Peak Storage= 0.56'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 181.80 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
 Length= 320.0' Slope= 0.0625 '/'
 Inlet Invert= 1,022.00', Outlet Invert= 1,002.00'



Reach D5T: D5 Terrace

Hydrograph



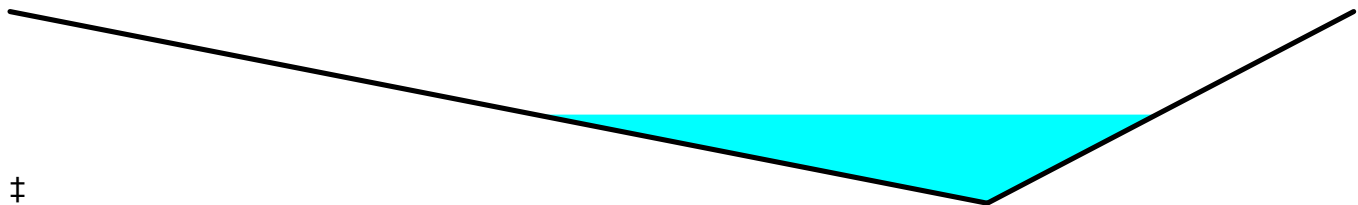
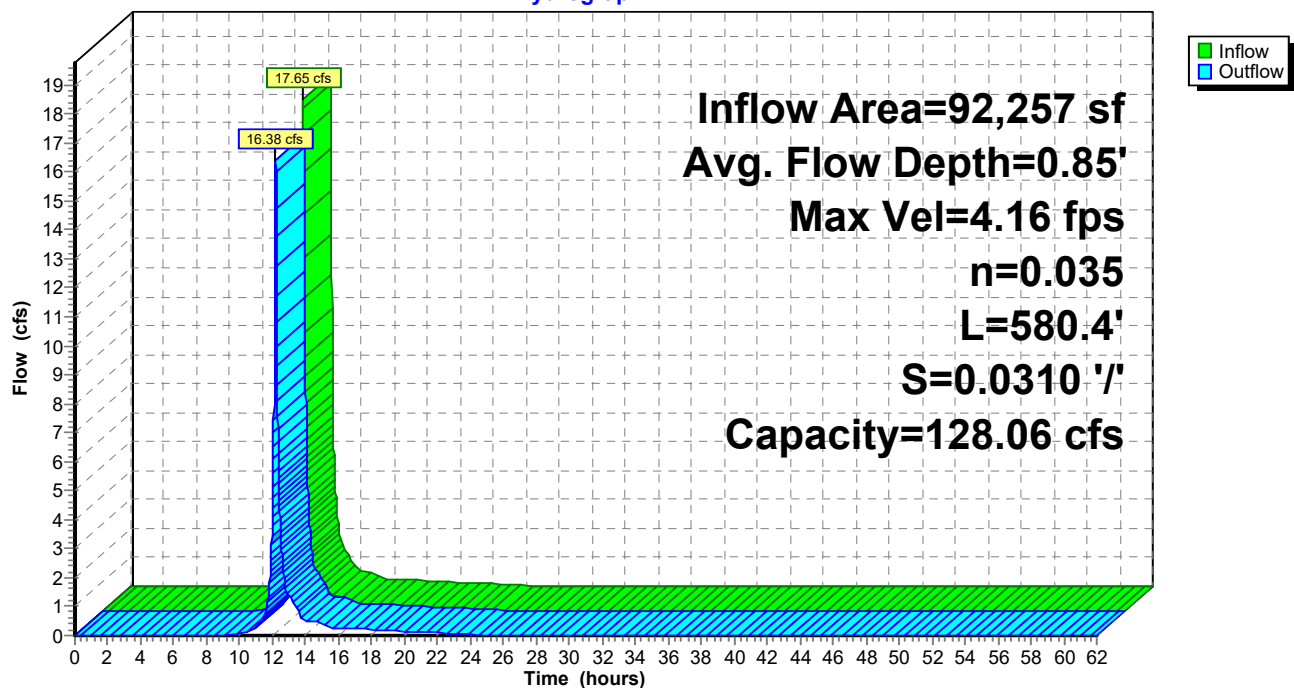
Summary for Reach D6T: D6 Terrace

Inflow Area = 92,257 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 17.65 cfs @ 12.13 hrs, Volume= 33,975 cf
Outflow = 16.38 cfs @ 12.19 hrs, Volume= 33,975 cf, Atten= 7%, Lag= 3.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.16 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 1.33 fps, Avg. Travel Time= 7.3 min

Peak Storage= 2,289 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.85'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 128.06 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 580.4' Slope= 0.0310 '/'
Inlet Invert= 1,020.00', Outlet Invert= 1,002.00'

**Reach D6T: D6 Terrace****Hydrograph**

Summary for Reach D7T: D7 Terrace

Inflow Area = 54,813 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 10.40 cfs @ 12.13 hrs, Volume= 20,186 cf
 Outflow = 9.99 cfs @ 12.17 hrs, Volume= 20,186 cf, Atten= 4%, Lag= 2.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.38 fps, Min. Travel Time= 1.5 min

Avg. Velocity = 1.46 fps, Avg. Travel Time= 4.6 min

Peak Storage= 926 cf @ 12.15 hrs

Average Depth at Peak Storage= 0.65'

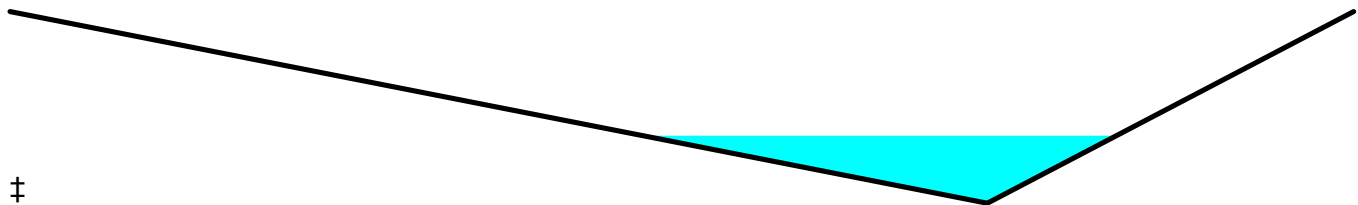
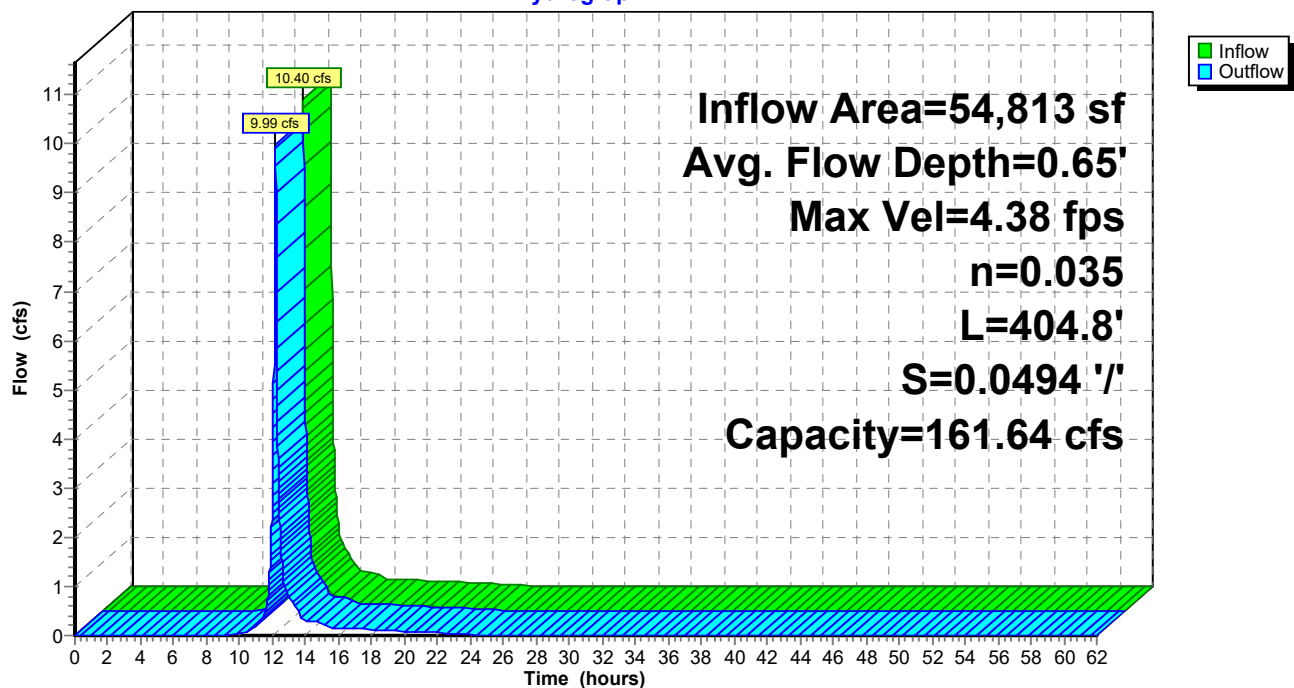
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 161.64 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'

Length= 404.8' Slope= 0.0494 '/'

Inlet Invert= 984.00', Outlet Invert= 964.00'

**Reach D7T: D7 Terrace****Hydrograph**

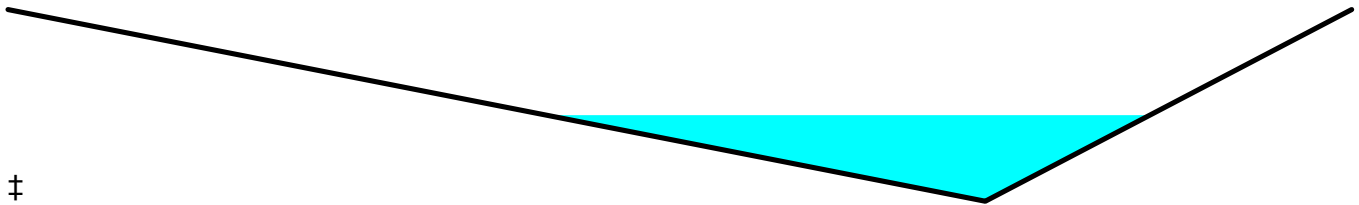
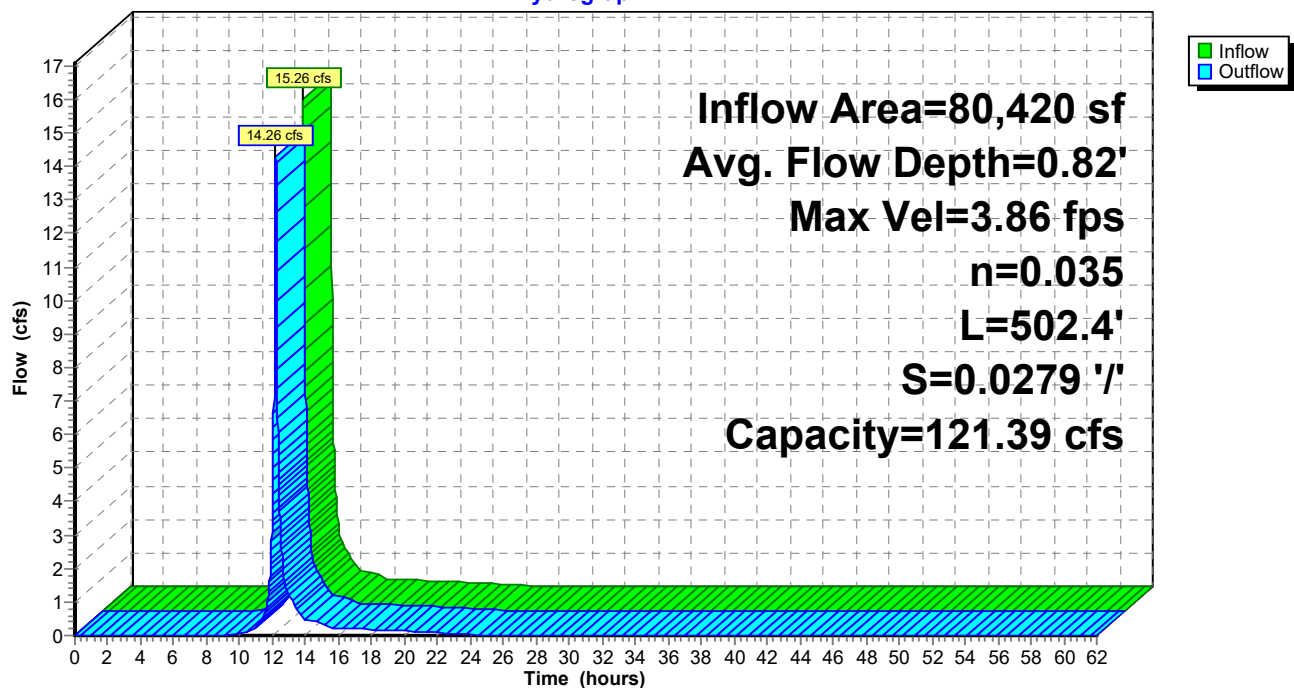
Summary for Reach D8T: D8 Terrace

Inflow Area = 80,420 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 15.26 cfs @ 12.13 hrs, Volume= 29,616 cf
 Outflow = 14.26 cfs @ 12.19 hrs, Volume= 29,616 cf, Atten= 7%, Lag= 3.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 3.86 fps, Min. Travel Time= 2.2 min
 Avg. Velocity = 1.25 fps, Avg. Travel Time= 6.7 min

Peak Storage= 1,861 cf @ 12.15 hrs
 Average Depth at Peak Storage= 0.82'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 121.39 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
 Length= 502.4' Slope= 0.0279 '/'
 Inlet Invert= 978.00', Outlet Invert= 964.00'

**Reach D8T: D8 Terrace****Hydrograph**

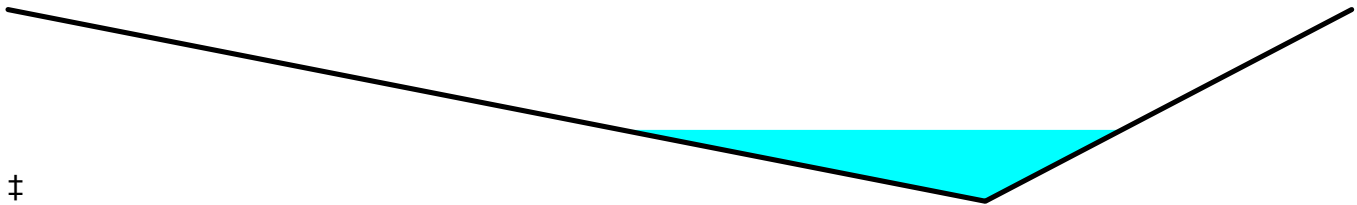
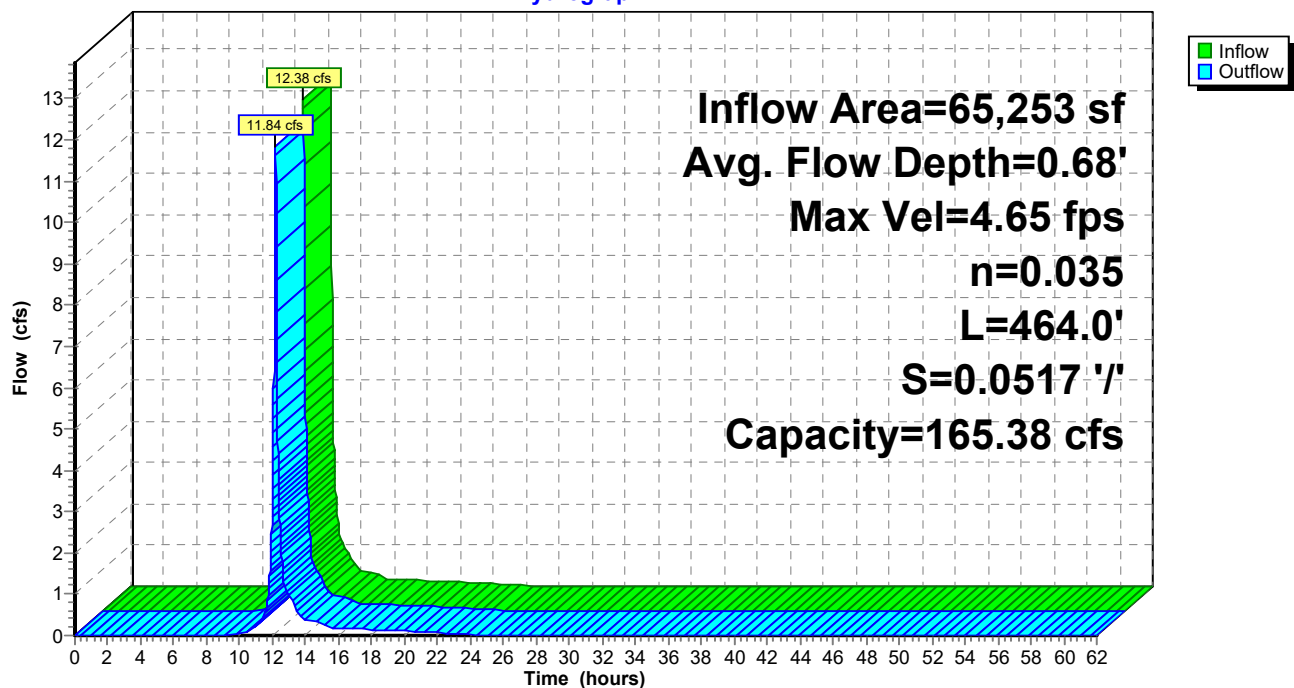
Summary for Reach D9T: D9 Terrace

Inflow Area = 65,253 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 12.38 cfs @ 12.13 hrs, Volume= 24,031 cf
Outflow = 11.84 cfs @ 12.17 hrs, Volume= 24,031 cf, Atten= 4%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.65 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.54 fps, Avg. Travel Time= 5.0 min

Peak Storage= 1,185 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.68'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 165.38 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 464.0' Slope= 0.0517 '/'
Inlet Invert= 946.00', Outlet Invert= 922.00'

**Reach D9T: D9 Terrace****Hydrograph**

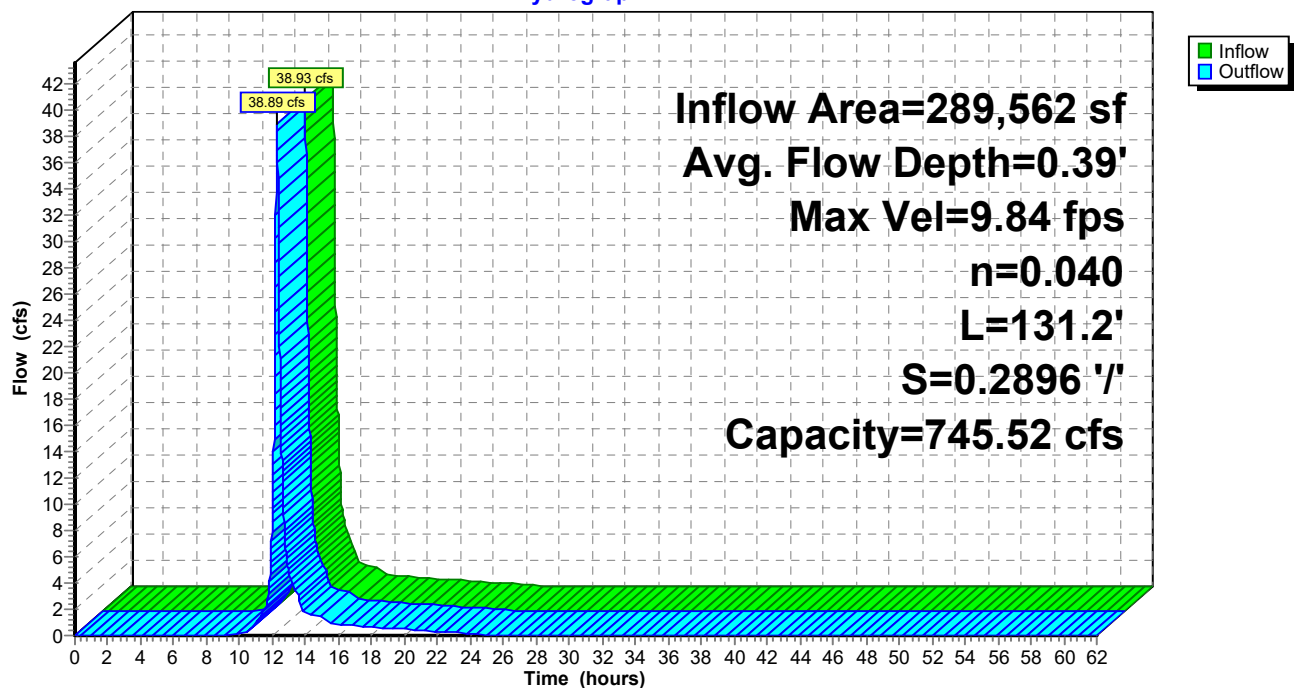
Summary for Reach DDS1: D Downslope 1

Inflow Area = 289,562 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 38.93 cfs @ 12.25 hrs, Volume= 106,637 cf
Outflow = 38.89 cfs @ 12.26 hrs, Volume= 106,637 cf, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.84 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.40 fps, Avg. Travel Time= 0.9 min

Peak Storage= 519 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 745.52 cfs

9.00' x 2.00' deep channel, n= 0.040
Side Slope Z-value= 3.0 '/' Top Width= 21.00'
Length= 131.2' Slope= 0.2896 '/'
Inlet Invert= 1,080.00', Outlet Invert= 1,042.00'

**Reach DDS1: D Downslope 1****Hydrograph**

Summary for Reach DDS2: D Downslope 2

[62] Hint: Exceeded Reach D3T OUTLET depth by 0.30' @ 12.27 hrs

[61] Hint: Exceeded Reach D4T outlet invert by 0.47' @ 12.22 hrs

[62] Hint: Exceeded Reach DDS1 OUTLET depth by 0.11' @ 12.18 hrs

Inflow Area = 414,878 sf, 0.00% Impervious, Inflow Depth = 4.50" for 100-yr 24-hr event
Inflow = 56.87 cfs @ 12.22 hrs, Volume= 155,485 cf
Outflow = 56.82 cfs @ 12.22 hrs, Volume= 155,485 cf, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 11.50 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 2.62 fps, Avg. Travel Time= 0.8 min

Peak Storage= 633 cf @ 12.22 hrs

Average Depth at Peak Storage= 0.47'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 774.39 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 ' ' Top Width= 21.00'

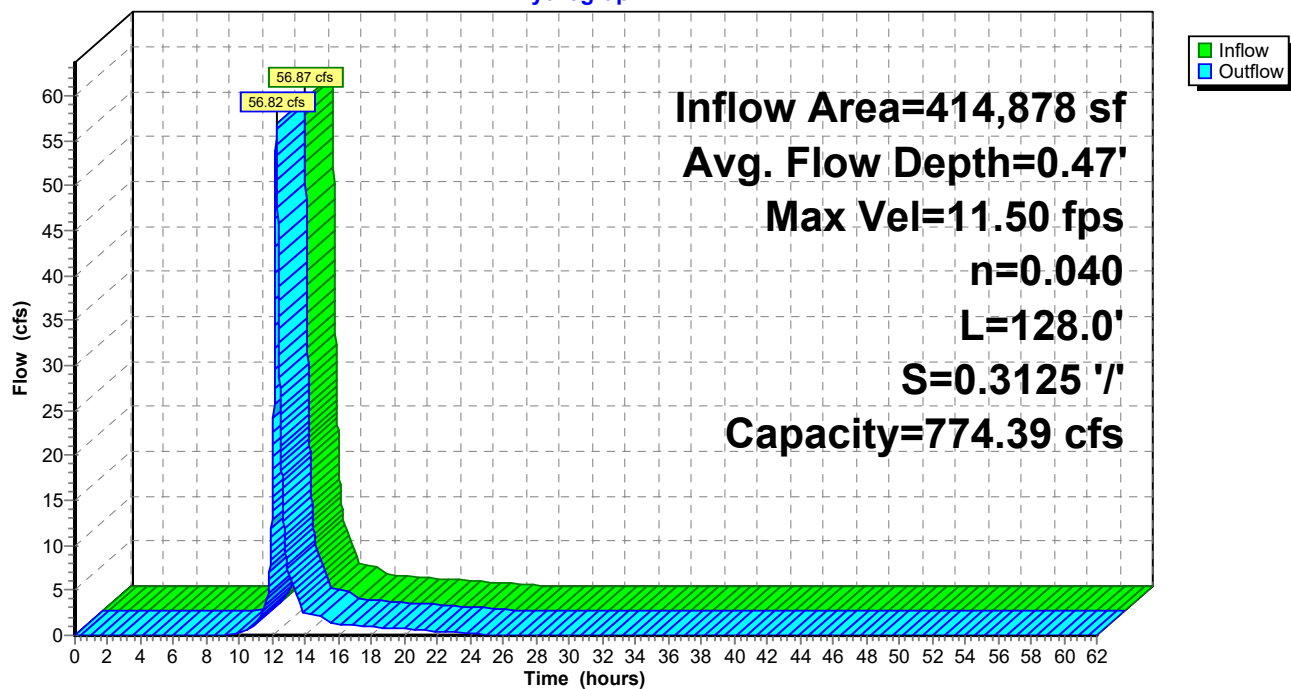
Length= 128.0' Slope= 0.3125 ' '

Inlet Invert= 1,042.00', Outlet Invert= 1,002.00'



Reach DDS2: D Downslope 2

Hydrograph



Summary for Reach DDS3: D Downslope 3

[62] Hint: Exceeded Reach D5T OUTLET depth by 0.11' @ 12.27 hrs

[61] Hint: Exceeded Reach D6T outlet invert by 0.59' @ 12.21 hrs

[62] Hint: Exceeded Reach DDS2 OUTLET depth by 0.12' @ 12.19 hrs

Inflow Area = 551,229 sf, 0.00% Impervious, Inflow Depth = 4.48" for 100-yr 24-hr event
Inflow = 79.00 cfs @ 12.21 hrs, Volume= 205,699 cf
Outflow = 78.89 cfs @ 12.21 hrs, Volume= 205,699 cf, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 12.53 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 2.77 fps, Avg. Travel Time= 0.8 min

Peak Storage= 827 cf @ 12.21 hrs

Average Depth at Peak Storage= 0.59'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 745.52 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 ' ' Top Width= 21.00'

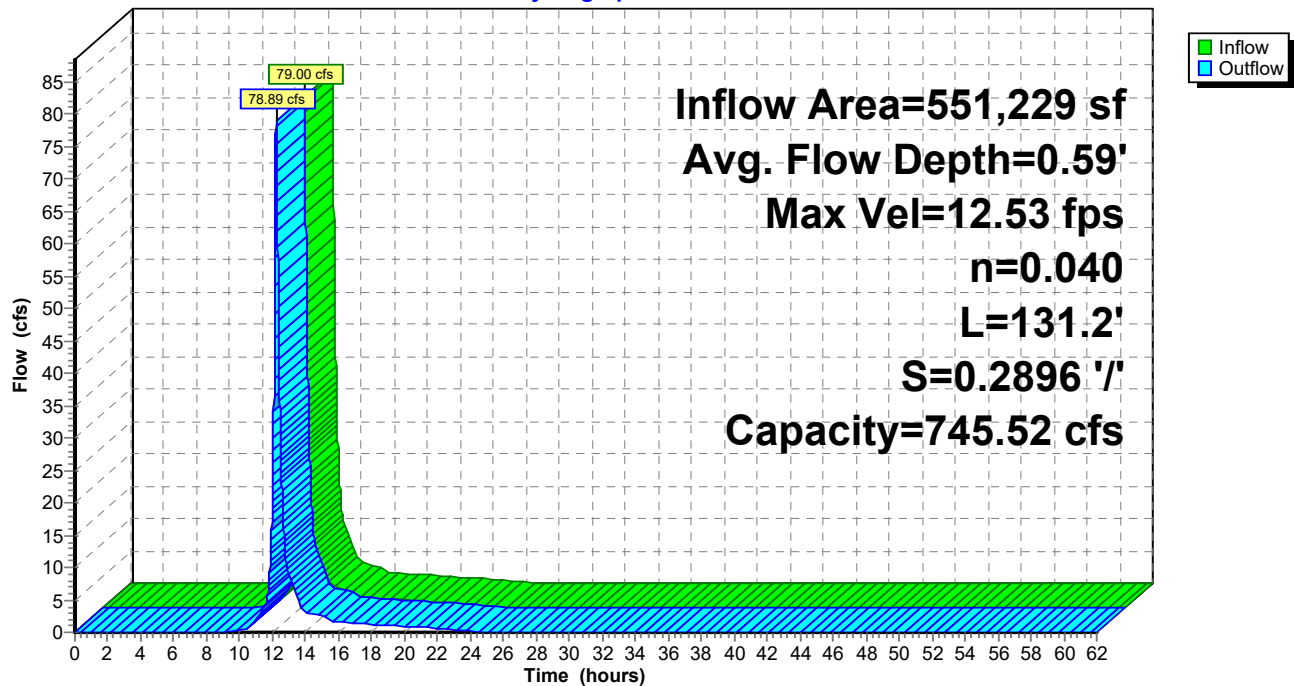
Length= 131.2' Slope= 0.2896 ' '

Inlet Invert= 1,002.00', Outlet Invert= 964.00'



Reach DDS3: D Downslope 3

Hydrograph



Summary for Reach DDS4: D Downslope 4

[62] Hint: Exceeded Reach D7T OUTLET depth by 0.12' @ 12.24 hrs

[61] Hint: Exceeded Reach D8T outlet invert by 0.66' @ 12.20 hrs

[62] Hint: Exceeded Reach DDS3 OUTLET depth by 0.07' @ 12.18 hrs

Inflow Area = 686,462 sf, 0.00% Impervious, Inflow Depth = 4.47" for 100-yr 24-hr event
 Inflow = 101.33 cfs @ 12.20 hrs, Volume= 255,501 cf
 Outflow = 101.17 cfs @ 12.20 hrs, Volume= 255,501 cf, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 14.07 fps, Min. Travel Time= 0.2 min
 Avg. Velocity = 3.07 fps, Avg. Travel Time= 0.7 min

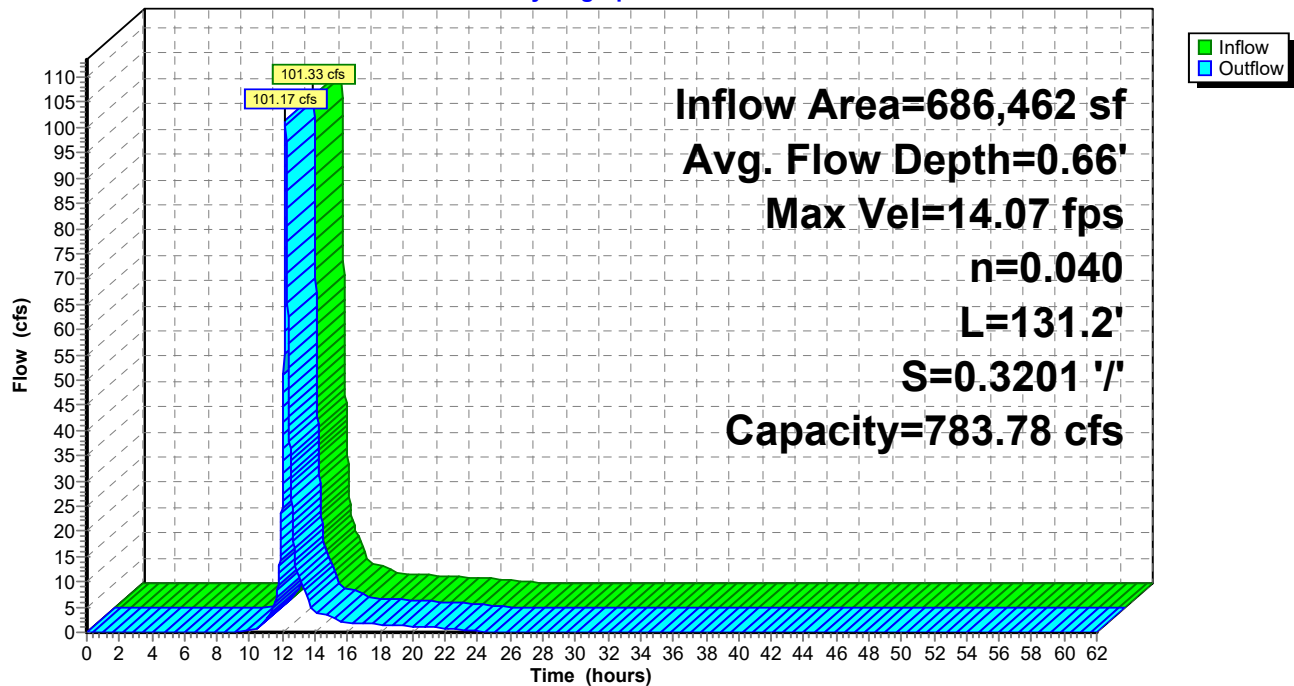
Peak Storage= 945 cf @ 12.20 hrs
 Average Depth at Peak Storage= 0.66'
 Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 783.78 cfs

9.00' x 2.00' deep channel, n= 0.040
 Side Slope Z-value= 3.0 '/' Top Width= 21.00'
 Length= 131.2' Slope= 0.3201 '/'
 Inlet Invert= 964.00', Outlet Invert= 922.00'



Reach DDS4: D Downslope 4

Hydrograph



Summary for Reach DDS5: D Downslope 5

[62] Hint: Exceeded Reach D10T OUTLET depth by 0.10' @ 12.24 hrs

[62] Hint: Exceeded Reach D9T OUTLET depth by 0.20' @ 12.23 hrs

[62] Hint: Exceeded Reach DDS4 OUTLET depth by 0.12' @ 12.19 hrs

Inflow Area = 819,523 sf, 0.00% Impervious, Inflow Depth = 4.46" for 100-yr 24-hr event
 Inflow = 123.62 cfs @ 12.20 hrs, Volume= 304,504 cf
 Outflow = 123.42 cfs @ 12.20 hrs, Volume= 304,504 cf, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 13.97 fps, Min. Travel Time= 0.2 min
 Avg. Velocity = 3.02 fps, Avg. Travel Time= 0.7 min

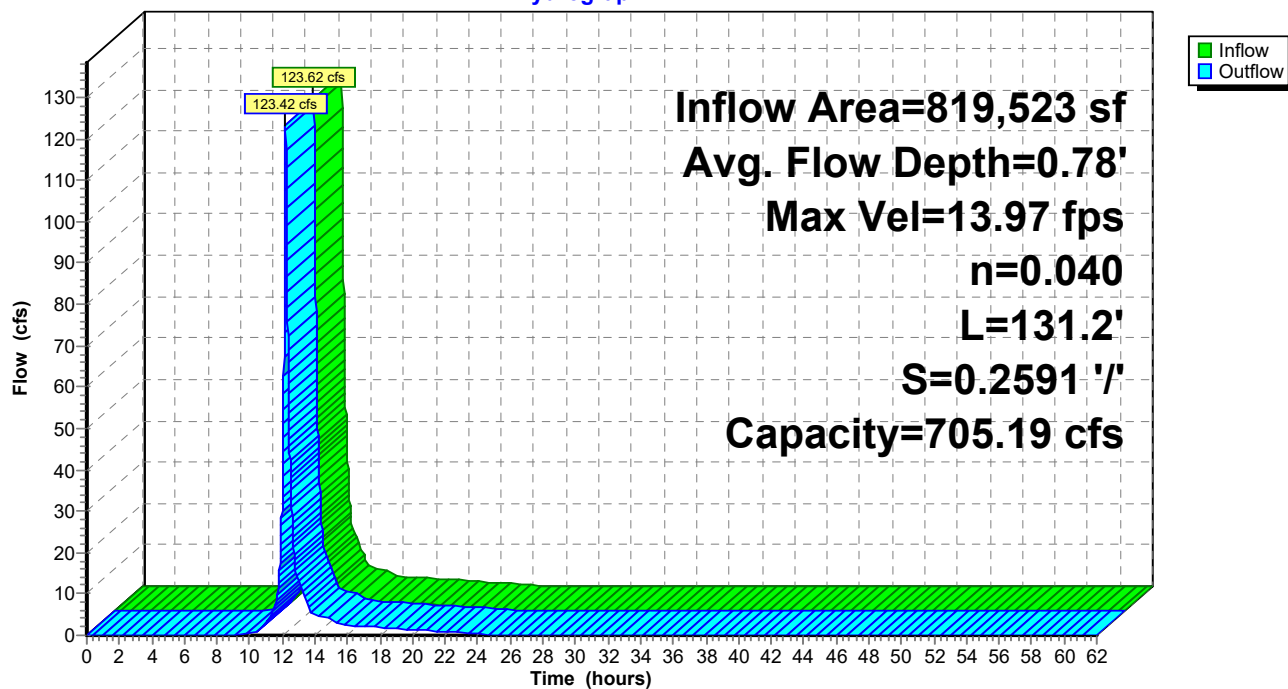
Peak Storage= 1,161 cf @ 12.20 hrs
 Average Depth at Peak Storage= 0.78'
 Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 705.19 cfs

9.00' x 2.00' deep channel, n= 0.040
 Side Slope Z-value= 3.0 '/' Top Width= 21.00'
 Length= 131.2' Slope= 0.2591 '/'
 Inlet Invert= 922.00', Outlet Invert= 888.00'



Reach DDS5: D Downslope 5

Hydrograph



Summary for Reach DDS6: D Downslope 6

[61] Hint: Exceeded Reach D11T outlet invert by 0.85' @ 12.20 hrs

[62] Hint: Exceeded Reach D12T OUTLET depth by 0.37' @ 12.23 hrs

[62] Hint: Exceeded Reach DDS5 OUTLET depth by 0.14' @ 12.56 hrs

Inflow Area = 1,163,867 sf, 0.00% Impervious, Inflow Depth = 4.45" for 100-yr 24-hr event
Inflow = 147.64 cfs @ 12.20 hrs, Volume= 431,315 cf
Outflow = 147.41 cfs @ 12.21 hrs, Volume= 431,315 cf, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 15.02 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 2.80 fps, Avg. Travel Time= 0.7 min

Peak Storage= 1,226 cf @ 12.20 hrs

Average Depth at Peak Storage= 0.85'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 722.61 cfs

9.00' x 2.00' deep channel, n= 0.035

Side Slope Z-value= 3.0 ' ' Top Width= 21.00'

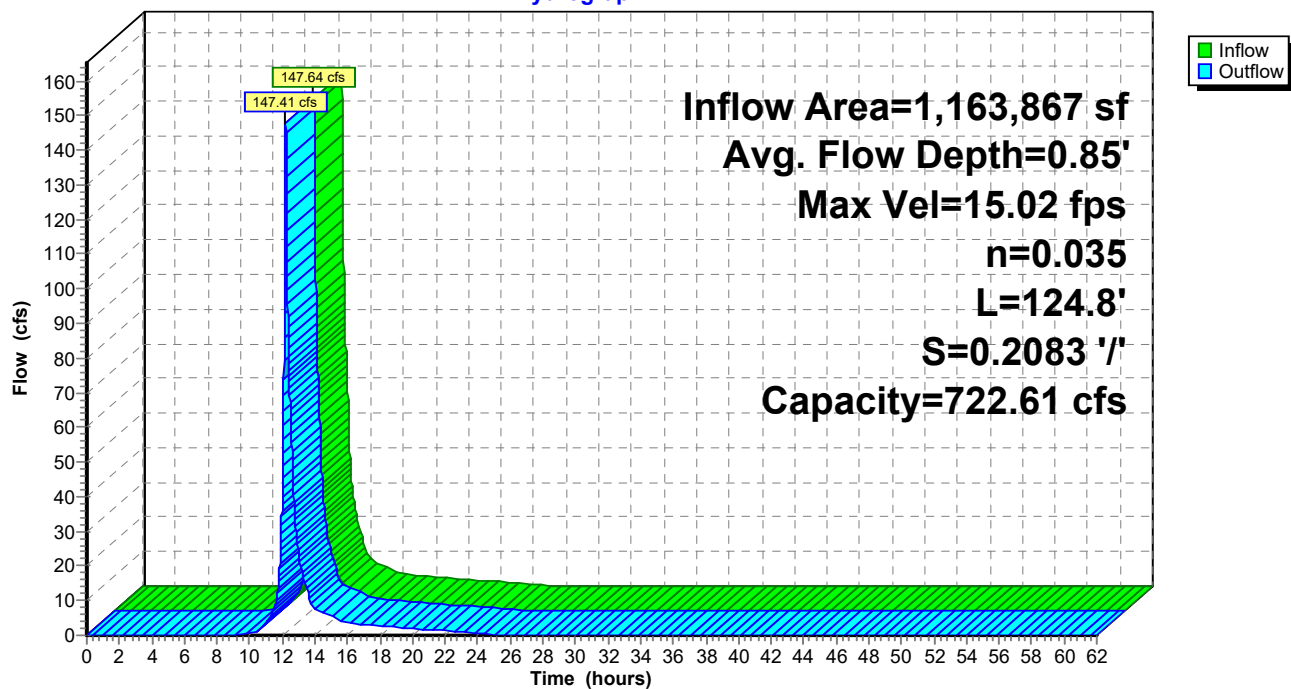
Length= 124.8' Slope= 0.2083 ' '

Inlet Invert= 888.00', Outlet Invert= 862.00'



Reach DDS6: D Downslope 6

Hydrograph



Summary for Reach E10T: E10 Terrace

Inflow Area = 211,515 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 36.56 cfs @ 12.15 hrs, Volume= 77,895 cf
Outflow = 28.42 cfs @ 12.32 hrs, Volume= 77,895 cf, Atten= 22%, Lag= 9.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.46 fps, Min. Travel Time= 6.6 min

Avg. Velocity= 1.24 fps, Avg. Travel Time= 23.9 min

Peak Storage= 11,290 cf @ 12.21 hrs

Average Depth at Peak Storage= 1.08'

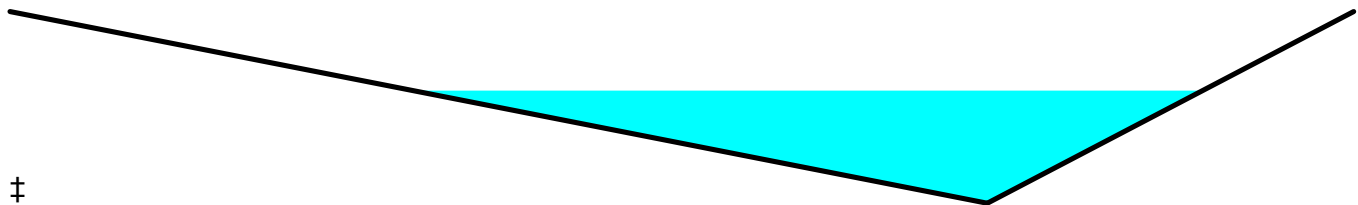
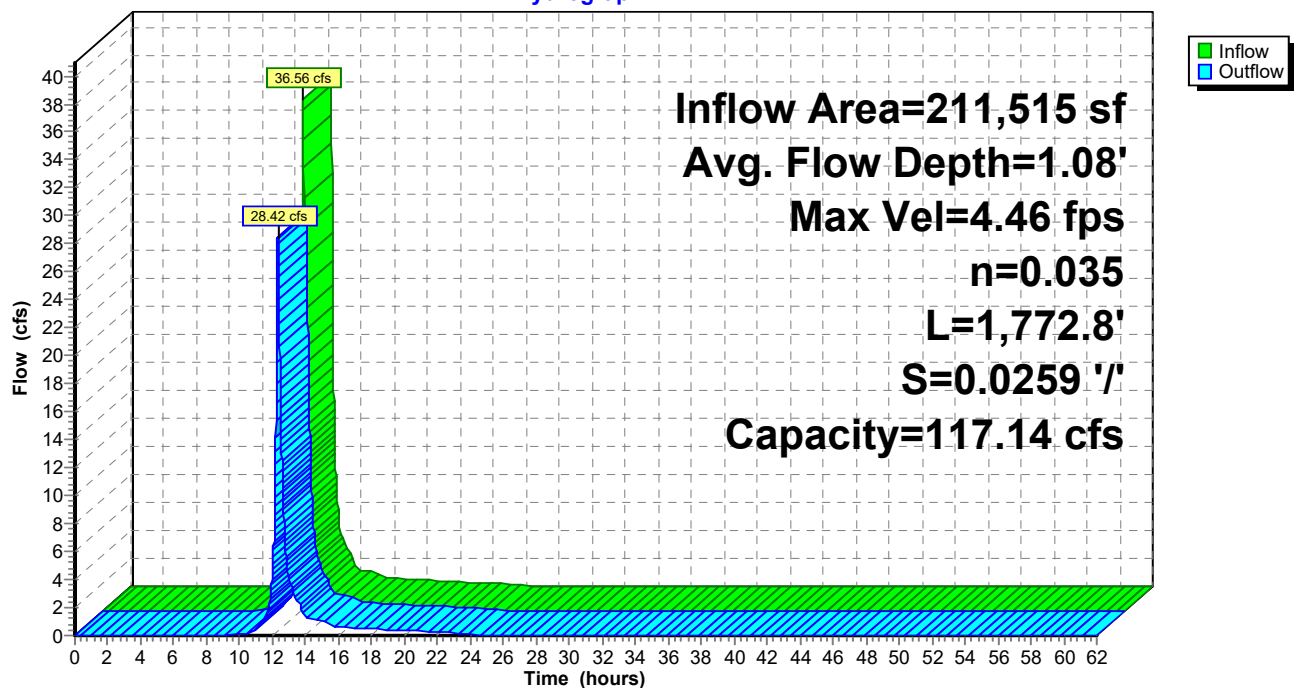
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 117.14 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 1,772.8' Slope= 0.0259 '/'

Inlet Invert= 956.00', Outlet Invert= 910.00'

**Reach E10T: E10 Terrace****Hydrograph**

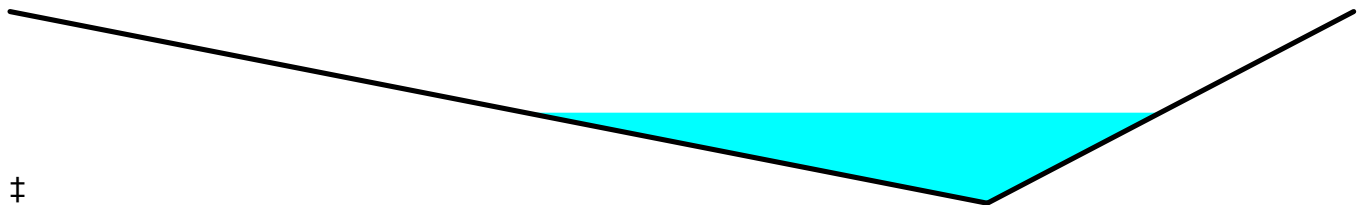
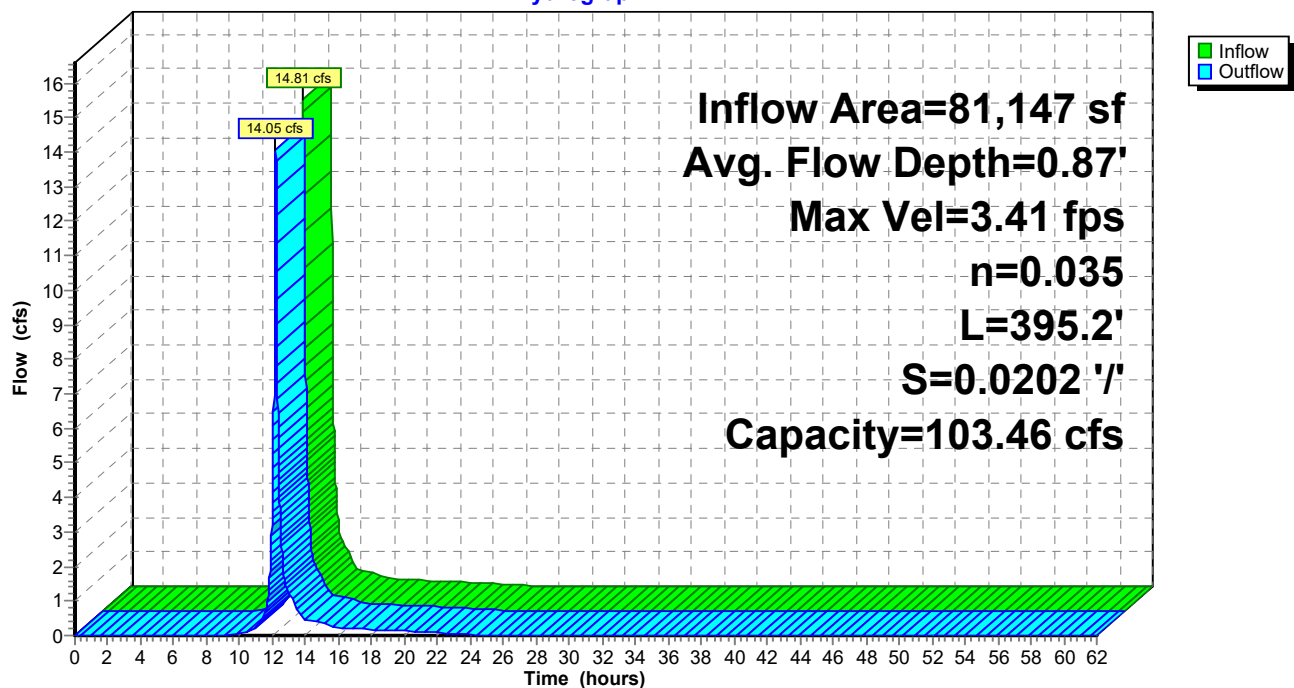
Summary for Reach E11T: E11 Terrace

Inflow Area = 81,147 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 14.81 cfs @ 12.14 hrs, Volume= 29,884 cf
Outflow = 14.05 cfs @ 12.19 hrs, Volume= 29,884 cf, Atten= 5%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.41 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.11 fps, Avg. Travel Time= 5.9 min

Peak Storage= 1,630 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 103.46 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 395.2' Slope= 0.0202 '/'
Inlet Invert= 890.00', Outlet Invert= 882.00'

**Reach E11T: E11 Terrace****Hydrograph**

Summary for Reach E12T: E12 Terrce

Inflow Area = 245,497 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 41.99 cfs @ 12.15 hrs, Volume= 90,409 cf
 Outflow = 32.05 cfs @ 12.33 hrs, Volume= 90,409 cf, Atten= 24%, Lag= 10.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 4.62 fps, Min. Travel Time= 7.2 min

Avg. Velocity= 1.25 fps, Avg. Travel Time= 26.5 min

Peak Storage= 13,774 cf @ 12.21 hrs

Average Depth at Peak Storage= 1.12'

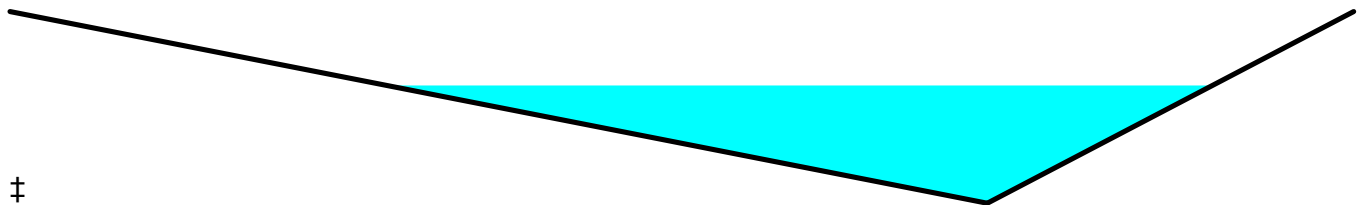
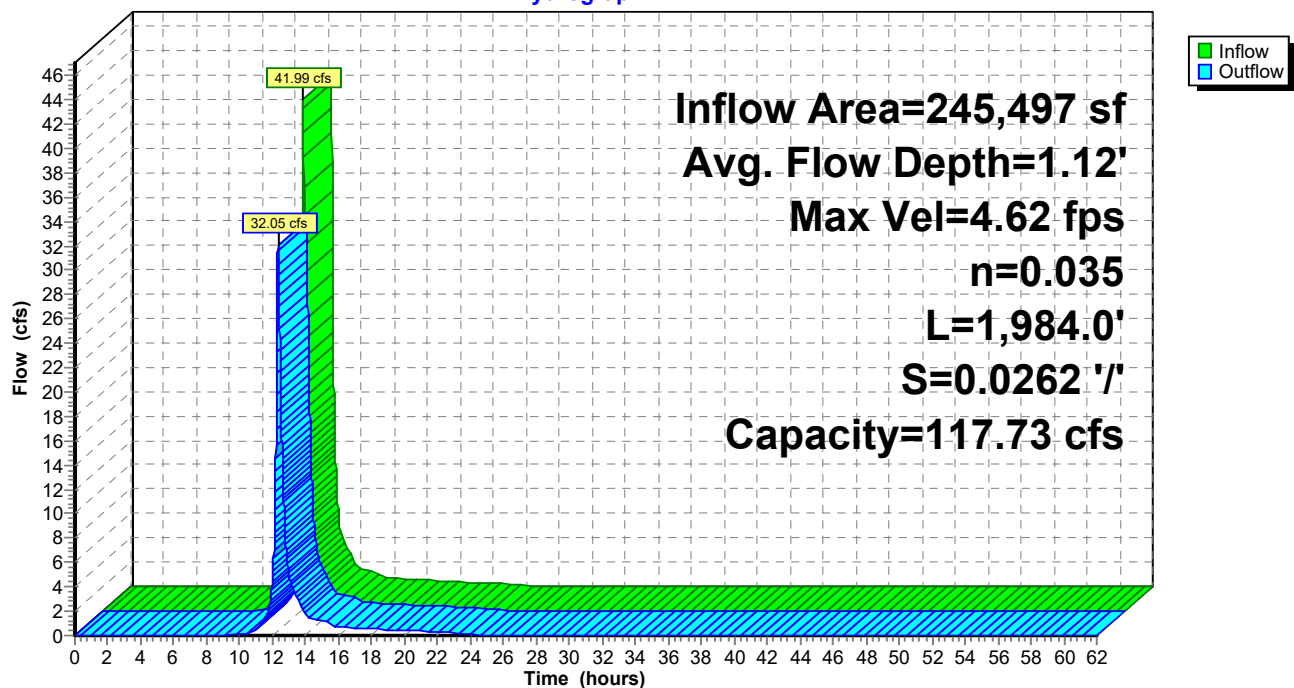
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 117.73 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'

Length= 1,984.0' Slope= 0.0262 '/'

Inlet Invert= 938.00', Outlet Invert= 886.00'

**Reach E12T: E12 Terrce****Hydrograph**

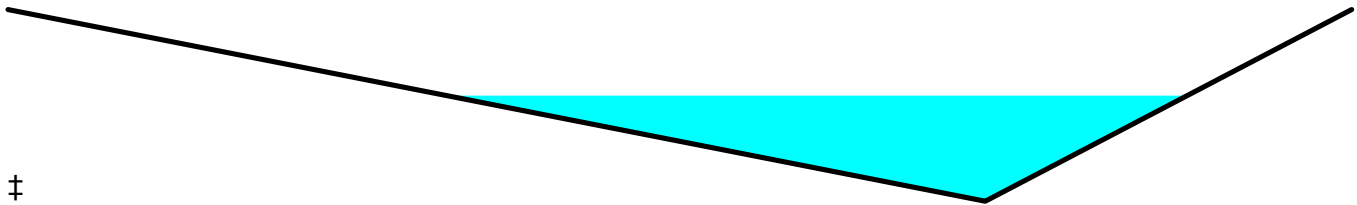
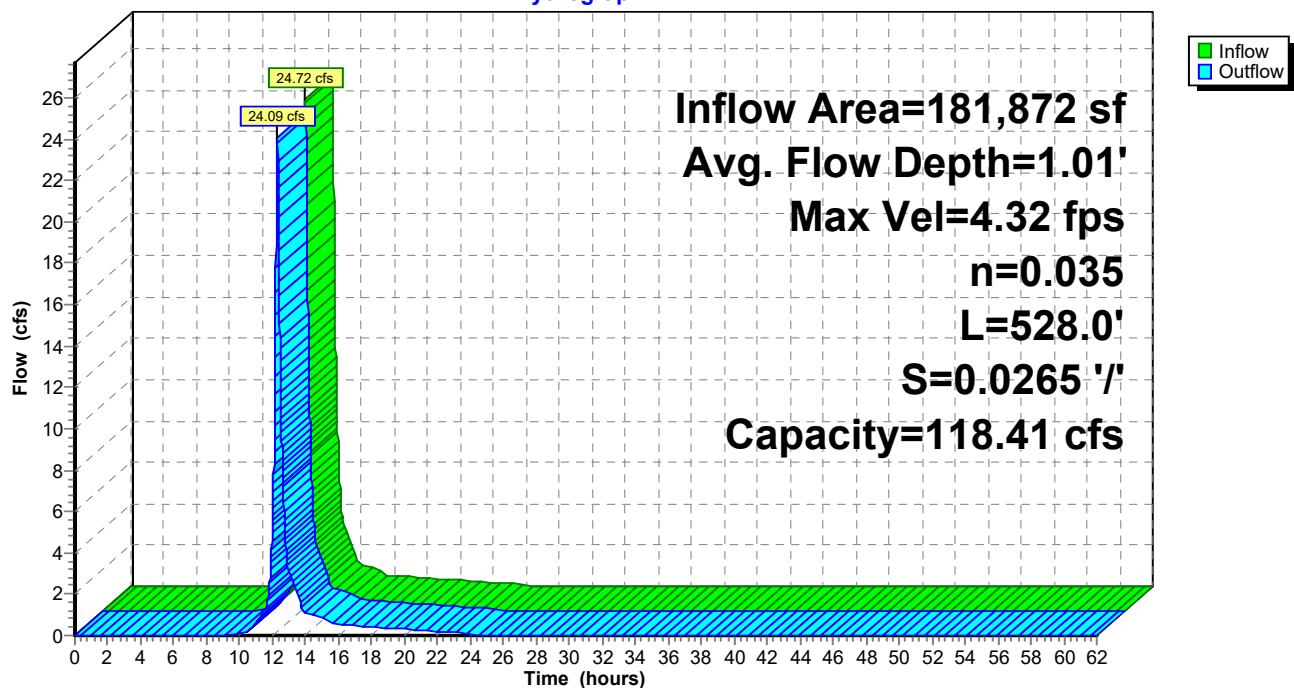
Summary for Reach E1T: E1 Terrace

Inflow Area = 181,872 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 24.72 cfs @ 12.22 hrs, Volume= 66,978 cf
 Outflow = 24.09 cfs @ 12.28 hrs, Volume= 66,978 cf, Atten= 3%, Lag= 3.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 4.32 fps, Min. Travel Time= 2.0 min
 Avg. Velocity = 1.47 fps, Avg. Travel Time= 6.0 min

Peak Storage= 2,947 cf @ 12.25 hrs
 Average Depth at Peak Storage= 1.01'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 118.41 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
 Length= 528.0' Slope= 0.0265 '/'
 Inlet Invert= 1,094.00', Outlet Invert= 1,080.00'

**Reach E1T: E1 Terrace****Hydrograph**

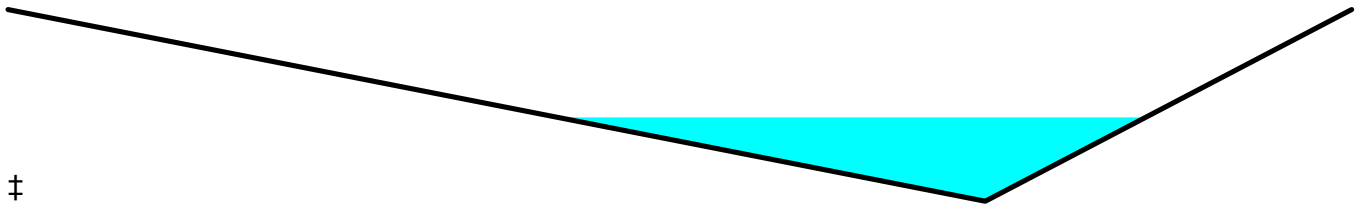
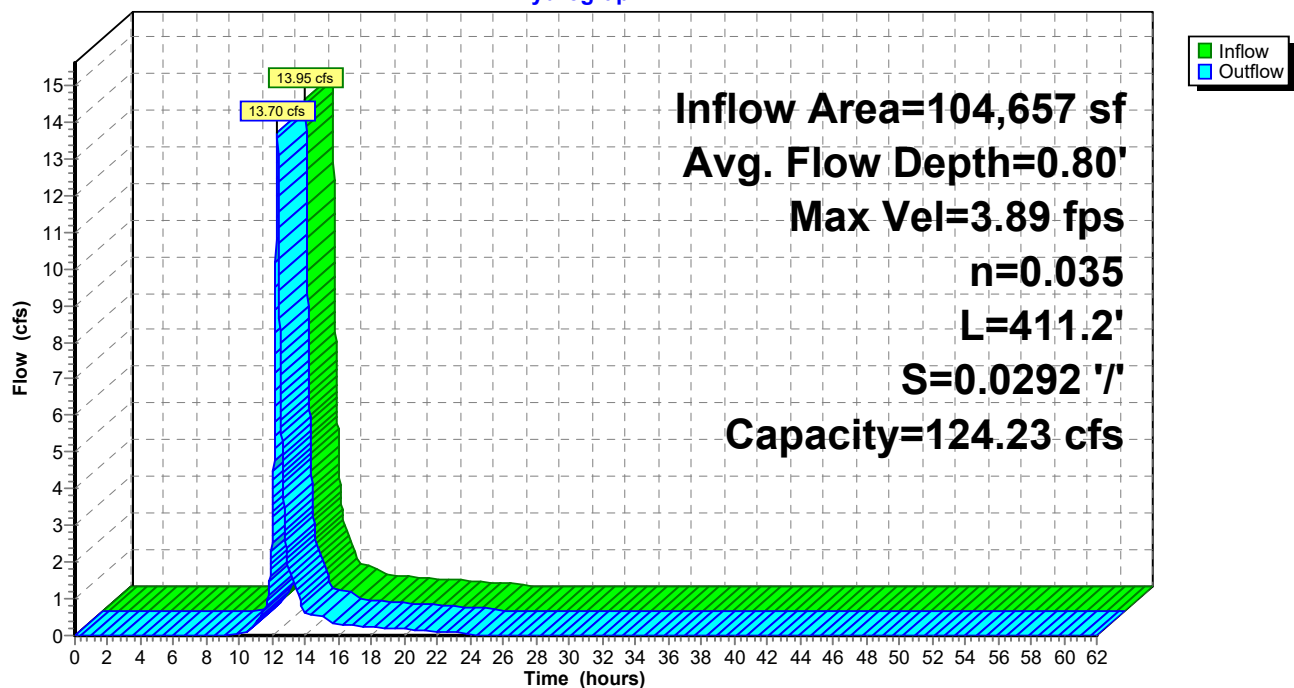
Summary for Reach E2T: E2 Terrace

Inflow Area = 104,657 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 13.95 cfs @ 12.23 hrs, Volume= 38,542 cf
 Outflow = 13.70 cfs @ 12.28 hrs, Volume= 38,542 cf, Atten= 2%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 3.89 fps, Min. Travel Time= 1.8 min
 Avg. Velocity = 1.37 fps, Avg. Travel Time= 5.0 min

Peak Storage= 1,450 cf @ 12.25 hrs
 Average Depth at Peak Storage= 0.80'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 124.23 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
 Length= 411.2' Slope= 0.0292 '/'
 Inlet Invert= 1,092.00', Outlet Invert= 1,080.00'

**Reach E2T: E2 Terrace****Hydrograph**

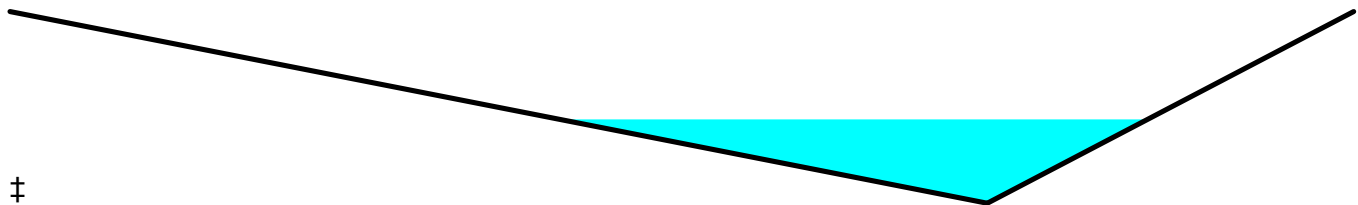
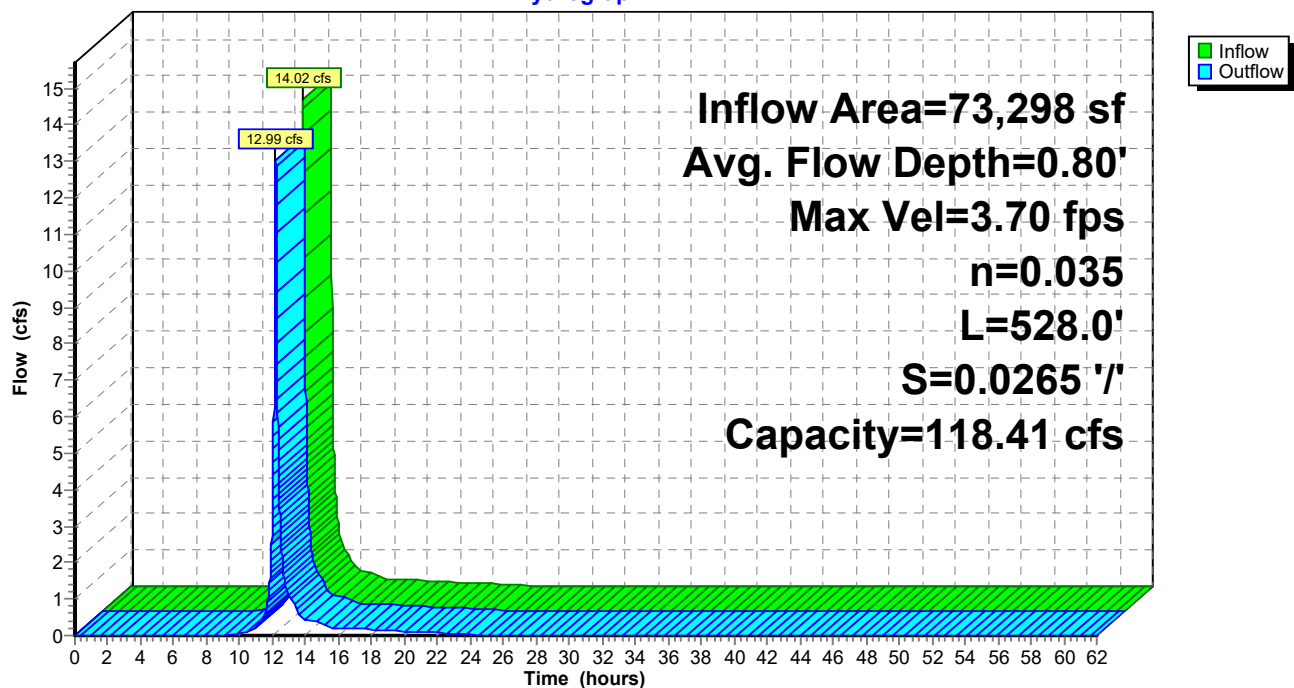
Summary for Reach E3T: E3 Terrace

Inflow Area = 73,298 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 14.02 cfs @ 12.13 hrs, Volume= 26,993 cf
Outflow = 12.99 cfs @ 12.19 hrs, Volume= 26,993 cf, Atten= 7%, Lag= 3.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.70 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 1.19 fps, Avg. Travel Time= 7.4 min

Peak Storage= 1,855 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 118.41 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 528.0' Slope= 0.0265 '/'
Inlet Invert= 1,054.00', Outlet Invert= 1,040.00'

**Reach E3T: E3 Terrace****Hydrograph**

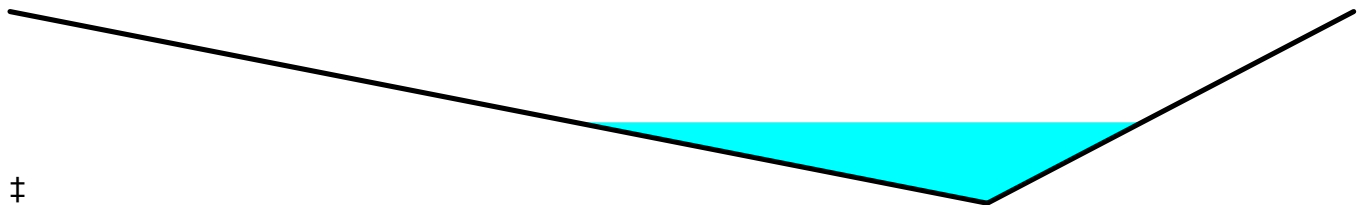
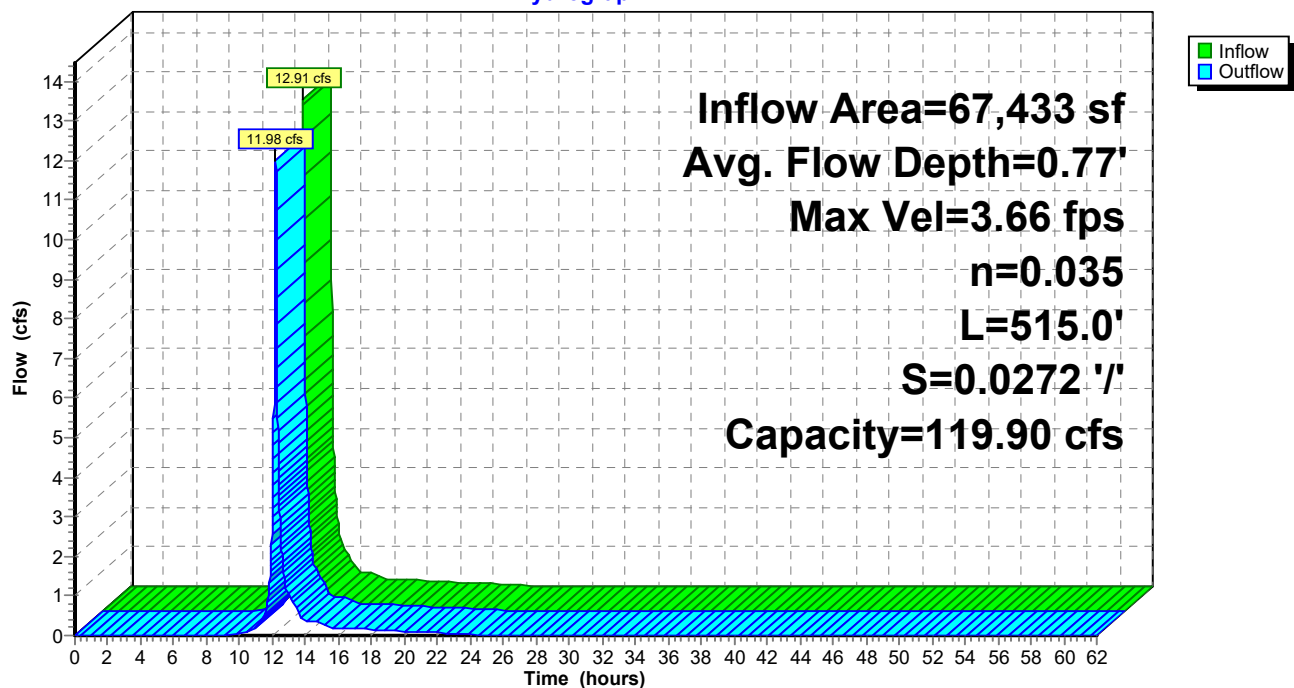
Summary for Reach E4T: E4 Terrace

Inflow Area = 67,433 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 12.91 cfs @ 12.13 hrs, Volume= 24,834 cf
Outflow = 11.98 cfs @ 12.19 hrs, Volume= 24,834 cf, Atten= 7%, Lag= 3.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.66 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 1.18 fps, Avg. Travel Time= 7.3 min

Peak Storage= 1,687 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.77'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 119.90 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 515.0' Slope= 0.0272 '/'
Inlet Invert= 1,054.00', Outlet Invert= 1,040.00'

**Reach E4T: E4 Terrace****Hydrograph**

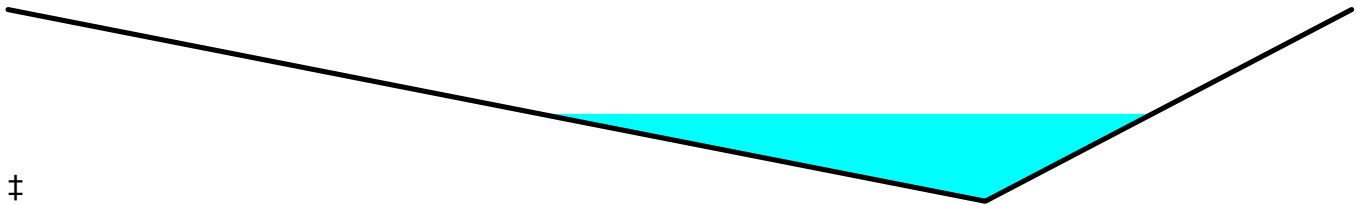
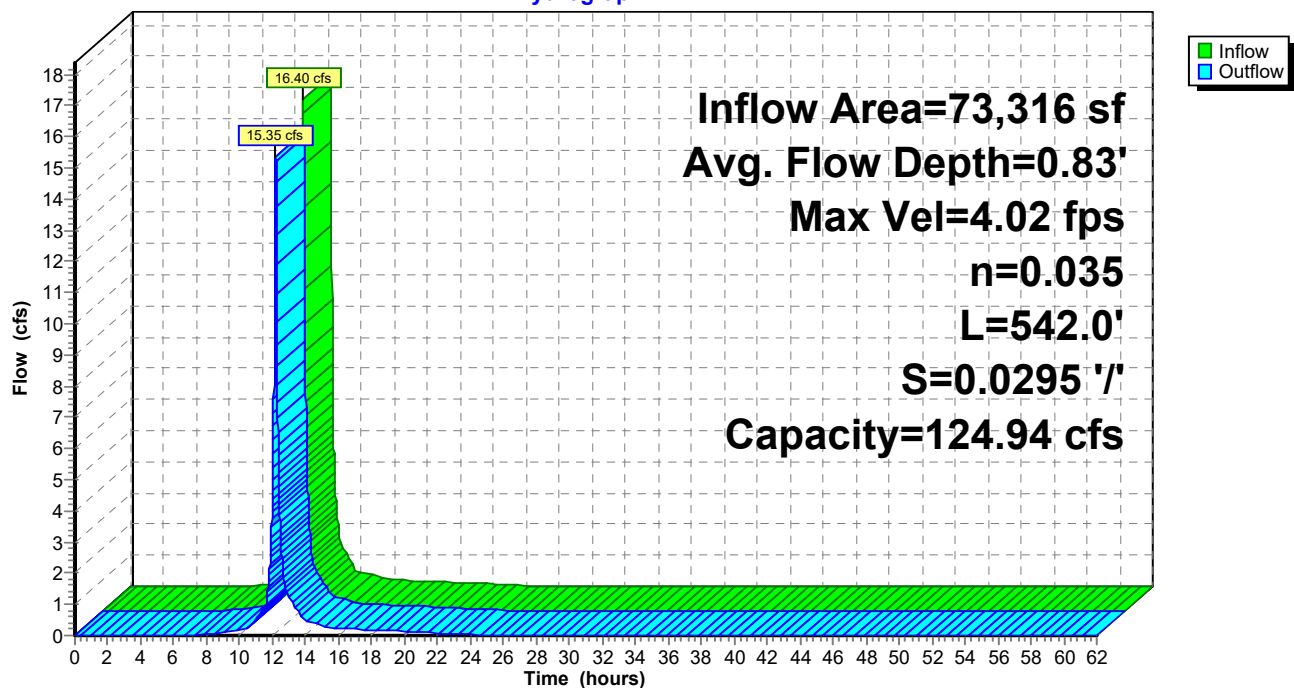
Summary for Reach E5T: E5 Terrace

Inflow Area = 73,316 sf, 0.00% Impervious, Inflow Depth = 5.43" for 100-yr 24-hr event
 Inflow = 16.40 cfs @ 12.13 hrs, Volume= 33,205 cf
 Outflow = 15.35 cfs @ 12.19 hrs, Volume= 33,205 cf, Atten= 6%, Lag= 3.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 4.02 fps, Min. Travel Time= 2.2 min
 Avg. Velocity = 1.26 fps, Avg. Travel Time= 7.2 min

Peak Storage= 2,075 cf @ 12.15 hrs
 Average Depth at Peak Storage= 0.83'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 124.94 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
 Length= 542.0' Slope= 0.0295 '/'
 Inlet Invert= 1,016.00', Outlet Invert= 1,000.00'

**Reach E5T: E5 Terrace****Hydrograph**

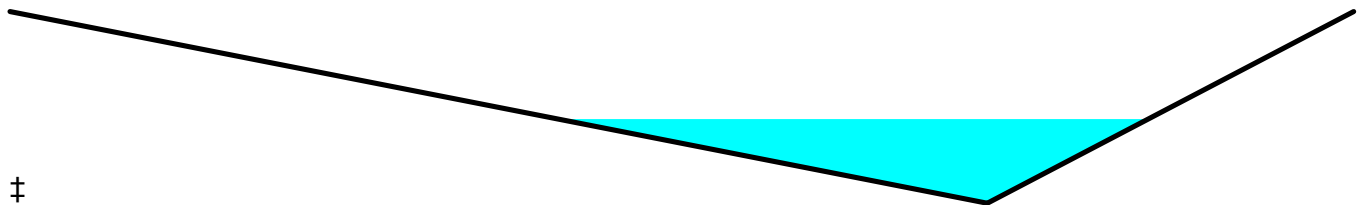
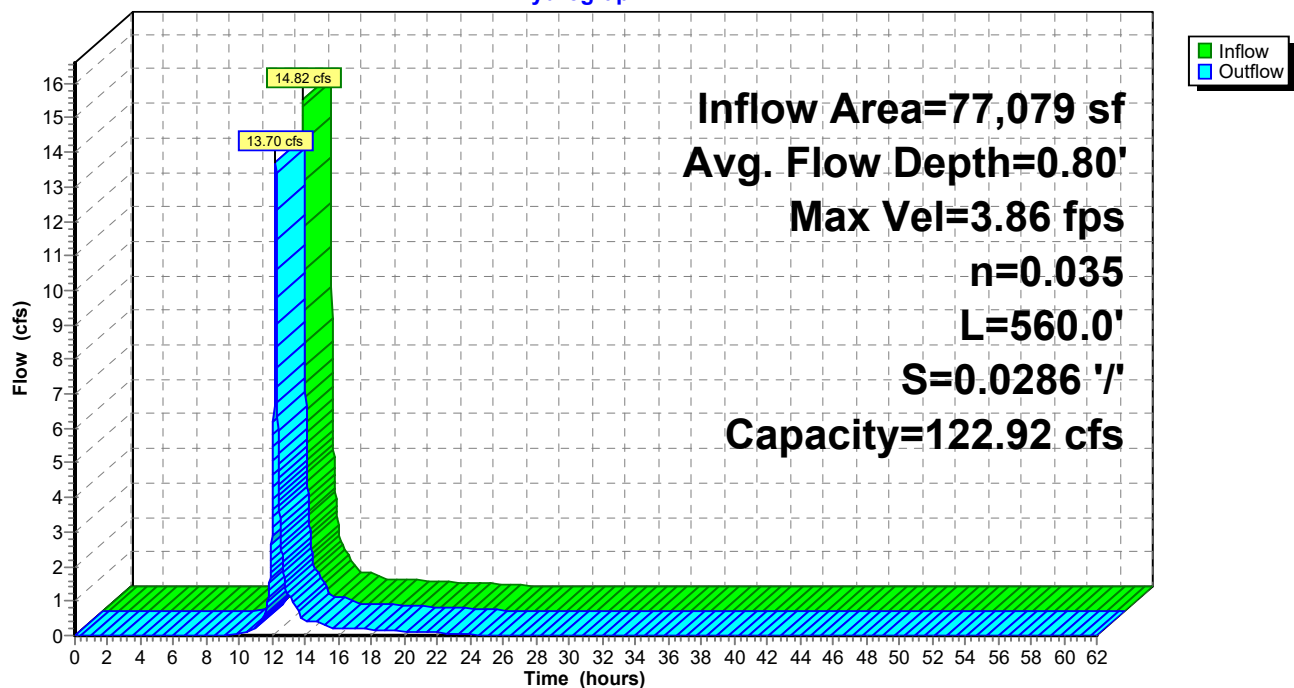
Summary for Reach E6T: E6 Terrace

Inflow Area = 77,079 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 14.82 cfs @ 12.13 hrs, Volume= 28,386 cf
Outflow = 13.70 cfs @ 12.19 hrs, Volume= 28,386 cf, Atten= 8%, Lag= 3.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.86 fps, Min. Travel Time= 2.4 min
Avg. Velocity= 1.23 fps, Avg. Travel Time= 7.6 min

Peak Storage= 1,990 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 122.92 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 560.0' Slope= 0.0286 '/'
Inlet Invert= 1,016.00', Outlet Invert= 1,000.00'

**Reach E6T: E6 Terrace****Hydrograph**

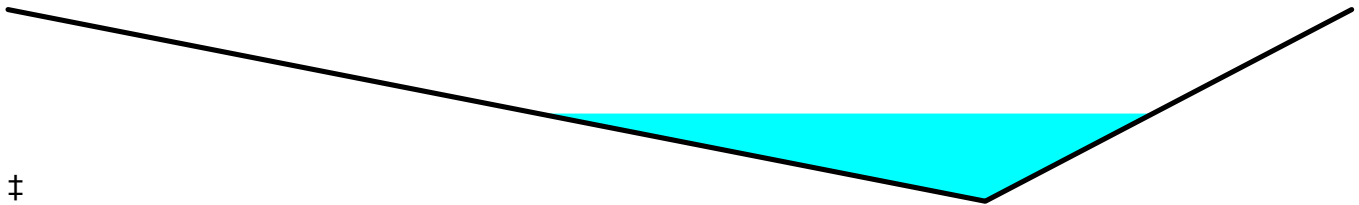
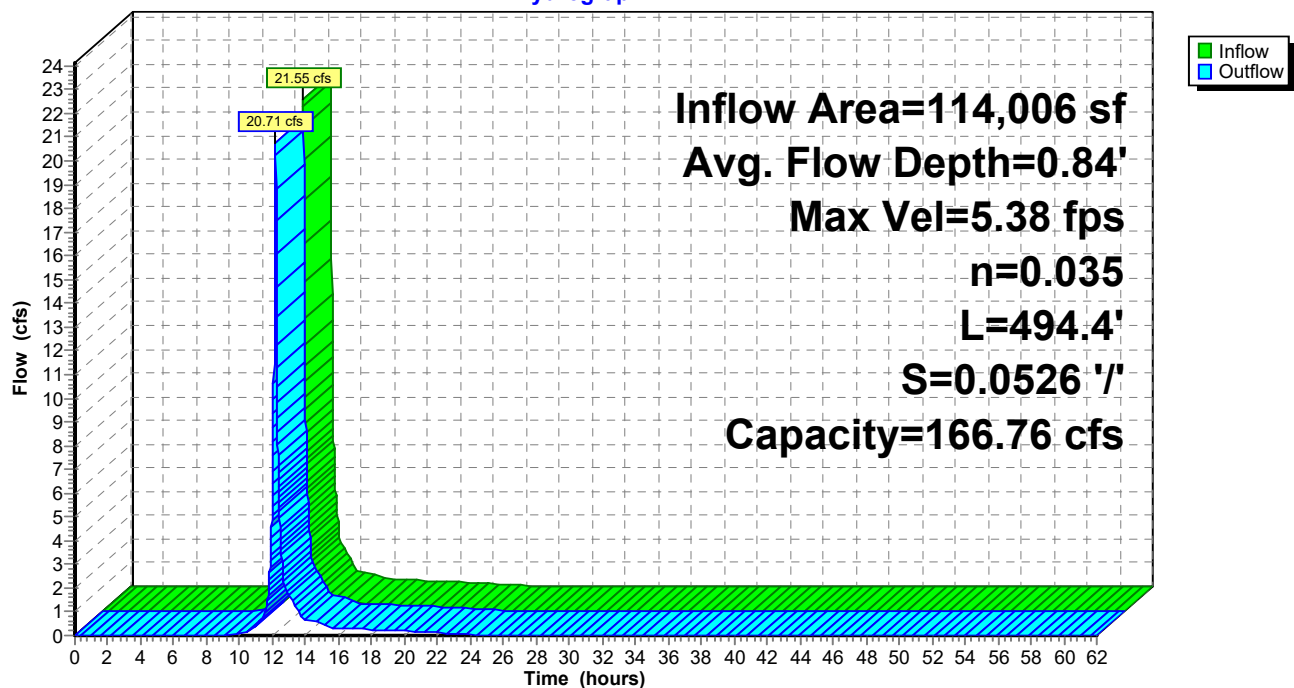
Summary for Reach E7T: E7 Terrace

Inflow Area = 114,006 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 21.55 cfs @ 12.13 hrs, Volume= 41,985 cf
 Outflow = 20.71 cfs @ 12.17 hrs, Volume= 41,985 cf, Atten= 4%, Lag= 2.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Max. Velocity= 5.38 fps, Min. Travel Time= 1.5 min
 Avg. Velocity = 1.77 fps, Avg. Travel Time= 4.7 min

Peak Storage= 1,909 cf @ 12.15 hrs
 Average Depth at Peak Storage= 0.84'
 Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 166.76 cfs

0.00' x 1.83' deep channel, n= 0.035
 Side Slope Z-value= 8.0 3.0 ' Top Width= 20.13'
 Length= 494.4' Slope= 0.0526 ' / '
 Inlet Invert= 962.00', Outlet Invert= 936.00'

**Reach E7T: E7 Terrace****Hydrograph**

Summary for Reach E8T: E8 Terrce

Inflow Area = 166,528 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 26.38 cfs @ 12.17 hrs, Volume= 61,327 cf
 Outflow = 21.85 cfs @ 12.33 hrs, Volume= 61,327 cf, Atten= 17%, Lag= 9.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 3.99 fps, Min. Travel Time= 5.9 min

Avg. Velocity = 1.16 fps, Avg. Travel Time= 20.1 min

Peak Storage= 7,680 cf @ 12.23 hrs

Average Depth at Peak Storage= 1.00'

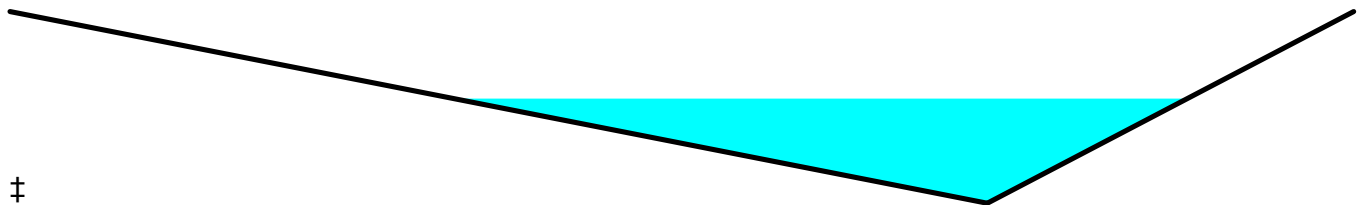
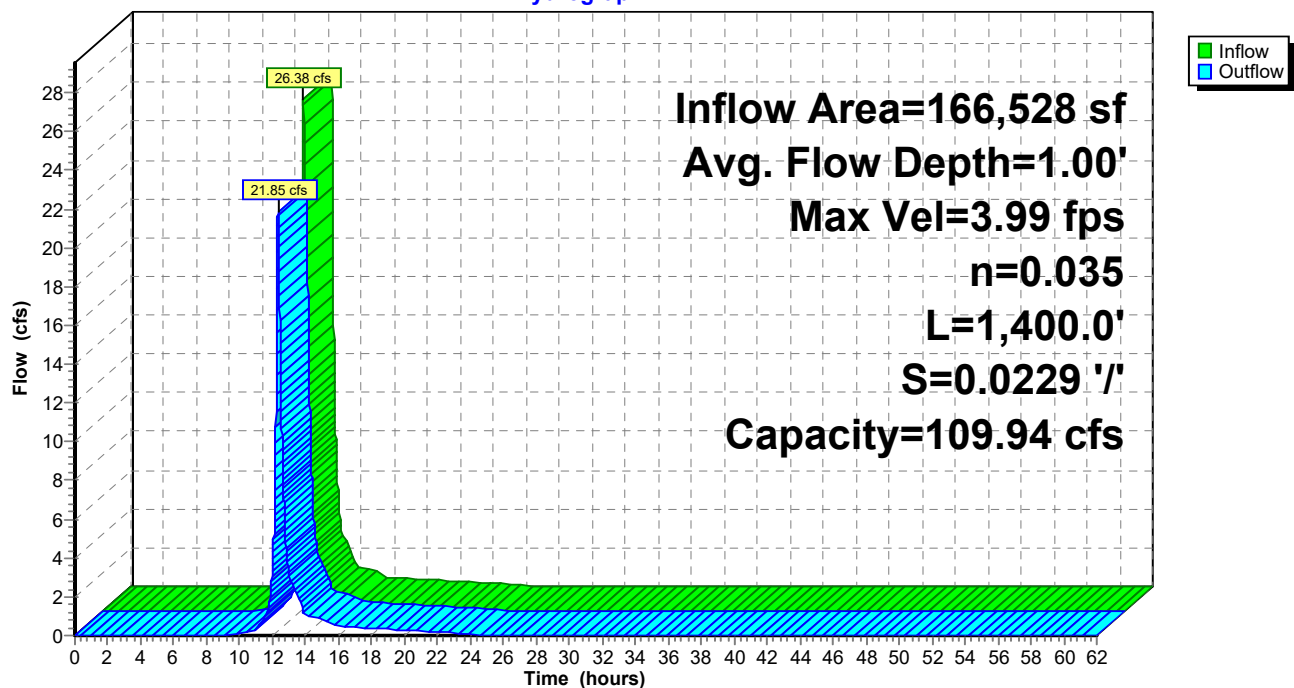
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 109.94 cfs

0.00' x 1.83' deep channel, n= 0.035

Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'

Length= 1,400.0' Slope= 0.0229 '/'

Inlet Invert= 982.00', Outlet Invert= 950.00'

**Reach E8T: E8 Terrce****Hydrograph**

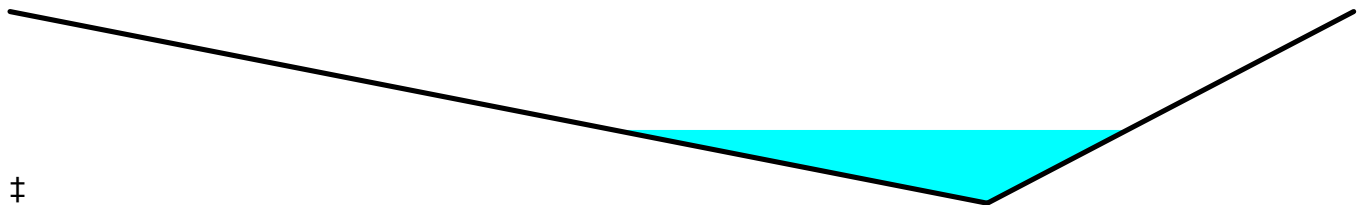
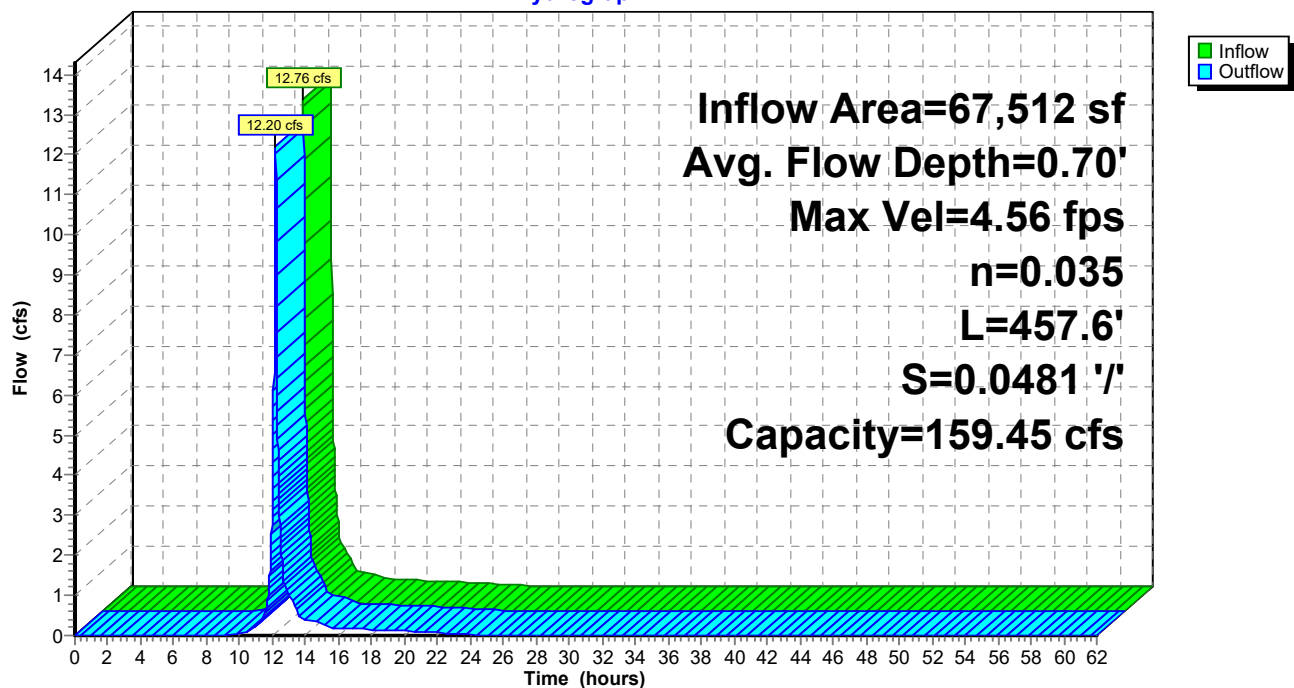
Summary for Reach E9T: E9 Terrace

Inflow Area = 67,512 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 12.76 cfs @ 12.13 hrs, Volume= 24,863 cf
Outflow = 12.20 cfs @ 12.18 hrs, Volume= 24,863 cf, Atten= 4%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.56 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.51 fps, Avg. Travel Time= 5.0 min

Peak Storage= 1,228 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.70'
Bank-Full Depth= 1.83' Flow Area= 18.4 sf, Capacity= 159.45 cfs

0.00' x 1.83' deep channel, n= 0.035
Side Slope Z-value= 8.0 3.0 '/' Top Width= 20.13'
Length= 457.6' Slope= 0.0481 '/'
Inlet Invert= 932.00', Outlet Invert= 910.00'

**Reach E9T: E9 Terrace****Hydrograph**

Summary for Reach EDS1: E Downslope 1

[61] Hint: Exceeded Reach E1T outlet invert by 0.38' @ 12.28 hrs

[61] Hint: Exceeded Reach E2T outlet invert by 0.38' @ 12.28 hrs

Inflow Area = 286,529 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 37.79 cfs @ 12.28 hrs, Volume= 105,520 cf
Outflow = 37.75 cfs @ 12.29 hrs, Volume= 105,520 cf, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 9.94 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 2.43 fps, Avg. Travel Time= 0.9 min

Peak Storage= 493 cf @ 12.28 hrs

Average Depth at Peak Storage= 0.38'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 769.59 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

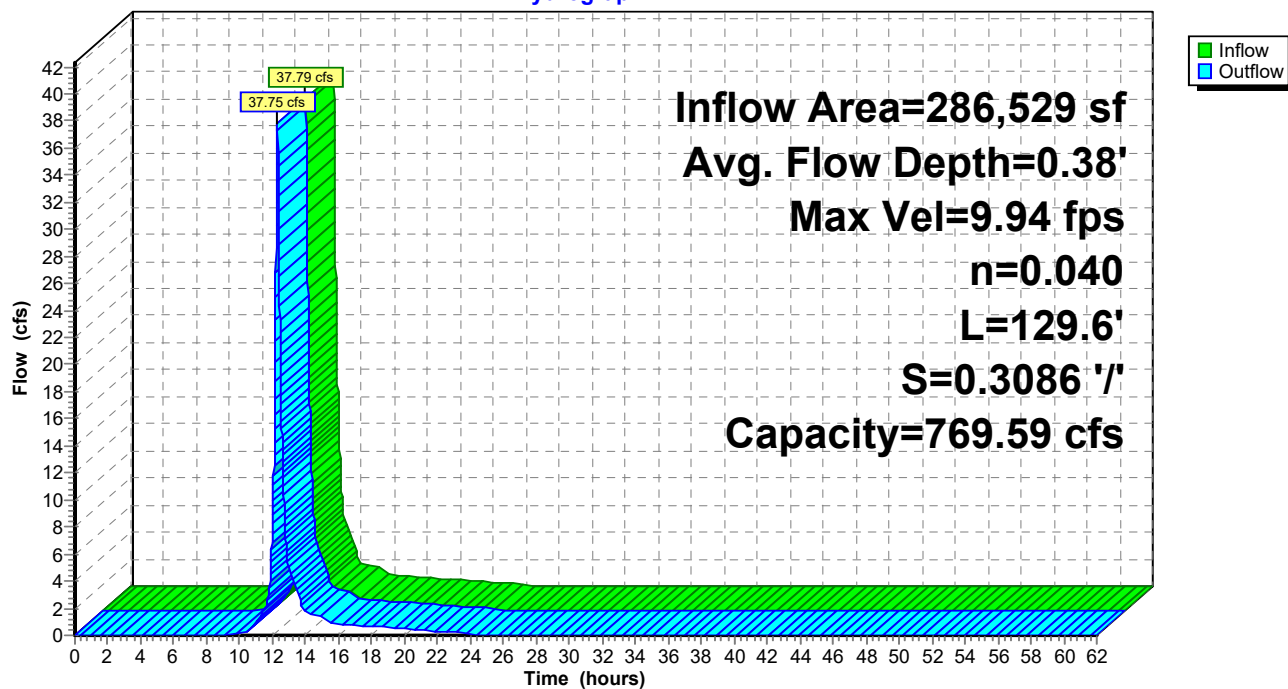
Length= 129.6' Slope= 0.3086 '/'

Inlet Invert= 1,080.00', Outlet Invert= 1,040.00'



Reach EDS1: E Downslope 1

Hydrograph



Summary for Reach EDS2: E Downslope 2

[62] Hint: Exceeded Reach E3T OUTLET depth by 0.33' @ 12.32 hrs

[62] Hint: Exceeded Reach E4T OUTLET depth by 0.35' @ 12.32 hrs

[62] Hint: Exceeded Reach EDS1 OUTLET depth by 0.58' @ 12.19 hrs

Inflow Area = 427,260 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
Inflow = 54.55 cfs @ 12.23 hrs, Volume= 157,347 cf
Outflow = 54.52 cfs @ 12.23 hrs, Volume= 157,347 cf, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 11.92 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 4.13 fps, Avg. Travel Time= 0.5 min

Peak Storage= 608 cf @ 12.23 hrs

Average Depth at Peak Storage= 0.91'

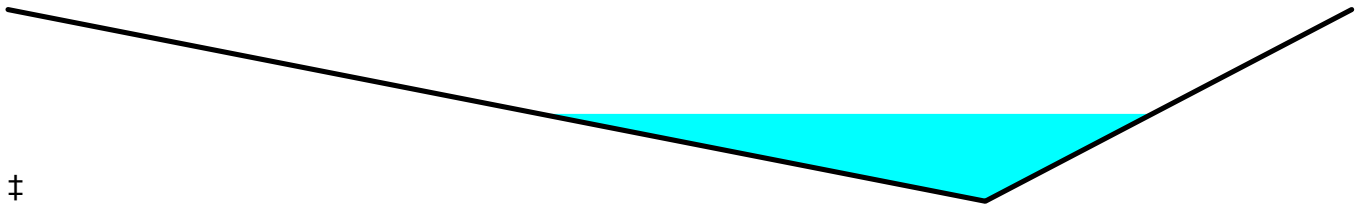
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 442.55 cfs

0.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 8.0 3.0 '/' Top Width= 22.00'

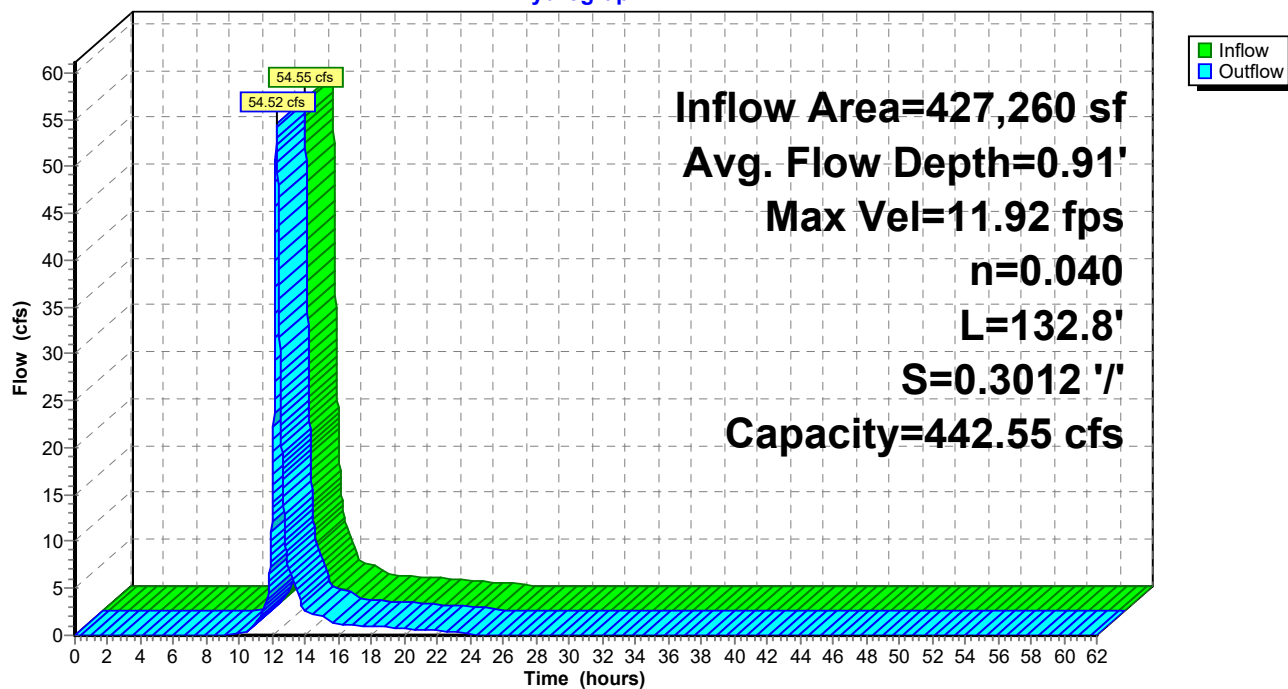
Length= 132.8' Slope= 0.3012 '/'

Inlet Invert= 1,040.00', Outlet Invert= 1,000.00'



Reach EDS2: E Downslope 2

Hydrograph



Summary for Reach EDS3: E Downslope 3

[62] Hint: Exceeded Reach E5T OUTLET depth by 0.40' @ 12.31 hrs

[62] Hint: Exceeded Reach E6T OUTLET depth by 0.42' @ 12.30 hrs

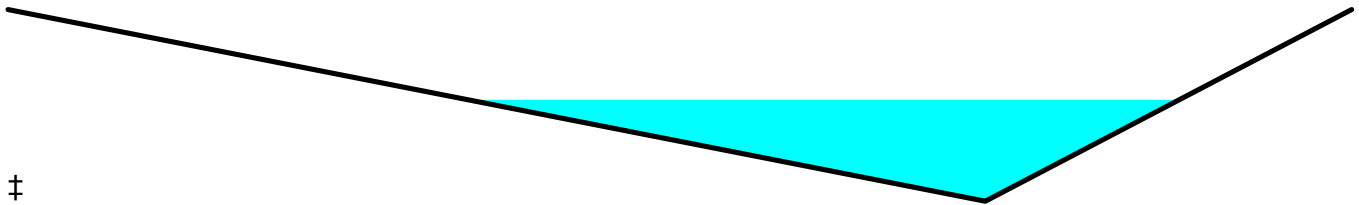
[62] Hint: Exceeded Reach EDS2 OUTLET depth by 0.16' @ 12.18 hrs

Inflow Area = 577,655 sf, 0.00% Impervious, Inflow Depth = 4.55" for 100-yr 24-hr event
Inflow = 81.25 cfs @ 12.21 hrs, Volume= 218,937 cf
Outflow = 81.11 cfs @ 12.21 hrs, Volume= 218,937 cf, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
Max. Velocity= 13.15 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 4.15 fps, Avg. Travel Time= 0.7 min

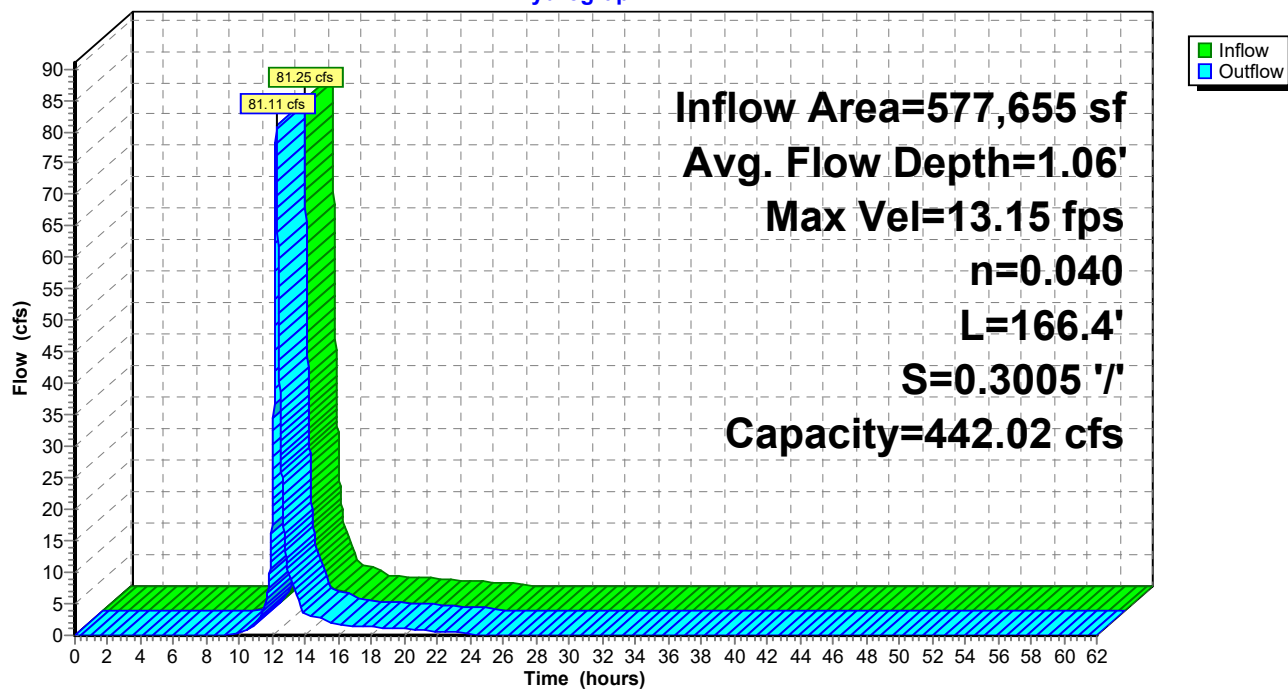
Peak Storage= 1,027 cf @ 12.21 hrs
Average Depth at Peak Storage= 1.06'
Bank-Full Depth= 2.00' Flow Area= 22.0 sf, Capacity= 442.02 cfs

0.00' x 2.00' deep channel, n= 0.040
Side Slope Z-value= 8.0 3.0 '/' Top Width= 22.00'
Length= 166.4' Slope= 0.3005 '/'
Inlet Invert= 1,000.00', Outlet Invert= 950.00'



Reach EDS3: E Downslope 3

Hydrograph



Summary for Reach EDS4: E Downslope 4

[61] Hint: Exceeded Reach E8T outlet invert by 0.66' @ 12.23 hrs

[61] Hint: Exceeded Reach EDS3 outlet invert by 0.66' @ 12.23 hrs

Inflow Area = 744,183 sf, 0.00% Impervious, Inflow Depth = 4.52" for 100-yr 24-hr event
Inflow = 94.45 cfs @ 12.22 hrs, Volume= 280,264 cf
Outflow = 94.37 cfs @ 12.23 hrs, Volume= 280,264 cf, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 12.91 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 2.80 fps, Avg. Travel Time= 0.4 min

Peak Storage= 550 cf @ 12.23 hrs

Average Depth at Peak Storage= 0.66'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 714.40 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 ' ' Top Width= 21.00'

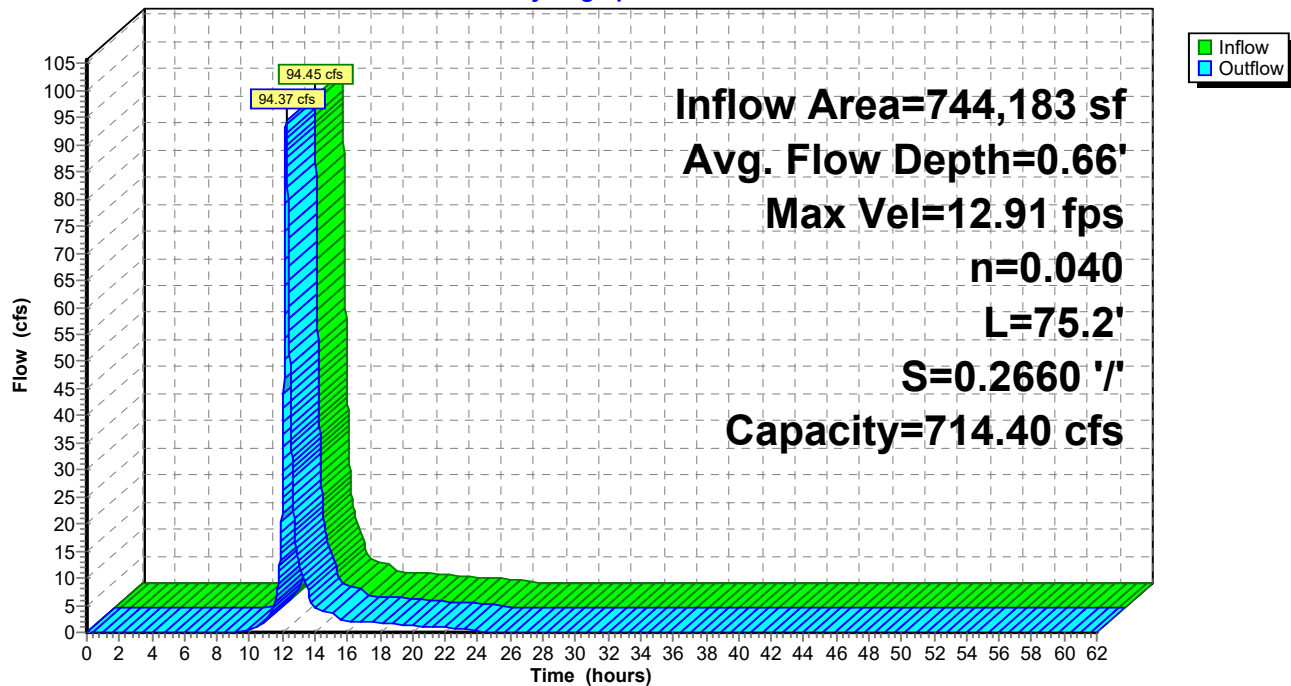
Length= 75.2' Slope= 0.2660 ' '

Inlet Invert= 950.00', Outlet Invert= 930.00'



Reach EDS4: E Downslope 4

Hydrograph



Summary for Reach EDS5: E Downslope 5

[62] Hint: Exceeded Reach EDS4 OUTLET depth by 0.24' @ 12.19 hrs

Inflow Area = 858,189 sf, 0.00% Impervious, Inflow Depth = 4.51" for 100-yr 24-hr event
 Inflow = 110.65 cfs @ 12.21 hrs, Volume= 322,249 cf
 Outflow = 110.46 cfs @ 12.22 hrs, Volume= 322,249 cf, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 10.51 fps, Min. Travel Time= 0.3 min

Avg. Velocity = 2.23 fps, Avg. Travel Time= 1.2 min

Peak Storage= 1,683 cf @ 12.21 hrs

Average Depth at Peak Storage= 0.90'

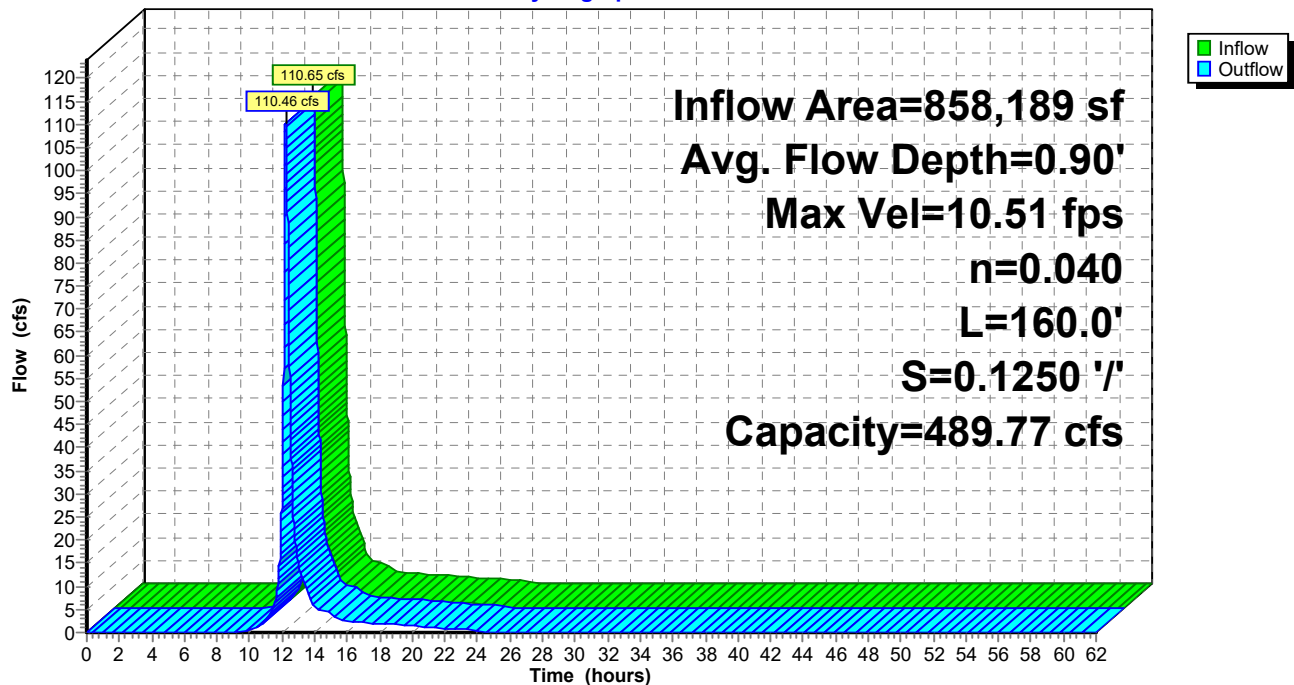
Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 489.77 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

Length= 160.0' Slope= 0.1250 '/'

Inlet Invert= 930.00', Outlet Invert= 910.00'

**Reach EDS5: E Downslope 5****Hydrograph**

Summary for Reach EDS6: E Downslope 6

[61] Hint: Exceeded Reach E10T outlet invert by 0.88' @ 12.23 hrs

[62] Hint: Exceeded Reach E9T OUTLET depth by 0.38' @ 12.31 hrs

[62] Hint: Exceeded Reach EDS5 OUTLET depth by 0.03' @ 12.37 hrs

Inflow Area = 1,137,216 sf, 0.00% Impervious, Inflow Depth = 4.48" for 100-yr 24-hr event
Inflow = 138.42 cfs @ 12.23 hrs, Volume= 425,006 cf
Outflow = 138.36 cfs @ 12.23 hrs, Volume= 425,006 cf, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Max. Velocity= 13.44 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 2.81 fps, Avg. Travel Time= 0.7 min

Peak Storage= 1,186 cf @ 12.23 hrs

Average Depth at Peak Storage= 0.88'

Bank-Full Depth= 2.00' Flow Area= 30.0 sf, Capacity= 632.29 cfs

9.00' x 2.00' deep channel, n= 0.040

Side Slope Z-value= 3.0 '/' Top Width= 21.00'

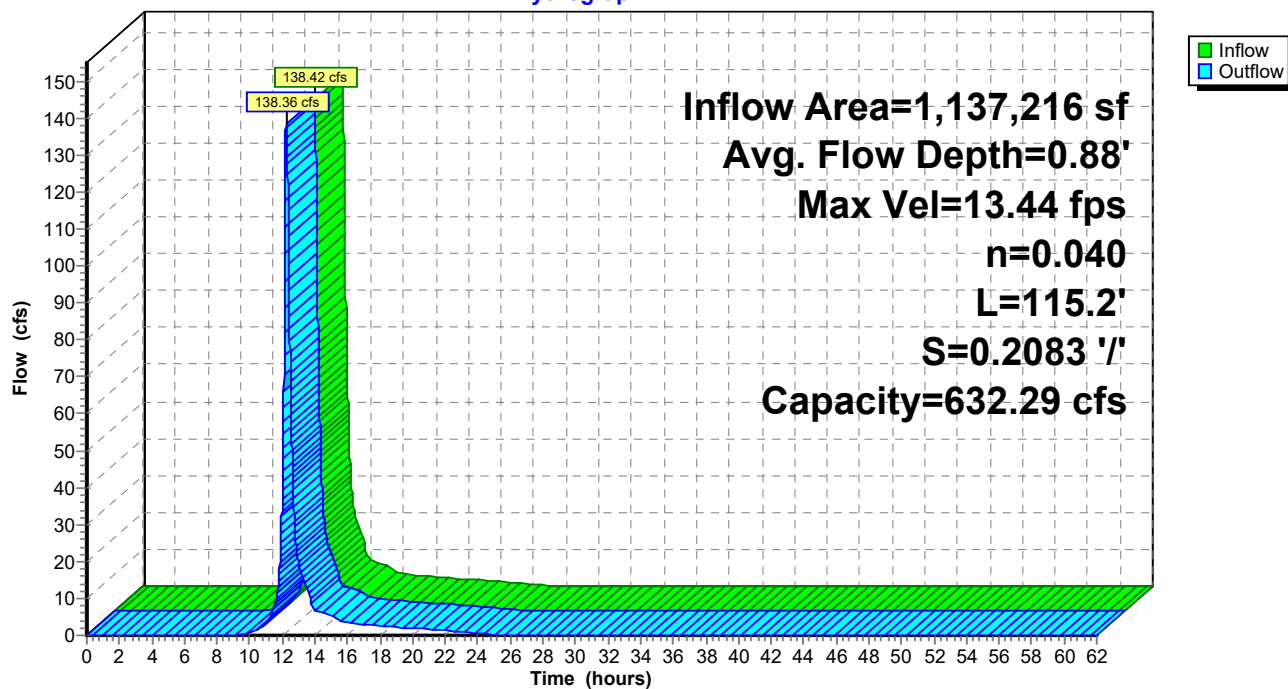
Length= 115.2' Slope= 0.2083 '/'

Inlet Invert= 910.00', Outlet Invert= 886.00'



Reach EDS6: E Downslope 6

Hydrograph



Summary for Pond 1P: Existing West Pond (infiltration)

Inflow Area = 1,473,067 sf, 0.00% Impervious, Inflow Depth = 4.47" for 100-yr 24-hr event
 Inflow = 171.45 cfs @ 12.26 hrs, Volume= 548,690 cf
 Outflow = 1.70 cfs @ 21.85 hrs, Volume= 287,565 cf, Atten= 99%, Lag= 575.9 min
 Discarded = 1.70 cfs @ 21.85 hrs, Volume= 287,565 cf

Routing by Stor-Ind method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 850.70' @ 21.85 hrs Surf.Area= 91,131 sf Storage= 476,356 cf

Plug-Flow detention time= 1,436.9 min calculated for 287,565 cf (52% of inflow)
 Center-of-Mass det. time= 1,352.2 min (2,163.9 - 811.6)

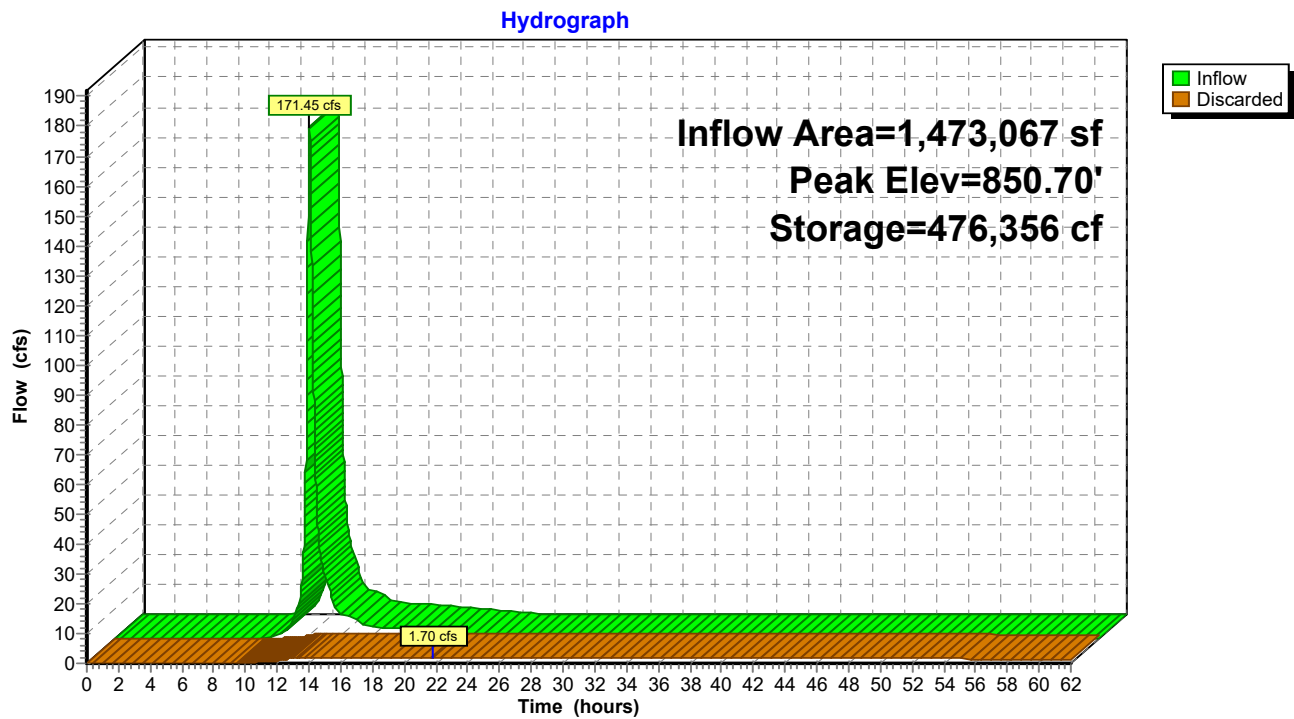
Volume	Invert	Avail.Storage	Storage Description
#1	843.00'	1,565,998 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
843.00	7,708	0	0
844.00	30,410	19,059	19,059
845.00	45,796	38,103	57,162
846.00	64,648	55,222	112,384
847.00	69,110	66,879	179,263
848.00	75,650	72,380	251,643
849.00	81,456	78,553	330,196
850.00	87,020	84,238	414,434
851.00	92,934	89,977	504,411
852.00	99,015	95,975	600,386
853.00	105,834	102,425	702,810
854.00	117,429	111,632	814,442
855.00	130,852	124,141	938,582
856.00	144,383	137,618	1,076,200
857.00	157,201	150,792	1,226,992
858.00	169,560	163,381	1,390,372
859.00	181,692	175,626	1,565,998

Device	Routing	Invert	Outlet Devices
#1	Discarded	843.00'	0.800 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=1.70 cfs @ 21.85 hrs HW=850.70' (Free Discharge)

↑**1=Exfiltration** (Controls 1.70 cfs)

Pond 1P: Existing West Pond (infiltration)



Summary for Pond 2P: 96" RCP

Inflow Area = 1,473,067 sf, 0.00% Impervious, Inflow Depth = 4.47" for 100-yr 24-hr event
 Inflow = 171.45 cfs @ 12.26 hrs, Volume= 548,690 cf
 Outflow = 171.45 cfs @ 12.26 hrs, Volume= 548,690 cf, Atten= 0%, Lag= 0.0 min
 Primary = 171.45 cfs @ 12.26 hrs, Volume= 548,690 cf

Routing by Stor-Ind method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Peak Elev= 860.92' @ 12.26 hrs

Flood Elev= 882.00'

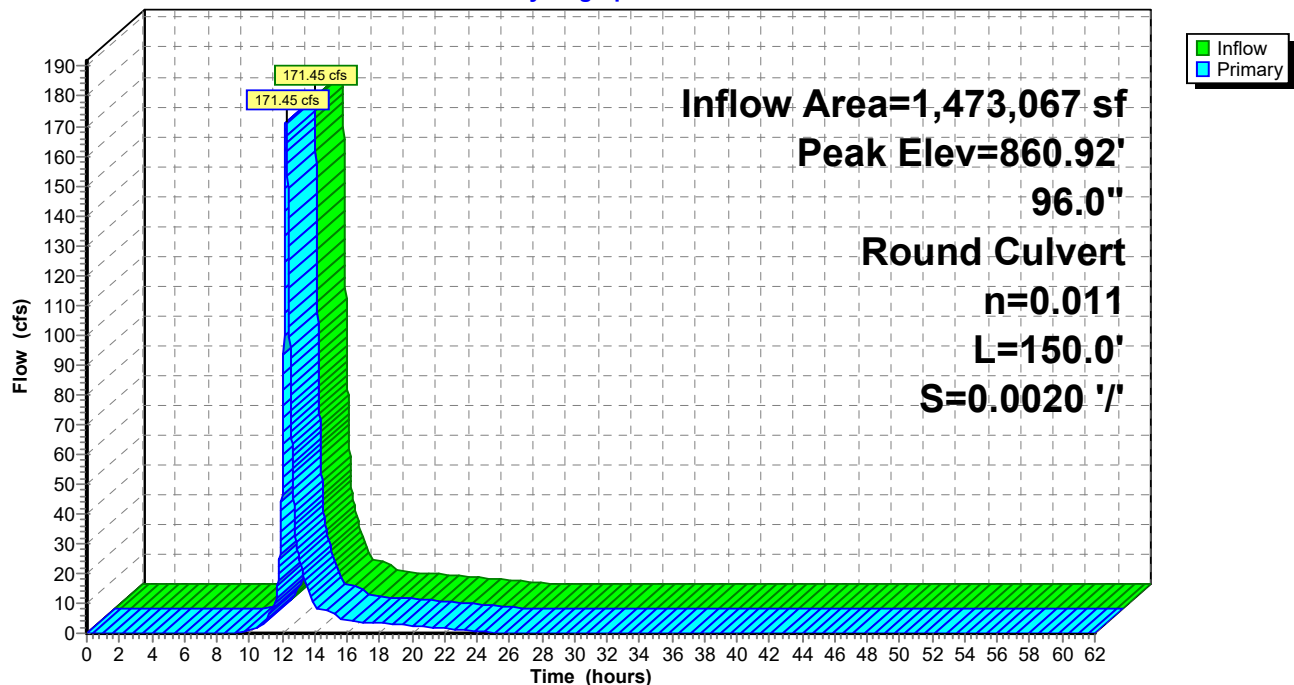
Device	Routing	Invert	Outlet Devices
#1	Primary	856.00'	96.0" Round Culvert L= 150.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 856.00' / 855.70' S= 0.0020 '/ Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 50.27 sf

Primary OutFlow Max=171.43 cfs @ 12.26 hrs HW=860.92' (Free Discharge)

↑1=Culvert (Barrel Controls 171.43 cfs @ 7.56 fps)

Pond 2P: 96" RCP

Hydrograph



Summary for Pond 3P: Existing Northwest Sedimentation Pond

[62] Hint: Exceeded Reach DDS6 OUTLET depth by 5.62' @ 61.99 hrs

Inflow Area = 1,163,867 sf, 0.00% Impervious, Inflow Depth = 4.45" for 100-yr 24-hr event
 Inflow = 147.41 cfs @ 12.21 hrs, Volume= 431,315 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Peak Elev= 867.62' @ 62.00 hrs Surf.Area= 63,679 sf Storage= 431,302 cf

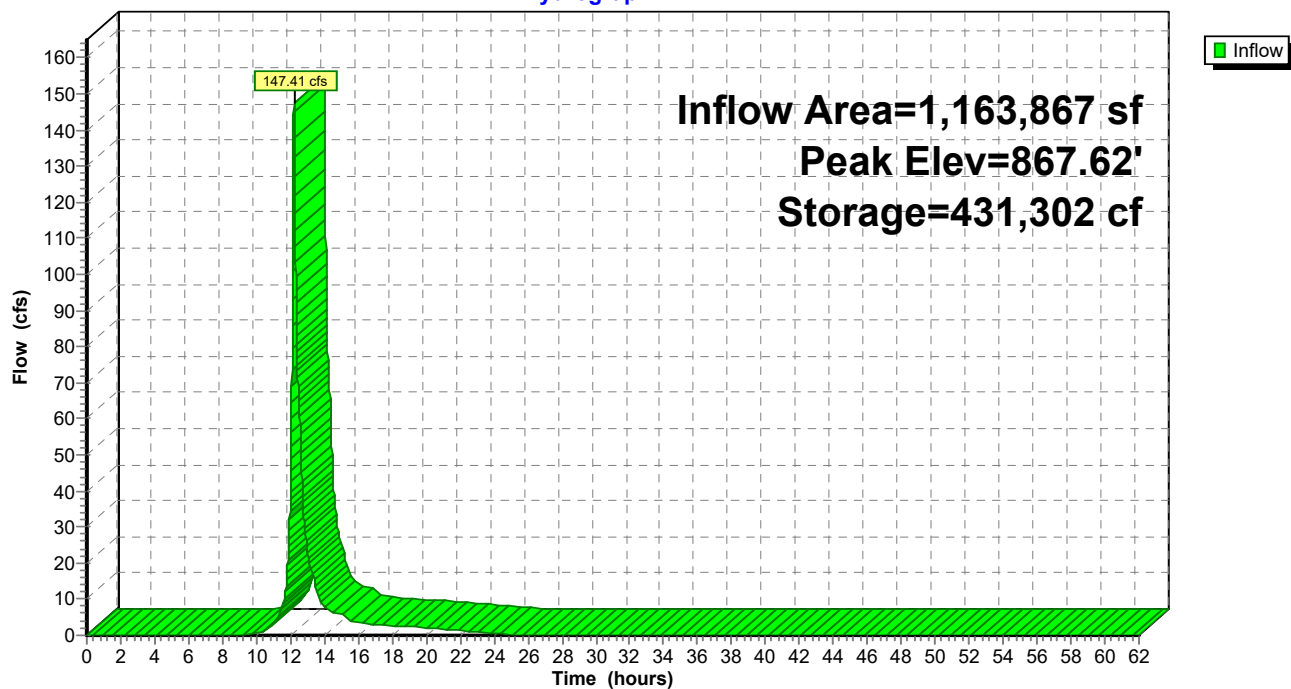
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	858.00'	1,100,759 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
858.00	25,547	0	0
860.00	32,527	58,074	58,074
862.00	39,433	71,960	130,034
864.00	52,356	91,789	221,823
866.00	58,389	110,745	332,568
868.00	64,929	123,318	455,886
870.00	72,080	137,009	592,895
872.00	79,010	151,090	743,985
874.00	89,732	168,742	912,727
876.00	98,300	188,032	1,100,759

Pond 3P: Existing Northwest Sedimentation Pond

Hydrograph



Summary for Pond 4P: Existing Northeast Sedimentation Pond

Inflow Area = 2,763,645 sf, 0.00% Impervious, Inflow Depth = 4.55" for 100-yr 24-hr event
 Inflow = 329.95 cfs @ 12.28 hrs, Volume= 1,048,186 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs

Peak Elev= 890.13' @ 62.00 hrs Surf.Area= 130,021 sf Storage= 1,048,162 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)

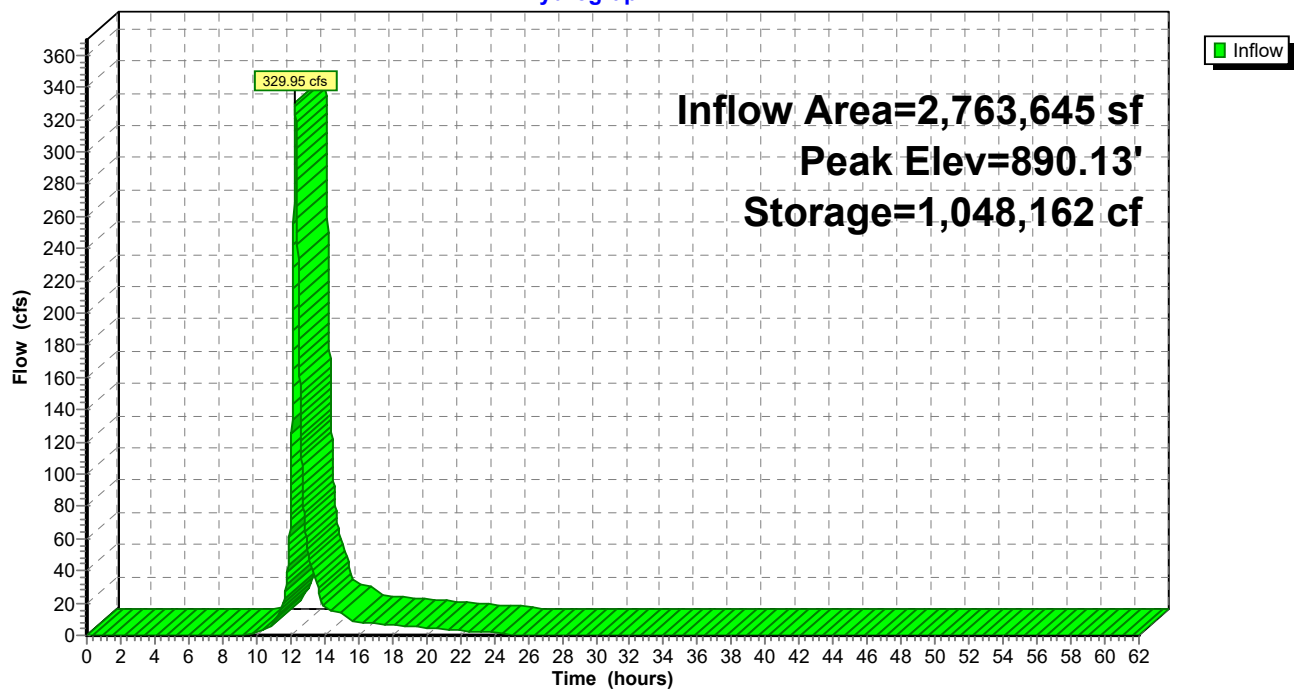
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	878.00'	2,655,287 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
878.00	2,966	0	0
880.00	59,726	62,692	62,692
882.00	79,845	139,571	202,263
884.00	90,522	170,367	372,630
886.00	102,795	193,317	565,947
888.00	116,521	219,316	785,263
890.00	129,005	245,526	1,030,789
892.00	144,149	273,154	1,303,943
894.00	156,212	300,361	1,604,304
896.00	163,360	319,572	1,923,876
898.00	181,105	344,465	2,268,341
900.00	205,841	386,946	2,655,287

Pond 4P: Existing Northeast Sedimentation Pond

Hydrograph



Summary for Pond 5P: Existing ponding area

Inflow Area = 1,440,685 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 146.95 cfs @ 12.20 hrs, Volume= 530,560 cf
 Outflow = 146.87 cfs @ 12.24 hrs, Volume= 530,560 cf, Atten= 0%, Lag= 2.6 min
 Primary = 146.87 cfs @ 12.24 hrs, Volume= 530,560 cf

Routing by Stor-Ind method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Peak Elev= 898.70' @ 12.24 hrs Surf.Area= 1,778 sf Storage= 3,547 cf

Plug-Flow detention time= 0.3 min calculated for 530,475 cf (100% of inflow)
 Center-of-Mass det. time= 0.3 min (813.1 - 812.8)

Volume	Invert	Avail.Storage	Storage Description
#1	895.40'	11,006 cf	Custom Stage Data (Irregular) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
895.40	500	97.0	0	0	500
901.57	3,524	537.0	11,006	11,006	22,785

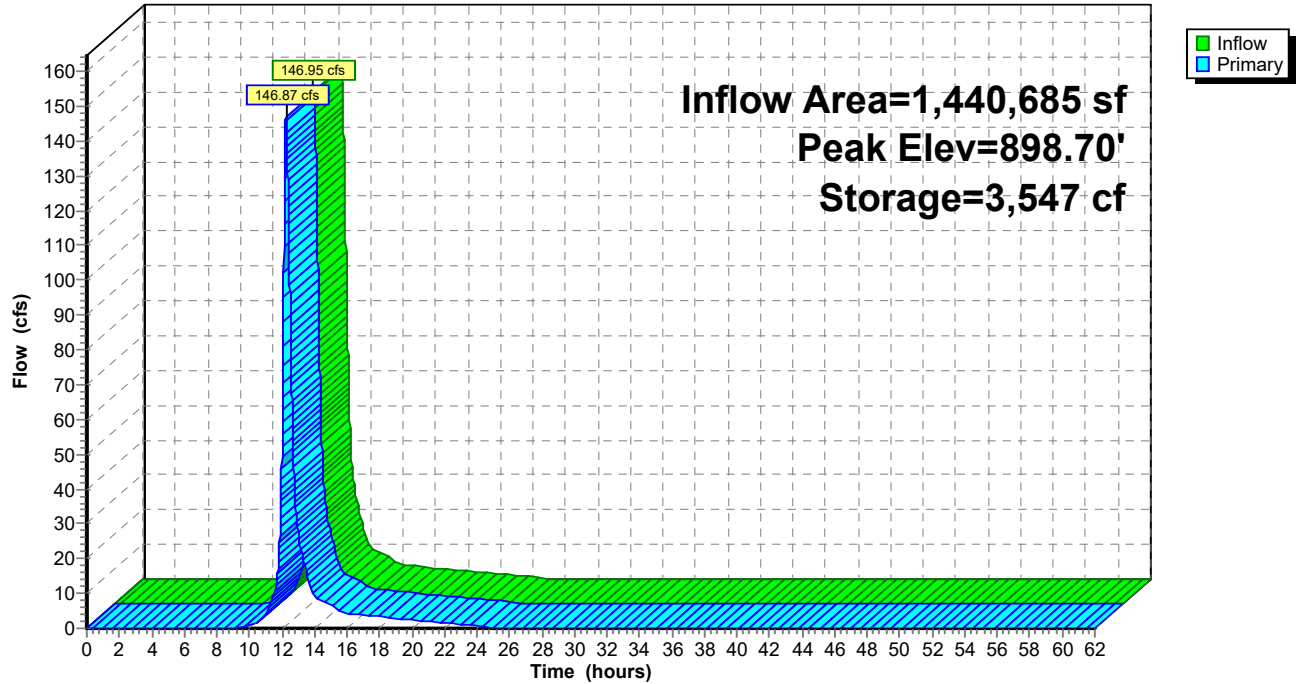
Device	Routing	Invert	Outlet Devices
#1	Primary	895.39'	36.0" Round RCP_Round 36" L= 135.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 895.39' / 888.64' S= 0.0500 ' S= 0.0500 ' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf
#2	Primary	895.00'	36.0" Round RCP_Round 36" X 2.00 L= 135.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 895.00' / 888.25' S= 0.0500 ' S= 0.0500 ' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=146.86 cfs @ 12.24 hrs HW=898.70' (Free Discharge)

1=RCP_Round 36" (Inlet Controls 45.83 cfs @ 6.48 fps)
 2=RCP_Round 36" (Inlet Controls 101.04 cfs @ 7.15 fps)

Pond 5P: Existing ponding area

Hydrograph



Summary for Pond 6P: Existing East Sedimentation Pond

[79] Warning: Submerged Pond 5P Primary device # 1 OUTLET by 0.54'

[79] Warning: Submerged Pond 5P Primary device # 2 OUTLET by 0.93'

Inflow Area = 1,440,685 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 146.87 cfs @ 12.24 hrs, Volume= 530,560 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Peak Elev= 889.18' @ 51.43 hrs Surf.Area= 99,337 sf Storage= 530,535 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)

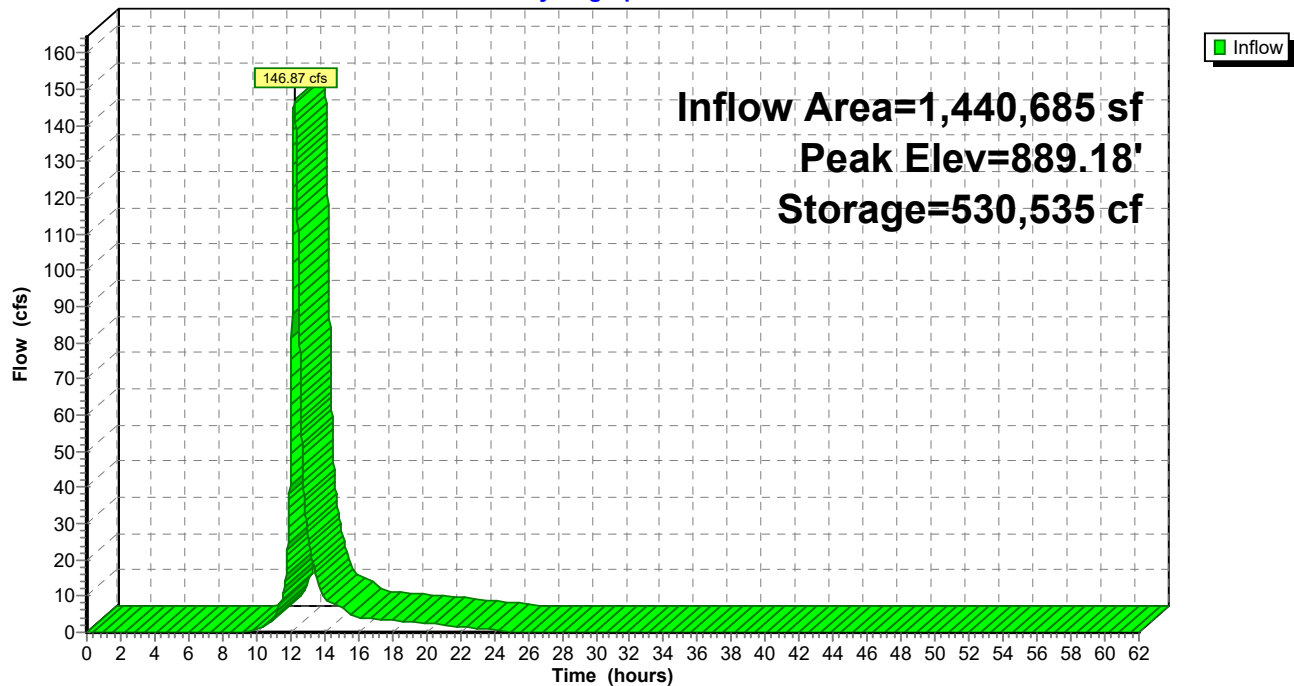
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	882.00'	1,503,755 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
882.00	57,623	0	0
884.00	65,899	123,522	123,522
886.00	75,012	140,911	264,433
888.00	83,528	158,540	422,973
890.00	110,405	193,933	616,906
892.00	139,953	250,358	867,264
894.00	159,007	298,960	1,166,224
896.00	178,524	337,531	1,503,755

Pond 6P: Existing East Sedimentation Pond

Hydrograph



Summary for Pond 7P: Diversion Structure with 60" RCP

Inflow Area = 1,473,067 sf, 0.00% Impervious, Inflow Depth = 4.47" for 100-yr 24-hr event
 Inflow = 171.46 cfs @ 12.25 hrs, Volume= 548,690 cf
 Outflow = 171.45 cfs @ 12.26 hrs, Volume= 548,690 cf, Atten= 0%, Lag= 0.3 min
 Primary = 171.45 cfs @ 12.26 hrs, Volume= 548,690 cf

Routing by Stor-Ind method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Peak Elev= 875.79' @ 12.26 hrs Surf.Area= 401 sf Storage= 2,124 cf
 Flood Elev= 882.00' Surf.Area= 401 sf Storage= 3,613 cf

Plug-Flow detention time= 0.3 min calculated for 548,690 cf (100% of inflow)
 Center-of-Mass det. time= 0.3 min (811.6 - 811.3)

Volume	Invert	Avail.Storage	Storage Description
#1	870.00'	3,613 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
870.00	15	0	0
870.50	200	54	54
871.00	401	150	204
871.50	401	201	405
872.50	401	401	806
873.50	401	401	1,207
874.50	401	401	1,608
875.50	401	401	2,009
876.50	401	401	2,410
877.50	401	401	2,811
878.50	401	401	3,212
879.50	401	401	3,613

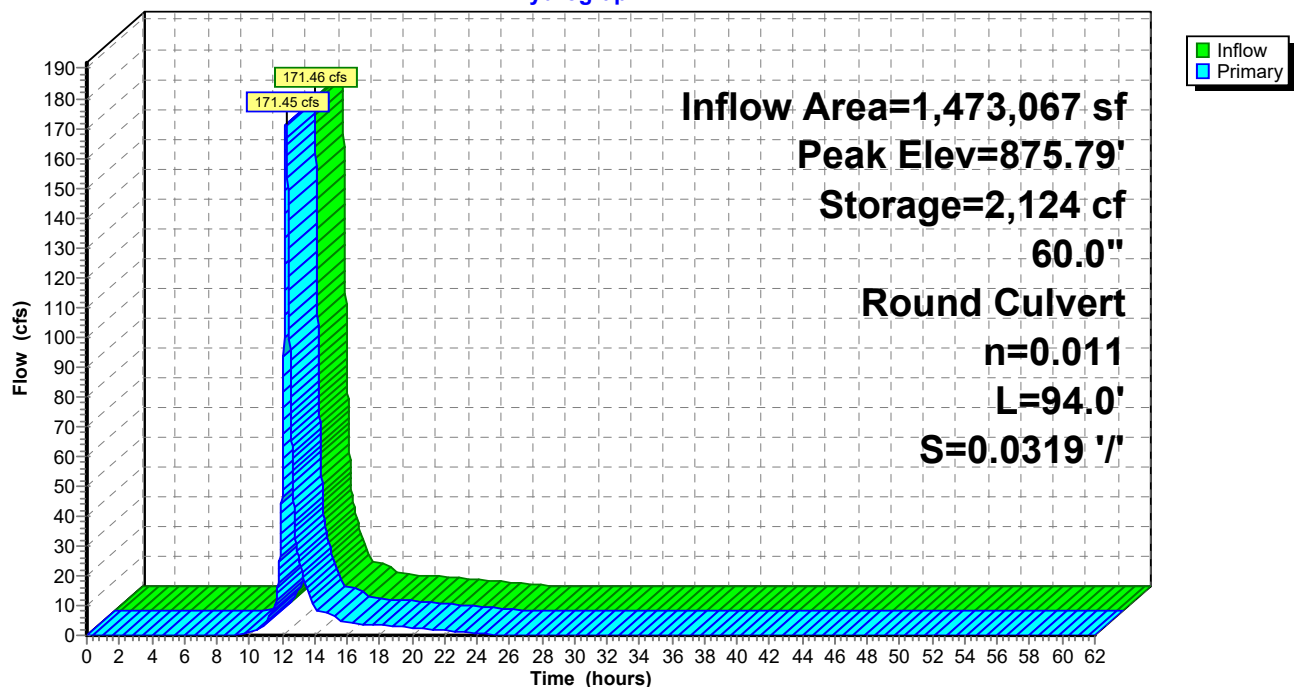
Device	Routing	Invert	Outlet Devices
#1	Primary	870.00'	60.0" Round Culvert L= 94.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 870.00' / 867.00' S= 0.0319 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 19.63 sf

Primary OutFlow Max=171.44 cfs @ 12.26 hrs HW=875.79' (Free Discharge)

↑ **1=Culvert** (Inlet Controls 171.44 cfs @ 8.73 fps)

Pond 7P: Diversion Structure with 60" RCP

Hydrograph



Summary for Pond 8P: Existing Southwest Pond (infiltration)

Inflow Area = 1,456,312 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 182.57 cfs @ 12.28 hrs, Volume= 536,315 cf
 Outflow = 2.40 cfs @ 20.19 hrs, Volume= 318,776 cf, Atten= 99%, Lag= 474.5 min
 Discarded = 2.40 cfs @ 20.19 hrs, Volume= 318,776 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 844.92' @ 20.19 hrs Surf.Area= 128,809 sf Storage= 445,720 cf

Plug-Flow detention time= 1,284.9 min calculated for 318,776 cf (59% of inflow)

Center-of-Mass det. time= 1,203.0 min (2,017.0 - 813.9)

Volume	Invert	Avail.Storage	Storage Description
#1	837.00'	598,141 cf	Custom Stage Data (Prismatic) Listed below (Recalc) x 1.1

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
837.00	28,968	0	0
838.00	31,837	30,403	30,403
839.00	34,768	33,303	63,705
840.00	37,762	36,265	99,970
841.00	40,817	39,290	139,260
842.00	46,277	43,547	182,807
843.00	66,570	56,424	239,230
844.00	82,099	74,335	313,565
845.00	120,141	101,120	414,685
846.00	138,019	129,080	543,765

Device	Routing	Invert	Outlet Devices
#1	Discarded	837.00'	0.800 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 0.00'
#2	Primary	845.90'	8.0' long x 10.0' breadth emergency overflow Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

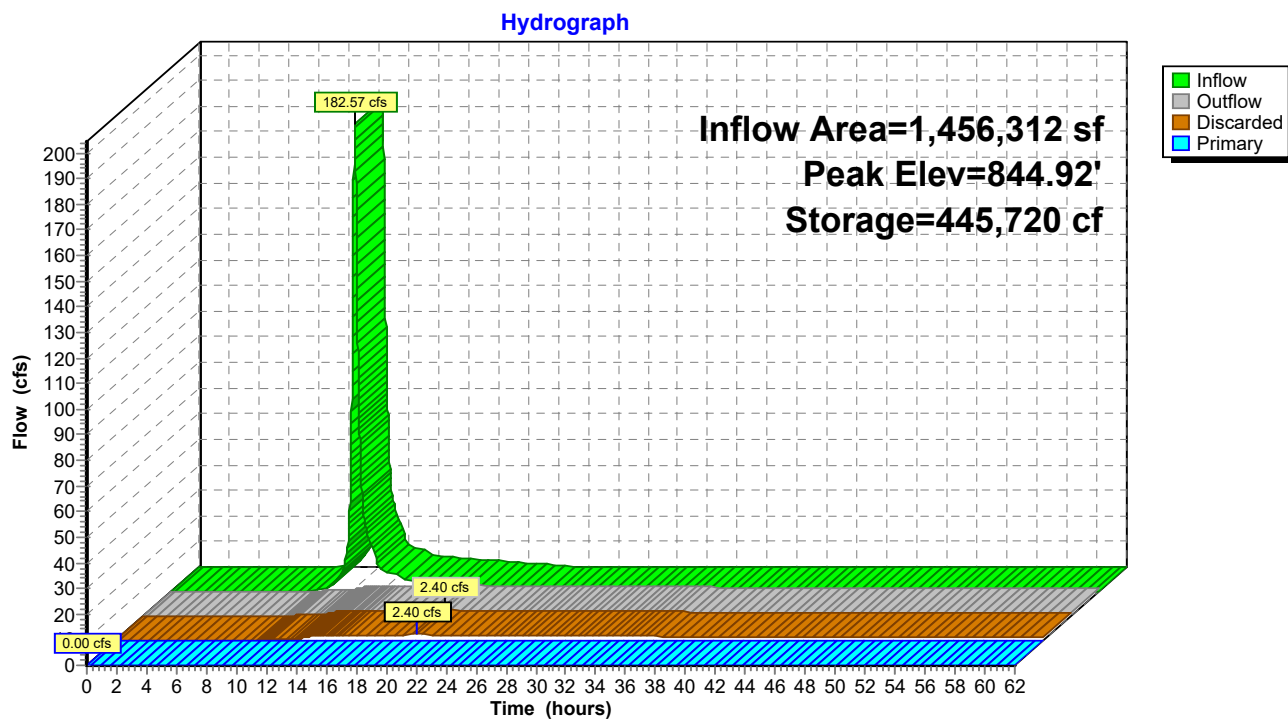
Discarded OutFlow Max=2.40 cfs @ 20.19 hrs HW=844.92' (Free Discharge)

↑ **1=Exfiltration** (Controls 2.40 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=837.00' (Free Discharge)

↑ **2=emergency overflow** (Controls 0.00 cfs)

Pond 8P: Existing Southwest Pond (infiltration)



Summary for Pond 9P: Diversion Structure with 48" RCP

[62] Hint: Exceeded Reach ADS5 OUTLET depth by 0.57' @ 12.28 hrs

Inflow Area = 1,456,312 sf, 0.00% Impervious, Inflow Depth = 4.42" for 100-yr 24-hr event
 Inflow = 182.88 cfs @ 12.28 hrs, Volume= 536,315 cf
 Outflow = 182.57 cfs @ 12.28 hrs, Volume= 536,315 cf, Atten= 0%, Lag= 0.5 min
 Primary = 182.57 cfs @ 12.28 hrs, Volume= 536,315 cf

Routing by Stor-Ind method, Time Span= 0.00-62.00 hrs, dt= 0.01 hrs
 Peak Elev= 863.61' @ 12.28 hrs Surf.Area= 276 sf Storage= 2,896 cf
 Flood Elev= 882.00' Surf.Area= 276 sf Storage= 3,281 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 0.2 min (813.9 - 813.7)

Volume	Invert	Avail.Storage	Storage Description
#1	852.50'	3,281 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
852.50	15	0	0
853.00	138	38	38
854.00	276	207	245
855.00	276	276	521
856.00	276	276	797
857.00	276	276	1,073
858.00	276	276	1,349
859.00	276	276	1,625
860.00	276	276	1,901
861.00	276	276	2,177
862.00	276	276	2,453
863.00	276	276	2,729
864.00	276	276	3,005
865.00	276	276	3,281

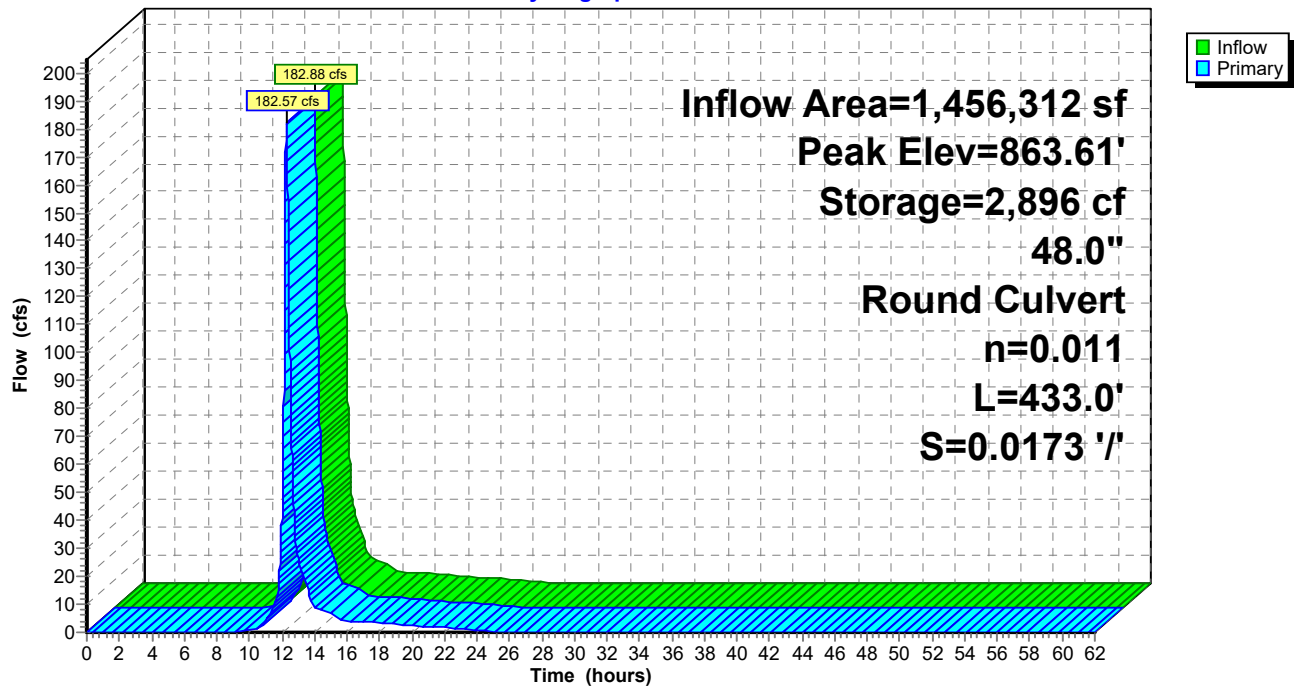
Device	Routing	Invert	Outlet Devices
#1	Primary	852.50'	48.0" Round Culvert L= 433.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 852.50' / 845.00' S= 0.0173 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 12.57 sf

Primary OutFlow Max=182.45 cfs @ 12.28 hrs HW=863.59' (Free Discharge)

↑ **1=Culvert** (Inlet Controls 182.45 cfs @ 14.52 fps)

Pond 9P: Diversion Structure with 48" RCP

Hydrograph



Appendix F Closure, Post Closure, and Contingency Action Plan Cost Estimates



Table 1
Closure Cost Estimate
Pine Bend Landfill, SW-45

Item	Description	Depth (ft)	Quantity	Unit	Unit Cost		Cost
Construction Costs							
1	Final Closure Construction ⁽¹⁾		173.0	AC			
2	Mobilization and Demobilization		5	LS	\$	54,500.00	\$ 272,500.00
3	Temporary Construction Facilities and Utilities		5	LS	\$	5,020.00	\$ 25,100.00
4	Buffer Soils	0.5	139,553	CY	\$	6.00	\$ 837,320.00
5	40 mil LLDPE Liner		7,535,880	SF	\$	0.70	\$ 5,275,116.00
6	Geocomposite (double sided)		7,535,880	SF	\$	1.13	\$ 8,515,544.40
7	Drain Piping / Stormwater Management Features		20,000	LF	\$	8.50	\$ 170,000.00
8	Cover Soils	1.5	418,660	CY	\$	6.00	\$ 2,511,960.00
9	Topsoil	0.5	139,553	CY	\$	20.00	\$ 2,791,066.67
10	Erosion Control (Erosion Mat, Seed, Fertilize and Mulch)		173.0	AC	\$	2,500.00	\$ 432,500.00
11	Gas Collection System Infrastructure		1	LS	\$	1,000,000.00	\$ 1,000,000.00
Engineering and Certification Costs							
12	Drawings, Specifications, CQA Plan, Bid Process		1	LS	\$	100,000.00	\$ 100,000.00
13	Construction Observation, Testing, and Surveying		1	LS	\$	865,000.00	\$ 865,000.00
14	Documentation Report		1	LS	\$	40,000.00	\$ 40,000.00
15	Contingency (5% of total Closure Construction Costs)		1	LS	\$	1,091,555.35	\$ 1,091,555.35
TOTAL COST						\$	23,927,662.42
COST PER ACRE						\$	138,310.19

Comments:

1. Assumes 5 closure construction events. Gas system infrastructure will be installed throughout operational life and bid item 11 includes cost for gas system construction at the time of final closure.
2. Updated 2022 construction bid costs

Table 2
Post-Closure Care Cost Estimate
Annual Cost Summary
Pine Bend Landfill, SW-45

Item	Description	Extension⁽¹⁾
1	Facility Inspection Costs	\$ 7,100.00
2	Routine Maintenance and Repair Costs	\$ 71,750.00
3	Leachate System Management Costs	\$64,360
4	Landfill Gas Management Costs	\$ 63,180.00
5	Monitoring Costs	\$ 99,526.00
6	Administrative and Reporting Services Costs	\$ 8,300.00
TOTAL (Annual)		\$ 314,216.00

Comments:

(1)Refer to Tables 2A to 2F for an itemized breakdown of annual costs.

Table 2A
Post-Closure Care Cost Estimate
Facility Inspection Costs
Pine Bend Landfill, SW-45

Item	Description	Quantity	Unit	Unit Cost	Extension ⁽¹⁾
1	Landfill Supervisor	80	AC	\$ 75.00	\$ 6,000.00
2	Mobilization and Demobilization	32	LS	\$ 33.00	\$ 1,100.00
TOTAL (Annual)					\$ 7,100.00

Comments:

(1)Extensions are rounded to the nearest \$100. Updated 2022 costs.

Table 2B
Post-Closure Care Cost Estimate
Routine Maintenance
Pine Bend Landfill, SW-45

Item	Description	Quantity	Unit	Unit Cost	Extension ⁽¹⁾
1	Mowing (assume 1x/yr) ⁽²⁾	180	HR	\$ 150.00	\$ 27,000.00
2	Fertilizing (assume 1x/yr)	8	AC	\$ 220.00	\$ 1,750.00
3	Cover Revegetation (assume 1x/yr) ⁽³⁾	4	AC	\$ 2,100.00	\$ 8,400.00
4	Security and Building Repairs	1	LS	\$ 2,200.00	\$ 2,200.00
5	Surface Water Management and Maintenance	1	LS	\$ 14,000.00	\$ 14,000.00
6	Access Road Maintenance	1	LS	\$ 2,500.00	\$ 2,500.00
7	Rodent Control	20	HR	\$ 45.00	\$ 900.00
8	Erosion Repair (assume 1x/yr) ⁽⁴⁾	2	AC	\$ 7,500.00	\$ 15,000.00
TOTAL (Annual)					\$ 71,750.00

Comments:

(1)Extensions are rounded to the nearest \$100.

(2)Mowing: 180 acres at 1 hour/acre, once per year. Includes all closed areas on landfill.

(3)Cover revegetation: 4 acres per event. Includes all closed areas on landfill. Assume 2% of landfill cover.

(4) Assume 1% of landfill cover.

Table 2C
Post-Closure Care Cost Estimate
Leachate System Management Costs
Pine Bend Landfill, SW-45

Item	Description	Quantity	Unit	Unit Cost		Extension ⁽¹⁾	
1	Collection System Cleaning (once per year)	6,000	LF	\$	0.66	\$	3,960.00
2	Leachate Management ⁽²⁾	900,000	Gal	\$	0.06	\$	54,000.00
Leachate Monitoring							
3	Monthly Sample Collection	12	Samples	\$	110.00	\$	1,300.00
4	Monthly Analysis	12	Samples	\$	60.00	\$	700.00
5	Quarterly Analysis	4	Samples	\$	990.00	\$	4,000.00
6	Annual Analysis	1	Samples	\$	440.00	\$	400.00
TOTAL (Annual)							\$64,360

Comments:

(1)Extensions are rounded to the nearest \$100.

(2)Assumes hauling and treatment at MCES

Table 2D
Post-Closure Care Cost Estimate
Landfill Gas Management System Costs
Pine Bend Landfill, SW-45

Item	Description	Quantity	Unit	Unit Cost	Extension ⁽¹⁾
1	Blower and Flare Replacements	1	LS	\$ 11,050.00	\$ 11,050.00
2	Flare and Generator Maintenance	1	LS	\$ 1,330.00	\$ 1,330.00
	System Operation				
3	Electrical Requirements	1	LS	\$ 19,560.00	\$ 19,600.00
4	Management (on-site personnel for inspection and operations management)	500	Hr.	\$ 33.00	\$ 16,500.00
5	Collection System Replacement (one well 100-foot deep and wellhead every two years)	0.5	LS	\$ 12,380.00	\$ 6,200.00
6	Emissions Testing	1	LS	\$ 3,870.00	\$ 3,900.00
7	Reporting	1	LS	\$ 4,640.00	\$ 4,600.00
TOTAL (Annual)					\$ 63,180.00

Comments:

(1) Extensions are rounded to the nearest \$100.

Table 2E
Post-Closure Care Cost Estimate
Monitoring Costs
Pine Bend Landfill, SW-45

Item	Description	Quantity	Unit	Unit Cost	Extension ⁽¹⁾
1	Water Sample Collection (17 monitoring wells assumed) ⁽²⁾	3	LS	\$ 5,800.00	\$ 17,400.00
2	Lab Analysis ⁽²⁾	3	LS	\$ 3,900.00	\$ 11,700.00
3	Surface Water (5 points 3X/Year)	15	Samples	\$ 280.00	\$ 4,200.00
4	System Maintenance	16	Hr.	\$ 75.00	\$ 1,200.00
5	Bio attenuation O&M	1	LS	\$ 55,300.00	\$ 55,300.00
6	Monitoring Well Replacement (3 wells every 10 years)	0.3	Well	\$ 4,420.00	\$ 1,326.00
7	Gas Monitoring	1	LS	\$ 3,320.00	\$ 3,320.00
8	Reporting	1	LS	\$ 5,080.00	\$ 5,080.00
TOTAL (Annual)					\$ 99,526.00

Comments:

(1)Extensions are rounded to the nearest \$100.

(2)Based on actual 2022 costs

Table 2F
Post-Closure Care Cost Estimate
Administrative and Reporting Services Costs
Pine Bend Landfill, SW-45

Item	Description	Quantity	Unit	Unit Cost	Extension ⁽¹⁾
1	PBL/Third Party Project Management	1	LS	\$ 8,290.00	\$ 8,300.00
TOTAL (Annual)					\$ 8,300.00

Comments:

(1) Extensions are rounded to the nearest \$100. Updated 2022 costs.

TABLE 3
Event-Triggered Contingencies
Pine Bend Landfill

Event-Triggered Contingency	Result	Action
1. Severe Rainfall	Threatened Embankment Stability	Report; immediately assess damage visually; within five days place sand bags, soil fill or riprap to temporarily stabilize embankment; check for cracking and differential movement; evaluate condition and design and prepare permanent repair procedures report; implement recommendations.
	Erosion	Report; within five days place temporary erosion controls, such as hay bales, erosion control mats, silt fences, or mulch; assess damage; make permanent repairs.
	Damaged Surface Water Control	Report; within five days place sandbags, soil fill, and/or temporary piping to make surface water controls temporarily functional; remove sediments from outlets; evaluate and make permanent repairs.
2 Leachate Spill	Damaged Vegetation	Report; assess damage; if necessary, within five days place temporary erosion controls; evaluate cause; revegetate.
	Surface Water or Groundwater Contamination	Report; immediately contain and collect retrievable leachate and absorb remaining leachate; monitor; evaluate impact; determine and implement appropriate follow-up actions.
	Soil Contamination	Report; within five days collect saturated soil for disposal in lined cell; collect soil samples below excavation; evaluate impact; determine and implement appropriate follow-up actions.
3. Grass Fire	Damaged Vegetation	Report; contact City of Inver Grove Heights Fire Department if necessary to extinguish fire; clear access roads for equipment access; immediately place soil over fire or use water to extinguish fire; place temporary erosion controls; revegetate.
4. Subsurface Fire	Waste Burning	Notify the City of Inver Grove Heights Fire Department. Reduce extraction rate from gas wells and cover area with impermeable soils.
5. Explosion		Report; contact City of Inver Grove Heights Fire Department; if necessary to extinguish fire, evaluate damage, determine and implement appropriate follow-up action.
6. Vandalism	Damage to Facility Features	Report; within ten days assess impact; based on impact, repair damage; assess site security.

TABLE 4
Inspection-Triggered Contingencies
Pine Bend Landfill

Inspection-Triggered Contingency	Result	Action
1. Leachate Head Buildup	Increased Groundwater Contamination Potential	Extract and dispose or treat leachate; monitor; evaluate cause of leachate head buildup; if necessary, increase leachate hauling frequency.
2. Erosion or Degradation of Cap	Increased Leachate Generation, Potential Surface Water Contamination	Report; immediately assess damage; within two weeks place temporary erosion controls; evaluate cause and design; make permanent repairs.
3. Clogged Surface Water Controls	Erosion	Report; within five days place temporary erosion controls; remove cause of clogs; assess damage; repair erosion; evaluate design and make any needed changes; clean pipes, ditches, and sedimentation ponds, as needed.
4. Leachate Conveyance System Failure	Potential Groundwater Contamination	Monitor; evaluate impact; evaluate cause, repair or replace failing component, such as lift pump, or pipe joint; Monitor. If failure is under a significant amount of waste, final cover the area in question.

TABLE 5
Monitoring-Triggered Contingencies
Pine Bend Landfill

Monitoring-Triggered Contingency		Result	Action
1.	Exceedance of Groundwater Standard	Groundwater Contamination	Notify MPCA; check sampling, handling techniques; resample; evaluate impact; complete feasibility study and determine remedial action; prepare report within 30 days; implement remedial action.
2.	Exceedance of Surface Water Standard (in sedimentation basins)	Surface Water Contamination	Notify MPCA; check sampling, handling techniques; resample; evaluate impact; complete feasibility study and determine remedial action; prepare report within 30 days; implement remedial action.
3.	Exceedance of Allowable Levels for Leachate Discharge to Treatment Plant	Unacceptable Impacts at MCES Treatment Plant	Monitor; report; evaluate cause of exceedance; design permanent pretreatment actions or choose alternative disposal method, choose alternative and write report; implement recommendations
4.	Leachate Detected in Leachate Leak Detection System	Increased Groundwater Contamination Potential	Report; within five days extract and dispose or treat leachate; monitor; evaluate quantity and rate of leakage; evaluate potential impacts on groundwater; if necessary, evaluate cause and determine potential remedial actions; implement remedial action.
5.	Detection of methane concentrations above acceptable limits at gas monitoring points	Potential explosive conditions	If exceedance is near any enclosed structures, evacuate and ventilate structure, investigate whether methane is entering structure, propose response to protect structure if needed; report; adjust flow rate at applicable extraction wells; continue monitoring. For continued exceedances at compliance boundary, PBL will prepare an evaluation report including evaluation of existing probes where exceedances are occurring for determination if they were placed in waste; evaluate the gas flows at the adjacent gas extraction wells and determine if they are efficiently extracting landfill gas; evaluate the need to install additional or replacement monitoring probes or gas extraction wells; evaluate the need for additional blower/flare capabilities. Prepare report within 60 days: implement remedial action.

Table 6
Contingency Action Cost Estimate
Pine Bend Landfill

Description	Quantity	Unit	Unit Cost	Cost ⁽¹⁾
<u>Event Triggered Contingency</u>				
1. Severe Rainfall (Erosion/Embankment Repair)				
Cover Fill	7,300	CY	\$ 8.00	\$ 58,400.00
Clean Surface Water Controls	1	LS	\$ 38,700.00	\$ 38,700.00
Revegetation	3	acres	\$ 2,200.00	\$ 6,600.00
2. Leachate or Fuel Spill (1,000 gallons, 100 cy soil)				
Problem Assessment and Engineering	1	LS	\$ 2,200.00	\$ 2,200.00
Mobilization	1	LS	\$ 2,800.00	\$ 2,800.00
Liquid Recovery	6	HR	\$ 280.00	\$ 1,700.00
Disposal	2	truckload	\$ 83.00	\$ 200.00
Contaminated Soil Excavation	100	CY	\$ 17.00	\$ 1,700.00
Clean Soil Fill	100	CY	\$ 6.00	\$ 600.00
Revegetation (assume 1 acre)	1	acres	\$ 2,210.00	\$ 2,200.00
3. Grass Fire				
Extinguish Fire	8	HR	\$ 660.00	\$ 5,300.00
Revegetation	2	acres	\$ 2,210.00	\$ 4,400.00
Gas Well Repair	2	well heads	\$ 1,660.00	\$ 3,300.00
4. Subsurface Fire				
Firefighting	1	LS	\$ 276,300.00	\$ 276,300.00
5. Explosion				
Extinguish Fire	6	HR	\$ 660.00	\$ 4,000.00
Problem Assessment and Engineering	1	LS	\$ 2,200.00	\$ 2,200.00
Repair LFG components	1	LS	\$ 11,100.00	\$ 11,100.00
6. Vandalism				
Miscellaneous Repairs	1	LS	\$ 2,800.00	\$ 2,800.00
<u>Inspection-Triggered Contingency</u>				
1. Leachate Head Buildup				
Problem Assessment and Engineering	1	LS	\$ 1,700.00	\$ 1,700.00
High pressure flushing	2,000	LF	\$ 4.00	\$ 8,000.00
2. Erosion, Settlement, or Degradation of Cap				
Problem Assessment and Engineering	1	LS	\$ 5,500.00	\$ 5,500.00
Temporary erosion controls	1	LS	\$ 2,200.00	\$ 2,200.00
Repair cap	1	LS	\$ 110,500.00	\$ 110,500.00
3. Clogged Surface Water Controls				
Problem Assessment and Engineering	1	LS	\$ 1,110.00	\$ 1,100.00
Clean Surface Water Controls/Sedimentation Pond	1,000	CY	\$ 3.00	\$ 3,000.00
4. Leachate Collection System Repair (3)				
A. Cleaning of Collection and Conveyance Pipe	6,000	LF	\$ 4.00	\$ 24,000.00
B. Replace Collapsed Pipe	200	LF	\$ 17.00	\$ 3,400.00
C. Excavate and Replace Waste	9,000	CY	\$ 17.00	\$ 153,000.00
D. If damage is deep, install final cover	1	LS	\$ 497,300.00	\$ 497,300.00
<u>Monitoring-Triggered Contingency</u>				
1. Exceedance of GW Standard				
Work Plan	1	LS	\$ 6,100.00	\$ 6,100.00
Sample Collection and Analysis	33	EA	\$ 660.00	\$ 21,800.00
Evaluation and Report	1	LS	\$ 18,800.00	\$ 18,800.00
Installation of additional wells	3	EA	\$ 7,180.00	\$ 21,500.00
2. Groundwater Containment/Extraction System				
Install Additional Wells with pumps	4	EA	\$ 16,600.00	\$ 66,400.00
Lift station, piping, appurtenances	1	LS	\$ 66,300.00	\$ 66,300.00
Electrical power	500	LF	\$ 14.00	\$ 7,000.00
Systems design and specs	1	LS	\$ 11,100.00	\$ 11,100.00
3. Groundwater Treatment				
On-site treatment facility	1	LS	\$ 221,000.00	\$ 221,000.00
4. Groundwater Extraction/Containment Operating costs				
Water disposal (on-site treatment)	50,000	1,000 gal	\$ 3.00	\$ 150,000.00
Electrical cost	15	YR	\$ 550.00	\$ 8,300.00

Pump maintenance	15	YR	\$	550.00	\$	8,300.00
Monitoring	90	event	\$	1,100.00	\$	99,000.00
5. Surface Water Assessment Monitoring						
Sample Collection and Analysis	8	locations	\$	550.00	\$	4,400.00
Sample analysis	8	samples	\$	1,100.00	\$	8,800.00
QC samples	2	samples	\$	880.00	\$	1,800.00
Reporting	2	LS	\$	550.00	\$	1,100.00
6. Additional Flare for when Gas Recovery System is Down						
Mobilization of portable flare	1	LS	\$	11,100.00	\$	11,100.00
Operating costs	12	Months	\$	3,090.00	\$	37,100.00
7. Methane Migration Analysis and Containment						
Evaluation fieldwork and reporting	1	LS	\$	8,800.00	\$	8,800.00
Install additional gas monitoring probes	6	EA	\$	1,330.00	\$	8,000.00
Install additional gas extraction wells	3	EA	\$	11,100.00	\$	33,300.00
TOTAL						\$1,873,800.00
EXPECTED VALUE (60% OF TOTAL)						\$ 1,124,300.00

Comments:

1. Extensions are rounded to the nearest \$100.
2. Based on PBL experience
3. Use higher of A+B+C or D

Payment rate estimate table

Solid Waste Permit Program

Doc Type: Permitting Annual Report

Submit with 2023 Annual Report

Go to <https://www.pca.state.mn.us/business-with-us/solid-waste->

Facility name **Pine Bend Landfill**

SW# **45**

Type of mechanism used (select one): **Surety bond guaranteeing payment**

2023 approved closure cost estimate	\$ 23,927,662.42
2023 approved annual postclosure care cost estimate	\$ 314,216.00
2023 approved contingency action cost estimate	\$ 1,124,300.00

Trust Fund and Dedicated Trust Fund

Account balance on December 31, 2023

Operating life in months (maximum 120)

Letter of Credit, Surety Bond, Self Insurance, or other mechanism

Value of guarantee on December 31, 2023

(Letter of Credit or Surety Bond)

Inflation factor = **3.479%**

Discount rate = **5.50%**
Basis for this years payments

2024 Closure cost estimate
2024 Postclosure care cost estimate
2024 Contingency action cost estimate

Total

Current value	Present value*
\$24,760,105.80	\$24,760,105.80
\$9,175,254.29	\$5,445,103.27
\$1,163,414.40	\$1,163,414.40
\$35,098,774.49	\$31,368,623.47

* Present value is only for Trust Funds and Dedicated Trust Funds

Account balance on December 31, 2022

\$0.00

Value of guarantee on December 31, 2022

\$0.00

Operating life in months (never greater than 120 months)

0

Your trust fund or dedicated trust fund monthly payment if not discounting =

#DIV/0!

Your trust fund or dedicated trust fund monthly payment if discounted =

#DIV/0!

2024

Annual postclosure care cost estimate

\$ 325,147.57

Year	Inflated annual cost		Inflated and discounted annual cost
2024	\$325,148		\$325,148
2025	\$336,459		\$318,919
2026	\$348,165		\$312,810
2027	\$360,278		\$306,817
2028	\$372,812		\$300,940
2029	\$385,782		\$295,175
2030	\$399,203		\$289,520
2031	\$413,091		\$283,974
2032	\$427,463		\$278,534
2033	\$442,334		\$273,199
2034	\$457,723		\$267,965
2035	\$473,647		\$262,832
2036	\$490,125		\$257,797
2037	\$507,177		\$252,858
2038	\$524,822		\$248,015
2039	\$543,080		\$243,264
2040	\$561,974		\$238,603
2041	\$581,525		\$234,033
2042	\$601,756		\$229,549
2043	\$622,691		\$225,152
Totals	\$9,175,254		\$5,445,103

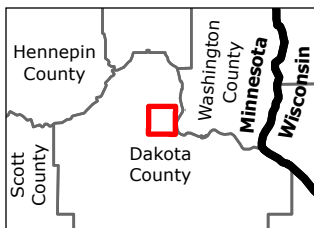
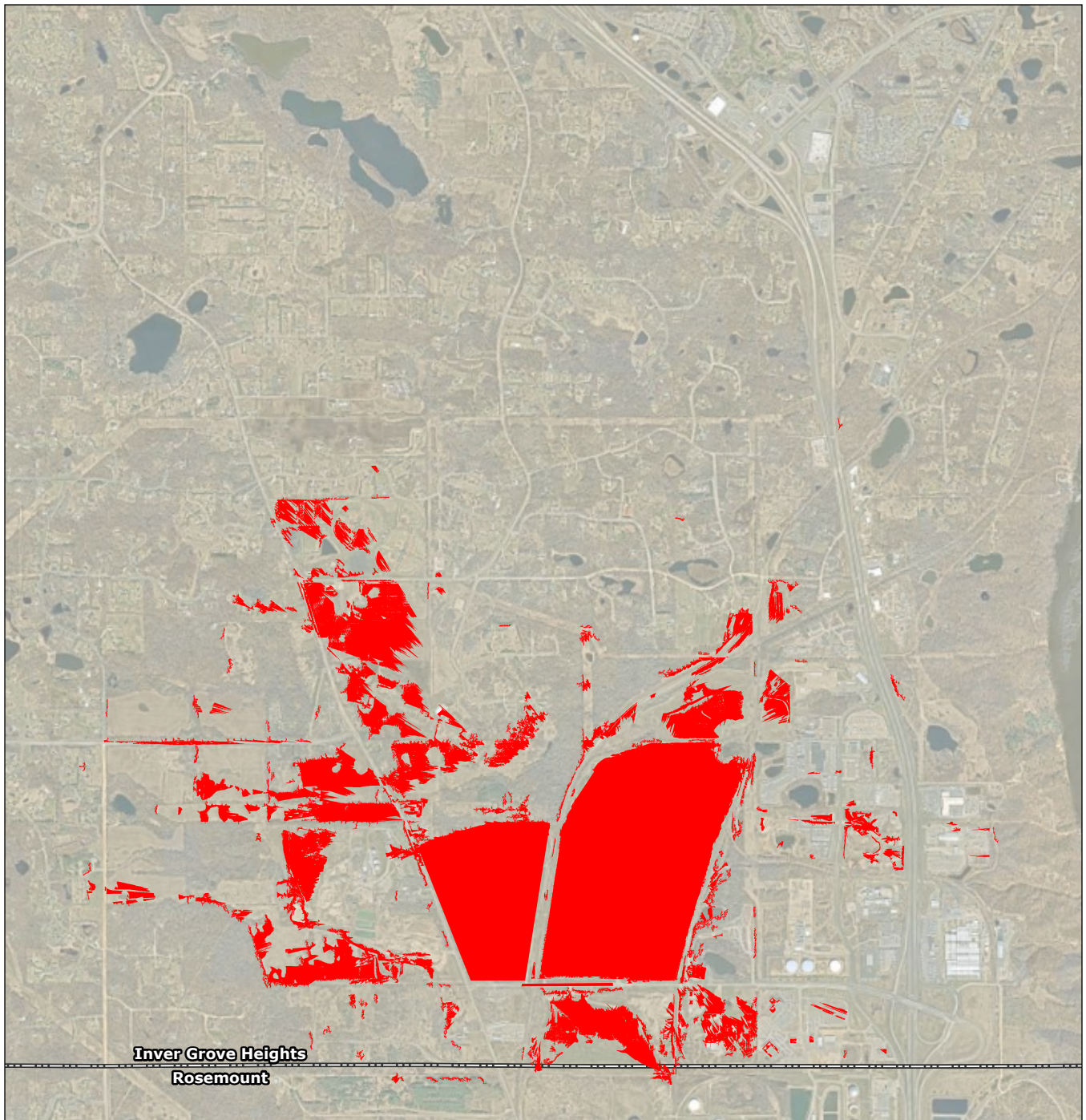
(Current value - not discounted)

(Current value - discounted)

Appendix G Viewshed Maps and 3D View Modeling



V:\2277\active\22770644203_data\gis_cad\gis\proj\pine_bend_viewshed_analysis.aprx Revised: 2024-06-03 By: ahyams



Notes
1. Coordinate System: NAD 1983 HARN Adj MN
Dakota Feet
2. Data Sources: Dakota County, Stantec
3. Background: Dakota County 2023 Aerial

Legend
■ Viewable Location (Existing)

0 1,250 2,500
Feet
(At original document size of 8.5x11)
1:30,000



Project Location Prepared by ARH on 2024-06-03
Inver Grove Heights, Dakota Co., MN

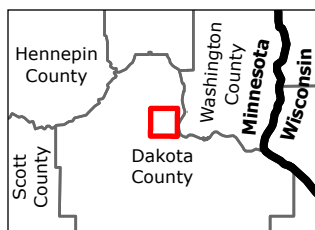
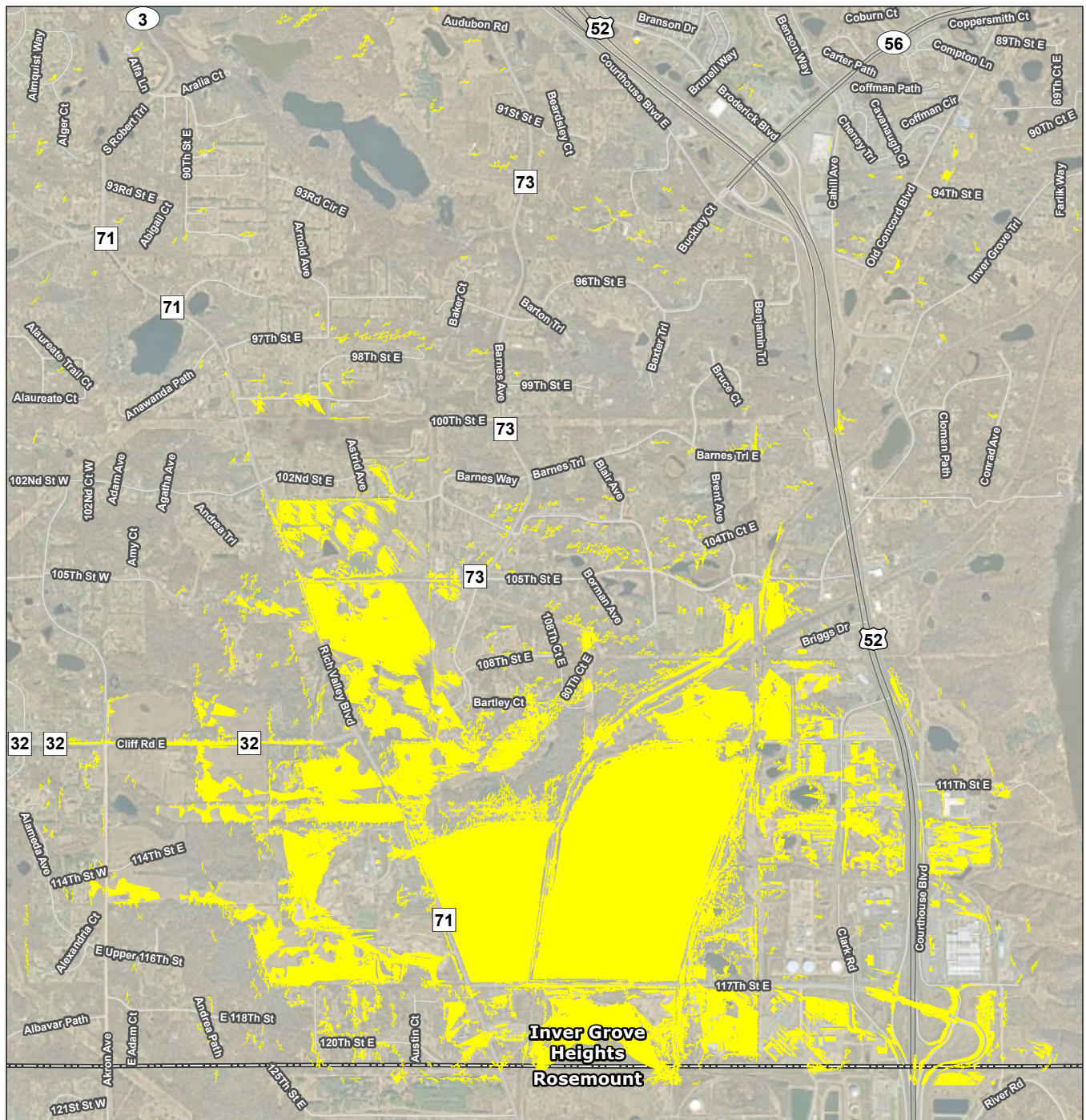
Client/Project Republic Services, Inc. 227706442
Pine Bend Landfill Expansion
Viewshed Analysis

Figure No.
1
Title
Locations where Existing Landfill is Viewable

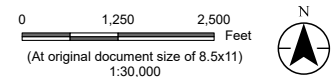
Page 1 of 1

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Legend
Viewable Location (Final Grade)



Project Location Inver Grove Heights, Dakota Co., MN Prepared by ARH on 2024-06-03

Client/Project Republic Services, Inc. 227706442
Pine Bend Landfill Expansion
Viewshed Analysis

Figure No. 2
Title
**Locations where Expanded Landfill
will be Viewable at Final Grade**

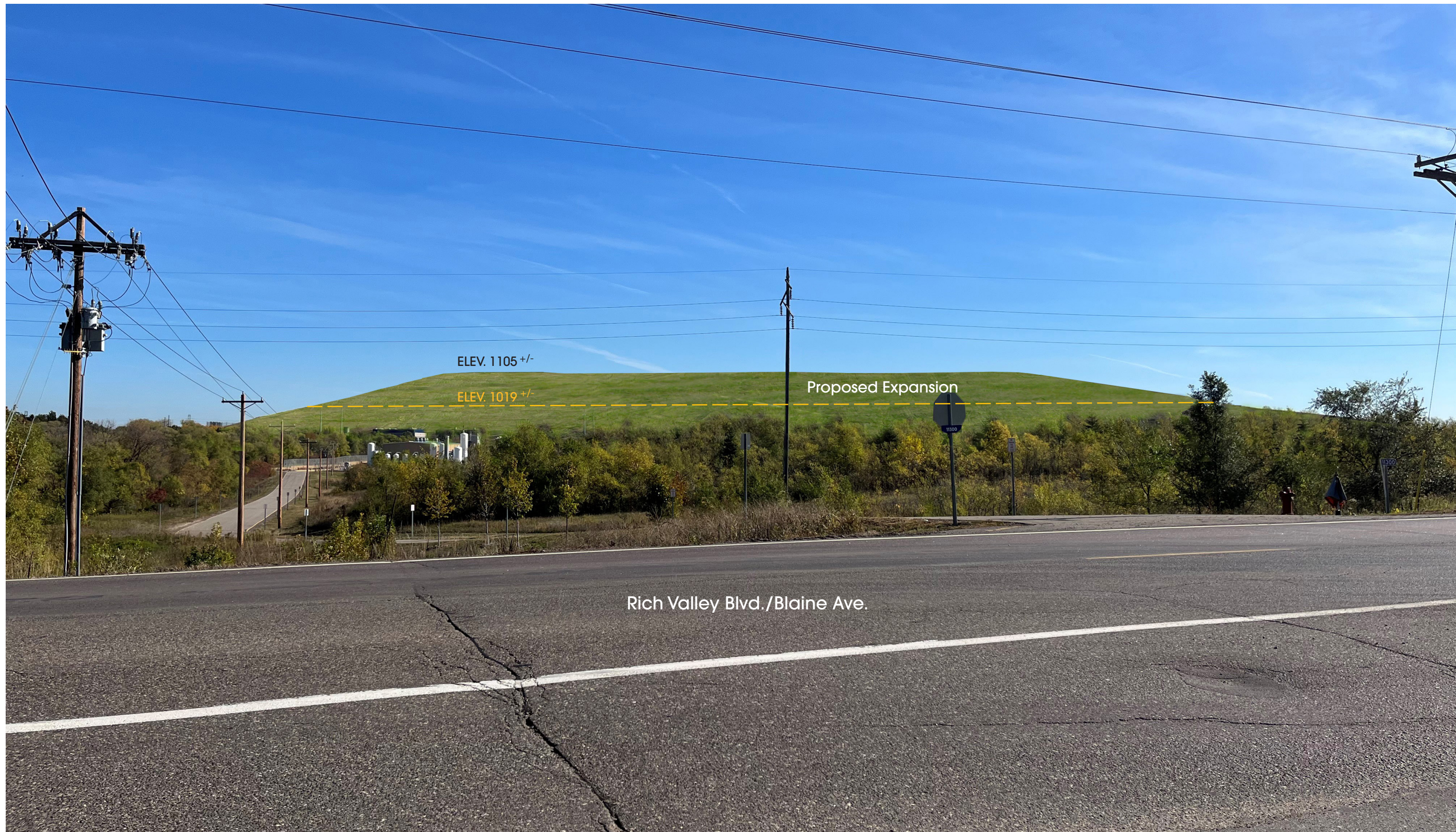
Page 1 of 1

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Bartley Court





Highway 52 Northbound





Highway 52 Southbound



Highway 52 Southbound



111th ST. E. - Mississippi River Greenway Scenic Trailhead



111th ST. E. - Mississippi River Greenway Scenic Trailhead

Item 4.A, Attachment 5 - Plan Set

BFI Waste Systems
of North America, LLC
Pine Bend Landfill
Inver Grove Heights, Minnesota
2022 Major Permit Modification

Prepared By:



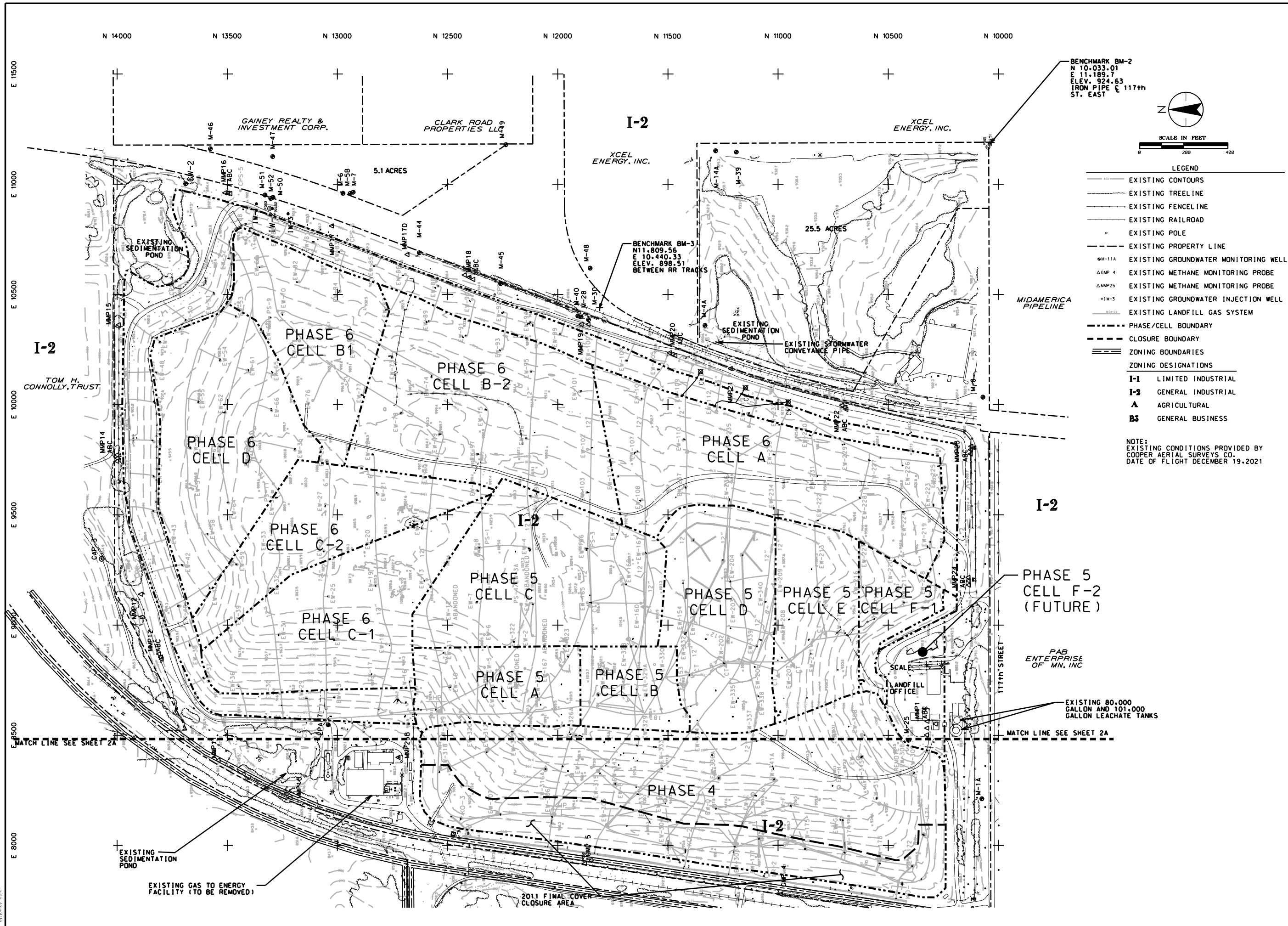
Stantec Consulting Services, Inc.
1800 Pioneer Creek Center
Maple Plain, MN 55359

2022.02.21

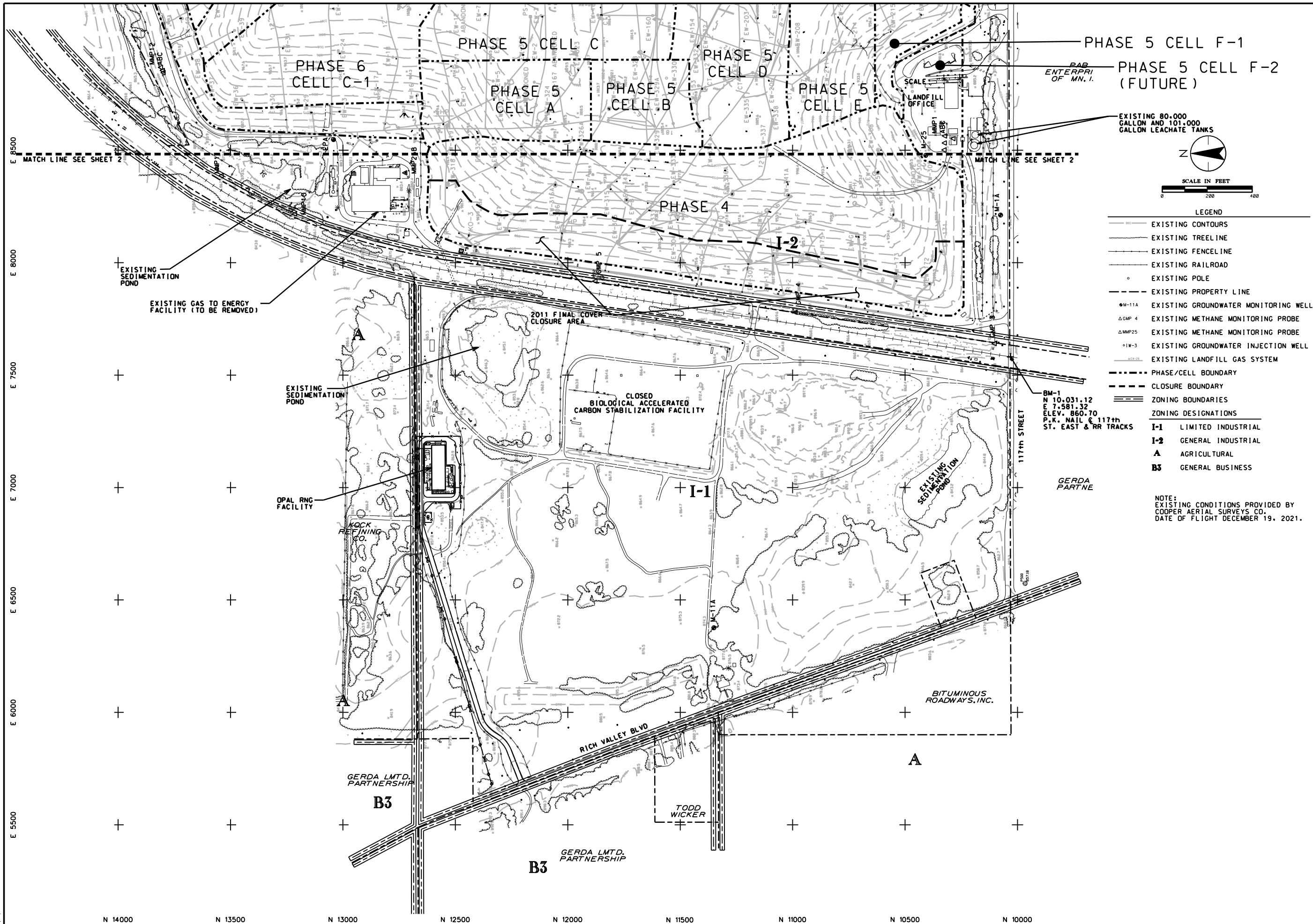
PROJECT NUMBER: 22704791

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- 2A. EXISTING CONDITIONS MAP (WEST SIDE)
3. PHASING PLAN
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FINAL COVER GRADING PLAN
5. PHASE 7-VERTICAL EXPANSION
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7. EXISTING GAS PIPING PLAN SOUTH HALF
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17. GAS SYSTEM DETAILS
18. GAS SYSTEM DETAILS



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By: jstusarich 10/25/2022



Client/Project	By	App'd	Issued
BH WASTE SYSTEMS OF NORTH AMERICA, LLC PINE BEND LANDFILL			YJW/JDO
2022 MAJOR PERMIT MODIFICATION INVER GROVE HEIGHTS, MINNESOTA			
Existing Conditions Map (West Half)			

Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA
Existing Conditions Map (West Half)

Permit-Seal
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME _____ THOMAS J. SHUSTARICH
SIGNATURE _____
DATE ____/____/____ LICENSE # ____ 21210
Project Number: 227704791
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JWI 2022.02.25
Drawing No. 2A
Revision Sheet
0 3 of 18

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By: jstustar



By	YJW/JD
App'd	
Issued	

Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION

INVER GROVE HEIGHTS, MINNESOTA

Phasing Plan

Permit-Seal

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PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE yy/mm/dd LICENSE # 21210

Project Number: 227704791

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JWT

2022.02.28

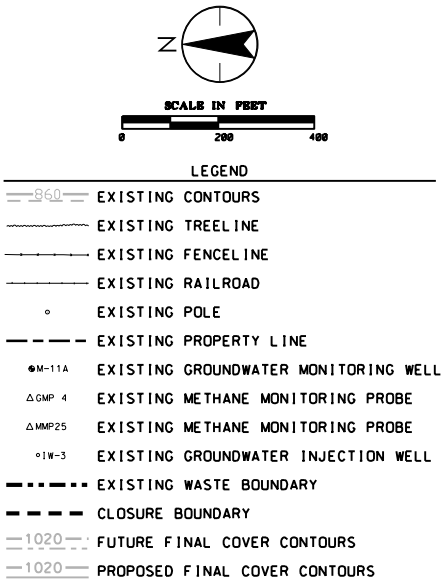
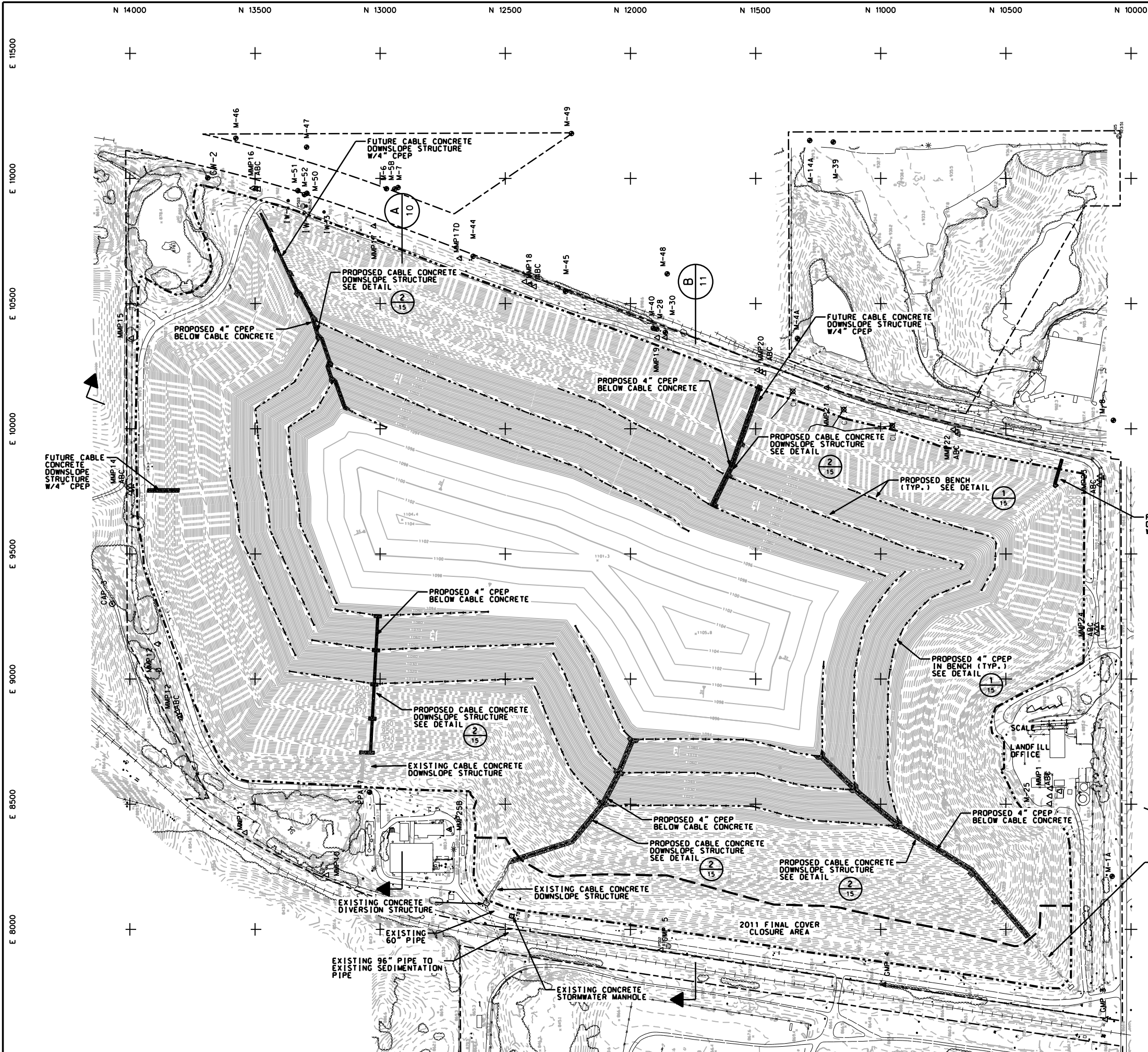
Drawing No. 3

Revision Sheet

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3 of 18

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By: jstusarich



NOTE:
EXISTING CONDITIONS PROVIDED BY
COOPER AERIAL SURVEYS CO.
DATE OF FLIGHT DECEMBER 19, 2021.



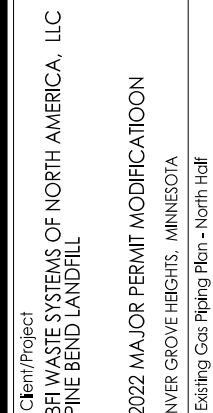
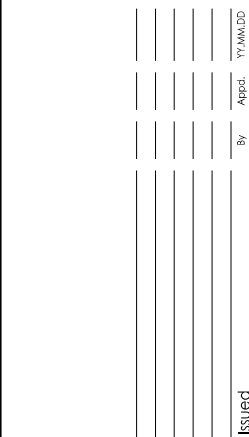
Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA
Phase 7 Vertical Expansion Surface Water Management Plan

Permit-Seal
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION,
OR REPORT WAS PREPARED BY ME OR UNDER
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LICENSED PROFESSIONAL ENGINEER UNDER THE
LAWS OF THE STATE OF MINNESOTA.

PRINT NAME: THOMAS J. SHUSTARICH
SIGNATURE: _____
DATE: yy/mm/dd LICENSE # 21210
Project Number: 227704791
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JWT 2022.03.11
Drawing No. 5
Revision Sheet
0 5 of 18



Permit-Seal

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PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE _____

DATE yy/mm/dd LICENSE # 21210

Project Number: 227704791

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Abstract

JWI 2022.03.1

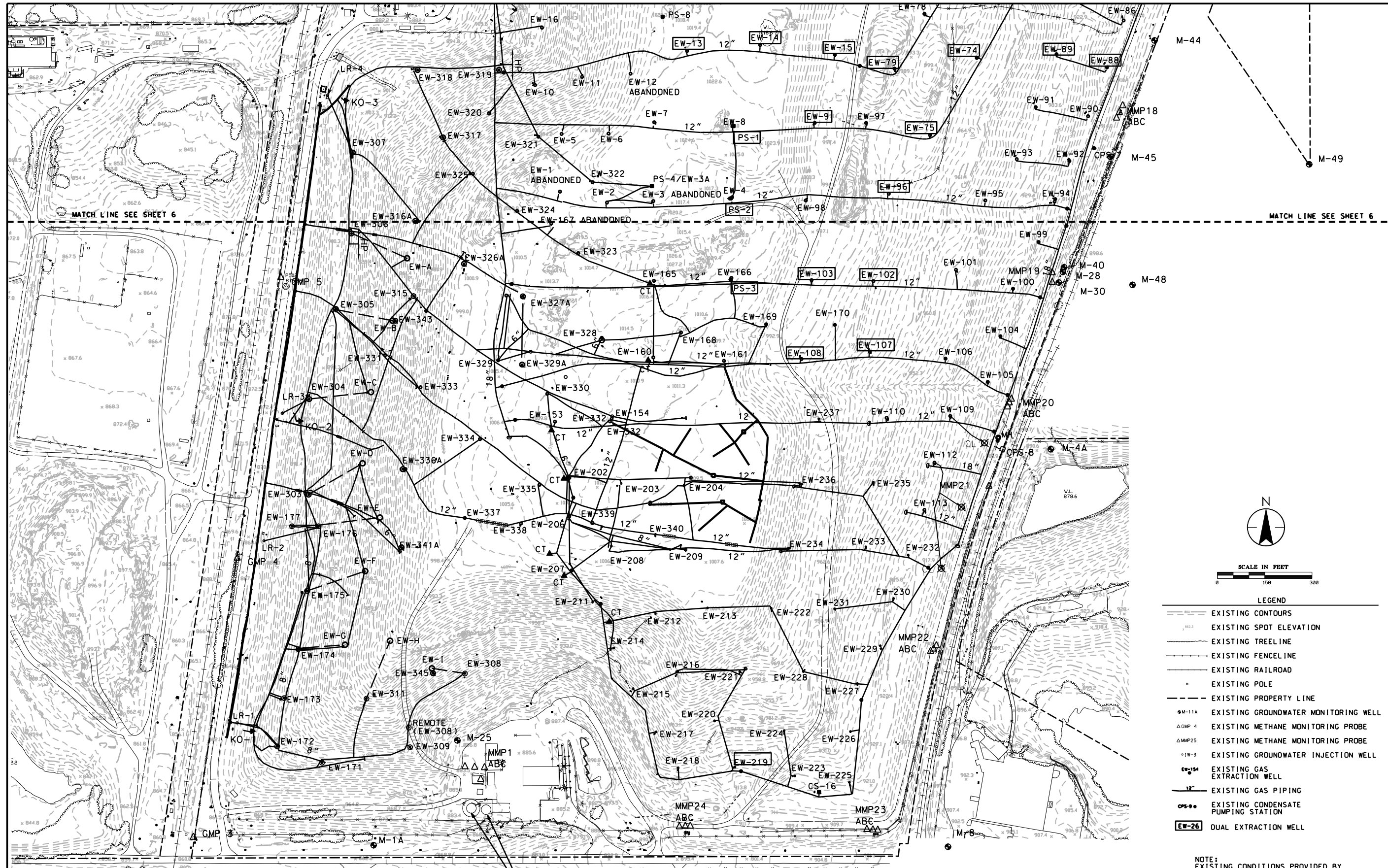
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Revision Sheet

0 6 of 18

1. **Introduction**

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By: jstustarich



EXISTING 80,000
GALLON AND 101,000
GALLON LEACHATE TANKS

NOTE:
EXISTING CONDITIONS PROVIDED BY
COOPER AERIAL SURVEYS CO.
DATE OF FLIGHT DECEMBER 19, 2021

- LEGEND
- EXISTING CONTOURS
 - EXISTING SPOT ELEVATION
 - EXISTING TREELINE
 - EXISTING FENCELINE
 - EXISTING RAILROAD
 - EXISTING POLE
 - EXISTING PROPERTY LINE
 - EXISTING GROUNDWATER MONITORING WELL
 - EXISTING METHANE MONITORING PROBE
 - EXISTING METHANE MONITORING PROBE
 - EXISTING GROUNDWATER INJECTION WELL
 - EXISTING GAS EXTRACTION WELL
 - EXISTING GAS PIPING
 - EXISTING CONDENSATE PUMPING STATION
 - DUAL EXTRACTION WELL



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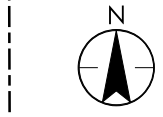
Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA
Existing Gas Piping Plan - South Half

Permit-Seal
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION,
OR REPORT WAS PREPARED BY ME OR UNDER
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LAWS OF THE STATE OF MINNESOTA.

PRINT NAME THOMAS J. SHUSTARICH
SIGNATURE
DATE yy/mm/dd LICENSE # 21210
Project Number: 227704791
04791e_gp_07.dgn

HORIZONTAL COLLECTION SYSTEM TRENCH POINT	APPROXIMATE DEPTH (FT)
①	8
②	14
③	8
④	7
⑤	7
⑥	7
⑦	9
⑧	8



- LEGEND**
- EXISTING CONTOURS
 - EXISTING SPOT ELEVATION
 - EXISTING TREELINE
 - EXISTING FENCELINE
 - EXISTING RAILROAD
 - EXISTING POLE
 - EXISTING PROPERTY LINE
 - EXISTING GROUNDWATER MONITORING WELL
 - EXISTING METHANE MONITORING PROBE
 - EXISTING METHANE MONITORING PROBE
 - EXISTING GROUNDWATER INJECTION WELL
 - EXISTING GAS EXTRACTION WELL
 - EXISTING GAS PIPING
 - EXISTING CONDENSATE PUMPING STATION
 - CURRENTLY PERMITTED CONTOURS
 - PROPOSED CONTOURS
 - PROPOSED 12" SUBHEADER
 - PROPOSED 6" SUBHEADER
 - PROPOSED GAS WELLS
 - PROPOSED CONTROL VALVE
 - PROPOSED HORIZONTAL COLLECTOR WELLHEAD
 - PROPOSED HORIZONTAL COLLECTOR PIPING (6" HDPE SDR 17)
 - PROPOSED LATERAL GAS SUBHEADER (8" HDPE SDR 17)
 - PROPOSED CONDENSATE SUMP
 - PROPOSED PUMPING STATION

NOTE:
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DATE OF FLIGHT DECEMBER 19, 2021.



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Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

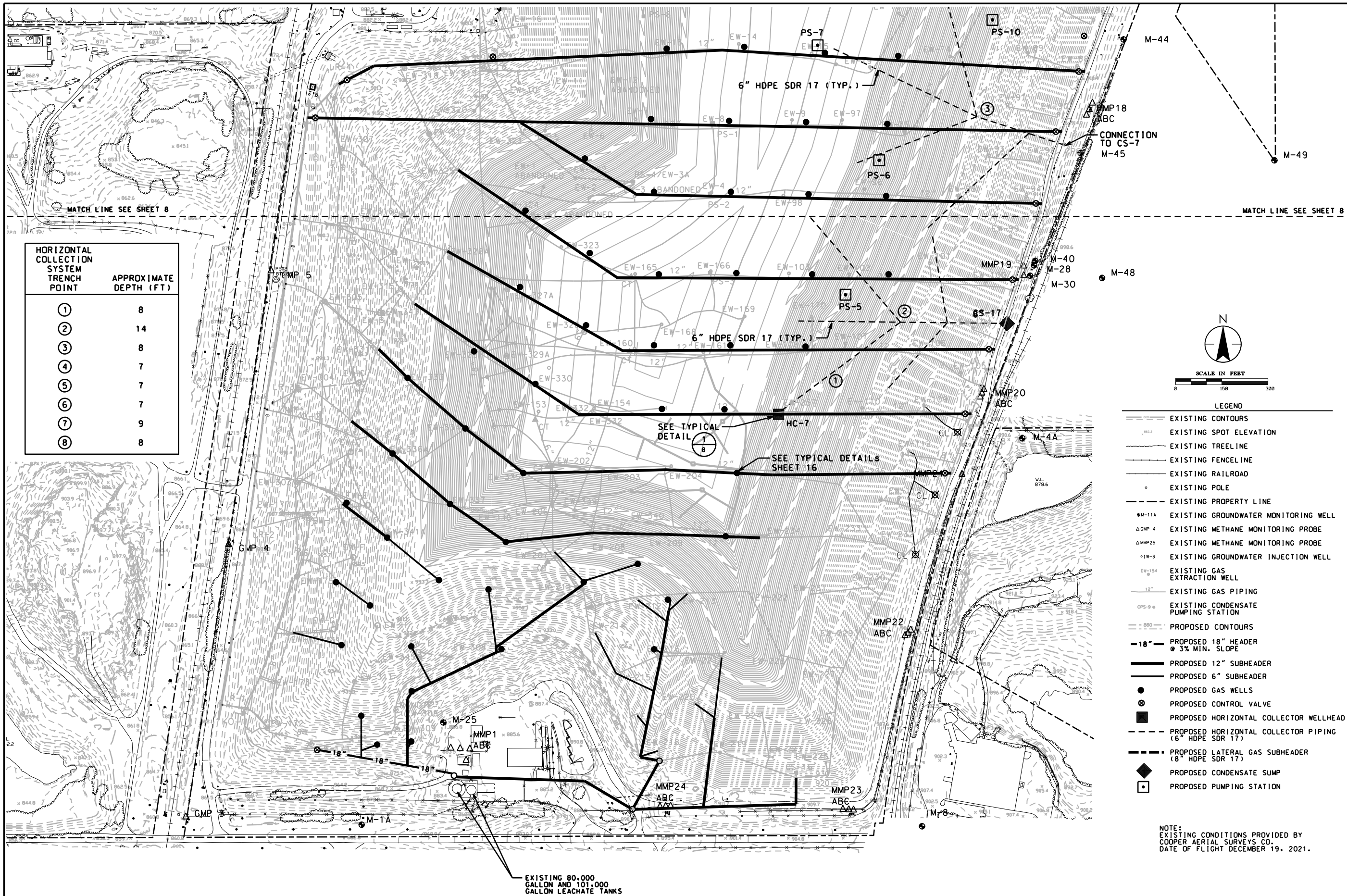
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INVER GROVE HEIGHTS, MINNESOTA
Proposed Gas Piping Plan - North Half

Permit-Seal
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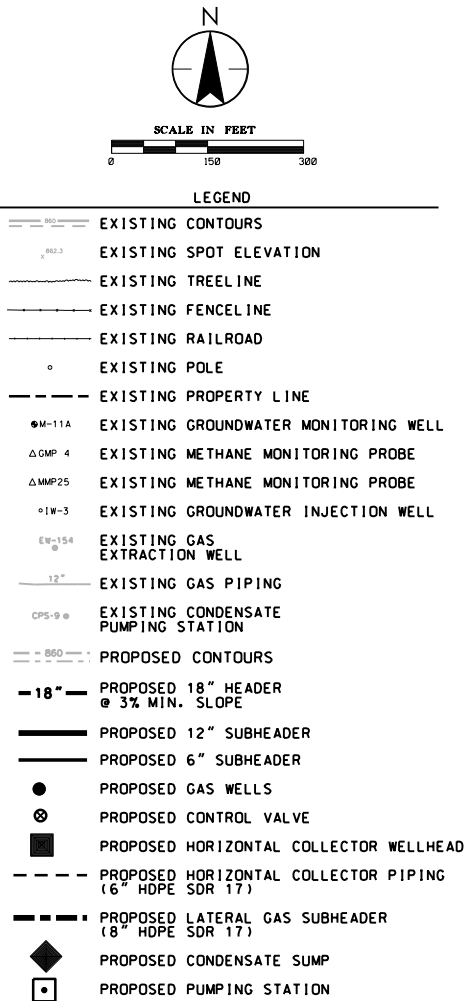
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SIGNATURE
DATE yy/mm/dd LICENSE # 21210
Project Number: 227704791
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JWT 2022.03.11
Drawing No. 8
Revision Sheet
0 8 of 18

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By: jstustarich



HORIZONTAL COLLECTION SYSTEM TRENCH POINT	APPROXIMATE DEPTH (FT)
①	8
②	14
③	8
④	7
⑤	7
⑥	7
⑦	9
⑧	8



NOTE:
EXISTING CONDITIONS PROVIDED BY
COOPER AERIAL SURVEYS CO.
DATE OF FLIGHT DECEMBER 19, 2021.



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App'd	
Issued	

Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA
Proposed Gas Piping Plan - South Half

Permit-Seal
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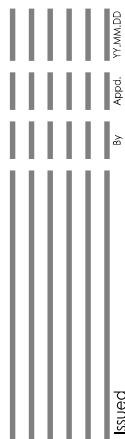
PRINT NAME THOMAS J. SHUSTARICH
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DATE yy/mm/dd LICENSE # 21210
Project Number 227704791
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Drawing No. 9

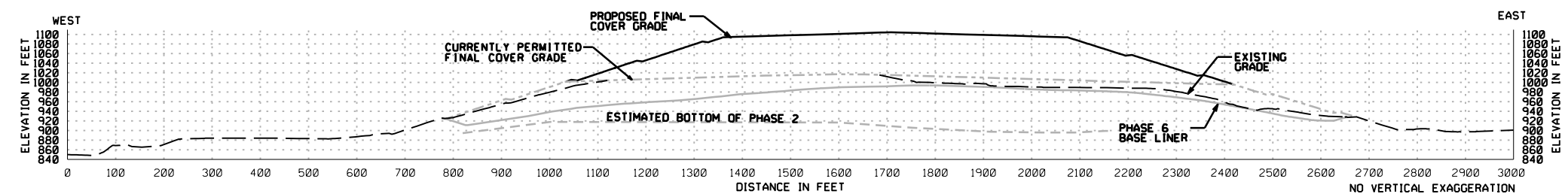
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0 9 of 18

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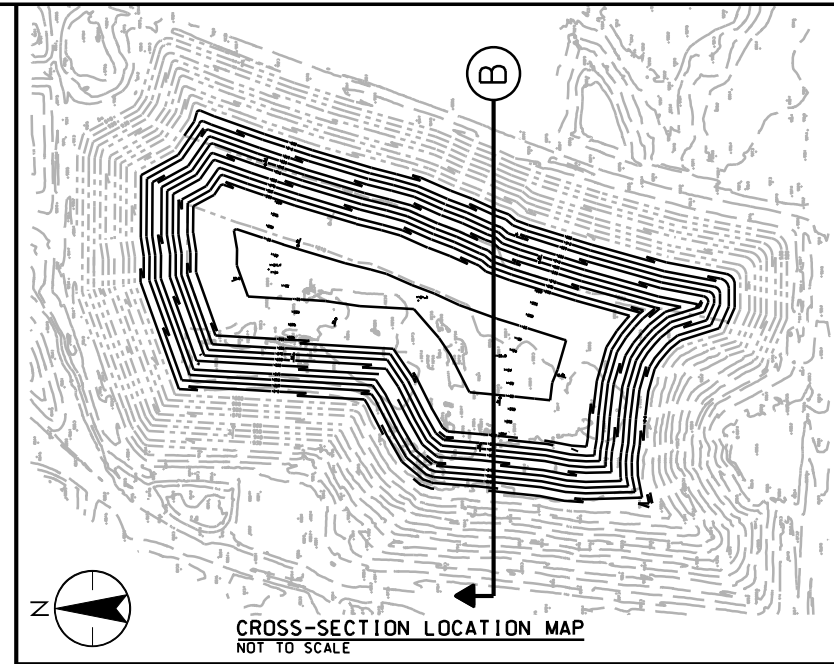
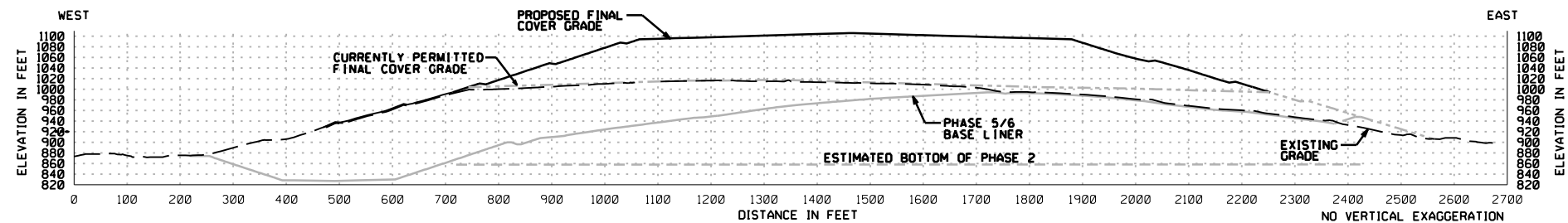
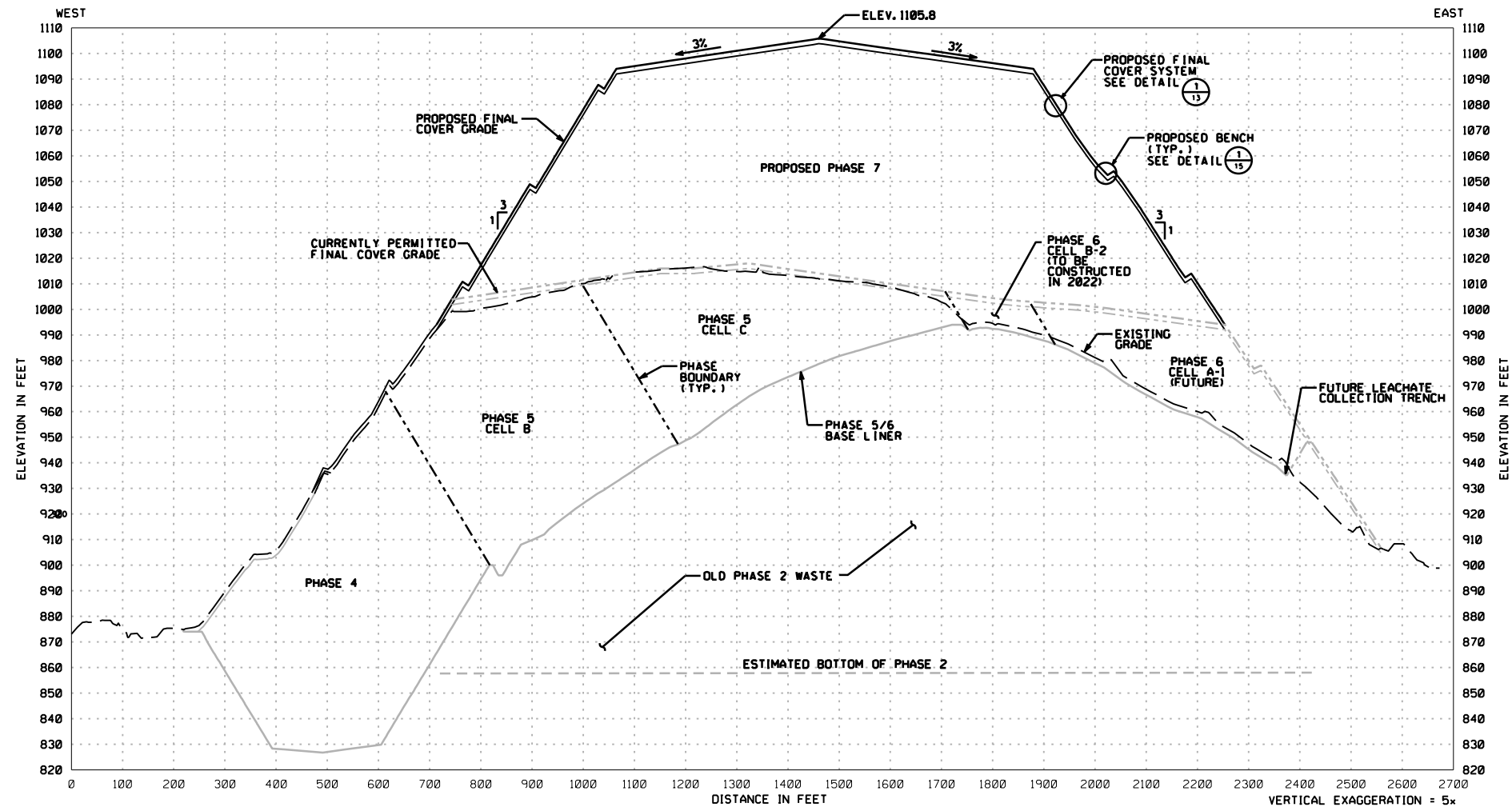
Cross-section A

0 10 of 18



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Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA

Cross-section B

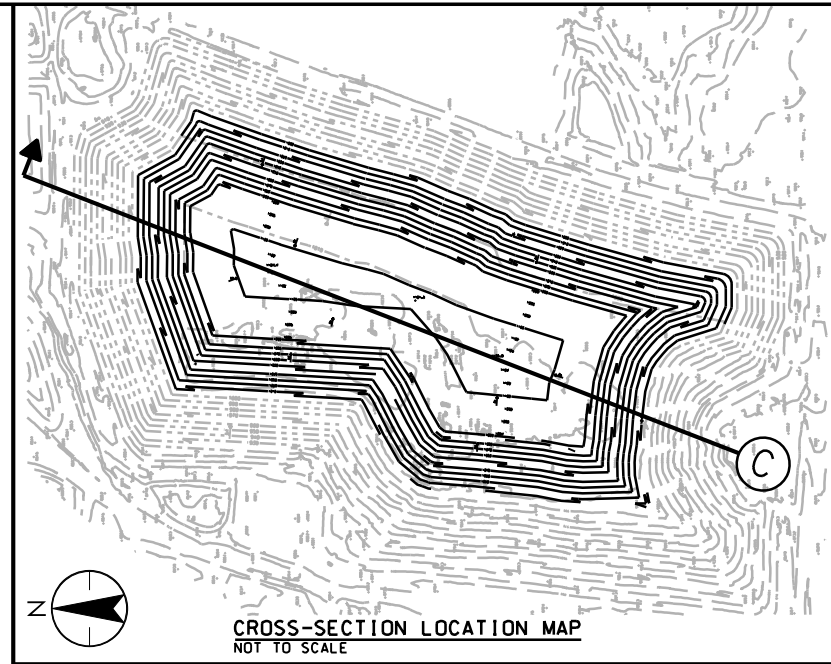
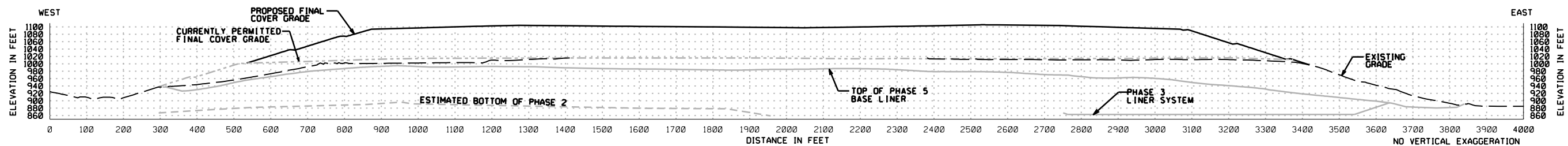
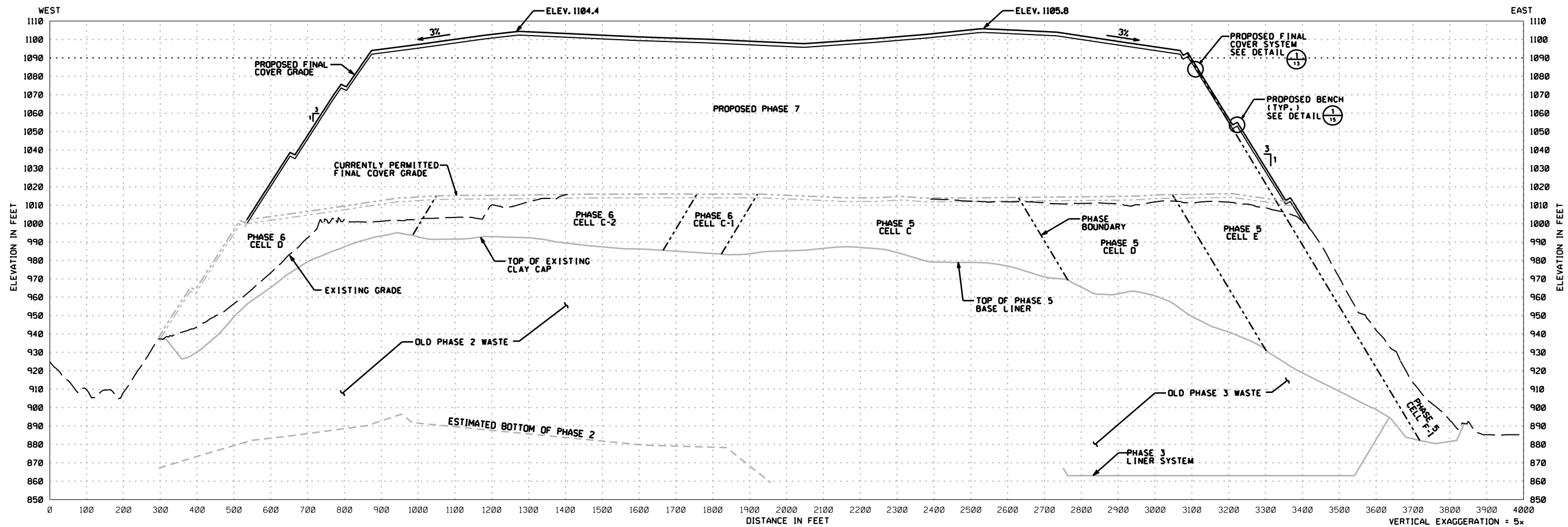
Permit-Seal
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PRINT NAME: THOMAS J. SHUSTARICH
SIGNATURE: _____
DATE: yy/mm/dd LICENSE # 21210
Project Number: 22704791
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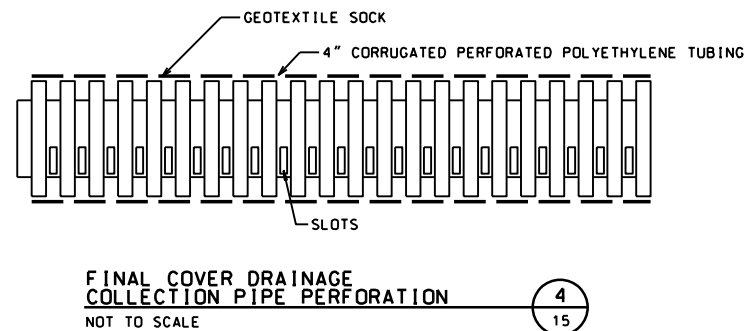
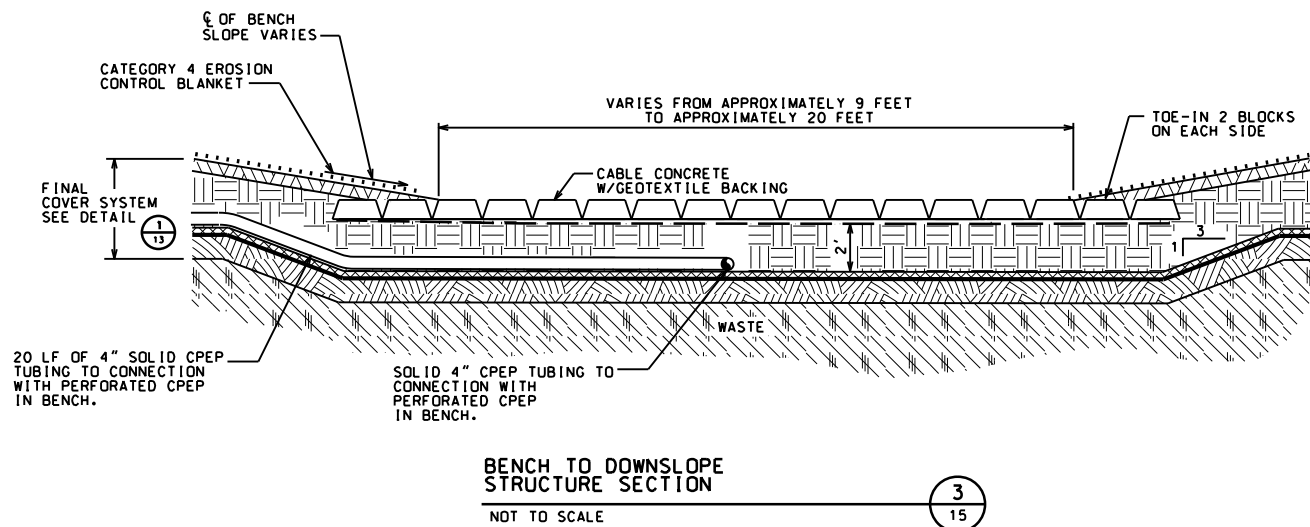
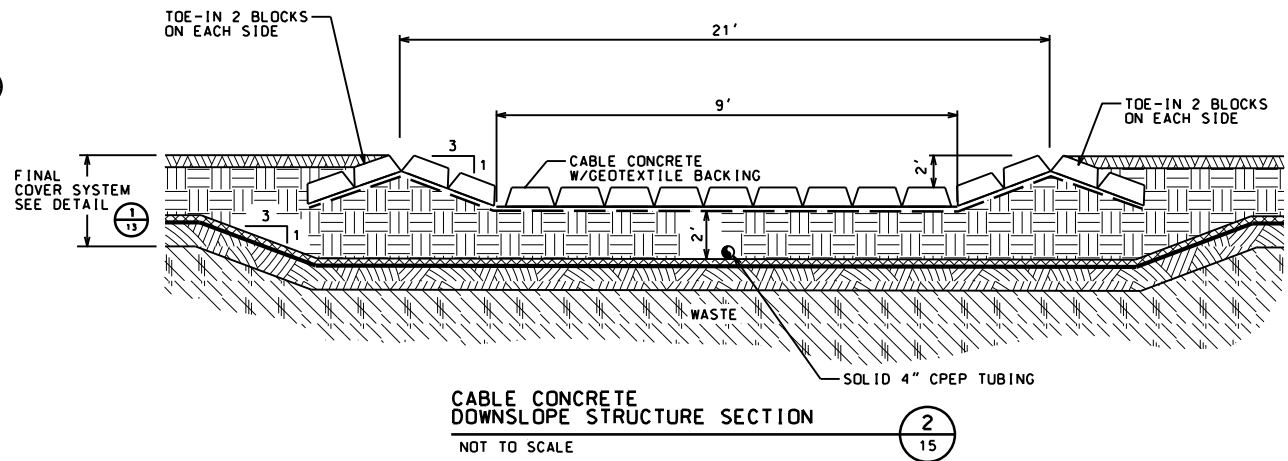
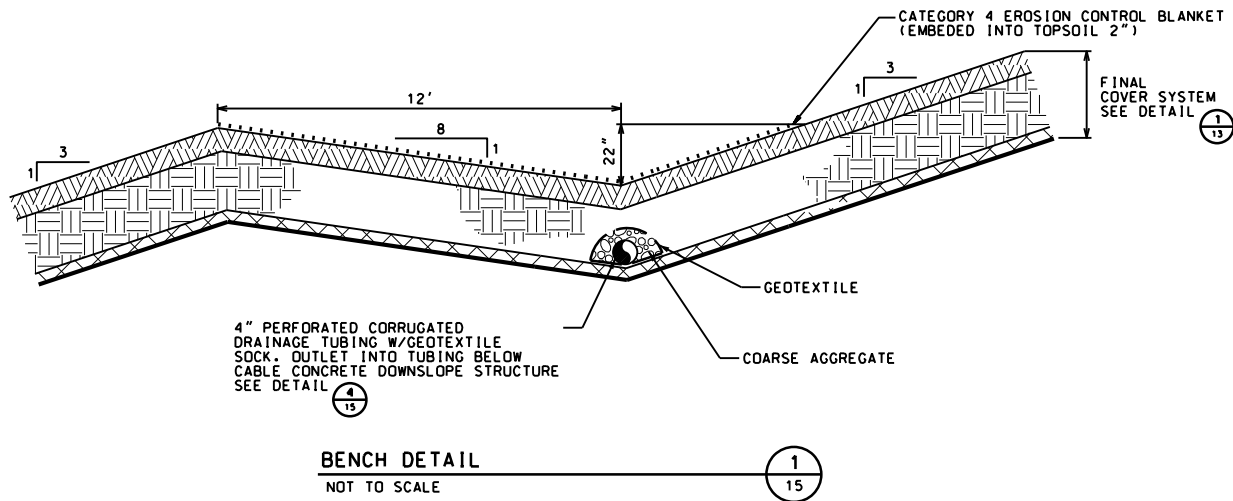
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Drawing No. 11
Revision Sheet
0 11 of 18

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By: jstuart







By	YJAW/DD
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Issued	

Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA
Surface Water Management Details

Permit-Seal
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE yy/mm/dd LICENSE # 21210

Project Number: 227704791

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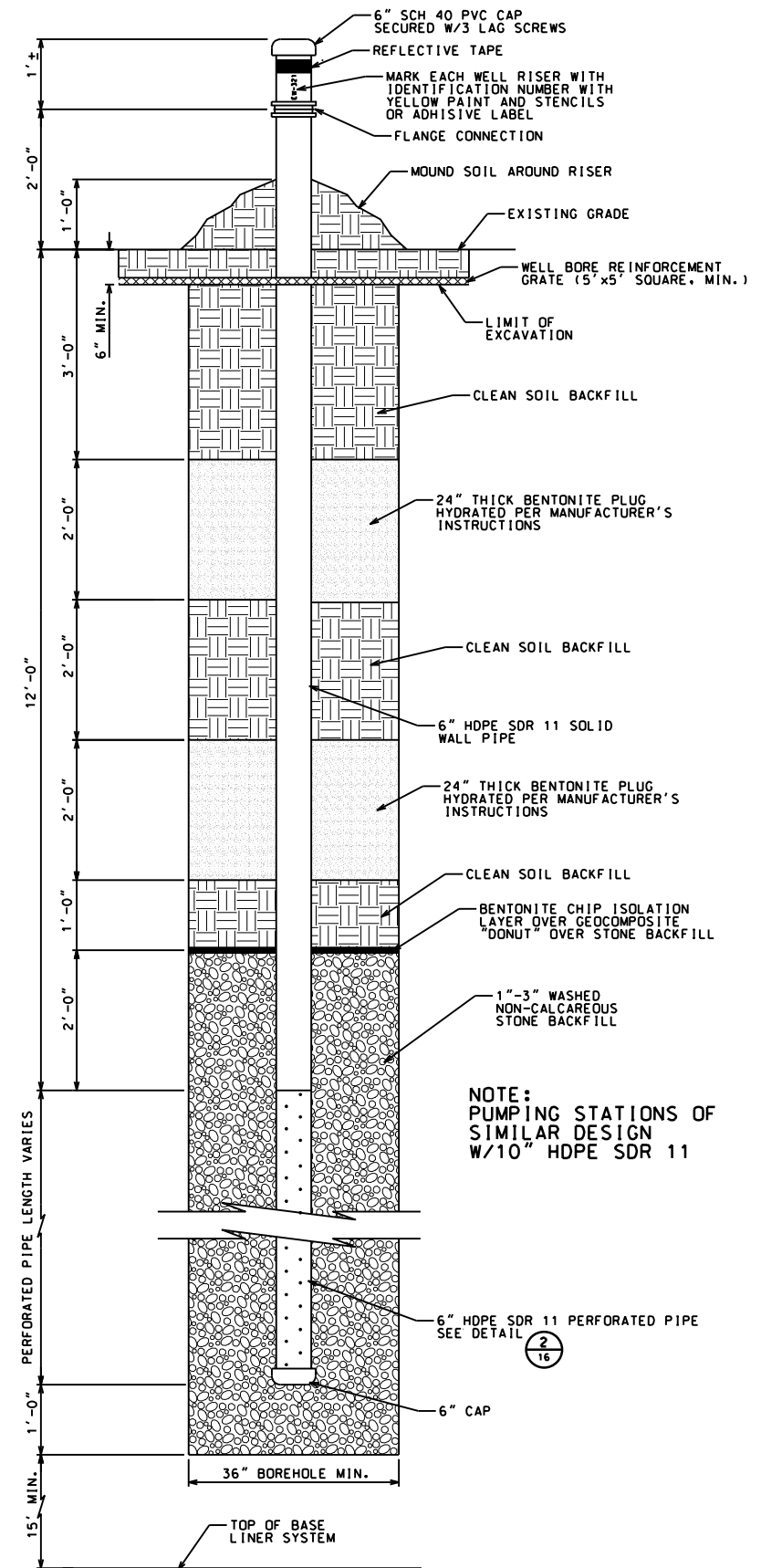
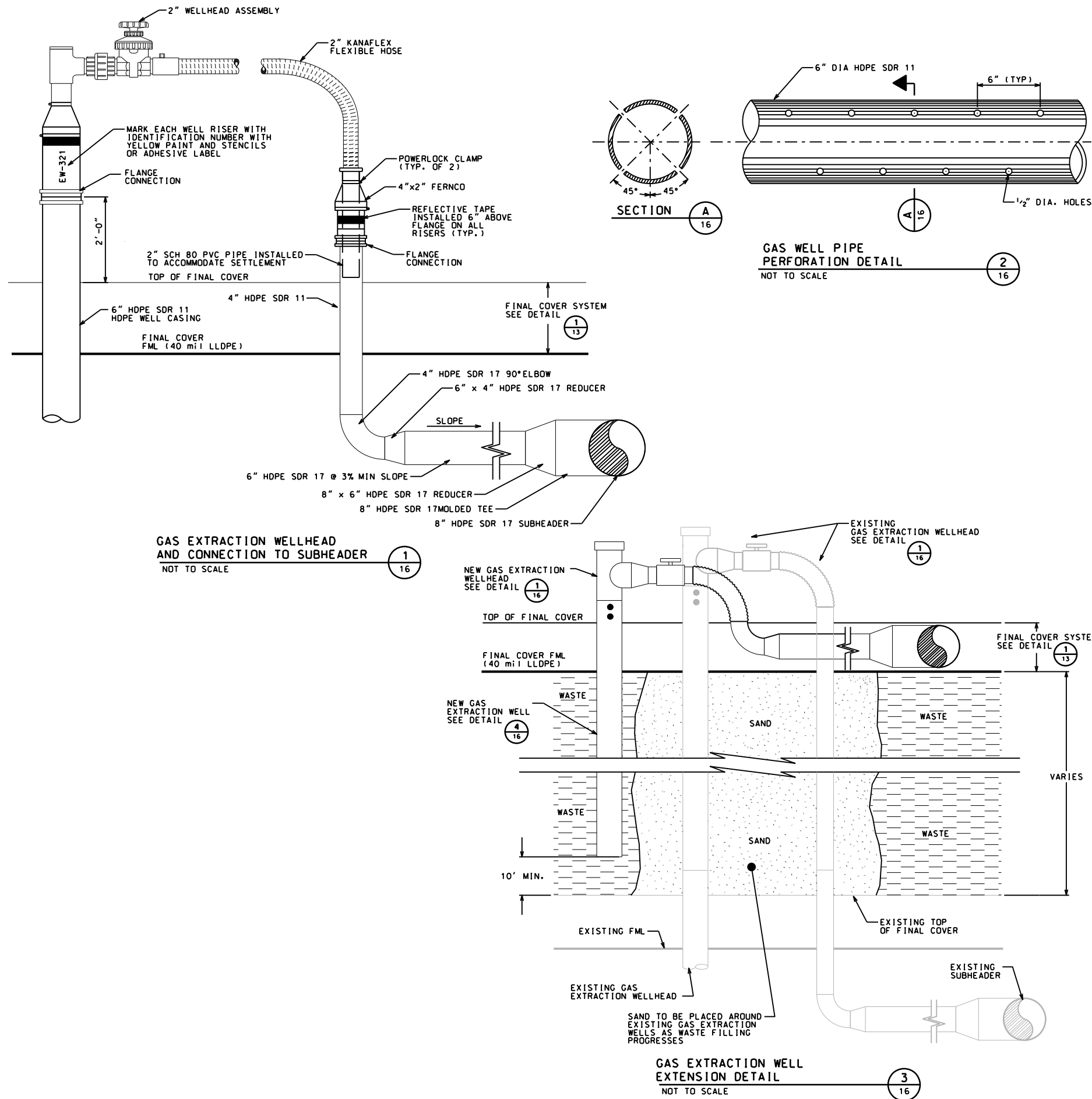
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Drawing No. 15

Revision Sheet

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04/11/2022
04/11/2022



LANDFILL GAS EXTRACTION WELL DETAIL
NOT TO SCALE

(4/16)



Client/Project
BH WASTE SYSTEMS OF NORTH AMERICA, LLC
PINE BEND LANDFILL

2022 MAJOR PERMIT MODIFICATION
INVER GROVE HEIGHTS, MINNESOTA

Gas System Details

Permit-Seal
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME: THOMAS J. SHUSTARICH

SIGNATURE: _____

DATE: yy/mm/dd LICENSE # 21210

Project Number: 227704791

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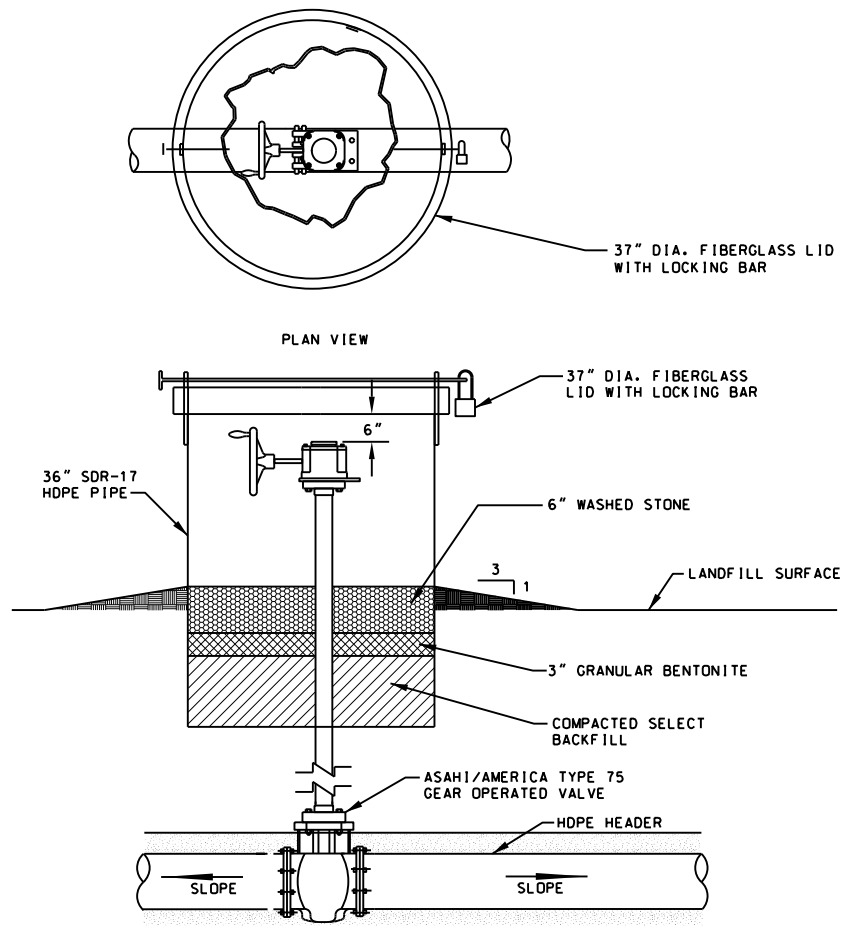
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Drawing No. 16

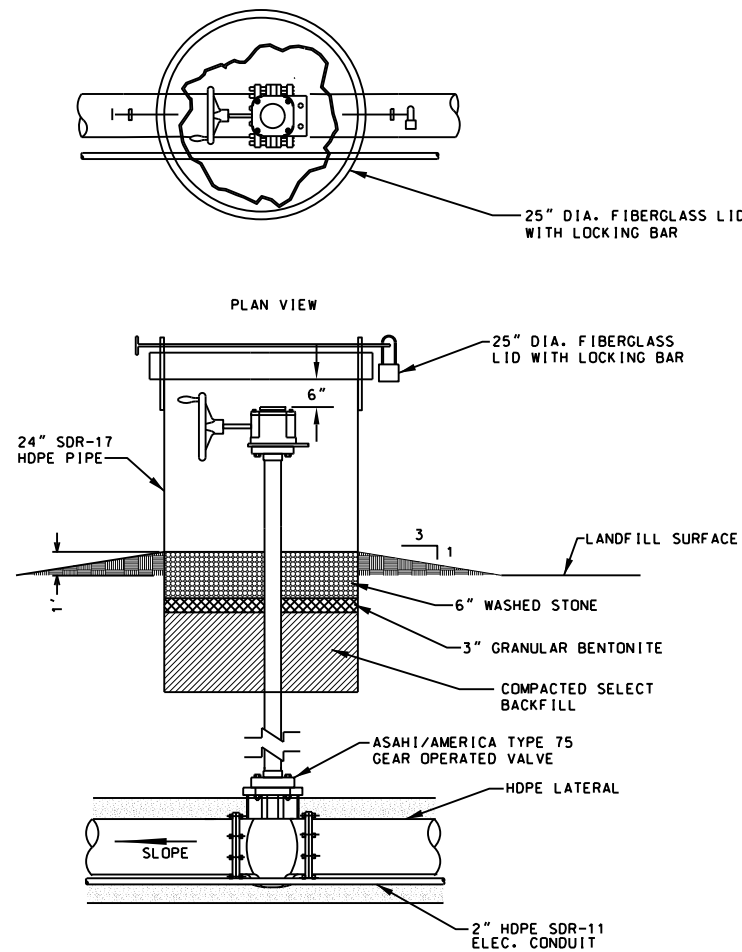
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0 16 of 18

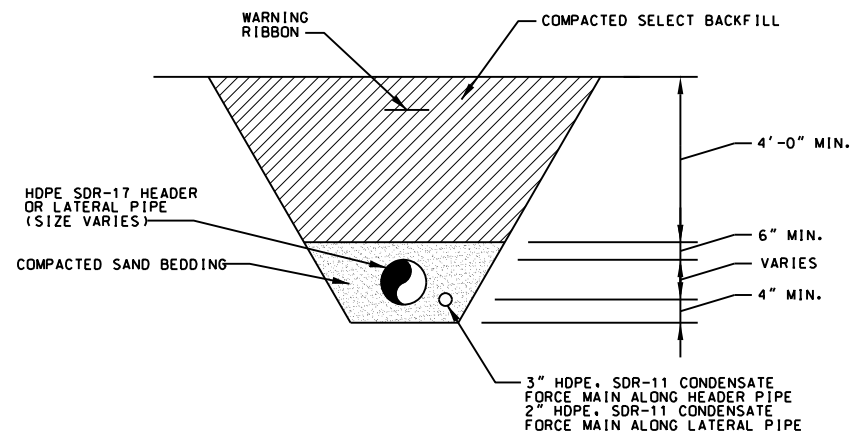
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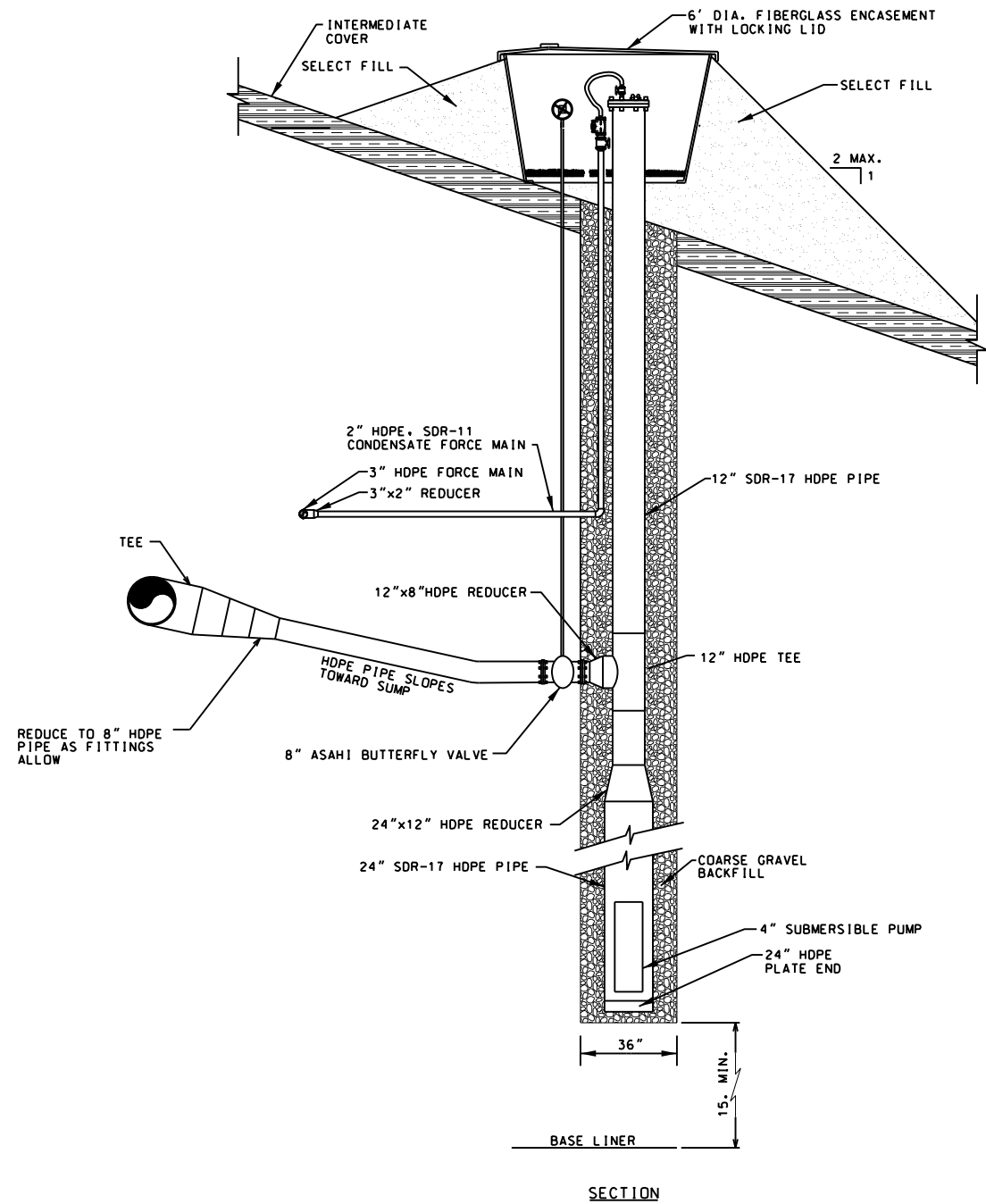
CONTROL VALVE DETAIL (GAS HEADER) 1
NOT TO SCALE 17



ISOLATION VALVE DETAIL (LATERAL) 2
NOT TO SCALE 17



TYPICAL PIPE TRENCH DETAIL 4
NOT TO SCALE 17



CONDENSATE SUMP DETAIL 3
NOT TO SCALE 17

Item 4.A, Attachment 6 - 2018 Conditional Use Permit

**CITY OF INVER GROVE HEIGHTS
DAKOTA COUNTY, MINNESOTA**

RESOLUTION NO. 18-69

**RESOLUTION APPROVING A CONDITIONAL USE PERMIT TO ALLOW A SIDE
SLOPE CAPACITY EXPANSION OF PINE BEND LANDFILL**

CASE NO. 07-36NCUC

PROPERTY LOCATED AT 2495 EAST 117TH STREET

WHEREAS, an application for a conditional use permit for a side slope capacity expansion of Pine Bend Landfill has been submitted by BFI Waste Systems of North America, LLC for property located at 2495 East 117th Street and legally described in Exhibit A and depicted in Exhibit B, attached hereto; and

WHEREAS, the side slope capacity expansion of Pine Bend Landfill is a conditional use in the IRM, Integrated Resource Management Overlay Zoning District; and

WHEREAS, the aforescribed property is currently zoned I-2, General Industry and IRM, Integrated Resource Management Overlay Zoning District; and

WHEREAS, in accordance with Minnesota Statutes, Section 462.357, Sub. 3, a public hearing concerning the proposed conditional use permit was held before the Inver Grove Heights Planning Commission on February 20, 2018.

WHEREAS, an application for a conditional use permit for an airspace capacity expansion of Pine Bend Sanitary Landfill was submitted in 2003 by BFI Waste Systems of North America Inc. for the same property and that conditional use permit was approved by the City Council on March 22, 2004, per Resolution No. 04-48.

NOW, THEREFORE, BE IT RESOLVED, by the City Council of the City of Inver Grove Heights, that a conditional use permit for BFI Waste Systems of North America, LLC for the side slope capacity expansion of Pine Bend Landfill is granted for the aforescribed property, subject to the following conditions:

AND BE IT FURTHER RESOLVED, that the conditional use permit for an airspace capacity expansion of Pine Bend Landfill, dated March 22, 2004 is hereby reaffirmed and ratified subject to the following conditions:

1. The side slope capacity expansion of 3.53 million cubic yards, not including the final cover system, when coupled with the airspace capacity limitation of the Non-Conforming Use Certificate of airspace capacity of 23.3 million cubic yards, and the 2004 conditional use permit expansion of 5.30 million cubic yards, not including the final cover system, shall not exceed 32.13 million cubic yards of airspace for disposed waste, not including the final cover system. The City and Pine Bend Landfill agree that prior to the airspace capacity expansion

allowed by this conditional use permit the remaining airspace capacity, as of December 2016, was 1.90 million cubic yards. The remaining airspace capacity will be recalculated each year as required by MPCA.

2. The terms and conditions of the conditional use permit for an airspace capacity expansion for Pine Bend Landfill, dated March 22, 2004 shall be the terms and conditions stated in this resolution and the terms and conditions in Resolution 04-48, dated March 22, 2004 are hereby superseded by this resolution.
3. The airspace capacity expansion granted March 22, 2004 and this side slope capacity expansion shall occur and be operated in substantial conformance with the following:
 - a. Narrative and plans of "Application to the City of Inver Grove Heights for the Pine Bend Landfill", dated August 2003
 - b. Twenty-six plan sheets, titled "Permit Application, Pine Bend Landfill-SW 45, prepared for BFI Waste Systems of North America, Inc.", dated February 2002, January 2003, and August 2003
 - c. Response to comments for BFI Pine Bend Landfill, as prepared by Wenck Associates Inc., dated November 11, 2003
 - d. "Application Submittal to the City of Inver Grove Heights for the Pine Bend Landfill – Phase 6 development, MPCA Permit #SW-45," revised February 2018

To the extent that paragraphs 3a, 3b, and 3c conflict with paragraph 3d, paragraph 3d shall prevail.

4. The area of the 2004 capacity expansion shall be limited to the area defined as Phase 5 and the area of the 2018 side slope capacity expansion shall be limited to the area defined as Phase 6 on the approved plans.
5. Pine Bend Landfill shall comply with all terms and conditions found in:
 - a. Resolution No. 6330 Approving a Conditional Use Permit for an Energy Recovery Facility for the Generation of Electricity, dated May 30, 1995
 - b. Resolution No. 6465 Granting a Non-Conforming Use Certificate for Pine Bend Landfill for a Sanitary Landfill, dated November 27, 1995
 - c. Resolution No. 2001-86 Approving a Conditional Use Permit for Open Storage for Truck and Trailer Storage/Parking, dated July 9, 2001
 - d. Resolution 01-117 Adopting a Revised Landscaping Plan, dated September 10, 2001

- e. Resolution No. 02-32 Amending the Non-Conforming Use Certificate by Modifying the Phasing Plan, Maximum Elevation, and Final Grading and Storm Water Plans, dated March 11, 2002
 - f. Resolution No. 02-127 Approving a Conditional Use Permit for the Stockpiling of Clean Soil Material as an Accessory Use to an Existing Landfill to a Maximum of 335,100 Cubic Yards, dated August 26, 2002
 - g. Resolution No. 04-48 Approving a Conditional Use Permit to Allow an Airspace Capacity Expansion of Pine Bend Landfill, dated March 22, 2004; as modified by this resolution.
 - h. Resolution No. 04-49 Amending Resolution No. 6465 Granting a Non-Conforming Use Certificate for Pine Bend Landfill for a Sanitary Landfill, dated March 22, 2004
 - i. Resolution No. 04-51 Declaring Lapse of Nonconforming Use Rights for Pine Bend Sanitary Landfill to Operate a Compost Facility, dated March 22, 2004
 - j. Resolution No. 04-50 Approving A Conditional Use Permit for the Stockpiling of Clean Soil Material as an Accessory Use to an Existing Landfill to a Maximum of 355,100 Cubic Yards, dated March 22, 2004
 - k. Resolution No. 18-____ Amending Resolution No. 6465 Granting a Non-Conforming Use Certificate for Pine Bend Sanitary Landfill for a Sanitary Landfill
6. The Non-Conforming Use Certificate, Section 5 through 10 inclusive, shall also apply to the side slope capacity expansion and the terms and conditions of those sections are made part of this Conditional Use Permit and incorporated by reference.
7. Notwithstanding anything to the contrary contained in Pine Bend Landfill's Solid Waste Management Plan, the types of waste to be disposed in the 2004 airspace capacity expansion and this side slope capacity expansion shall only include the following:
- a. Construction debris and demolition debris
 - b. Infectious waste which has been processed so as to become non-infectious
 - c. Mixed municipal solid waste from whatever source including, but not limited to, mixed municipal solid waste material from composting, energy recovery facilities, and recycling facilities and processes. The term mixed municipal solid waste shall be as defined in Section 1.29 of the "Non-Conforming Use Certificate for Pine Bend Sanitary Landfill for a Compost Facility and Sanitary Landfill," issued on November 27, 1995.
 - d. Non-hazardous industrial solid waste including, but not limited to, industrial incinerator ash, all in accord with the Industrial Waste Management Plan. The term industrial solid waste shall be as defined in Section 1.24 of the "Non-Conforming Use

Certificate for Pine Bend Sanitary Landfill for a Compost Facility and Sanitary Landfill," issued on November 27, 1995.

- e. Solid wastes approved by the MPCA for use as cover material including, but not limited to, foundry sands and certain sludges.

- 8. Vehicles coming into Pine Bend Landfill shall not queue onto 117th Street.
- 9. If sanitary sewer is extended to Pine Bend Sanitary Landfill, the Landfill shall connect the leachate collection/storage systems to the sanitary sewer, pay its pro rata share of special assessments (in conjunction with other lands served by the sanitary sewer extension) over a term determined by the City Council but not less than five years and not more than ten years, and pay connection and hook up charges, as soon as the sanitary sewer is accepted for use by the City.
- 10. Hours for the construction of the 2004 airspace capacity expansion and this side slope capacity expansion shall be:

Monday through Friday 6:00 AM to 8:00 PM
Saturday 6:00 AM to 4:00 PM

Upon the request of Pine Bend Sanitary Landfill, temporary extensions of hours or days of construction may be granted by the City Administrator.

- 11. Pine Bend Landfill shall comply with Minnesota Rules and the MPCA Solid Waste Permit issued July 30, 2015 regarding surface water and groundwater monitoring and groundwater compliance boundary requirements as well as the following special conditions:
 - a. As part of its annual report to the MPCA, Pine Bend Landfill may use alternative methods for the groundwater trend analysis, if approved in advance by the City.
 - b. Pine Bend Landfill shall conduct additional investigations, if required by the City Council, when hydrogeologic changes occur or continued release of contaminants to groundwater warrant, as determined by the City Council. Pine Bend Landfill shall start the investigation within 60 days after determined by the City Council, complete the investigation within 360 days including design for additional groundwater remedial measures, and implement remedial measures within 180 days of City Council's approval of remedial measures design.
 - c. Required water sampling may be waived by the City Administrator in conjunction with either the Community Development Director or Public Works Director, in the case of extenuating circumstances, such as inaccessibility caused by deep snow or wet soils. If such a waiver is granted, the City Council will be notified at its next regular meeting and the waiver shall be discussed at the next quarterly meeting with the City and Pine Bend Landfill and documented in the meeting minutes.

12. Pine Bend Landfill must comply with Minnesota Rules and the MPCA Solid Waste Permit issued July 30, 2015 regarding liner leak detection, and leachate collection, conveyance, storage, and treatment requirements as well as the following special conditions relating to the dual gas/leachate extraction system:

- a. As part of the annual report, due February 1 of each year, Pine Bend Landfill shall describe the system operations and maintenance, including quality and quantity of leachate collected, and provide recommendations for system modifications.
- b. Pine Bend Landfill shall perform the following and discuss efforts as part of the annual report, due February 1 each year, to:
 - i. Operate, maintain, and update the dual gas/leachate extraction system to maximize leachate extraction to the greatest extent practicable
 - ii. Lower pump intakes or provide an explanation of why pumps could not, or should not, be lowered
 - iii. Allow one full year of “dry” operations before removing pumps or provide explanation regarding why the pumps need to be removed and why they cannot be reinstalled
 - iv. Monitor leachate head level in wells after pumps are removed
 - v. Evaluate the market availability of new pumps that could be installed in the dual gas/leachate extraction wells
 - vi. Reinstall pumps in wells currently in the dual gas/leachate extraction system or provide an explanation of why the pumps could not, or should not, be reinstalled
 - vii. Install pumps in existing wells and add them to the dual gas/leachate extraction system or provide an explanation of why the pumps could not, or should not, be installed
- c. Requirements for the dual gas/leachate extraction system may be waived by the City Administrator in conjunction with either the Community Development Director or Public Works Director, in the case of extenuating circumstances, such as inability to reinstall pumps or if it is technically unfeasible to operate or maintain the dual gas/leachate extraction system. If such a waiver is granted, the City Council will be notified at its next regular meeting and the waiver shall be discussed at the next quarterly meeting with the City and Pine Bend Landfill and documented in the meeting minutes.

13. Pine Bend Landfill must comply with Minnesota Rules and the MPCA Solid Waste Permit issued July 30, 2015 regarding the Phase 5 expansion area liner leak detection, and leachate collection, conveyance, storage, and treatment requirements.

14. Pine Bend Sanitary Landfill must achieve compliance with Minnesota Rule 7035.2815, Subpart 11 regarding landfill gas management, including future similarly applicable Minnesota Rule revisions, for six consecutive months as certified by a professional engineer prior to the following, whichever occurs first:

- a. Filling of waste beyond 30.00 million cubic yards (excluding final cover) of the Pine Bend Sanitary Landfill capacity of 32.13 million cubic yards (excluding final cover);
or
- b. January 1, 2025.

If compliance with this condition is not achieved, Pine Bend Sanitary Landfill and BFI Waste Systems of North America, LLC must temporarily cease accepting waste for disposal at the Pine Bend Sanitary Landfill until this condition is met; when the condition is met, waste may once again be accepted for disposal at the Pine Bend Sanitary Landfill.

Until compliance is achieved for six consecutive months as required above, BFI Waste Systems of North America, LLC must present progress on its efforts to achieve compliance to the City of Inver Grove Heights Environmental Commission in the first quarter of every year and report progress in the annual report to the MPCA.

All ongoing gas migration related work plans and reports must be submitted to the City for review and comment.

The requirement contained above is not an election of remedies by the City and is not a waiver of the City's right and remedies under the conditional use permits or under the non-conforming use certificate or under any host community agreement.

The City specifically reserves the right to take action to enforce Minnesota Rule 7035.2815, Subpart 11 and to exercise its rights and remedies under the conditional use permits and under the non-conforming use certificate or under any host community agreement with respect to any past, existing or future violations of Minnesota Rule 7035.2815, Subpart 11, including future similarly applicable Minnesota Rule revisions.

No remedy conferred upon or reserved to the City in the conditional use permits or in the non-conforming use certificate or in any host community agreement shall be exclusive of any other available remedy or remedies, but each and every such remedy shall be cumulative and shall be in addition to every other remedy given under the conditional use permits or the non-conforming use certificate or in the host community agreement or now or hereafter existing at law or in equity or by statute. No delay or omission to exercise any right or power shall impair any such right or power or shall be construed to be a waiver thereof, but any such right and power may be exercised from time to time and as often as may be deemed expedient.

The City acknowledges that BFI Waste Systems of North America, LLC reserves the right to request an amendment to the requirement contained herein.

Nothing contained herein shall be deemed an acceptance or approval by the City of the requested amendment or any indication that the City will adopt such amendment.

During the time that the Pine Bend Sanitary Landfill must temporarily cease to accept waste for disposal in the event the above condition is not met, Pine Bend Sanitary Landfill and BFI Waste Systems of North America, LLC must nonetheless continue to pay the City the fees and payments stated in Section 8 of the Third Restated and Amended Host Community Agreement dated April 9, 2018, by and among BFI Waste Systems of North America, LLC, Browning-Ferris Industries, Inc. and the City of Inver Grove Heights (as amended from time to time); and Pine Bend Sanitary Landfill and BFI Waste Systems of North America, LLC must meet and comply with the other obligations stated in the Third Restated and Amended Host Community Agreement (as amended from time to time) including, but not limited to, the Host Community Fee, the Minimum Monthly Payment, the Per Ton Payment, the Inducement Amount, the Donation and the Payment for Firefighting Costs and the payments required under Sections 8.12 and 8.13 of the Third Restated and Amended Host Community Agreement.

15. Pine Bend Sanitary Landfill shall maintain a Minnesota Pollution Control Agency air emission permit for a rental enclosed flare to serve as contingency capacity for managing landfill gas.
16. The owner and operator of Pine Bend Sanitary Landfill are both responsible for complying with the obligations and conditions contained in this Conditional Use Permit.
17. Breach of any Host Community Agreement between the City and BFI Waste Systems of North America, Inc. is deemed to be violation of this Conditional Use Permit.
18. This conditional use permit shall become effective only upon the execution of the Third Restated and Amended Host Community Agreement and only upon the Third Restated and Amended Host Community Agreement becoming effective.

Be it further resolved that the City Clerk is hereby authorized and directed to record a certified copy of this resolution at the Dakota County Recorder's Office.

Res. No. 18-69

Adopted by the City Council of the City of Inver Grove Heights this 9th day of April, 2018.

AYES: 4

NAYS: 0

CITY OF INVER GROVE HEIGHTS

By:

George Touville
George Touville, Mayor

George Tourville, Mayor

Attest:

[Signature]

Michelle Tesser, City Clerk

(CITY SEAL)

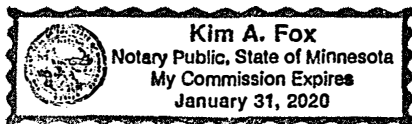
STATE OF MINNESOTA)

)

SS.

COUNTY OF DAKOTA)

On this 9th day of April, 2018, before me a Notary Public within and for said County, personally appeared George Tourville and Michelle Tesser to me personally known, who being each by me duly sworn, each did say that they are respectively the Mayor and City Clerk of the City of Inver Grove Heights, the municipality named in the foregoing instrument, and that the seal affixed to said instrument was signed and sealed on behalf of said municipality by authority of its City Council and said Mayor and City Clerk acknowledged said instrument to be the free act and deed of said municipality.




Notary Public

Notary Public

ACCEPTANCE

BFI Waste Systems of North America, LLC hereby accepts and agrees to the amendments and other provisions set forth in the foregoing Resolution.

Dated: May 23, 2018.

BFI Waste Systems of North America, LLC

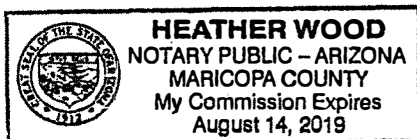
By: 

STATE OF Arizona)

) ss.

COUNTY OF Maricopa)

On this 23rd day of May, 2018, before me a Notary Public within and for said County, personally appeared John Nickerson, to me personally known, who being by me duly sworn, did say that he/she is the Vice President of BFI Waste Systems of North America, LLC, the limited liability company named in the foregoing instrument, and that the foregoing instrument was executed on behalf of the limited liability company by authority of the Boards of Governors of said entity and said Vice President acknowledged said instrument to be the free act and deed of the limited liability company.




Notary Public

EXHIBIT A

Lot 1, Block 1, and Lot 1, Block 2, and Outlot A, Pine Bend Sanitary Landfill, Dakota County, Minnesota, according to the recorded plat thereof on file and of record with the Dakota County Recorder.

**Item 4.A, Attachment 7 - City of Inver Grove Heights
Memo (dated May 22, 2024)**



May 22, 2024

**COMMUNITY
DEVELOPMENT
DEPARTMENT**

8150 Barbara Avenue
Inver Grove Heights
Minnesota 55077

651-450-2500

www.ighmn.gov

Mr. Abdi Hassan
Staff Engineer
Resource Management & Assistance Division
Minnesota Pollution Control Agency
520 Lafayette Road North
St Paul, MN 55155

**Re: City of Inver Grove Heights' Fourth Review of Pine Bend Landfill's
2022 Request for Major Modification of Permit #SW-45 Submitted to the
Minnesota Pollution Control Agency**

Dear Mr. Hassan:

This letter provides the City of Inver Grove Heights' fourth recommendations resulting from review of the Pine Bend Landfill (PBL) "Request for Major Modification of Permit #SW-45", prepared by Stantec Consulting Services Inc. (Stantec), dated June 2, 2022, including the addendum dated September 15, 2022 (June 2022 Application and September 2022 Addendum). This letter is a follow-up to Stantec's memorandum with attachments dated April 29, 2024 (April 29, 2024 Response) which responded to the City's April 23, 2024, recommendation letter relating to recommendations numbers 19 and 30.

The June 2022 Application and September 2022 Addendum proposes an airspace capacity expansion over the existing landfill footprint by extending the existing 3:1 (horizontal: vertical) side slopes around the entire existing landfill footprint including filling over the liner and leachate collection system previously installed over old unlined waste.

These recommendations were developed by Barr Engineering Co. (Barr). The City requests that the MPCA consider incorporation of these recommendations into the MPCA solid waste permit process. These recommendations will also be shared with Pine Bend Landfill and Dakota County.

The City also requests that the MPCA respond to this letter and indicate whether the MPCA concurs with the recommendations below.

Information used as part of the City's review included:

- April 29, 2024 Response memorandum with attachment:
 - o Closure, Post-closure, Contingency Action Plan dated June 1, 2022, revised April 2024
- April 12, 2024 Response memorandum with attachments:
 - o Introduction, Request for Major Permit Modification dated June 1, 2022, revised February 2024
 - o Design Report dated June 1, 2022, revised April 2024
 - o Operations and Maintenance Plan dated June 1, 2022, revised February 2024
 - o Closure, Post-closure, Contingency Action Plan dated June 1, 2022, revised April 2024

- Surface water model 2024 (.hcp file)
- Phase 6 Geosynthetic MQC that includes Geosynthetic Clay Liner and High Density Polyethylene Liner quality certifications
- February 2024 Response Memo with attachments:
 - Introduction dated June 1, 2022, revised February 2024
 - Design Report dated June 1, 2022, revised February 2024
 - Operations and Maintenance Plan dated June 1, 2022, revised February 2024
 - Closure, Post-closure, Contingency Action Plan dated June 1, 2022, revised February 2024
 - Surface water model 2023v2 (.hcp file)
- The June 2022 Application and September 2022 Addendum
- The "Application for Permit Renewal," prepared by Wenck Associates, Inc., dated November 2013 (November 2013 Application)
- Request for Major Modification of Permit #SW-45", prepared by Wenck Associates, Inc., dated August 2015 (August 2015 Application)
- Republic Services letter dated July 31, 2014, to the City of Inver Grove Heights (Tom Link) regarding air quality concerns associated with the proposed organic waste composter and acknowledging the need to comply with City ordinances and PBL's Non-Conforming Use Certificate
- PBL's MPCA Solid Waste Permit (SW-45) dated July 30, 2015, modified May 31, 2019 (May 2019 Modified MPCA Permit)

Our review of the June 2022 Application and September 2022 Addendum focused on these twelve technical topics:

- A. Waste Acceptance
- B. Groundwater Monitoring System
- C. Leachate Recirculation
- D. Solid Waste Composting
- E. Groundwater Quality
- F. Surface Water Management
- G. Waste Capacity
- H. Liner and Leachate Collection System Design
- I. Gas Monitoring and Gas Extraction/Treatment Systems
- J. Final Cover Design
- K. Closure, Post Closure, Contingency Action, and Operations and Maintenance Plans
- L. Financial Assurance Cost Estimates

This third set of recommendations (Barr April 23, 2024 Recommendations) are provided at the end of each topic and are numbered sequentially and include the City's initial November 28, 2023 recommendations and the City's second April 5, 2024 recommendations followed by Stantec's first and second round of responses in italic text from the February 2024 and April 12, 2024 Response memos respectively.

A. Waste Acceptance

The City assumes that the 2014 Solid Waste Management Plan that is approved in the May 2019 Modified MPCA Permit is still the plan being referenced in the June 2022 Application and September 2022 Addendum. If that is the case, then there are no changes being proposed in the June 2022 Application and September 2022 Addendum regarding waste acceptance.

The 2014 Solid Waste Management Plan describes the procedures that PBL uses to manage its mixed municipal and non-hazardous industrial solid waste. More specifically, the 2014 Solid Waste Management Plan describes:

- A customer notification procedure for review and acceptance of waste,
- A list of acceptable and unacceptable wastes plus a list of wastes that PBL does not accept,
- Waste categorization,
- Waste evaluation procedures,
- Use of waste as daily cover,
- Waste inspection and rejection procedures, and
- Numerous appendices including Dakota County Ordinance 110 and a Household Hazardous Waste Management Plan.

Barr Recommendations:

1. Barr November 28, 2023, Recommendation:

The Operations and Maintenance Manual dated August 2015 is listed as an approved plan in the May 2019 Modified MPCA Permit, and the July 2014 Solid Waste Management Plan is an appendix to the Operations and Maintenance Manual. The June 2022 Application and September 2022 Addendum should indicate that the July 2014 Solid Waste Management Plan version is still current.

Stantec February 2024 Response:

We agree, and the application has been updated to indicate this.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

2. Barr November 28, 2023, Recommendation:

The Operations and Maintenance Plan dated June 2, 2022, should include the July 2014 Solid Waste Management Plan as an Appendix.

Stantec February 2024 Response:

We agree, and the Operations and Maintenance Plan has been updated to include this.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

B. Groundwater Monitoring System

Based on the City's review, there are no changes being proposed in the June 2022 Application and September 2022 Addendum relating to the groundwater monitoring system.

Groundwater samples are collected from 22 monitoring wells located upgradient and downgradient from the landfill and two springs located downgradient from the landfill. Groundwater monitoring of flow direction and quality has been ongoing since the landfill began operating in 1971. Routine monitoring is conducted on a quarterly basis to facilitate the detection of releases to groundwater from the landfill in accordance with a sampling and analysis plan (SAP). The SAP establishes sampling methodologies, analytes, and quality assurance/quality control procedures. The SAP also provides for contingencies to increase monitoring intervals if certain water-quality levels are exceeded. Based on the contingency monitoring results, corrective action may be required.

Groundwater flows approximately southwest to northeast underneath the landfill, becoming primarily easterly along the northeast edge of the Crosby-American demolition landfill area located immediately north of PBL. The depth to the groundwater is considerable (over 100 feet in some locations). The water table is in glacial drift. Monitoring wells are completed both shallow and deep in the glacial drift and in the Prairie du Chien Group (limestone).

Groundwater underneath the site eventually discharges into the Mississippi River, east of PBL.

Barr Recommendations:

- None

C. Leachate Recirculation

Based on the City's review there are no changes being proposed in the June 2022 Application and September 2022 Addendum relating to leachate recirculation.

If implemented, leachate would be performed over lined areas of PBL as described in the November 2013 Application. The leachate would be sprayed onto the waste working surface via tanker truck.

Barr Recommendations:

- None

D. Solid Waste Composting

Solid waste composting was previously proposed as a January 2014 addendum to PBL's November 2013 Application.

City recommendations to model the potential odor and other air emissions from the proposed composting operation were not performed by PBL during the 2013 MPCA permitting process. However, based on discussions between the City and PBL and Republic Services' July 31, 2014, letter to the City, the City agreed that air quality modeling can be delayed until such time as PBL is ready to begin implementing plans to construct the organic waste compost facility. City approval is needed prior to SSOM composting implementation. Based on the City's review it unclear if solid waste composting is being proposed in the June 2022 Application and September 2022 Addendum.

Barr Recommendations:

3. Barr November 28, 2023, Recommendation:

Please clarify if solid waste composting is proposed to be performed as part of the June 2022 Application and September 2022 Addendum.

Stantec February 2024 Response:

The site intends to evaluate potential solid waste composting opportunities in the future. This activity would be regulated, operated, and reported under SW-45 along with the appropriate local approvals prior to any composting activities.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

4. Barr November 28, 2023, Recommendation:

If solid waste composting is not being proposed, please confirm that PBL will obtain City and County approval prior to initiating any solid waste composting activities.

Stantec February 2024 Response:

Per the prior response PBL intends to evaluate potential opportunities for solid waste composting activities, and PBL will obtain the appropriate City and County approvals prior to implementing any solid waste composting activities.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

E. Groundwater Quality

As mentioned above, groundwater samples are collected from 22 monitoring wells located upgradient and downgradient from the landfill and two springs located downgradient from the landfill. Samples are analyzed for volatile organic compounds (VOCs), metals, per- and polyfluoroalkyl substances (PFAS), 1,4-dioxane, and general geochemical parameters, such as temperature, specific conductance, and pH.

As has been the case for many years, intervention limits (ILs) are occasionally exceeded for some chlorinated organic compounds that are common in municipal solid waste (e.g., trichloroethylene, tetrachloroethylene, and biogenic breakdown products of these chlorinated compounds). Microbial reduction of the chlorinated compounds takes place in the groundwater and the geochemical indicators of this process are part of the monitoring program. The final reductive breakdown product is vinyl chloride, which is oxidized to carbon dioxide and water in the more oxidizing conditions downgradient of the landfill. Total concentrations of VOCs have generally shown a downward trend over the past several years. Some temporal increases are observed for individual parameters, which are expected.

Some PFAS concentrations in groundwater have been increasing and some have exceeded their ILs. PFAS concentrations in groundwater are expected to remain elevated in the future and may increase slightly from current levels. In addition, 1, 4-dioxane concentrations have increased at several wells, in several cases exceeding the IL. 1, 4-dioxane is considered a persistent organic pollutant and is expected to remain elevated in the future and may increase slightly from current levels.

The proposed leachate recirculation system is not expected to have an adverse impact on groundwater quality because the total mass of contaminants in the landfill is not expected to change because of leachate recirculation and because leachate recirculation will take place only over lined portions of the landfill.

The proposed solid waste composting operation is anticipated to generate leachate that will be ultimately captured by the landfill composite liner. The solid waste composting operation is not expected to generate any unique water quality parameters when compared to municipal solid waste leachate. Therefore, no modifications are needed to the leachate or groundwater monitoring programs.

Barr Recommendations:

- None

F. Surface Water Management

Barr reviewed the surface water management plan (Section 4.6 and Appendix C of the Design Report). The proposed design uses benches placed generally at 40-foot (vertical) intervals along the 3:1 side slope to direct runoff from the build-out expansion area to cable-concrete-lined trapezoidal channels, which discharge through existing and proposed junction vaults, pipes, and culverts to existing stormwater ponds. Hydro-CAD was used to simulate rainfall-runoff from the site. According to the

proposed plan, the existing ponds would not overflow from the site during the 100-year, 24-hour runoff event.

Barr Recommendations:

5. Barr November 28, 2023, Recommendation:

Please provide the HydroCAD model files for review with the next submittal.

Stantec February 2024 Response:

The model file will be submitted electronically with the next submittal. Note that some model updates and improvements were made to reflect existing conditions more accurately as of now. These do not make substantial changes to the outcome of the storm events or stormwater management currently or in the future.

Barr April 5, 2024 Recommendation:

The HydroCAD model file was received with Stantec's February 2024 Response submittal. Barr noticed that node 7P outlet was sized as a 96-inch RCP, rather than 60-inch RCP as specified in Section 4.6.3.5 of the report and in the node description within the HydroCAD model. Please update the model as necessary to reflect the correct pipe size, rerun, and confirm that the results still meet all requirements.

Stantec April 12, 2024 Response:

Agreed, in the model the outlet was revised to match the existing pipe size of 60-inch. Node 7P still meets requirements with this update.

Barr April 23, 2024 Recommendation:

Comment resolved.

6. Barr November 28, 2023, Recommendation:

Design Report, Section 4.6.3.1. Provide an explanation for the choices of curve numbers B and C for the sloped and flat areas, respectively. These curve numbers will result in steeper sloped areas producing less runoff volume than flatter areas. Is the cover soil different? It seems that if the cover soil were the same, the steeper sloped areas would produce greater runoff volume than the flatter areas.

Stantec February 2024 Response:

The curve numbers have been updated in the model to reflect C soils at 70% cover in both flat and sloped areas.

Barr April 5, 2024 Recommendation:

Curve number assumptions are appropriate. Recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

7. Barr November 28, 2023, Recommendation:

Design Report, Section 4.6.3.5, Infiltration subheading. New impervious area is not quantified. If new impervious is created by the project, provide a drainage area figure showing the new impervious area locations, and a table quantifying new impervious area, by drainage area.

Stantec February 2024 Response:

No new impervious area is created by the project.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

8. Barr November 28, 2023, Recommendation:

Design Report, Section 4.6.3.5, Infiltration subheading. Ponds used to meet infiltration requirements must be designed to meet MPCA requirements, e.g., they must draw down within 48 hours following the event and runoff must be pretreated before entering the infiltration area. If new impervious is being created by the project (see above comment) then provide pond details showing that MPCA design guidelines are met.

Stantec February 2024 Response:

No new impervious area is created by the project.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

9. Barr November 28, 2023, Recommendation:

Design Report, Appendix C, Peak Run-off subheading. Sample calculations for sloped and flat areas appear to indicate that sloped areas would be HSG C while flat would be HSG B, which contradicts the earlier text.

Stantec February 2024 Response:

The curve numbers have been updated in the model to reflect C soils at 70% cover in both flat and sloped areas. The text in the report has been updated to agree.

Barr April 5, 2024 Recommendation:

Curve number assumptions are appropriate. Recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

10. Barr November 28, 2023, Recommendation:

Design Report, Appendix C, Peak Run-off subheading. Sheet flow lengths up to 300 feet are used to calculate times of concentration. This is "allowed" in HydroCAD, but some agencies (e.g., NRCS) limit sheet flow length to a maximum of 100 ft. The City recommends that sheet flow lengths be limited to 100 feet as a conservative assumption.

Stantec February 2024 Response:

While general guidance does allow for sheet flow lengths of 300 feet, we have updated sheet flows to be no longer than 100 feet, the remaining length is calculated using shallow concentrated flows as recommended.

Barr April 5, 2024 Recommendation:

Sheet flow lengths updated, as noted by Barr. Recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

11. Barr November 28, 2023, Recommendation:

Design Report, Appendix C, HydroCAD model output. There are several warnings where water depth exceeded reach inlets or outlets. Warnings should be resolved and/or it should be confirmed whether the 100-year event is appropriately contained within each reach as stated within the report.

Stantec February 2024 Response:

The results from the model ran after the updates indicated that all water can be maintained in the stormwater ponds. Reach warnings were typically less than one foot and would still be contained where one reach meets another. In the case of any reach overtopping for any reason the stormwater would run down the slope as overland flow to the next reach.

Barr April 5, 2024 Recommendation:

- a. For back-to-back 100-year events, model contains warnings and errors that terraces and downslope channels, and ponds (3P) cannot contain the event, contrary to what the report says in Section 4.6.3.3. Please update the report to remove this statement if it is not part of

the design criteria (i.e., system is not designed to convey the back-to-back 100-year events).

Stantec April 12, 2024 Response:

Agreed, the statement in Section 4.6.3.3 was intended to say 100-year event instead of back-to-back 100-year events. This has been updated.

Barr April 23, 2024 Recommendation:

Comment resolved.

- b. For the 100-year event, the model contains warnings that the downslope channels cannot contain the event, contrary to what the report says in Section 4.6.3.2. Please update the report by removing the statement that channels can contain the event and include the Stantec February 2024 response for channels that may overtop.

Stantec April 12, 2024 Response:

In the 100-year event there are no reaches that overtop, all reaches are at least 1.83 feet deep at the point where they meet the downslopes and the outlet depth at that point are less, so they will be contained either within the reach leading to the downslope or the downslope itself. In the back-to-back 100-year event there is one reach that exceeds the storage capacity of the reach, and in that scenario would overtop the edge of the reach by 0.08 feet. We have added the statement that in the scenario where a reach could overtop the water would be directed to a downslope reach via overland flow and ultimately be directed to the same pond it would have in the original reach.

Barr April 23, 2024 Recommendation:

The description in the report is sufficient, comment resolved.

- c. Pond 9P storage is exceeded during the 100-year event, ensure proper overflows are accounted for or that 100-year event is appropriately contained within the structure.

Stantec April 12, 2024 Response:

The Pond 9P (a rectangular concrete diversion structure with culvert outlet) was previously modeled to a maximum elevation of 862, as that's where the cable concrete enters the structure in a small plunge pool with minimal storage that's lower than the adjacent ditches emptying into it. The storage could actually reach 865 before overtopping the area where the cable concrete meets the diversion structure. We have remodeled the node to include storage up to that point, and during the 100-year event the peak elevation is 863.61, where water would begin

to pool at the end of the cable concrete but would not overtop any incoming reaches.

Barr April 23, 2024 Recommendation:

Updated modeling is sufficient, comment resolved.

G. Waste Capacity

The June 2022 Application and September 2022 Addendum proposes to add 8,185,800 cubic yards of new capacity to PBL (including cover soils).

A review of the design drawings was completed to verify the accuracy of the capacity information for the proposed expansion. Based on review of the design drawings in AutoCAD Civil3D software, it appears that the volumes shown in the June 2022 Application and September 2022 Addendum are accurate.

The September 15, 2022, Addendum last page includes information comparing the remaining permitted airspace to the remaining Certificate of Need (CON).

Barr Recommendations:

12. Barr November 28, 2023, Recommendation:

Introduction Section, page 3 table. The permitted and proposed elevations are reported using "Local Landfill Datum". Additionally, the Design Report Section 3.1, Section 4.3.1, and Section 4.6.1 refers to elevation as "NGVD", "MSL, and "AMSL" respectively. The City assumes all elevations should be using the NGVD 29 vertical datum. Please clarify and make consistent throughout the application.

Stantec February 2024 Response:

All elevations are using the NGVD 29 vertical datum. Updates have been made throughout both documents.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

13. Barr November 28, 2023, Recommendation:

Design Report, Disposal Area Summary table on page 3. The Ultimate Design Capacity and Remaining Permitted Design Capacity values are different than the corresponding values on page 3 of the Introduction Section. Please reconcile.

Stantec February 2024 Response:

The Introduction Section is correct; the Design Report has been updated.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

14. Barr November 28, 2023, Recommendation:

Update the values in the Design Report, Section 2.2 (Waste Flows / Site Capacity / Phasing) to provide information from 2022.

Stantec February 2024 Response:

This section has been updated to reflect the remaining capacity of Phase 6 as of December 7, 2023. Phase 5F-2 and Phase 7 volumes are the same.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

H. Liner and Leachate Collection System Design

Barr's review of the Liner and Leachate Collection System Design had an emphasis on consideration of construction of the system on top of the old unlined waste deposit. Barr's review was concentrated on differential settlement regarding the liner system, leachate collection system, slope stability, and liner penetrations for gas recovery and leachate collection and piping. In review of the permit application and the permit drawings, the following recommendations regarding the liner and leachate collection system have been developed.

Barr Recommendations:

15. Barr November 28, 2023, Recommendation:

Design Report, Section 4.5.1, Historical Leachate Collection Data. The quantity of leachate collected for year 2017 through 2020 do not appear to match the annual reports for those years. Please address.

Stantec February 2024 Response:

This table has been corrected and updated, and now includes 2022 as well.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

16. Barr November 28, 2023, Recommendation:

Design Report, Section 4.5.1, Historical Leachate Collection Data Update the leachate collection data to include year 2022.

Stantec February 2024 Response:

This has been updated.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

17. Barr November 28, 2023, Recommendation:

Provide a summary of what areas have yet to receive a liner from Phase 5 and 6.

Stantec February 2024 Response:

As of the end of 2023 Phase 6 is completely constructed and Phase 5F-2 is the only cell remaining to construct in Phase 5.

Barr April 5, 2024 Recommendation:

Drawing 2 shows some of the Phase 6 Cells as future cells. Please update.

Stantec April 12, 2024 Response:

Agreed, as of the original submittal this was true, and since then Phase 6B-2 and 6A (constructed as one phase) have both been constructed, certified and approved. This has been updated.

Barr April 23, 2024 Recommendation:

Noted, recommendation resolved.

18. Barr November 28, 2023, Recommendation:

Provide a summary of which areas will have subgrade prepared on natural soil surface as described in the Design Report, Section 4.2 (Subbase Preparation).

Stantec February 2024 Response:

Phase 5F-2, the only remaining cell to be constructed, will have a natural soil subgrade.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

19. Barr November 28, 2023, Recommendation:

Provide analysis of additional strain on the existing liner and the potential for failure due to differential settlement from the Phase 7 vertical expansion (there seems a relatively high probability that the liner will experience excess strain at locations due to increased load from Phase 7 and resulting increased differential consolidation of waste below the liner).

Stantec February 2024 Response:

A settlement analysis of the site was performed and submitted in a memo entitled, "Pine Bend Landfill Phase 6 Geotechnical Evaluation, August 27, 2015" as part of the Phase 6 Expansion Permitting Documents. The analysis used consecutive years of site survey data to estimate total potential settlement from physical creep and followed a method developed by Leonard and Floom (2003) to estimate settlement due to biodegradation of waste. A portion of that analysis was updated to estimate the total potential settlement due to the Phase 7 expansion. The calculations indicated a potential differential settlement (maximum - minimum) of approximately 3.1 feet. It should be noted that this calculation assumes no settlement has yet occurred and is therefore conservative. Over an area of liner 100 x 100 ft, this equates to approximately 3.1% liner elongation potential. The yield threshold for liner material is generally 15% elongation, suggesting that the calculated differential settlement is acceptable for liner performance. The updated settlement calculations are included in Attachment A of this comment response.

Barr April 5, 2024 Recommendation:

The February 2024 response requires clarification as to the yield threshold applicable to the site-specific geomembrane liner and the yield threshold applicable to the site-specific geosynthetic clay liner, both of which are understood to underlie the proposed Phase 7 expansion. Please provide.

Stantec April 12, 2024 Response:

QC test results from individual cells are included as an attachment. Yield threshold of GCL is not usually tested during MQC, however a typical value is approximately 10%. The minimum observed yield elongation for any individual roll of the 60-mil HDPE was 14%. As described in the previous comment response memorandum the likely liner elongation potential in a 100x100 area is

approximately 3.1%, suggesting that the liner and GCL performance should be considered acceptable.

Barr April 23, 2024 Recommendation:

Please provide a supporting reference(s) for the stated yield threshold of GCL of approximately 10%, and specifically for the GCL type to be used on this project.

Stantec April 29, 2024 Response:

Please see attached the excerpt from the Geotechnical Fabrics Report's 1997 Specifier's Guide, showing greater than 10% tensile elongation for most GCLs, including Bentomat ST, the primary GCL used in Phase 6 cell construction events. Phone conversations with CETCO led to the discovery that there aren't recent published values widely available due to it not being a typical test, but in testing find the elongation at failure to be a wide range of approximately 5-40%, dependent on GCL type, individual samples, peak tensile strength at the time of failure, etc. With the previously described liner elongation potential of 3.1% the GCL performance should still be considered satisfactory.

Barr May 22, 2024 Recommendation:

Noted, recommendation resolved.

Stantec indicates that "Yield Threshold" (i.e., the point that is the limit of elastic behavior) is a value on the order of 10% strain or less. However, the response does not directly provide supporting "Yield Threshold" information for GCLs. Instead, the CETCO document attached to Stantec's April 29, 2024 memo provides "Tensile Elongation" data which is the measure of both elastic and plastic behavior.

Note that Barr's response is acknowledgement that, based on the liner design, the geomembrane will be relied upon to be the primary hydraulic barrier layer and the GCL beneath it would serve to minimize leakage through any holes in the geomembrane that escape detection and repair during geomembrane installation. Further, if GCL failure occurred it would likely be in isolated areas of significant differential waste settlement. With proper geomembrane installation quality control as planned, the likelihood of a geomembrane hole(s) remaining unrepaired is small, and generally no greater in an area of differential settlement that is severe enough to inhibit the performance of the GCL than elsewhere. Hence the response of "recommendation resolved."

20. Barr November 28, 2023, Recommendation:

The Geotechnical Evaluation provided as Application Appendix D is generally inadequate and should include:

- a. Demonstration of effectiveness (technical papers or other) of the suggested "drain liner with an overlying geotextile" as substitute for a geonet composite. For the former, a geotextile that is not bonded to the geonet could yield excessively and fill gaps in the geonet thereby reducing the geonet's flow transmission capability.

Stantec February 2024 Response:

After additional review PBL intends to use the geonet geocomposite shown on the permit drawings rather than evaluate alternatives. The model reflects the geonet geocomposite already.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

- b. Literature and site-specific test data that supports the cohesion values and friction angles used in the stability analyses that are presented. The factors of safety appear unreasonably high for a 3H:1V slope and are likely the result of cohesion values and friction angles for which supporting literature and test data is not provided.

Stantec February 2024 Response:

Interface friction and cohesion values for the proposed cover and liner components were previously established in a comment response submittal completed for the Pine Bend site on June 24, 2016, entitled, "Response to Geotechnical Comments – City of Inver Grove Heights, Request for Major Modification of Permit SW-45, Pine Bend Landfill." The liner component interface friction and cohesion values established in that submittal were based on interface friction testing of the liner components over a range of potential effective stress loads representing the proposed waste overlay. The values presented in that submittal were adopted for use in this comment response and are presented in the table below. In addition, conservative values of internal friction and cohesion are shown for cover soils, MSW, and existing native soils:

Interface	Friction (Degrees)	Cohesion (psf)
Peak Strength		
Buffer Soil/Liner	27.1	86
Liner/Geo-Composite	19.1	58
Geo-Composite/Cover Soils	33.3	62
Large Displacement		
Buffer Soil/Liner	26.5	81
Liner/Geo-Composite	13.4	59
Geo-Composite/Cover Soils	33.3	55
Other Materials		
Cover Soils	28	0
MSW	30	0
Native Soils	30	0

Barr April 5, 2024 Recommendation:

It is understood from previous responses that the 3H:1V covered areas are reported to be performing well. Include in future annual reports descriptions of any veneer (cover) instability and/or extra maintenance required on 3H:1V covered areas, if either condition occurs.

Stantec April 12, 2024 Response:

PBL will include any information regarding cover instability or noted maintenance and repairs of the cover area in annual reports, or a statement declaring that no issues were noted.

Barr April 23, 2024 Recommendation:

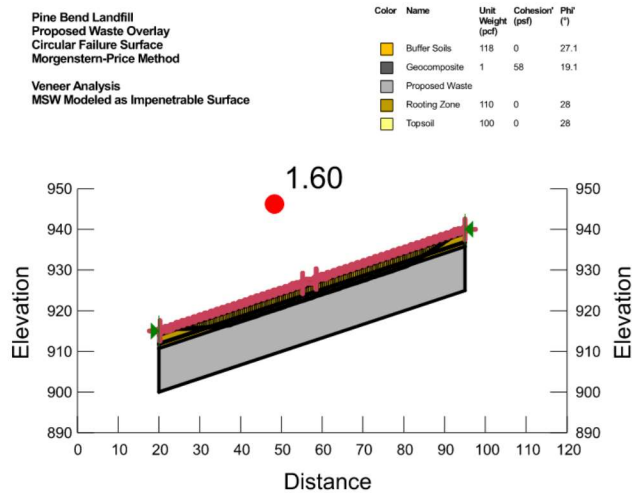
Noted, recommendation resolved.

- c. A veneer stability analyses of an isolated segment of the cover system on a 3H:1V slope appears to be absent from the analysis but is required to confirm stability of the proposed cover system.

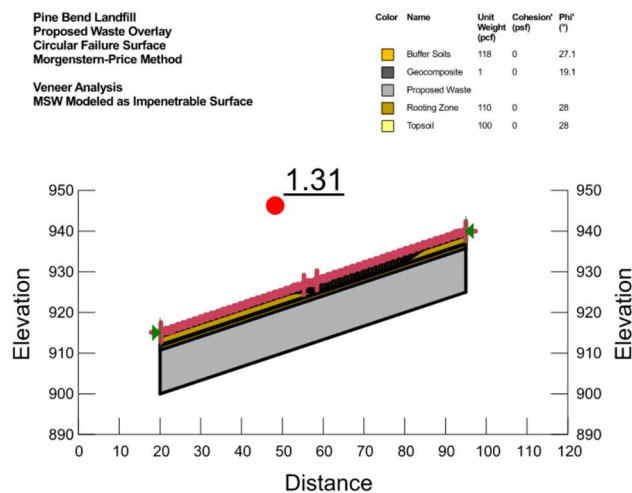
Stantec February 2024 Response:

A veneer stability analysis of an isolated segment of the proposed cover system on a 3H:1V slope was completed using SLOPE/W, a limit equilibrium slope stability analysis software. In the first analysis, all cover components were modeled assuming zero cohesion in the interface strength, except for the liner/geo-composite interface. Interface friction testing shows that cohesion is a component of the strength at this interface, and this should not change based on variations in the soil components of the cover. The MSW waste material was modeled as an impenetrable surface to limit the analysis to the cover components. The program's optimization function was enabled to allow the program to determine if the critical failure surface would closer resemble a circular or block type failure. The resulting factor of safety for this veneer analysis was 1.60, exceeding the desired minimum factor of safety of 1.5 for long term stability.

As a check, a second analysis as performed assuming no cohesion in the liner/geo-composite interface to represent a conservative and short-term case. The resulting factor of safety was 1.31, exceed the desired minimum factor of safety of 1.2 for short-term stability. The outputs for both veneer analyses are shown below.



Veneer Analysis – Long Term Slope Stability



Veneer Analysis – Short Term Slope Stability

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

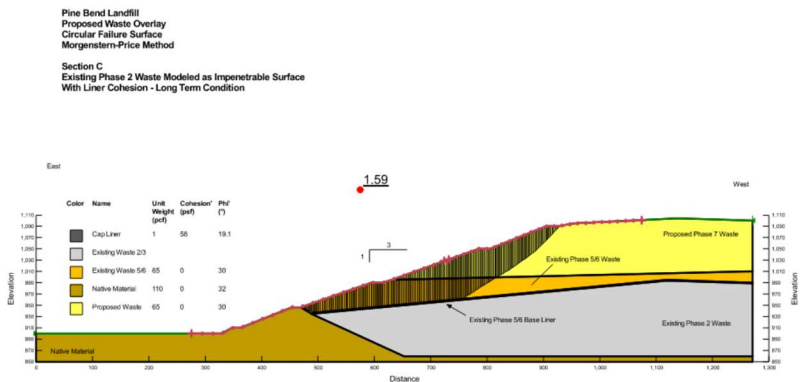
NA

- d. The overall slope stability analysis lacks evaluation of alternate failure surface entry and exit points and does not include analyses that treat the “existing cover liner” as an impenetrable surface. These additional analyses are critical to understanding overall stability of the proposed slope system.

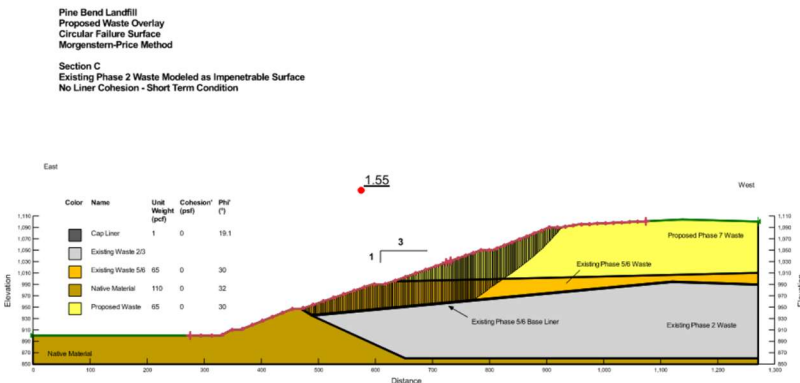
Stantec February 2024 Response:

The model was updated to reflect the existing and proposed conditions as illustrated in Section C of the plan set. Analyses were completed to evaluate the proposed overlay slope stability assuming that the existing Phase 2 waste material below the Phase 5/6 liner is an impenetrable surface. This

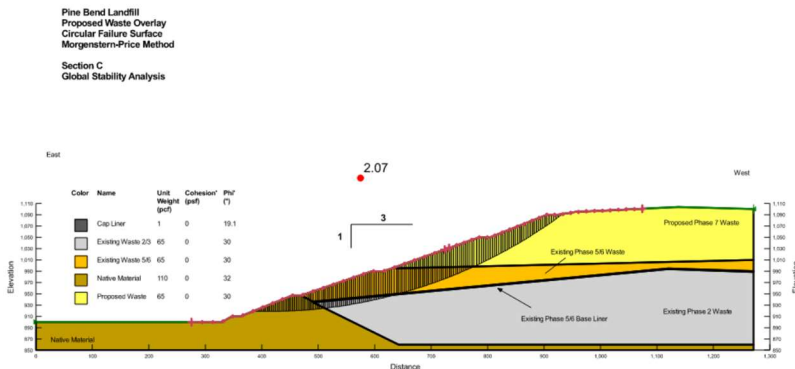
configuration was modeled assuming no cohesion in the waste or native materials and with and without cohesion on the Phase 5/6 liner. A third analysis considered global slope stability with all layers defined as penetrable and no cohesion strength attributed to any materials. As in the veneer analysis above, the program's optimization function was enabled to allow the program to determine if the critical failure surface would closer resemble a circular or block type failure. In each case, the resulting factor of safety exceeded the desired long-term factor of safety of 1.5. The model outputs are included below for reference.



Slope Stability Analysis - Phase 2 Waste Impenetrable, With Phase 5/6 Liner Cohesion



Slope Stability Analysis - Phase 2 Waste Impenetrable, No Phase 5/6 Liner Cohesion



Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Note that Barr's response is acknowledgement that, based on the available information and stability model outputs provided, the analyses performed appear to provide satisfactory slope stability factors of safety. Barr has not performed its own confirmatory modeling as part of this analysis.

Barr April 23, 2024 Recommendation:

NA

- e. The slope stability analysis outcomes are based on cohesion being present in all of the soil layers and at the interface between soils and geomembrane. This is potentially not a realistic assumption (non-cohesive soils may be used for construction) and it does not represent a conservative approach to the analyses. The stability analyses should be expanded by analyzing stability with zero cohesion.

Stantec February 2024 Response:

The analyses included in this comment response memo were performed with zero cohesion in the soil layers and with and without cohesion on the Phase 5/6 liner.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

I. Gas Monitoring and Gas Extraction/Treatment Systems

As indicated in Operations and Maintenance Plan, Appendix B-Gas Management and Monitoring Plan, which is included in the June 2022 Application and September 2022 Addendum, "Minnesota Rule 7035.2815 Subp. 11 requires that the concentration of any explosive gas not exceed the LEL at the property boundary or 25 percent of the LEL in or around facility structures." LEL is an abbreviation for Lower Explosive Limit.

The existing gas management system at PBL consists of:

- Gas extraction wells and piping,
- The gas monitoring system, and
- The Renewable Natural Gas (RNG) facility that was planned to start up in Spring 2022.

Based on the review of the Operations and Maintenance Plan in the June 2022 Application and September 2022 Addendum, the gas extraction system currently includes 190 gas extraction wells at the site and additional gas extraction wells are planned for Phase 5 and 6. Also, new gas extraction

wells a piping are planned to be installed for Phase 7 as shown on the Plan Drawings included as Appendix A in the Design Report. The construction and installation of the additional gas extraction wells will be in accordance with the MPCA-approved design and PBL design standards. Extracted gas is currently piped through laterals, sub-headers, and header piping to RNG facility that was planned to startup in Spring 2022.

The gas monitoring system is comprised of the three continuous electronic monitoring devices located in occupied buildings at PBL and 39 methane (gas) monitoring probes completed at varying depths around the perimeter of the landfill. The Gas Management and Monitoring Plan indicates the probes are monitored quarterly unless a positive gas reading is recorded, in which case, monitoring is increased to monthly until two consecutive passing months readings are recorded.

Historically, elevated concentrations of methane have been detected in several of the subsurface gas monitoring probes located along the eastern, southern, and western boundaries of PBL. Methane concentrations in the gas monitoring probes around the facility exceeded the LEL on numerous occasions in 2022 and previous years. Based on these monitoring results, it does not appear that the existing controls at the PBL meet the requirements of Minnesota Rule 7035.2815 Subp. 11. PBL has been working with the MPCA and City to address gas migration concerns for many years and has most recently submitted the "2022 Gas Migration Remedial Action Report" dated February 2023 as Attachment 6 to the 2022 Annual Report.

Based on review of the June 2022 Application and September 2022 Addendum, proposed augmentations to the gas extraction systems includes:

- Vertical extension of existing gas extraction wells in the Phases 6 and 7 footprints
- Installation of pumping stations (e.g., PS-5) that will be used for the extraction of leachate and may be retrofitted for gas extraction from the unlined waste beneath the Phase 6 build out. Seven pumping stations have been installed as of 2022 with two of those operating with leachate pumps. Six additional pumping stations are planned to be installed for a total of 11.
- Installation of a horizontal gas collection system beneath the final cover system in the Phases 6 and 7 build out where the proposed waste thickness is too thin for additional gas wells.
- Completion of a gas header (18-inch diameter) loop around the landfill once final grades have been reached.

Barr Recommendations:

21. Barr November 28, 2023, Recommendation:

Design Report, Section 4.7.1 should include a discussion that subsurface landfill gas is migrating beyond the property boundary at concentrations above the LEL and a summary of the efforts to mitigate.

Stantec February 2024 Response:

This section has been updated to include the discussion referenced above.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

22. Barr November 28, 2023, Recommendation:

Design Report, Section 4.7.4.2 describes the horizontal gas collectors installed in the Phase 6 expansion area. However, no discussion is included about any horizontal gas collectors as part of the Phase 7 expansion although Plan Drawings 8 and 9 seem to indicate that horizontal collectors will be installed as part of Phase 7. Please address this apparent discrepancy.

Stantec February 2024 Response:

The horizontal gas collectors shown in the drawings are intended to be installed as part of Phase 6. Construction of horizontal collectors will begin in 2024. Since the Phase 6 waste mass was not deep enough to install vertical gas extraction wells horizontal collectors will be installed. In Phase 7 the waste mass will be deep enough to install gas extraction wells, which will also collect gas from portions of Phase 6. Additional gas collectors may be installed in the future by PBL in addition to the vertical extraction wells, at their discretion.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

J. Final Cover Design

Barr's review of the final cover design was concentrated on differential settlement regarding the cover system and surface water drainage system, slope stability, and liner penetrations for the gas and leachate system components. In review of the June 2022 Application and September 2022 Addendum and the associated permit drawings, the following questions regarding the final cover system have been developed.

The slope stability factors of safety are computed based on assumed friction angles with no supporting data provided. The factors of safety seem unreasonably high and several potential failure scenarios are not evaluated (i.e., additional strain on the liner and the potential for failure due to differential settlement from the Phase 7 vertical expansion). See Section VIII of this letter for additional comments regarding slope stability.

Barr Recommendations:

23. Barr November 28, 2023, Recommendation:

Update the text to describe the current conditions in the Design Report, Section 1.1 (Introduction).

Stantec February 2024 Response:

The current phase construction status has been updated.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

24. Barr November 28, 2023, Recommendation:

Provide a summary of which portions of the 3H:1V slope area has final cover in place, how long it has been in place, and how has it performed from an infinite slope stability and erosion control standpoint.

Stantec February 2024 Response:

Approximately 11 acres of final cover have been installed in Phase 4 on the west side of the landfill. The final cover was constructed in 2011 and has had no slope stability or erosion control issues noted.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

25. Barr November 28, 2023, Recommendation:

If there is no on-site demonstration of suitable performance of this cover design, then provide evidence of adequate performance of this 3H:1V cover design from similar sites.

Stantec February 2024 Response:

The in-place cover has demonstrated suitable performance to continue with this cover design.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

26. Barr November 28, 2023, Recommendation:

Clarify the thickness of the Buffer Soils beneath the final cover section (12" thickness shown in the Drawings on Drawing No. 13 whereas a 6" thickness is specified in the Design Report, Section 4.6.1 - Design Overview).

Stantec February 2024 Response:

The detail in the drawing is correct, 12 inches of buffer soils will be installed, and the design report has been updated to reflect that.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

K. Closure, Post Closure, Contingency Action, and Operations and Maintenance Plans

The Operations and Maintenance plan in the June 2022 Application and September 2022 Addendum does not appear to have any significant changes from the August 2015 Application.

The Closure, Post Closure, Contingency Action Plan in the June 2022 Application and September 2022 Addendum does not appear to have any significant changes from the August 2015 Application, except for:

- Updated normal operating hours of the facility,
- Removal of discussion on tires, e-waste, and white goods removal from waste acceptance
- Removal of landfill design volumes and estimated dates for each phase closure
- Removal of a closure phasing plan

Barr Recommendations:

27. Barr November 28, 2023, Recommendation:

Section 3.5 (Waste Placement Techniques) of the Operations and Maintenance Plan considers the proposed Phase 7 expansion, provide consideration for all areas yet to be constructed.

Stantec February 2024 Response:

The only remaining phase to be constructed is Phase 5F-2, and the waste placement techniques described in Section 3.5 would apply in 5F-2 the same way they would in Phase 7.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

28. Barr November 28, 2023, Recommendation:

Provide landfill design volumes and estimated dates for each phase closure within the Closure, Post-Closure, Contingency Action Plan Section 2.2 (Notification of Cell Closure).

Stantec February 2024 Response:

This section has been updated to include more information about planned closure phasing.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

29. Barr November 28, 2023, Recommendation:

Provide a closure phasing plan within the Closure, Post-Closure, Contingency Action Plan Section 2.4 (Closure Schedule).

Stantec February 2024 Response:

This section has been updated to include more information about the planned closure phasing.

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

30. Barr November 28, 2023, Recommendation:

Section 2.9 (Closure Cost Estimate) within the Closure, Post-Closure, Contingency Action Plan reports an area of 69.4 acres whereas Table 1 lists 32.6 acres. Please reconcile or provide rationale for the difference.

Stantec February 2024 Response:

This has been reconciled, Table 1 has been updated.

Barr April 5, 2024 Recommendation:

- a. Closure, Post-Closure, Contingency Action Plan, Table 1. The unit cost for 40-mil LLDPE Liner decreased from \$0.70/Square Feet in the June 2022 Application and September 2022 Addendum to \$0.35/Square Feet in the February 2024 Response. Please reconcile or provide rationale for the difference.

Stantec April 12, 2024 Response:

The original value was a typical landfill cost estimate. Republic Services gets a discounted rate from manufacturers due to a high volume of

purchases nationwide, the updated cost estimate includes a value based on their current rate to order and install the material.

Barr April 23, 2024 Recommendation:

Financial assurance is required in case a landfill owner walks away from the facility. Therefore, the financial assurance cost estimates do not reflect the prices that the landfill owner could obtain but instead must reflect the costs that the MPCA or some other party would need to pay. Please review the April 5, 2024 Barr recommendation above and reply.

Stantec April 29, 2024 Response:

The rationale makes sense and we have reverted the unit cost to the original cost.

Barr May 22, 2024 Recommendation:

Noted, recommendation resolved.

- b. The unit cost for Geocomposite decreased from \$1.13/Square Feet in the June 2022 Application and September 2022 Addendum to \$0.44/Square Feet in the February 2024 Response. Please reconcile or provide rationale for the difference.

Stantec April 12, 2024 Response:

The original value was a typical landfill cost estimate. Republic services gets a discounted rate from manufacturers due to a high volume of purchases nationwide, the updated cost estimate includes a value based on their current rate to order and install the material.

Barr April 23, 2024 Recommendation:

Financial assurance is required in case a landfill owner walks away from the facility. Therefore, the financial assurance cost estimates do not reflect the prices that the landfill owner could obtain but instead must reflect the costs that the MPCA or some other party would need to pay. Please review the April 5, 2024 Barr recommendation above and reply.

Stantec April 29, 2024 Response:

The rationale makes sense and we have reverted the unit cost to the original cost.

Barr May 22, 2024 Recommendation:

Noted, recommendation resolved.

- c. The lump sum unit cost for Gas Collection System Infrastructure was \$200,000 in the June 2022 Application and September 2022 for

32.6 acres of final cover. The lump sum unit cost stayed the same in the February 2024 Response however the final cover area of 173 acres was over 5 times greater. It appears that the lump sum cost should be increased proportionally to approximately \$1,000,000. Please reconcile or provide rationale for the difference.

Stantec April 12, 2024 Response:

Pine Bend intends to complete the majority of the gas collection system installation in Phase 7 during Phase 7 operations, prior to closure events. At this time we are proposing to leave the value in the cost estimate at \$200,000 as an estimate of the last gas system construction event to be completed at the time of final closure.

Barr April 23, 2024 Recommendation:

The closure cost estimate must reflect the cost to close the landfill based on the area that is open. Because the gas collection system infrastructure is part of closure that a party like the MPCA may need to perform if PBL were to walk away from the site, the cost for it must be included in the closure cost estimate. Please review the April 5, 2024 Barr recommendation above and reply.

Stantec April 29, 2024 Response:

The rationale makes sense and we have updated the cost based on the size of the open area at the site.

Barr May 22, 2024 Recommendation:

Noted, recommendation resolved.

- d. It appears that final cover should be and could be installed in smaller acreages as areas reach final grades rather than having 173 acres without final cover. Please explain or modify.

Stantec April 12, 2024 Response:

The cost estimate was originally set up as a single, maximum possible event. The likely scenario is approximately 5 events of 20-40 acres of closure at a time, and the cost estimate has been updated as such.

Barr April 23, 2024 Recommendation:

Noted, recommendation resolved.

L. Financial Assurance Cost Estimates

The MPCA requires financial assurance for all mixed municipal solid waste landfills in Minnesota, including PBL. Financial assurance is intended to provide funds for closure, post-closure, and contingency action activities if the landfill owner goes out of business.

Based on the City's review, the approach and most unit costs appear to be reasonable and are consistent with the financial assurance updates provided in the annual reports.

Barr Recommendations:

31. Barr November 28, 2023, Recommendation:

The total financial assurance value should be updated to match the 2022 Annual Report value of \$20,846,216.

Stantec February 2024 Response:

The financial assurance values in the 2022 Annual Report are based on approved closure, post-closure, and contingency action costs from the 2018 expansion. The closure, post-closure, and contingency action cost estimates were updated based on this expansion and current unit costs. Entering those values into the MPCA's Payment Rate Estimator results in a total of approximately \$25.4 Million for 2024.

Barr April 5, 2024 Recommendation:

The values for Closure (\$15,054,640) and Contingency Action (\$1,163,414) shown in Section 5 of the Closure, Post-closure, Contingency Action Plan dated June 1, 2022, revised February 2024 do not appear to match the value in the subsequent tables. Please review and modify.

Stantec April 12, 2024 Response:

The values in the tables were 2023 cost estimates, which were then inflated to 2024 dollars using the MPCA Payment Rate Estimate Table (included as Table 7 after the cost estimate tables). Table 1 and Table 7 have both been updated in accordance with comment and responses above, with the same methodology as the previous submittal. With the updates to the cost estimate tables PBL is proposing to use the new values as "2024 approved cost estimates" for the 2024 Annual Report if the permit is issued before then. Financial assurance will be updated once an approved permit is issued.

Barr April 23, 2024 Recommendation:

Noted, recommendation resolved.

32. Barr November 28, 2023, Recommendation:

Please provide the value of the bond to Dakota County.

Stantec February 2024 Response:

The bond in place with Dakota County is for \$643,631.00

Barr April 5, 2024 Recommendation:

Noted, recommendation resolved.

Barr April 23, 2024 Recommendation:

NA

In addition to submitting the June 2022 Application and September 2022 Addendum to the MPCA, Pine Bend Landfill will also need to apply to the City of Inver Grove Heights for the proposed project. The City will need to consider an Ordinance Amendment, Conditional Use Permit Amendment, and Non-Conforming Use Certificate Amendment for this proposed project. It is the City's understanding that the MPCA will not reissue the solid waste permit until these City approvals are complete.

Thank you for the opportunity to provide comments and recommendations. The City appreciates your consideration of the recommendations and looks forward to your reply. If the MPCA has any questions, please contact City of Inver Grove Heights Environmental Specialist Ally Sutherland at 651-604-8511 or asutherland@ighmn.gov.

Sincerely,

CITY OF INVER GROVE HEIGHTS

c: Ally Sutherland, City of Inver Grove Heights
Aaron Janusz, Pine Bend Landfill
Tyler Kraft, Pine Bend Landfill
Tom Shustarich, Stantec Consulting Services Inc.
Terry Muller, Dakota County
Dave Magnuson, Dakota County
Bryan Pitterle, Barr Engineering Co.
Jeff Ubl, Barr Engineering Co.

**Item 4.A, Attachment 8 - Response to City of Inver
Grove Heights' October 16, 2024 Review Letter
(dated October 29, 2024)**



Pine Bend Landfill
2495 E 117th Street
Inver Grove Heights, MN 55077

October 29, 2024

Kris Wilson
City Administrator
City of Inver Grove Heights
8150 Barbara Avenue
Inver Grove Heights, MN 55077

RE: Response to City Review of Fall 2024 Gas Migration Work Plan

Dear Ms. Wilson:

Comments regarding the proposed Pine Bend Landfill CUP and NCUC amendments, provided in a letter prepared by the City of Inver Grove Heights and dated October 16, 2024, are presented below followed by the responses.

RNG Facility and Dual Gas/Leachate Extraction System

No further questions.

Fall 2024 Draft Gas Migration Remedial Workplan

3. *a. If the proposed gas vents prove successful is PBL prepared to install potentially hundreds of them along the landfill perimeter?*

Response: Pine Bend Landfill (PBL) will install what is necessary to mitigate gas migration. With most of the exceedances observed in the same area of the landfill it is likely that concentrating efforts in that vicinity is the action most likely to meet these goals.

b. If many more gas vents are installed, please evaluate the possibility of collecting that gas and routing it to the RNG facility.

Response: When compared to the active gas collection wells within the landfill footprint, the gas vents tend to have high oxygen concentrations and lower methane concentrations. The recommended concentration of oxygen for gas received at the plant is less than one percent. While some vents do occasionally meet that criterion, there is a high variability of the concentrations at the vents that consistently do not meet that criterion. At this time, the gas vents are not good candidates for collection and routing to the RNG plant. Temporary flares or other localized collection methods may be evaluated as needed.

c. If the proposed geoprobe work detects landfill gas beyond the landfill boundary, it is recommended that PBL install permanent gas probes near those locations.

Response: PBL is open to the installation of permanent gas probes in locations beyond the property boundary in the event of landfill gas detections.

d. Please evaluate whether any groundwater monitoring wells that have partially exposed screens can be used to measure gas concentration.

Response: PBL can attempt to collect gas concentration measurements at groundwater wells, but results may not necessarily provide meaningful data. Groundwater and screened intervals of groundwater wells at the site are typically around 100 feet below ground surface. This is 60 feet deeper than the gas probe depths. The groundwater wells are also a sealed system – solid pipe down to the screen, which is under water. There are no pathways for landfill gas to enter the groundwater well except through the groundwater itself.

Waste Filling and Visual Screening

5. *a. It appears that a soil berm (or similar barrier) installed near the north and west crests of the 3:1 (H:V) slopes of the annual filling footprints may be effective in reducing visibility (of waste and operating equipment) from nearby residents. Please provide cross sections from several nearby residents through the landfill to evaluate whether a berm at these locations would be effective at reducing visibility.*

Response: PBL's primary concern with a soil berm would be the impacts to stormwater management, potentially creating ponding or rerouting water resulting in a more concentrated flow. PBL is open to the possibility of creating temporary soil berms for visual screening where feasible with gaps to allow for stormwater releases.

When creating the 3-dimensional visual modeling it was determined that the view angle to see the top of the landfill from the Bartley Court and Rich Valley Boulevard photo locations ranged from approximately 4.5-6 degrees, or 7.8-10.5% slope. A landfill compactor is approximately 14 feet tall. Conservatively using an 8% slope, you could see at least a portion of the landfill compactor when the compactor is within approximately 175 feet of the crest of the slope, and you could see half or more of the compactor when it is within 88 feet of the crest of the slope.

Creating the berms will not be feasible when the active area is on a slope or within 100 feet of the slope due to the filling activities, but a small berm may be created when working further from the crest. Visibility by residences or business will be limited while working on the eastern or southern areas of the landfill due to these angles. As the working area gets higher in elevation the viewing angle gets steeper, creating more blind spots from viewing areas such as roads, residences or businesses.

Ms. Kris Wilson
Response to City Review of Fall 2024 Gas Migration Work Plan
October 29, 2024
Page 3 of 3

If you have any questions regarding this submittal, please contact me at 651-434-9843 or ajanusz@republicservices.com.

Sincerely,

A handwritten signature in black ink, appearing to read 'A. Janusz', with a stylized flourish at the end.

Aaron Janusz
Environmental Manager

cc: Tyler Kraft, Republic Services
Bridget Nason, City Attorney

**Item 4.A, Attachment 9 - Response to City of Inver
Grove Heights' September 10, 2024 Review Letter
(dated September 23, 2024)**

To: Kris Wilson
City of Inver Grove Heights

From: Aaron Janusz, Pine Bend Landfill
Tom Shustarich, Stantec Consulting
Services, Inc.
Ethan Ketelsen, Stantec Consulting
Services, Inc.

CC: Bridget Nason, City Attorney
Jeff Ubl, Barr Engineering

Project/File: 227706442

Date: September 23, 2024

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's CUP and NCUC Amendments

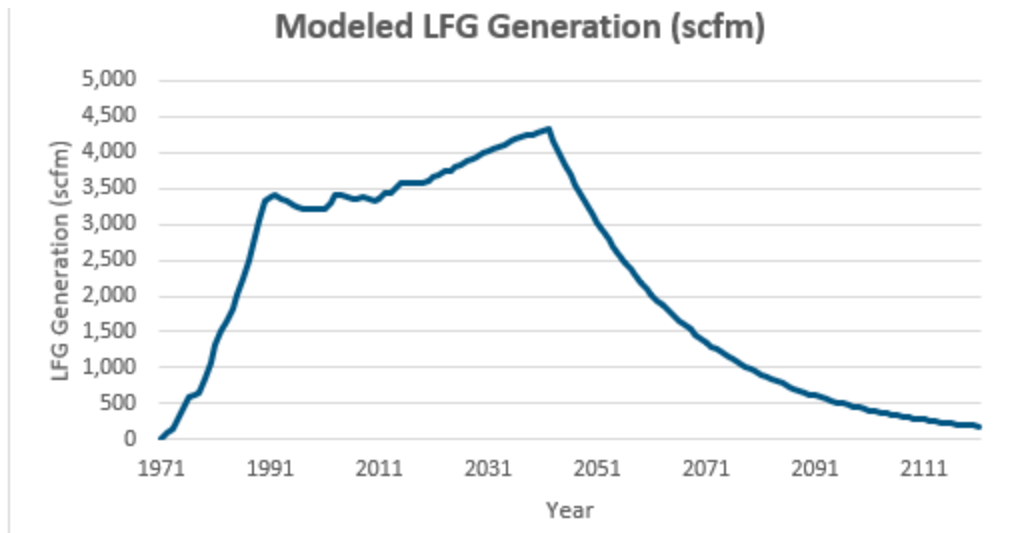
Comments regarding the proposed Pine Bend Landfill CUP and NCUC amendments, provided in a letter prepared by the City of Inver Grove Heights and dated September 10, 2024, are presented below followed by the responses.

Gas Capture & Subsurface Gas Migration

1. *What is the useful life and total capacity of the existing Renewable Natural Gas (RNG) facility collecting gas from Pine Bend Landfill (PBL)? Is the existing RNG capable of processing the gas expected if Phase 7 proceeds and doing so for the life of the proposed Phase 7 expansion?*

Response: The RNG plant is designed to process a gas flow of up to 3,200 standard cubic feet per minute (scfm) and currently operates in a range of approximately 2,500-2,700 scfm. The landfill gas generation model (see graph below) for the vertical expansion predicts a peak generation of around 4,500 scfm at the time of closure. With a 75% collection efficiency that is around 3,300 scfm. There also will be continued production and collection during the post-closure period.

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's CUP and NCUC Amendments



2. *Pine Bend's 2023 annual report indicates that no leachate was removed in the dual gas/leachate extraction system in 2023, but it is less clear on whether the system was actively extracting gas. Was gas collected from the dual gas/leachate extraction system in 2023? Is gas currently being collected from the system as of September 2024? Please describe how this system functions currently, how it is impacted by active cell construction and filling operations, and how it would function during the time when the proposed Phase 7 expansion area is being filled.*

Response: The system has still been continuously extracting gas at the dual extraction wells whether they have a pump in them or not. Each well has remained active in 2023 and 2024 and will continue to extract gas when pumps are installed/reinstalled. A wellhead installed at the top of well allows for flow control and tuning of the gas wells to continue to extract gas.

During cell construction and active filling operations in the vicinity of a gas well the well is extended by adding a stick of solid HDPE (or PVC if applicable) pipe to raise the well and corresponding lateral gas riser, and ensure they are not buried during filling. This allows the gas technician to continue to read and tune the well during filling operations.

The system would function similarly during Phase 7 filling, with wells being raised during filling operations, continuing gas extraction throughout the process. New wells will also be installed as the newer waste starts producing gas. When pumps are installed in pumping stations and dual extraction wells the proposed air and forcemain lines would be vertically extended with it, allowing for the pumps to stay in operation during filling.

3. *Condition #14 of Pine Bend's current Conditional Use Permit (CUP) states that PBL must achieve compliance with Minnesota Rule 7035.2815, Subpart 11 regarding landfill gas management for six consecutive months prior to January 1, 2025, and that if compliance with this condition is not achieved, PBL must temporarily cease accepting waste for disposal until this condition is met.*

Reference: City of Inver Grove Heights' Review of Pine Bend Landfill's CUP and NCUC Amendments

Based on Pine Bend's annual presentation to the City's Environmental Advisory Commission (EAC) on June 25, 2024, it is the City's understanding that subsurface gas migration continues to be detected beyond the concentration limits in the above Minnesota Rule, therefore suggesting that Pine Bend will not have six consecutive months of compliance with this CUP condition by January 1, 2025. Should the City consider modifying this requirement of the CUP, as part of acting on PBL's expansion request, what revised or additional mitigation efforts does PBL propose for addressing this issue and bringing the landfill into compliance with this Rule? Given the ongoing challenge of controlling subsurface gas migration at or near the property boundary, the City is specifically, but not solely, interested in having PBL undertake efforts to investigate the lateral extent (footprint) of gas beyond PBL's boundary, and make regular report to the City regarding its progress toward achieving compliance with the above Minnesota Rule.

Response: PBL is preparing a proposed remedial work plan for actions to be completed in fall 2024 and 2025. A draft of the workplan is attached. Please review and provide feedback.

Timing and Phasing for Filling of Proposed Phase 7

4. *a. The proposed Phase 7 vertical expansion would include the landfilling of additional waste over a substantial portion of the landfill's surface area. As part of its review of the proposed expansion, the City is requesting a phasing plan for filling and installing the final cover for the Phase 7 expansion area in increments similar in size to the Phase 6 liner. Please discuss the feasibility of filling from north to south and installing final cover incrementally, starting with the area on the north that is visible to residential properties in Inver Grove Heights.*

Response: PBL has completed a 5-year plan to address where and how filling would tentatively be completed in the next five (5) years, including within existing Phase 6A. At this time PBL intends to fill the Phase 7 area in lifts of approximately 20 feet, starting from the north side and working south. Once the south side of the landfill is reached they would work back from south to north with another approximately 20-foot lift. It is projected that two more lifts would need to be completed to achieve final grade.

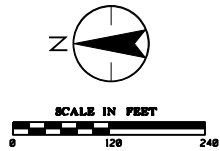
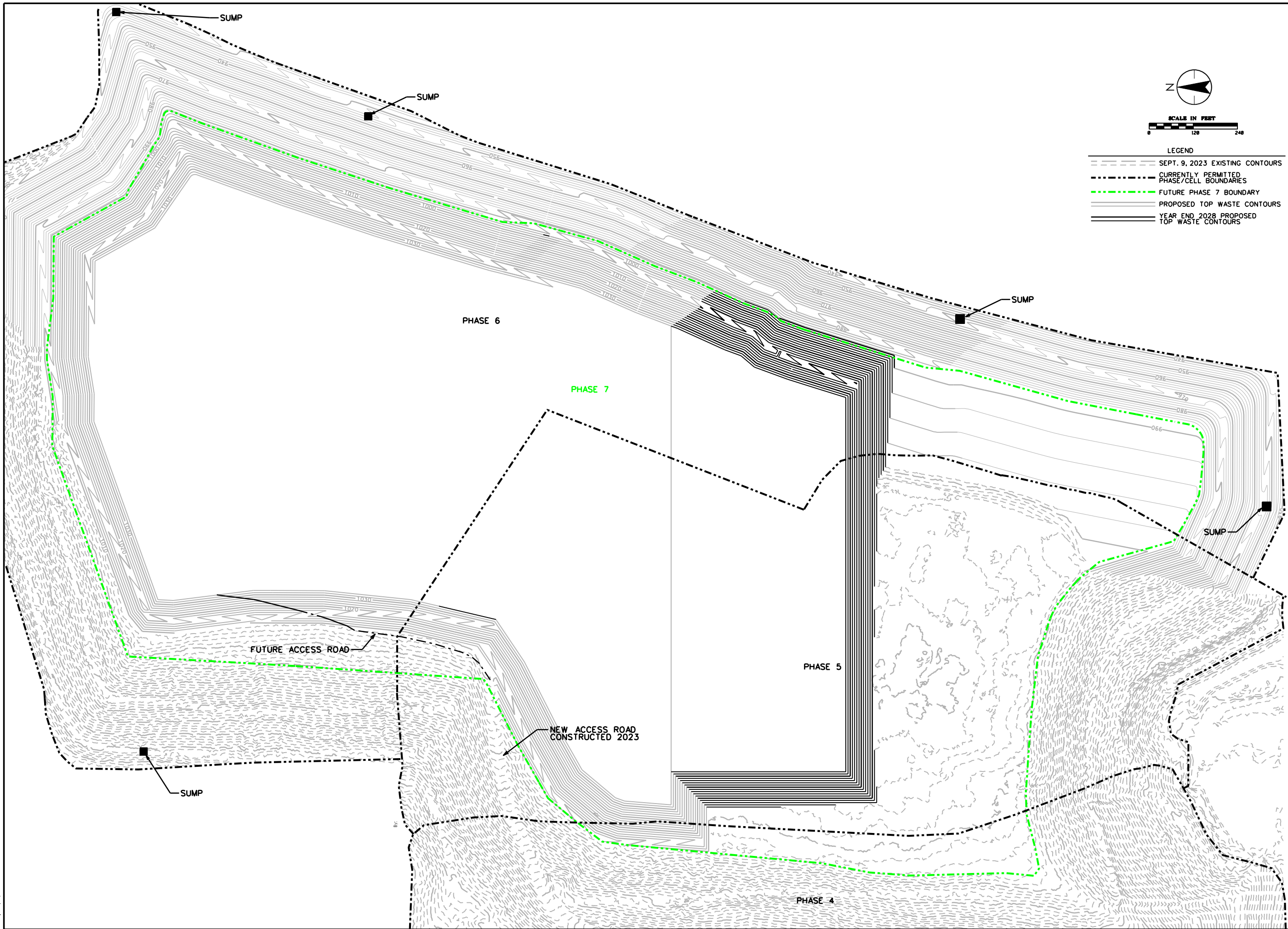
Final cover would be installed incrementally as final grades are reached. Intermittent/intermediate cover would be installed in areas that fill has been placed but final grades have not been reached to promote runoff of stormwater.

5. *b. Please include a plan for visual screening of the waste working face from nearby residents.*

Response: The working face will primarily be visible during operating hours when filling near the slopes on the north, west or south side. The working face is covered at the end of every day with soil or tarps. The slopes will be seeded when leaving an area.

When working in the middle of the proposed Phase 7 expansion area the majority of the working face will be obstructed from resident view by the landfill itself. The landfill also uses several layers of litter screening around the working face.

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	Geotechnical	
	Structural	
	Electrical	
	MEP	
	Environmental	
	Construction	
	Operations	
	Management	
	Other	



**Draft Fall 2024 Gas Migration
Remedial Work Plan**

Pine Bend Landfill – MPCA Permit
#SW-45

September 2024

Prepared for:

BFI Waste Systems of North America,
LLC
2495 E. 117th Street, Inver Grove
Heights, MN 55077

Prepared by:

Stantec Consulting Services Inc.
1 Carlson Parkway, Suite 100
Plymouth, MN 55447
Phone: 763-479-4200
Fax: 763-479-4242

Table of Contents

1.0	PROPOSED REMEDIAL ACTION WORK PLAN	1.1
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1.2	RECOMMENDATIONS	1.2
2.0	SCHEDULE.....	2.3

FIGURES

1. LANDFILL GAS COLLECTION SYSTEM AND EXISTING GAS MONITORING PROBES
2. FULL SITE PROPOSED GAS VENT INSTALLATION AND ELECTRICAL PLAN
3. PROPOSED GAS VENT INSTALLATION AND ELECTRICAL PLAN
4. PROPOSED GEOPROBE LOCATIONS – EAST
5. PROPOSED GEOPROBE LOCATIONS - WEST



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1.0 PROPOSED REMEDIAL ACTION WORK PLAN

1.1 BACKGROUND

The Pine Bend Landfill (PBL) is owned and operated by BFI Waste Systems of North America, LLC, and is located at 2495 E 117th Street, Inver Grove Heights, MN. PBL consists of unlined and lined landfill cells located on a 255-acre parcel. PBL began first accepting waste in 1971 and is currently operated as a mixed-municipal solid waste (MSW) facility. The facility's abutting parcels are zoned for industrial, limited industrial, and agricultural use.

Among other landfill infrastructure, the facility's LFG infrastructure includes an active LFG collection system, a new onsite renewable natural gas (RNG) facility and flare station, and a LFG migration monitoring system at the site. The migration monitoring system consists of soil gas probes around the perimeter of the landfill and continuous gas monitoring in regularly occupied onsite buildings as well as the recyclery building to the east. Per MPCA and MN requirements (Minnesota Rule 7035.2815, Subpart 11), all existing soil gas probes are monitored at the facility. In addition, PBL implemented passive soil gas mitigation controls at select locations along the perimeter of the property starting in 2018.

LFG in soil gas probes is measured using a Landtec GEM5000 or equivalent portable LFG analyzer and is measured by Opal Fuels, LLC (Opal), PBL's contracted LFG developer. The frequency of LFG concentration measurements is performed in accordance with the facility permit, which is generally monthly at gas probes which have historically exceeded the methane lower explosive limit (LEL), and quarterly at all other locations. As presented in previous reports and herein, Stantec Consulting Services, Inc., (Stantec) has performed supplemental LFG concentration measurements at passive soil gas vents. It should be noted that all data presented for gas probes (i.e., MMP, GMP or MWM) have been collected by Opal and all data presented for gas vents (i.e., GV) have been collected by Stantec. The locations of the landfill's active LFG collection system and the gas monitoring probes are shown on Figure 1.

In accordance with the 2018 CUP (Case No. 07-36NCUC), PBL must achieve compliance with Minnesota Rule 7035.2815 Subp. 11, which requires that explosive gases do not exceed 100% of the LEL, which is 5% by volume for methane, at the property boundary. Additionally, the Rule requires that explosive gases do not exceed 25% of the LEL in or around facility structures or monitoring points. Historically, gas probes located to the east, south, and west of the landfill have had methane concentrations exceeding 25% of the LEL (1.25% methane by volume). Figure 1 shows the probes that have had an exceedance within the last six (6) months. Recent exceedances have been observed in GMP-5, MMP-17, and at least one of the probes in the probe nests at MMP-14, MMP-16, and MMP-18, a total of five (5) of the 20 monitoring locations around the perimeter of the landfill. Remedial tasks described in the following sections are recommended to mitigate and investigate gas migration activities in the vicinity of these probes/probe nests.

Methane concentrations at GMP-5 have been observed to be more sporadic than others, varying in concentration from 0% to 65.1% methane in the past five (5) years. In 2016/2017 a GMP-5 source analysis study was completed to "fingerprint" the landfill gas. Gas samples were collected in November 2016 from GMP-5, wells in the unlined area, and wells in the lined area using Summa canisters and

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analyzed using EPA Method TO-15. Tables and stiff diagrams were prepared to compare gas composition between the samples from the different areas but found that the similarities in all samples made the findings inconclusive.

1.2 RECOMMENDATIONS

Based on the fact that vents installed near several existing probes have proven to be effective in decreasing or in some cases eliminating exceedances, PBL is proposing to install new passive gas vents near probes MMP-14A, B, and C, MMP-16A, B, and C, and MMP-17. For example, permanent power was installed to the radon fans on passive vents near probe nests MMP-22A, B and C and MMP-24A, B and C in September 2023 and no exceedances have been observed in any of the probes at either nest since the September 2023 reading. Vents installed near MMP-17 are proposed to be installed approximately 15 feet from the existing probe MMP-17, closer to the probe than the existing vents, to evaluate gas concentrations between the existing vents and the existing probe. The gas vents would be constructed to the same depth and specifications of the existing vents onsite, see detail on Figure 3. Permanent electrical power will be established to the radon fans on the vents near MMP-14, MMP-16, MMP-17D, MMP-18 and MMP-19. Solar power will be established for the radon fans on the vents near GMP-5.

PBL is proposing to complete geoprobes this fall at several locations both onsite and offsite; including on a parcel east of the site and a parcel west of the site, to aid in determination of lateral extents of the gas migration near areas of exceedances. Geoprobes proposed onsite are to be located just east of MMP-17 in the same locations completed in 2021, to compare current methane concentrations to the 2021 readings. Geoprobes use direct push technology to push hollow steel rods into the ground. Once the probe reaches a depth the tip of the rod can be popped off to evaluate gas in the soil. Methane concentrations would be measured at depth intervals of 5 feet from a depth of 40 feet to the surface, and compared to probe readings and previous geoprobe investigations. Proposed geoprobe locations are shown on Figures 4 and 5.

PBL is also proposing to complete additional fingerprinting analysis/source analysis for methane at GMP-5, including sample collection from GMP-5 and various wells within the lined and unlined areas to be determined. The analysis would be completed in either 2024 or 2025 at this time.

2.0 SCHEDULE

PBL continues to actively work toward addressing gas migration issues at the site. PBL has proposed additional remedial action items for fall 2024. A proposed schedule for upcoming future work items and submittals is as follows:

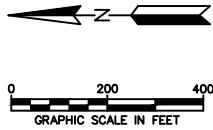
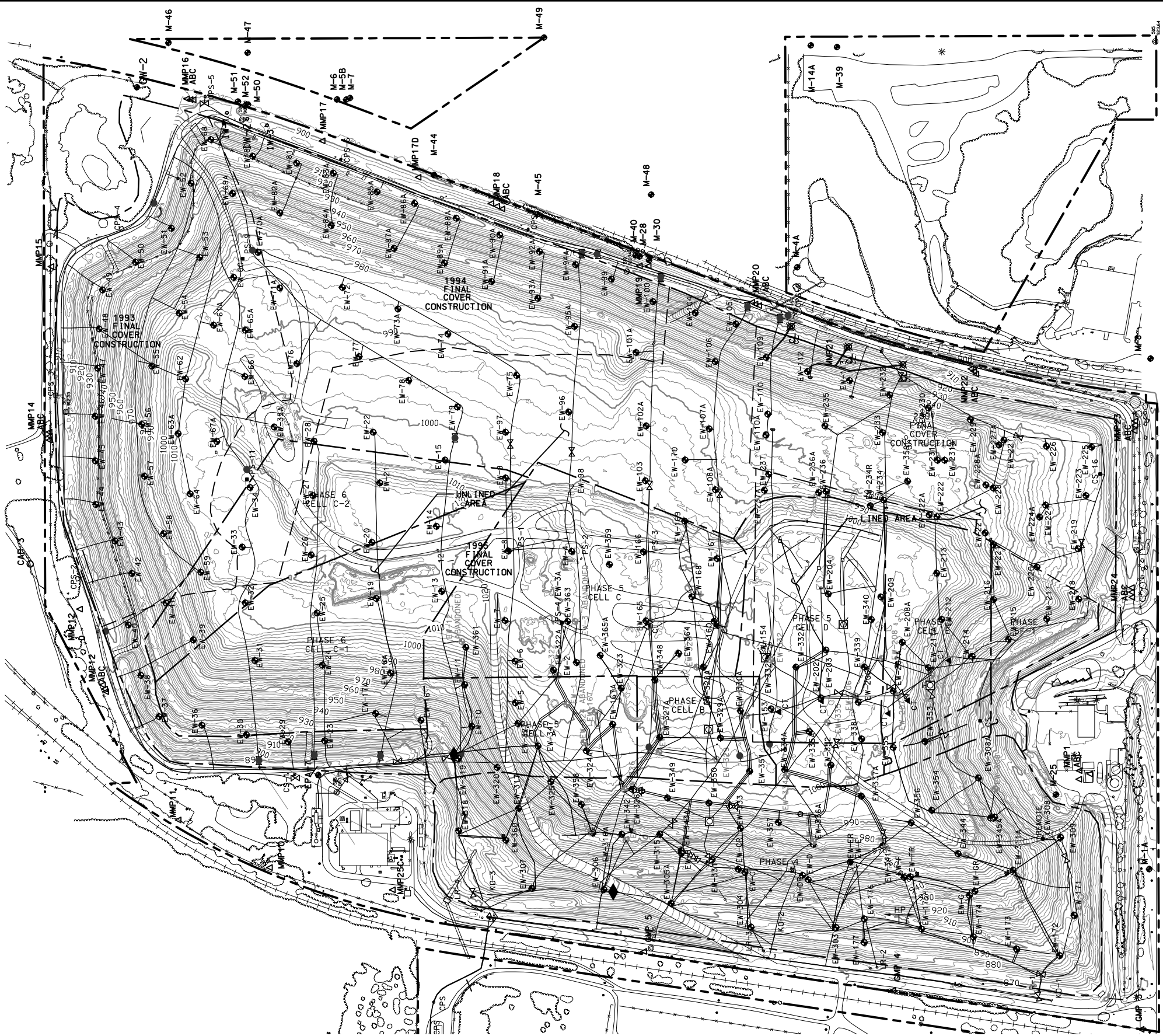
	<u>Remedial Task to be Completed</u>	<u>Anticipated Completion Date</u>
1.	Establish permanent electrical and/or solar power to new fans and previously installed radon fans that are currently on temporary power.	November 15, 2024
2.	Install three new vents near MMP-14A, B, and C.	November 15, 2024
3.	Install three new vents near MMP-16A, B, and C.	November 15, 2024
4.	Install two new vents near MMP-17.	November 15, 2024
5.	Offsite geoprobe investigation to collect methane readings on parcel northeast of MMP-17, and west of GMP-5 to assess lateral extent of migration.	November 15, 2024
6.	Submit 2024 Annual Gas Migration Remedial Action report to MPCA, City, and County including a summary of work performed, and an evaluation of data, and recommendation for additional remedial measures.	March 1, 2025
7.	Collect Summa canister samples at GMP-5, wells in unlined area and wells in lined area for further fingerprinting analysis.	2024-2025
8.	Potentially install additional permanent gas monitoring probes on PBL property east and west of the existing landfill parcel.	2025



FIGURES

- 1. Landfill Gas Collection System and Existing Gas Monitoring Probes**
- 2. Full Site Proposed Gas Vent Installation and Electrical Plan**
- 3. Proposed Gas Vent Installation and Electrical Plan**
- 4. Proposed Geoprobe Locations – East**
- 5. Proposed Geoprobe Locations - West**





- LEGEND
- PROPERTY BOUNDARY
 - - - EXISTING CELL BOUNDARY
 - EXISTING MAJOR CONTOUR
 - EXISTING MINOR CONTOUR
 - ===== EXISTING RAILROAD TRACK
 - ~~~~~ EXISTING TREE LINE
 - M-11A EXISTING GROUNDWATER MONITORING WELL
 - △ GMP 4 EXISTING METHANE MONITORING PROBE
 - △ MMP25 EXISTING METHANE MONITORING PROBE
 - IW-3 EXISTING GROUNDWATER INJECTION WELL

NOTES:

EXISTING TOPOGRAPHY PROVIDED BY AERIAL DRONE SURVEY COMPLETED BY FIRMATEK ON JUNE 19TH, 2024.

#	DESCRIPTION	XXX	XXX	XX/XX/XX
REV	REVISION DESCRIPTION	DWN	APP	REV DATE

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PROJECT TITLE
2024 GAS MIGRATION PLAN

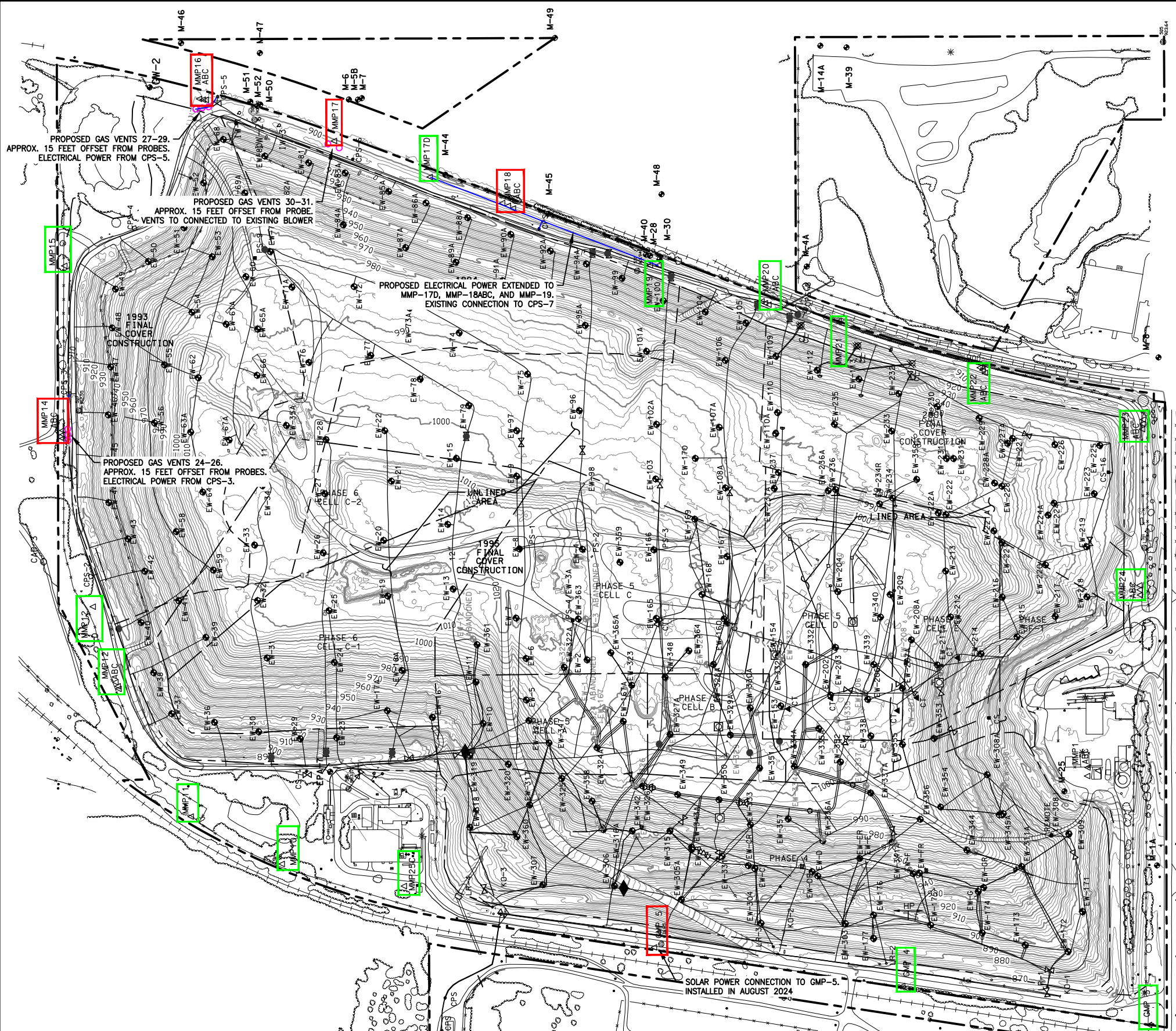
BFI WASTE SYSTEMS OF
NORTH AMERICA, LLC

PINE BEND LANDFILL
INVER GROVE HEIGHTS, MN

SHEET TITLE
LANDFILL GAS COLLECTION SYSTEM
AND EXISTING GAS MONITORING
PROBES

DWN BY JJT	CHK'D EDK	APP'D EDK	DWG DATE SEPT. 2024
PROJECT NO. 227706747	SHEET NO. FIGURE 1	SCALE AS SHOWN	REV NO. -

Plot Date & Time: 19 September 2024 1:10 PM
U:\227706747\dwg\fig_2024 Gas Migration\cvt\Figure 2-Full Site Installation.dwg



LEGEND

- PROPERTY BOUNDARY
- EXISTING CELL BOUNDARY
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING RAILROAD TRACK
- EXISTING TREE LINE
- EXISTING GROUNDWATER MONITORING WELL
- EXISTING METHANE MONITORING PROBE
- EXISTING METHANE MONITORING PROBE
- EXISTING GROUNDWATER INJECTION WELL
- PROPOSED ELECTRICAL LINE
- PROPOSED GAS VENT
- PROBE (OR AT LEAST ONE IN NEST) WITH AT LEAST ONE EXCEEDANCE WITHIN PAST 6 MONTHS
- PROBE (OR AT LEAST ONE IN NEST) WITH NO EXCEEDANCE WITHIN PAST 6 MONTHS

NOTES:
EXISTING TOPOGRAPHY PROVIDED BY AERIAL DRONE SURVEY COMPLETED BY FIRMATEK ON JUNE 19TH, 2024.

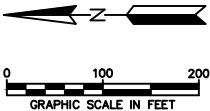
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PRIME CONSULTANT

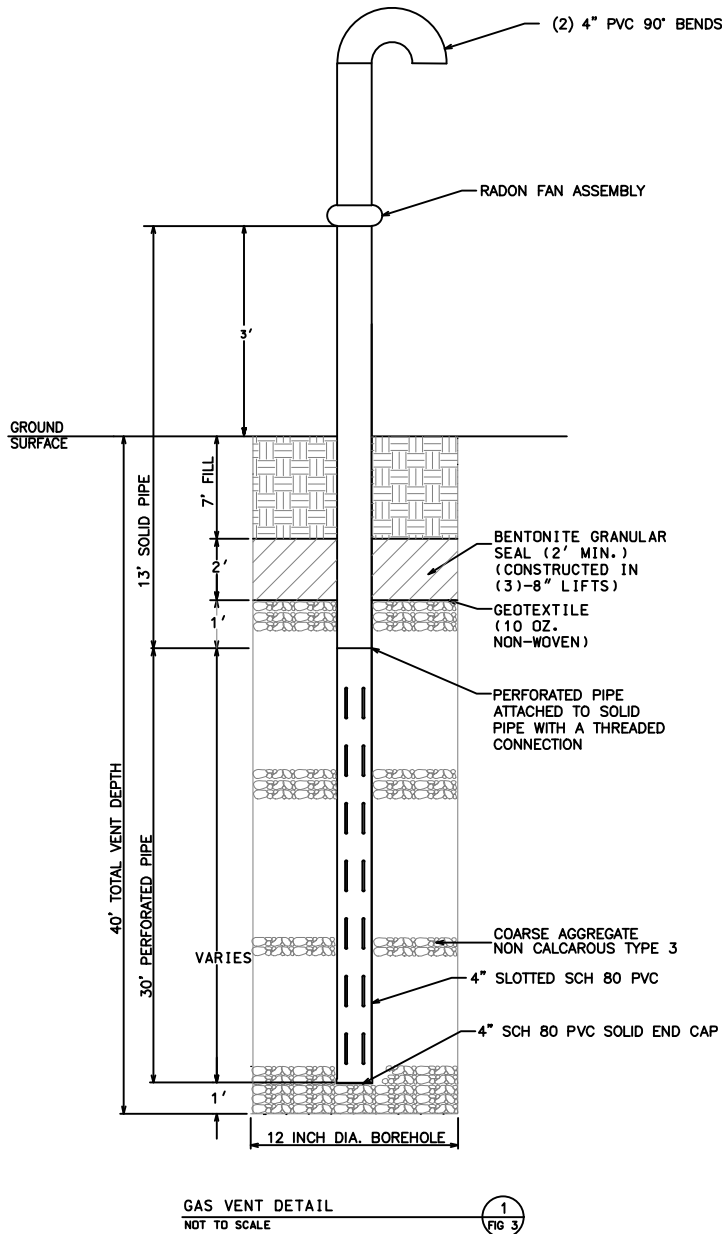
PROJECT TITLE 2024 GAS MIGRATION PLAN		SHEET TITLE FULL SITE PROPOSED GAS VENT INSTALLATION AND ELECTRICAL PLAN	
BFI WASTE SYSTEMS OF NORTH AMERICA, LLC		DWN BY JJT	CHK'D EDK
PINE BEND LANDFILL INVER GROVE HEIGHTS, MN		APP'D EDK	DWG DATE SEPT. 2024
PROJECT NO. 227706747		SCALE AS SHOWN	
SHEET NO. FIGURE 2		REV NO. -	



	PROPERTY BOUNDARY
	EXISTING CELL BOUNDARY
	EXISTING MAJOR CONTOUR
	EXISTING MINOR CONTOUR
	EXISTING RAILROAD TRACK
	EXISTING TREE LINE
● M-11A	EXISTING GROUNDWATER MONITORING WELL
△ GMP 4	EXISTING METHANE MONITORING PROBE
△ MMP25	EXISTING METHANE MONITORING PROBE
○ IW-3	EXISTING GROUNDWATER INJECTION WELL
	PROPOSED ELECTRICAL LINE
○ GV-24	PROPOSED GAS VENT

NOTES:

EXISTING TOPOGRAPHY PROVIDED BY AERIAL DRONE SURVEY COMPLETED BY FIRMATEK ON JUNE 19TH, 2024.



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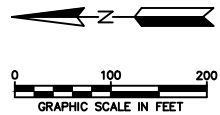
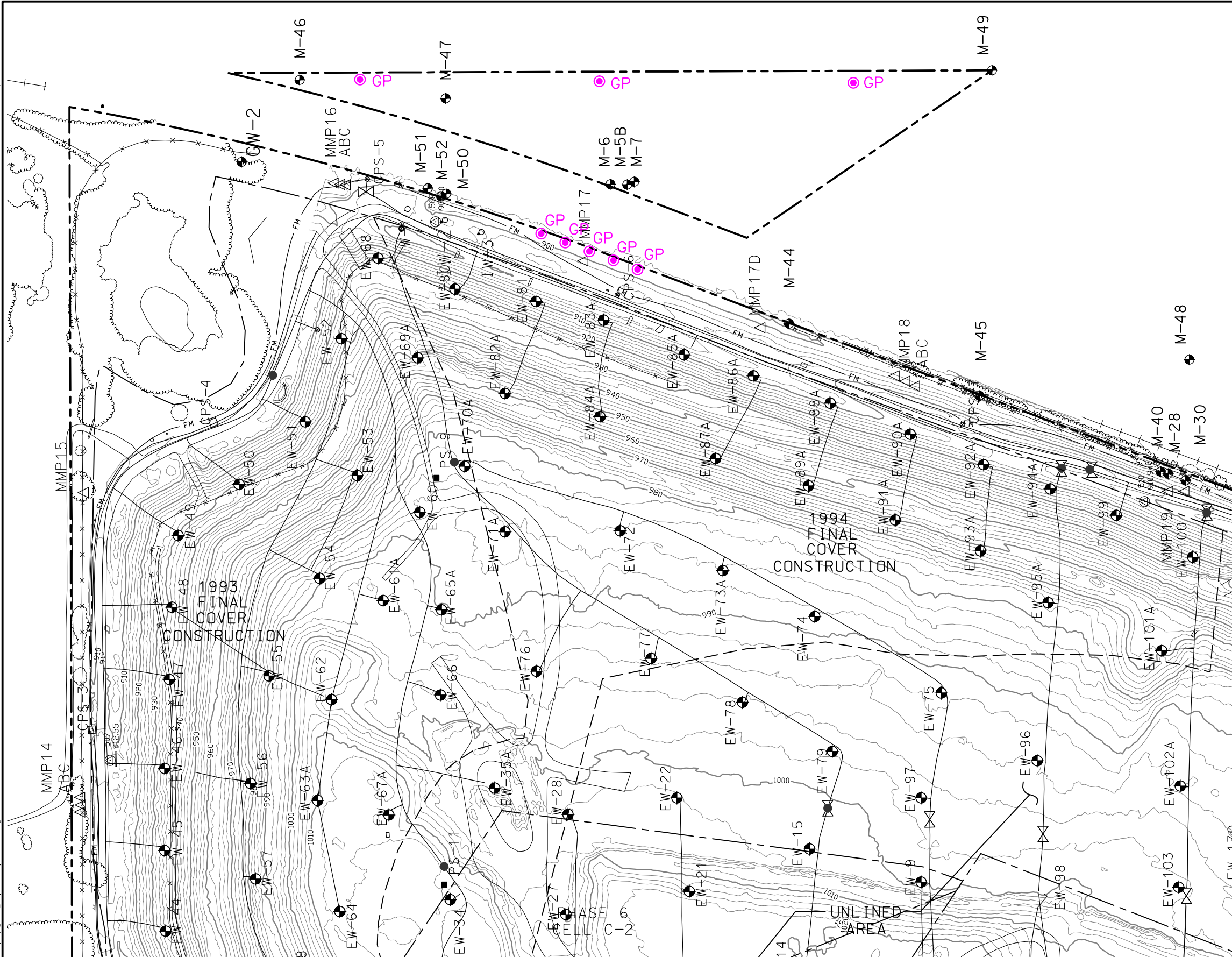


TITLE
2024 GAS MIGRATION PLAN

BFI WASTE SYSTEMS OF
NORTH AMERICA, LLC

PINE BEND LANDFILL
INVER GROVE HEIGHTS, MN

SHEET TITLE			
PROPOSED GAS VENT INSTALLATION AND ELECTRICAL PLAN			
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PROJECT NO. 227706747		SHEET NO. FIGURE 3	REV NO. -



LEGEND

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| | EXISTING TREE LINE |
| | EXISTING GROUNDWATER MONITORING WELL |
| | EXISTING METHANE MONITORING PROBE |
| | EXISTING METHANE MONITORING PROBE |
| | EXISTING GROUNDWATER INJECTION WELL |
| | PROPOSED GEOPROBE |

NOTES:

EXISTING TOPOGRAPHY PROVIDED BY AERIAL DRONE SURVEY COMPLETED BY FIRMATEK ON JUNE 19TH, 2024.

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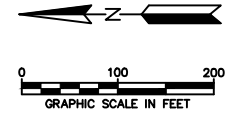
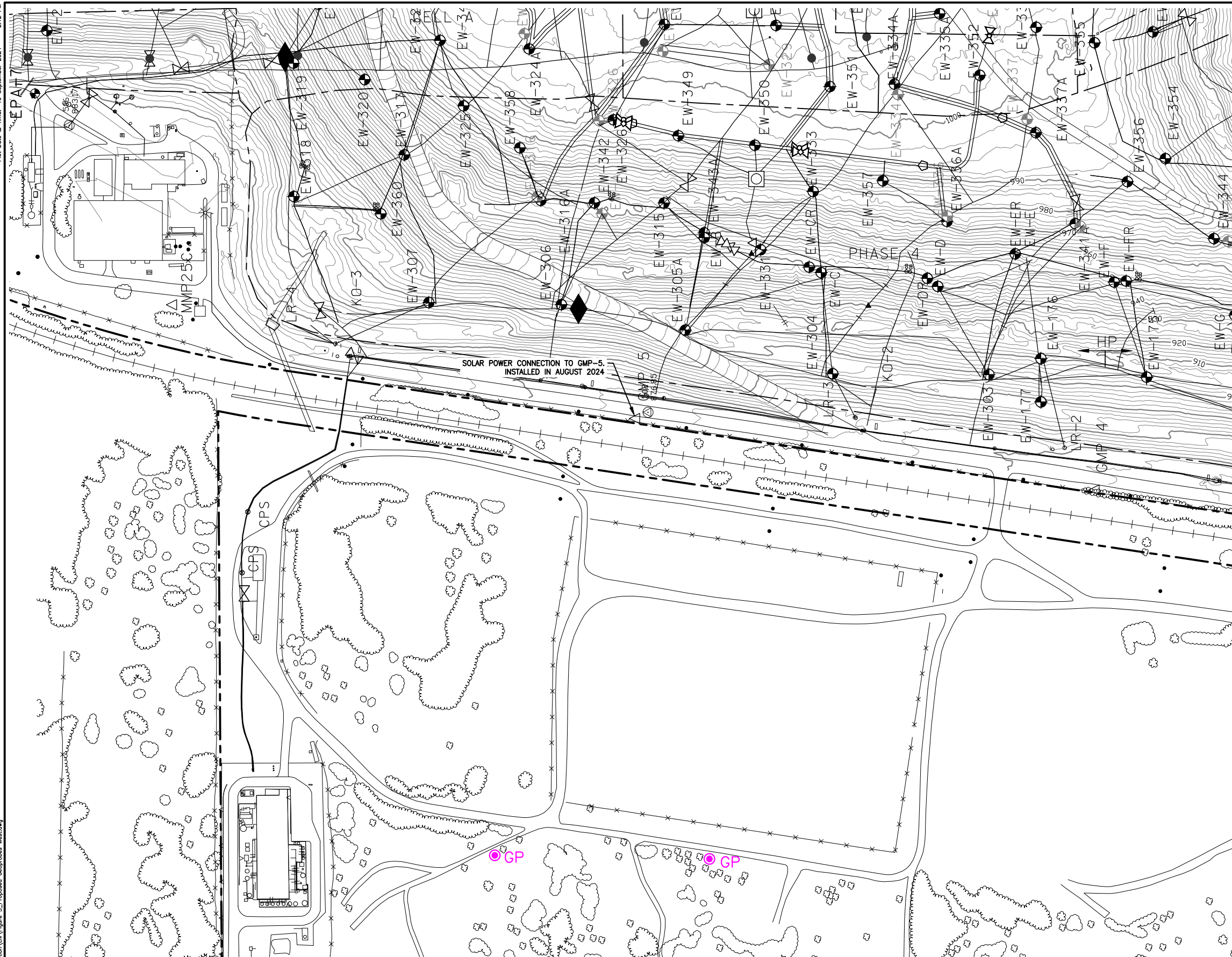
PROJECT TITLE	2024 GAS MIGRATION PLAN
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BFI WASTE SYSTEMS OF
NORTH AMERICA, LLC

PINE BEND LANDFILL
INVER GROVE HEIGHTS, MN

SHEET TITLE
**PROPOSED GEOPROBE
LOCATIONS – EAST**

DNW BY JJT	CHK'D EDK	APP'D EDK	DWG DATE SEPT. 2024
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PROJECT NO. 227706747		SHEET NO. FIGURE 4	REV NO. —



	PROPERTY BOUNDARY
	EXISTING CELL BOUNDARY
	EXISTING MAJOR CONTOUR
	EXISTING MINOR CONTOUR
	EXISTING RAILROAD TRACK
	EXISTING TREE LINE
M-11A	EXISTING GROUNDWATER MONITORING WELL
GMP 4	EXISTING METHANE MONITORING PROBE
MMP25	EXISTING METHANE MONITORING PROBE
IW-3	EXISTING GROUNDWATER INJECTION WELL
GP	PROPOSED GEOPROBE

EXISTING TOPOGRAPHY PROVIDED BY AERIAL DRONE SURVEY COMPLETED
BY FIRMATEK ON JUNE 19TH, 2024.

#	DESCRIPTION	XXX	XXX	XX/XX/XX	
REV	REVISION DESCRIPTION	DWN	APP	REV DATE	

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PRIME CONSULTANT



PROJECT TITLE	2024 GAS MIGRATION PLAN
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BFI WASTE SYSTEMS OF
NORTH AMERICA, LLC

PINE BEND LANDFILL
INVER GROVE HEIGHTS, MN

SHEET TITLE
**PROPOSED GEOPROBE
LOCATIONS – WEST**

DWN BY JJT	CHK'D EDK	APP'D EDK	DWG DATE SEPT. 2024
		SCALE AS SHOWN	
PROJECT NO. 227706747		SHEET NO. FIGURE 5	REV NO. —

**Item 4.A, Attachment 10 - Final Barr Pine Bend
Landfill Letter Report (dated November 8, 2024)**

November 8, 2024

Ms. Ally Sutherland
Environmental Specialist
City of Inver Grove Heights
8150 Barbara Avenue
Inver Grove Heights, MN 55077-3412

Re: Pine Bend Landfill (PBL) Phase 7 Expansion – City Application Review

Dear Ms. Sutherland:

This letter presents Barr Engineering Co.'s (Barr's) review of the Pine Bend Landfill (PBL) "Application Submittal to the City of Inver Grove Heights for the Pine Bend Landfill – Phase 7 Development," prepared by Stantec Consulting Services Inc., dated Revised July 2024 (Revised July 2024 City Application).

This letter includes:

- an executive summary
- brief summaries of the Revised July 2024 City Application and the City's regulatory history of PBL,
- a history of recent requests and approval regarding PBL
- City technical review of PBL's permit application to the MPCA including key technical issues and associated recommended modifications for the amended Non-Conforming Use Certificate (NCUC), new Conditional Use Permit (CUP), and amended Zoning Ordinance
- a discussion of environmental-related considerations from the proposed Phase 7 expansion, and
- summary and conclusions

Executive Summary

PBL is seeking approval for a proposed vertical expansion (Phase 7) that would increase the landfill's approved height by approximately 87 feet and increase its airspace capacity (waste and cover material) by approximately 8.2 million cubic yards. The Phase 7 expansion would fill waste over a liner and leachate collection system that was approved as part of the 2018 Phase 6 expansion.

Phase 7 would not change the landfill's the aerial footprint.

The City, with Barr's assistance, performed a detailed technical reviewed PBL's Phase 7 MPCA solid waste permit application. PBL addressed all items identified by the City/Barr review and satisfactorily modified its MPCA permit application.

Key environmental-related considerations related to the Phase 7 expansion are:

- Potential negative impacts would be increased visibility from nearby properties, and potential increase in litter and odor due to the proposed increased landfill height.

- Landfill gas is currently collected, cleaned, and conveyed into a nearby natural gas pipeline. Additional landfill gas generated by the increased waste disposal in Phase 7 would increase the quantity of gas supplied to the natural gas pipeline and therefore would be an environmental benefit, assuming the existing operation has the capacity to process additional gas.
- It is not expected that offsite subsurface migration of landfill gas would increase with the proposed Phase 7 expansion because it is believed that the source of the subsurface gas is waste in the old unlined area, however the issue of how to reduce or mitigate the existing subsurface gas migration remains.
- Potential negative impacts to surface water are mitigated with the final cover system and surface water design and management system.

If the City is in agreement with the Phase 7 expansion, it will need to amend the NCUC, issue a new CUP, and amend its ordinance. Barr's recommendations for these three documents are below:

NCUC Amendment:

- Add reference to the 2018 NCUC Amendment to the "Whereas" section
- Add the Appendix C Plan Sheets and Appendix E Stormwater Management Model and Calculations from the Revised July 2024 City Application to NCUC Exhibit D
- Add the Revised July 2024 City Application, Appendix E Stormwater Management Model and Calculations to the list of approved documents

New CUP:

- Use the 2018 CUP and edit it as indicted below to create the 2024 CUP:
 - Add the landfill's increased maximum elevation to 1105.8 feet
 - Add the increased 7,888,250 cubic yards of airspace capacity for a new total airspace capacity of 40,018,250 cubic yards excluding final cover volume
 - Edit 2018 CUP item 14 regarding subsurface gas migration to allow the City Council to waive or modify PBL's requirements if the City Council determines that adequate progress is being made to mitigate subsurface gas migration
 - In the new CUP, add a requirement for PBL to perform a subsurface gas concentration trend analysis and include in future annual reports
 - In the new CUP, add a requirement for PBL to identify the horizontal and vertical extent of the subsurface gas plum beyond the waste boundaries including on adjacent properties
 - Add the 2018 CUP to the "Whereas" section
 - Add the Revised July 2024 City Application to item number 3
 - Add the Revised July 2024 City Application to item number 4
 - Complete the reference to the 2018 NCUC Amendment to item number 5.k
 - Add new NCUC Amendment to item number 5

- Add the Phase 7 expansion to item number 6
- Update item number 10 to show hours of waste received to be Monday through Saturday 6:00 AM to 4:00 PM and Sunday 7:00 AM to 3:00 PM
- Update item number 11 to reference the May 31, 2019 MPCA Permit Modification
- Remove the reference to February 1 annual report due date in items 12.a and 12.b
- Add requirement to install pumps in the pumping stations in item 12.b.vii
- Update item number 13 to reference the May 31, 2019 MPCA Permit Modification
- Delete item number 15

Ordinance Amendment to City Code Section 10-13E-6:

- Delete item H regarding allowing a percentage increase of cubic yards (including the final cover system) from the original 1995 NCUC
- Delete item J related to the limit of surface area limitation of the landfill final cover

Summary of Revised July 2024 City Application

The Revised July 2024 City Application contains information regarding the proposed Phase 7 expansion at PBL including general project description, facility and design information, operational information, a discussion of potential environmental and land use impacts, and additional information regarding the host community fee, compliance history, and status of non-City permits and approvals.

The Revised July 2024 City Application also includes a solid waste management plan, permit-level plan sheets, a geotechnical analysis, stormwater management model and calculations, financial assurance cost estimates for closure, postclosure, and contingency action, and 3D view modeling.

City Regulatory History of PBL

In general City Resolution No. 6465 (1995 NCUC) established, among other things, limits to the waste capacity and maximum elevation of PBL. City Resolution No. 04-48 (2004 CUP) and City Resolution No. 18-69 (2018 CUP) allowed an increase to the capacity of PBL. Below is a brief summary of the City's past regulation of PBL.

NCUC History

- City Resolution No. 6465 (1995 NCUC) – “A Resolution Granting a Non-Conforming Use Certificate for Pine Bend Sanitary Landfill for a Compost Facility and a Sanitary Landfill,” dated November 27, 1995. The 1995 NCUC was granted to PBL subject to terms, conditions, and qualifications contained in the 1995 NCUC. The 1995 NCUC granted a total airspace capacity (not including final cover) of 23.3 million cubic yards and a maximum elevation of 1020 feet above mean sea level.
- City Resolution No. 02-32 (2002 NCUC Amendment) – “Resolution Amending Resolution No. 6465, Granting a Non-Conforming Use Certificate for Pine Bend Landfill by Modifying the Phasing Plan, Maximum Elevation, and Final Grading and Stormwater Plans”, dated March 11, 2002. The

2002 NCUC Amendment reduced the maximum elevation of Pine Bend Landfill to 1010 feet above mean sea level.

- City Resolution No. 04-49 (2004 NCUC Amendment)– “A Resolution Amending Resolution No. 6465 Granting a Non-Conforming Use Certificate for Pine Bend Sanitary Landfill for a Sanitary Landfill”, dated March 22, 2004. The 2004 NCUC Amendment established that the remaining airspace capacity as of October 1994 was 5.65 million cubic yards and limited the maximum elevation of PBL to an elevation of 1,019 feet above mean sea level.
- City Resolution No. 18-70 (2018 NCUC Amendment) – “A Resolution Amending Resolution No. 6465 Granting a Non-Conforming Use Certificate for Pine Bend Sanitary Landfill for a Sanitary Landfill”, dated April 9, 2018. The 2018 NCUC Amendment:
 - Amended Exhibit D of the 1995 NCUC to add Appendix C (28 permit design plan sheets) and Appendix D (Stormwater Management Model and Calibrations) from the “Application Submittal to the City of Inver Grove Heights for the Pine Bend Landfill – Phase 6 Development” prepared by Wenck Associates dated revised February 2018.
 - Did not change the airspace capacity or maximum elevation.

CUP History

- City Resolution No. 6330 – “Approving a Conditional Use Permit for an Energy Recovery Facility for the Generation of Electricity in the General Industry (I-2) Zoning District,” dated May 30, 1995.
- City Resolution No. 04-48 (2004 CUP) - “Resolution Approving a Conditional Use Permit to Allow an Airspace Capacity Expansion of the Pine Bend Sanitary Landfill,” dated March 22, 2004. The 2004 CUP granted an airspace expansion which brought the total airspace (not including final cover) to 28.6 million cubic yards but did not change the maximum elevation.
- City Resolution No. 18-69 (2018 CUP) – “Resolution Approving a Conditional Use Permit to Allow a Side Slope Capacity Expansion of Pine Bend Landfill”, dated April 9, 2018. The 2018 CUP:
 - Granted an airspace expansion which brought the total airspace (not including final cover) to 32.13 million cubic yards but did not change the maximum elevation
 - Adopted the terms and conditions in the 2004 CUP and then indicated that the 2004 CUP terms and conditions are superseded by the 2018 CUP
 - Required that the 2004 capacity expansion and the 2018 side slope capacity expansion conform to the 2003 Application to the City, 2002 and 2003 plan sheets, November 2003 response to comments, and the 2018 Application to the City
 - Limited the areas of the 2004 capacity expansion and the 2018 side slope capacity expansion
 - Required compliance with numerous historical CUPs and amendments, the NCUC and amendments
 - Made 1995 NCUC, section 5 through 10 applicable to the 2018 CUP

- Restricted the types of waste to be disposed of in the 2004 capacity expansion and the 2018 side slope capacity expansion
- Prohibited vehicles coming to PBL to not queue on 117th street
- Required that, if the sanitary sewer is extended to PBL, PBL pay its share and connect the leachate collection system to the sanitary sewer as soon as the City accepts the sanitary sewer for use
- Identified the hours of operation for PBL
- Required compliance with the 2015 MPCA Solid Waste Permit and in addition, allowed alternative groundwater trend analysis, conduct additional investigations when hydrogeologic conditions change or continued release of contaminants to groundwater warrant as determined by the City Council, and allows the City Administer to waive water sampling in the case of extenuating circumstances
- Identified numerous requirements for the dual gas/leachate management system
- Required compliance with the 2015 MPCA Solid Waste Permit for liner leak detection and leachate collection, conveyance, storage, and treatment
- Required achieving compliance with Minnesota Rule 7035.2815, subpart 11 regarding landfill gas migration for six consecutive months prior to, filling beyond 30 million cubic yard or January 1, 2025, whichever occurs first. Maintain an MPCA air emission permit for rental of an enclosed flare to serve as contingency for managing landfill gas
- Required both PBL's owner and operator to be responsible for complying with the CUP
- Stipulated that breach of the Host Community Agreement is deemed a violation of the CUP
- Indicated that the CUP becomes effective upon execution of the Third Restated and Amended Host Community Agreement

Ordinance History

- City Ordinance No. 721. On April 22, 1991 the City adopted Ordinance No. 721, which amended the City Zoning Code, Section 515.43, "I-2" General Industry District, and made mixed municipal solid waste disposal facilities (among others) prohibited uses. Ordinance No. 721 permitted prohibited uses that existed prior to April 22, 1991.
- City Ordinance No. 850. On November 27, 1995 the City adopted Ordinance 850 - "An Ordinance Establishing a Procedure for the Consideration of Nonconforming Use Certificates", amended the City Zoning Code to permit owners of a prohibited use to apply for a NCUC.
- City Ordinances No. 851 and 852. On November 27, 1995 the City adopted Ordinance 851 - "An Ordinance Establishing City Code Section 550 Integrated Resource Management Overlay Zoning District" and Ordinance 852 - "An Ordinance Rezoning Property to "IRM", Integrated Resource Management Overlay District", amended the City Zoning Code to create an Integrated Resource Management Overlay District which included PBL.

- City Ordinance No. 1084 (2004 Ordinance Amendment) – “An Ordinance Amending Inver Grove Heights City Code Section 515.80. Subd. 33 (E) by Adding a Conditional Use Permit for the Expansion of the Airspace of an Existing Sanitary Landfill”, dated March 22, 2004.
- City Ordinance No. 1351 (2018 Ordinance Amendment) – “An Ordinance Amending Inver Grove Heights City Code Section 10-13E-6 Relating to Expansion of the Air Space of an Existing Sanitary Landfill”, dated April 9, 2018 increased the percentage capacity allowed and increased area of final cover.

Brief History of Recent Requests and Approvals

PBL was first issued a solid waste permit by the MPCA in 1971. Since then, the MPCA solid waste permit has been reissued numerous times and most recently on July 30, 2015 and modified on May 31, 2019. The July 30, 2015 permit (with 2019 modification) authorized the Phase 6 sideslope expansion of the landfill by 4.1 million cubic yards to bring the total permitted capacity to 33.9 million cubic yards (including final cover). Below is a brief history of recent MPCA- and City-related requests and actions related to PBL.

City Review of PBL Permit Application to the MPCA

PBL submitted a “Request for Major Modification of Permit #SW-45,” prepared by Stantec Consulting Services Inc., dated June 2, 2022, including the addendum dated September 15, 2022 (June 2022 Application and September 2022 Addendum) to the MPCA.

The June 2022 Application and September 2022 Addendum proposes an airspace capacity expansion of 8.2 million cubic yards over the existing landfill footprint which would bring the total permitted capacity to 42.1 million cubic yards including cover soils and an elevation increase of 86.8 feet to a maximum elevation of 1105.8 by extending the existing 3:1 (horizontal:vertical) sideslopes around the existing landfill footprint including filling over the liner and leachate collection system previously installed over old unlined waste. This proposed expansion is referred to as the Phase 7 expansion.

The City, with Barr’s assistance, performed four rounds of technical review of the June 2022 Application and September 2022 Addendum that focused on these twelve topics:

- I. Waste Acceptance
- II. Groundwater Monitoring System
- III. Leachate Recirculation
- IV. Solid Waste Composting
- V. Groundwater Quality
- VI. Surface Water Management
- VII. Waste Capacity
- VIII. Liner and Leachate Collection System Design
- IX. Gas Monitoring and Gas Extraction/Treatment Systems
- X. Final Cover Design
- XI. Closure, Post Closure, Contingency Action, and Operations and Maintenance Plans

XII. Financial Assurance Cost Estimates

Following the City/Barr review, PBL subsequently modified the June 2022 Application and September 2022 Addendum via three memoranda prepared by Stantec Consulting Services Inc. as shown below. All City/Barr review recommendations have been adequately addressed by PBL via these three memoranda.

- February 12, 2024 Response Memo with attachments,
- April 12, 2024 Response memorandum with attachments, and
- April 29, 2024 Response memorandum with attachment

The June 2022 Application and September 2022 Addendum and the three memoranda listed above comprise the 2022-2024 MPCA Permit Application.

More detailed information regarding the review of these topics is contained in the four rounds of City/Barr review letters and three PBL response memoranda noted above and can be provided if requested.

The MPCA is waiting for the City and County to complete their review and approval processes prior to reissuing the MPCA solid waste permit.

MPCA EAW

The MPCA prepared a draft Environmental Assessment Worksheet (EAW) for public review on October 31, 2023 that evaluated the current proposed Phase 7 expansion. The City, with Barr's assistance, provided extensive review and numerous comments on the draft EAW in a letter dated November 28, 2023. Numerous other parties also submitted comments on the draft EAW. Subsequently, the MPCA issued a final EAW and response to comments dated March 1, 2024. The final EAW concluded that proposed Phase 7 expansion project does not have the potential for significant environmental effects and that there is not a need for an Environmental Impact Statement.

City NCUC, CUP, and Zoning Ordinance Amendment Request

PBL is requesting that the City amend its NCUC, CUP, and zoning ordinance to allow the proposed Phase 7 expansion. The request is included in the Revised July 2024 City Application discussed above.

Key Technical Issues and Recommended NCUC/CUP/Ordinance Modifications

From the above twelve technical topics included in the City/Barr review of PBL's permit application to the MPCA, there were four topics that were of particular importance as they relate to the City's NCUC, CUP, and Ordinance. The remaining eight technical topics did not directly relate to the City's NCUC, CUP, and Ordinance but are summarized briefly at the end of this section.

These four topics that are of particular importance are:

- waste capacity,
- groundwater quality and trends,
- surface water, and

- gas migration and trends and are discussed in detail below.

Recommendations for changes to the NCUC, CUP, and Ordinance and a discussion regarding environmental impacts (if any) are provided at the end of each topic.

Waste Capacity

PBL is permitted by the MPCA for a capacity of 33.94 million cubic yards which includes waste and cover material. The remaining capacity (including final cover) of PBL was approximately 1.05 million cubic yards at the end of 2023 based on PBL's 2023 Annual Report.

The June 2022 Application and September 2022 Addendum proposes an airspace capacity expansion 8,185,800 cubic yards over the existing landfill footprint by extending the existing 3:1 (horizontal:vertical) sideslopes around the existing landfill footprint including filling over the liner and leachate collection system previously installed over old unlined waste. This quantity includes the bottom liner drainage layer, waste, and final cover. The proposed expansion would increase the capacity of PBL to 42,123,200 cubic yards of waste and cover material.

The City-approved capacity of 32.13 million cubic yards is slightly less than the MPCA's because it excludes the final cover material.

The maximum height of PBL would increase approximately 87 feet from elevation 1,019 feet as approved in City Resolution 04-09, dated March 22, 2004 to an elevation of 1105.8 feet.

The estimated final closure date of the PBL is proposed to be extended approximately 13.6 years from approximately 2027 without the Phase 7 expansion to approximate 2040 with the Phase 7 expansion. This final closure date is based on an assumed fill rate for all waste types and final cover of 600,000 cubic yards per year.

A review of the design drawings was completed to verify the accuracy of the capacity information for the proposed expansion. Based on review of the design drawings in AutoCAD Civil3D software, it appears that the volumes shown in the Revised July 2024 City Application are accurate.

Recommended NCUC/CUP/Ordinance modifications:

- New NCUC Amendment:
 - None
- New CUP:
 - Add the landfill's increased maximum elevation to 1105.8 feet
 - Add the increased 7,888,250 cubic yards of airspace capacity for a new total airspace capacity of 40,018,250 cubic yards excluding final cover volume
- New Ordinance Amendment:

- Delete item H regarding allowing a percentage increase of cubic yards (including the final cover system) from the original 1995 NCUC

Environmental Impacts:

- Because more waste will be disposed of at PBL with the proposed Phase 7 expansion, there would be associated potential negative environmental impacts related to groundwater and air emissions. These potential impacts would be mitigated by the approved 2018 sideslope expansion (Phase 6) liner and leachate collection system and the proposed final cover and gas collection systems.

Groundwater Quality and Trends

Based on our review, there are no changes being proposed to the groundwater monitoring system in the June 2022 Application and September 2022 Addendum or the revised Revised July 2024 City Application.

Groundwater samples are collected from 22 monitoring wells located upgradient and downgradient from the landfill and 2 downgradient springs (Pipeline and Ravine Springs). Groundwater monitoring of flow direction and quality has been ongoing since the landfill began operating in 1971. Routine monitoring is conducted on a quarterly basis to facilitate the detection of releases to groundwater from the landfill in accordance with a sampling and analysis plan (SAP). The SAP establishes sampling methodologies, analytes, and quality assurance/quality control procedures. The SAP also provides for contingencies to increase monitoring intervals if certain water-quality levels are exceeded. Based on the contingency monitoring results, corrective action may be required.

Groundwater flows approximately southwest to northeast underneath the landfill, becoming primarily easterly along the northeast edge of the Crosby-American demolition landfill area located immediately north of PBL. The depth to the groundwater is considerable (over 100 feet in some locations). The water table is in glacial drift. Monitoring wells are completed both shallow and deep in the glacial drift and in the Prairie du Chien Group (limestone). Groundwater underneath the site eventually discharges into the Mississippi River, east of PBL.

Groundwater samples are analyzed for volatile organic compounds (VOCs), metals, polyfluoroalkyl substances (PFAS), and general geochemical parameters, such as temperature, specific conductance, and pH. As has been the case for many years, groundwater intervention limits (ILs) concentrations are occasionally exceeded for some VOC chlorinated organic compounds that are common in municipal waste (e.g., trichloroethylene, tetrachlorethylene, and biogenic breakdown products of these chlorinated compounds). Microbial reduction of the chlorinated compounds takes place in the groundwater and the geochemical indicators of this process are part of the monitoring program. The final reductive (low oxygen) breakdown product is vinyl chloride, which is oxidized to carbon dioxide and water in the more oxidizing conditions that likely exists a further distance downgradient of the landfill. Total concentrations of VOCs have generally shown a downward trend over the past several years. Some temporal (sequential) increases are observed for individual parameters as breakdown occurs, which are expected.

Manganese concentrations have exceeded the IL at many groundwater wells and in the Pipeline Spring for many years. These elevated manganese concentrations may be due, in part, to low oxygen concentrations in the groundwater (i.e. reduced conditions) that could cause the manganese to be converted to its soluble form and become mobile in groundwater. However, the manganese concentrations appear to be stable (i.e. neither an increasing nor decreasing trend). No further action is recommended at this time but the trends in concentrations of manganese and other metals should continue to be monitored to determine if remedial efforts downgradient from PBL should be performed.

PFAS compounds (i.e. perfluorocarbon compounds associated with Teflon, Scotchguard, etc.) have been monitored in the groundwater on a regular basis at PBL starting in 2011. The IL concentrations for four PFAS compounds (PFBA, PFOS, PFOA, and PFHxS) are 1,750 parts per trillion (ppt), 3.75 ppt, 8.75 ppt, and 11.75 ppt respectively, and have routinely been exceeded at numerous monitoring wells and at the two springs.

Temporal trends in PFAS compounds are very hard to quantify for a variety of reasons but the overall pattern is one of continuing presence of these constituents in groundwater and in the springs. It should be noted that remediation of PFAS compounds in groundwater is difficult because they do not biodegrade or otherwise react with the soil—they are very persistent. The need for the landfill to respond to the PFAS occurrences will largely be dependent on whether or not there are potential environmental and human health exposures.

Current NCUC/CUP: Section 5.6.1 of the 1995 NCUC requires approval by the City Council if certain percentages of the number of groundwater monitoring wells, monitoring frequency, or sampling parameters are proposed to be reduced. The baseline for determining these percentages is the June 1995 Permit Reissuance Application.

However, Item 10 of the 2004 CUP also describes the requirements for the groundwater monitoring system and sampling parameters based on the EnecoTech Report dated October 2003. Because the 2004 CUP was developed subsequent to the 1995 NCUC, it appears that the intent of the 2004 CUP monitoring system requirements was to supersede the 1995 NCUC requirements.

Recommended NCUC/CUP/Ordinance modification:

- None

Environmental Impacts:

- The 2018 Phase 6 expansion installed a liner and leachate collection system over existing unlined waste. The proposed Phase 7 expansion is proposed to be located above the Phase 6 expansion liner and leachate collection system. The proposed Phase 7 would also include a final cover and a gas collection system. Because the liner and final cover will minimize the amount of precipitation that could migrate into the unlined waste and produce leachate that could migrate to groundwater and because the gas collection system will extract gas for beneficial use, the proposed

Phase 7 expansion is not expected to have any significant negative environmental groundwater impact.

Surface Water

Barr reviewed the surface water management plan and modeling contained in the June 2022 Application and September 2022 Addendum. The proposed design uses benches placed generally at 40-foot (vertical) intervals along the 3:1 sideslopes to direct runoff from the build-out expansion area to cable-concrete-lined trapezoidal channels, which discharge through existing and proposed junction vaults, pipes, and culverts to existing stormwater ponds. HydroCAD version 10.10 was used to simulate rainfall-runoff from the site. According to the proposed plan, the existing ponds would not overflow from the site during the 100-year, 24-hour runoff event.

The 2018 NCUC Amendment added the 2018 stormwater model and calibrations as an amendment to NCUC Exhibit D.

Recommended NCUC/CUP/Ordinance modification:

- Add the 2024 City Application, Appendix E Stormwater Management Model and Calculations to the list of approved documents

Environmental Impacts:

- There is a potential negative environmental impact to surface water because the proposed Phase 7 expansion includes an increase in the amount of 3:1 (horizontal:vertical) sideslopes that will increase the rate of surface water runoff and potentially increase the amount of erosion on the sideslopes. However, these potential negative environmental impacts are mitigated with the proposed final cover and stormwater management systems that are designed to accommodate the steeper sideslopes.

Gas Migration and Trends

Landfill gas (primarily methane and carbon dioxide) is produced by the decomposition of solid waste under the anaerobic conditions that exist in landfills such as PBL. Methane can be a major concern at landfills due to its potential to migrate in the soil subsurface and accumulate in structures at explosive concentrations.

Minnesota Rule 7035.2815 Subp. [sic] 11 requires that the concentration of any explosive gas not exceed the Lower Explosive Limit (LEL) at the property boundary or 25 percent of the LEL in or around facility structures.

The existing gas management system at PBL consists of:

- Gas collection wells and piping
- The gas-to-natural gas processing plant
- The gas monitoring system

Based on the review of the Operations and Maintenance Plan in the August 2015 Application, the gas extraction system currently includes 190 gas extraction wells at the site and additional gas extraction wells are planned for Phases 5 and 6. These gas extraction wells are included in the proposed Phase 7 expansion design. The construction and installation of the additional gas extraction wells will be in accordance with the MPCA-approved design and PBL design standards. Extracted gas is currently piped through laterals, sub-headers, and header piping to a landfill gas-to-natural gas plant and/or a flare. F

The gas monitoring system is comprised of the three continuous electronic monitoring devices located in occupied buildings at PBL and 39 methane (gas) monitoring probes completed at varying depths around the perimeter of the landfill. The Gas Management and Monitoring Plan indicates the probes are monitored quarterly unless a positive gas reading is recorded, in which case, monitoring is increased to monthly. In recent years, the gas probes have been monitored on a monthly or weekly basis, as a result of methane detections at multiple probes around the facility.

Historically, elevated concentrations of methane have been detected in several of the subsurface gas monitoring probes located along the eastern, southern, and western boundaries of PBL. Methane concentrations in the gas monitoring probes around the facility exceeded the LEL on numerous occasions over the years. Based on these monitoring results, it does not appear that the existing controls at the PBL meet the requirements of Minnesota Rule 7035.2815 Subp. 11. PBL has been working with the MPCA and City to address gas migration concerns and annually provides a status update on this work to the City Environmental Advisory Commission.

Based on review of the Revised July 2024 City Application, proposed augmentations to the gas extraction systems includes:

- Vertical extension of existing gas extraction wells in the Phase 7 footprint
- Installation of new vertical gas extraction wells in the Phase 7 footprint
- Installation of a horizontal gas collection system beneath the final cover system in the Phase 6 and Phase 7 build outs where the proposed waste thickness is too thin for additional vertical gas wells

A dual gas and leachate extraction system has been operating in unlined Phases 1 and 2 of PBL since 2002. Twenty-six of the forty-six wells originally configured for dual extraction operations, plus two new recently installed pump stations (PS-1 and PS-2), were operated as dual extraction wells in 2013. Pumps were added to PS-1 and PS-2 in 2013 in order to make them operational. Nine additional pump stations (PS-3 through PS-11) are proposed to be installed in the unlined area as part of the Phase 6 and Phase 7 expansions.

Current NCUC/CUP: Section 2.3.9 of the 1995 NCUC allows PBL to control subsurface gas generated at the landfill by construction of probes, gas extraction wells, etc.

The 2018 CUP, item 12 included requirements for the dual gas/leachate extraction system that appear to be adequate without further modification.

Recommended NCUC/CUP/Ordinance modifications:

- Edit 2018 CUP item 14 regarding subsurface gas migration to allow the City Council to waive or modify PBL's requirements if the City Council determines that adequate progress is being made to mitigate subsurface gas migration.
- In the new CUP, add a requirement for PBL to perform a subsurface gas concentration trend analysis and include in future annual reports.
- In the new CUP, add a requirement for PBL to identify the horizontal and vertical extent of the subsurface gas plum beyond the waste boundaries including on adjacent properties.

Environmental Impacts:

- The Phase 6 expansion included the addition of new pumping stations that could be used to increase the extraction of gas from the unlined area which is believed to be the source of the subsurface gas migration to the PBL property boundary. The proposed Phase 7 expansion does not appear to add any means to increase gas extraction from the unlined area but neither does it decrease gas extraction from this area. Therefore, the proposed Phase 7 expansion is not expected to have negative environmental impacts related to subsurface gas migration.

Summary of Eight Remaining Technical Topics

The remaining eight technical topics (waste acceptance, groundwater monitoring system, leachate recirculation, solid waste composting, liner and leachate collection system design, final over design, closure, post closure contingency action, and operations and maintenance plans, and financial assurance cost estimates) are summarized below.

These eight technical topics were included in the four rounds of City/Barr review of PBL's MPCA permit application and three PBL response memoranda noted above. PBL's three response memoranda will be included in the pending MPCA solid waste permit and therefore do not need to be addressed directly in the NCUC, CUP, and Ordinance.

Waste Acceptance

There are no changes to PBL's waste acceptance.

The 2014 Solid Waste Management Plan describes the procedures that PBL uses to manage its mixed municipal and non-hazardous industrial solid waste. More specifically, the 2014 Solid Waste Management Plan describes:

- A customer notification procedure for review and acceptance of waste,

- A list of acceptable and unacceptable wastes plus a list of wastes that PBL does not accept,
- Waste categorization,
- Waste evaluation procedures,
- Use of waste as daily cover,
- Waste inspection and rejection procedures, and
- Numerous appendices including Dakota County Ordinance 110 and a Household Hazardous Waste Management Plan.

Groundwater Monitoring System

There are no changes to PBL's groundwater monitoring system.

Groundwater samples are collected from 22 monitoring wells located upgradient and downgradient from the landfill and two springs located downgradient from the landfill. Groundwater monitoring of flow direction and quality has been ongoing since the landfill began operating in 1971. Routine monitoring is conducted on a quarterly basis to facilitate the detection of releases to groundwater from the landfill in accordance with a sampling and analysis plan (SAP). The SAP establishes sampling methodologies, analytes, and quality assurance/quality control procedures. The SAP also provides for contingencies to increase monitoring intervals if certain water-quality levels are exceeded. Based on the contingency monitoring results, corrective action may be required.

Groundwater flows approximately southwest to northeast underneath the landfill, becoming primarily easterly along the northeast edge of the Crosby-American demolition landfill area located immediately north of PBL. The depth to the groundwater is considerable (over 100 feet in some locations). The water table is in glacial drift. Monitoring wells are completed both shallow and deep in the glacial drift and in the Prairie du Chien Group (limestone).

Groundwater underneath the site eventually discharges into the Mississippi River, east of PBL.

Leachate Recirculation

PBL is not proposing changes regarding potential future leachate recirculation.

If implemented, leachate would be performed over lined areas of PBL as described in the November 2013 Application. The leachate would be sprayed onto the waste working surface via tanker truck.

Solid Waste Composting

Solid waste composting was previously proposed as a January 2014 addendum to PBL's November 2013 Application.

City recommendations to model the potential odor and other air emissions from the proposed composting operation were not performed by PBL during the 2013 MPCA permitting process. However, based on discussions between the City and PBL and Republic Services' July 31, 2014, letter to the City, the City agreed that air quality modeling can be delayed until such time as PBL is ready to begin implementing plans to construct the organic waste compost facility. City approval is needed prior to SSOM composting implementation.

PBL has indicated that they intend to evaluate solid waste composting in the future and that it would be regulated by the MPCA and local governments including the City.

Liner and Leachate Collection System Design

The liner and leachate collection system for Phase 6 has been installed and only the liner and leachate system for one cell in Phase 5 (Cell 5F-2 at the location of existing landfill office and other infrastructure) remains to be installed. Phase 7 waste would be placed over Phase 6 which partially lies on top of the old unlined waste deposit.

Barr's review of the Liner and Leachate Collection System Design had an emphasis on consideration of construction of the system on top of the old unlined waste deposit. Barr's review was concentrated on differential settlement regarding the liner system, leachate collection system, slope stability, and liner penetrations for gas recovery and leachate collection and piping.

PBL adequately responded to Barr's review recommendations and revised the MPCA permit application via the three memoranda prepare by Stantec.

Final Cover Design

Barr's review of the final cover design was concentrated on differential settlement regarding the cover system and surface water drainage system, slope stability, and liner penetrations for the gas and leachate system components.

PBL adequately responded to Barr's review recommendations and revised the MPCA permit application via the three memoranda prepare by Stantec.

Closure, Post Closure, Contingency Action, and Operations and Maintenance Plans

These plans do not have any significant changes from the August 2015 MPCA permit application.

Barr developed review recommendations related to closure phasing and closure acreages and the closure cost estimate used for financial assurance.

PBL adequately responded to Barr's review recommendations and revised the MPCA permit application via the three memoranda prepare by Stantec.

Financial Assurance Cost Estimates

The MPCA requires financial assurance for all mixed municipal solid waste landfills in Minnesota, including PBL. Financial assurance is intended to provide funds for closure, post-closure, and contingency action activities if the landfill owner goes out of business.

In response to Barr review recommendations, PBL adequately adjusted the financial assurance cost estimates and revised the MPCA permit application via the three memoranda prepare by Stantec.

In addition to the \$643,631 bond that PBL has with Dakota County, the 2024 MPCA financial assurance estimates are:

Closure	\$15,375,408
Postclosure	\$9,175,254
Contingency Action	<u>\$1,163,414</u>
total	\$25,714,076

Additional Recommended NCUC/CUP/Ordinance Modifications

In addition to the recommended NCUC/CUP/Ordinance modifications discussed above, additional modifications are recommended as discussed below.

The 2018 NCUC Amendment amended the 1995 NCUC, Exhibit D to include the 28 permit design plan sheets included with the 2018 City Application.

Recommended NCUC/CUP/Ordinance modifications:

- New NCUC Amendment:
 - Add reference to the 2018 NCUC Amendment to the "Whereas" section.
 - Add the Appendix B Plan Sheets and Appendix D Stormwater Management Model and Calculations from the Revised July 2024 City Application to NCUC Exhibit D.
- New CUP:
 - Add the 2018 CUP (whereas section).
 - Add the Revised July 2024 City Application to item number 3.
 - Add the Revised July 2024 City Application to item number 4.
 - Complete the reference to the 2018 NCUC Amendment to item number 5.k.
 - Add new NCUC Amendment to item number 5.
 - Add the Phase 7 expansion to item number 6.
 - Update item number 10 to show hours of waste received to be Monday through Saturday 6:00 AM to 4:00 PM and Sunday 7:00 AM to 3:00 PM.

- Update item number 11 to reference the May 31, 2019 MPCA Permit Modification.
 - Remove the reference to February 1 annual report due date in items 12.a and 12.b.
 - Add requirement to install pumps in the pumping stations in item 12.b.vii.
 - Update item number 13 to reference the May 31, 2019 MPCA Permit Modification
 - Delete item number 15
- Ordinance Amendment to City Code Section 10-13E-6:
 - Delete item J related to the limit of surface area limitation of the landfill final cover

Key Environmental-Related Considerations

Key environmental-related considerations related to the Phase 7 expansion are:

- Potential negative impacts would be increased visibility from nearby properties, and potential increase in litter and odor due to the proposed increased landfill height.
- Landfill gas is currently collected, cleaned, and conveyed into a nearby natural gas pipeline. Additional landfill gas generated by the increase waste disposal would increase the quantity of gas supplied to the natural gas pipeline and therefore would be an environmental benefit, assuming the existing operation has the capacity to process additional gas.
- It is not expected that offsite subsurface migration of landfill gas would increase with the proposed Phase 7 expansion because it is believed that the source of the subsurface gas is waste in the old unlined area, however the issue of how to reduce or mitigate the existing subsurface gas migration remains.
- There is a potential negative environmental impact to surface water because the proposed Phase 7 expansion includes an increase in the amount of 3:1 (horizontal:vertical) sideslopes that will increase the rate of surface water runoff and potentially increase the amount of erosion on the sideslopes. However, these potential negative environmental impacts are mitigated with the proposed final cover and stormwater management systems that are designed to accommodate the steeper sideslopes.

Summary and Conclusions

The City, with Barr's assistance, performed an extensive technical review of the June 2022 Application and September 2022 Addendum. PBL responded to the City/Barr review with application modifications which were deemed to be adequate.

The four major technical topics (waste capacity, groundwater quality and trends, surface water, and gas migration) are discussed above and require some modifications to the NCUC, CUP, and Ordinance. Additional NCUC, CUP, and Ordinance recommendations not related to the four major topics are also provided above.

Environmental considerations related to the proposed Phase 7 expansion (additional natural gas generation), increased visibility and potential for increased litter and odor are identified and discussed above.

Given PBL's adequate application modifications in response to the City/Barr technical review and the potential environmental benefit from the Phase 7 expansion, Barr believes the proposed Phase 7 expansion is reasonable and appropriate because:

- The type of waste being accepted does not change,
- The benefit of increased natural gas production
- The potential increase in odor and litter due to increased height and can be minimized by keeping the open working waste area as small as practicable and diligent litter prevention and cleanup
- Increased visibility is a concern for residential properties located north/northwest from PBL. Property owners in other directions are mostly non-residential and therefore the increased visibility would not be expected to negatively impact those property owners. The landfill height increase would occur gradually and thereby negative visual impact to nearby residents would hopefully be acceptable.
- Potential negative impacts to surface water are mitigated with the final cover system and surface water management design and management.

Sincerely,

A handwritten signature in black ink, appearing to read "Jeff Ubl". The signature is fluid and cursive, with the first name "Jeff" and last name "Ubl" clearly distinguishable.

Jeff Ubl, P.E

List of References

Sequencing Ordinance for Dakota County Ordinance 119, amended March 25, 1997 relating to need for city or township approval prior to County processing the license

Request for Major Modification of Permit #SW-45", prepared by Stantec Consulting Services Inc. (Stantec), dated June 2, 2022, including the addendum dated September 15, 2022 (June 2022 Application and September 2022 Addendum).

City of Inver Grove Heights review recommendations letter dated November 28, 2023

City of Inver Grove Heights comment letter on draft Environmental Assessment Worksheet (EAW) for Request for Major Modification of MPCA Permit #SW-45 dated November 28, 2023

Stantec Consulting Services Inc. recommendations response memorandum dated February 12, 2024

MPCA Findings of Fact, Conclusions of Law, and Order for a Negative Declaration on the need for an Environmental Impact Statement on the Pine Bend Landfill Vertical Expansion Project including response to comments on the Environmental Assessment Worksheet dated March 1, 2024

City of Inver Grove Heights review recommendations letter dated April 5, 2024

Stantec Consulting Services Inc. recommendations response memorandum dated April 12, 2024

City of Inver Grove Heights review recommendations letter dated April 23, 2024

Stantec Consulting Services Inc. recommendations response memorandum dated April 29, 2024

City of Inver Grove Heights review recommendations letter dated May 22, 2024

Application Submittal to the City of Inver Grove Heights for the Pine Bend Landfill – Phase 7 Development," prepared by Stantec Consulting Services Inc., dated Revised July 2024 (Revised July 2024 City Application)

Minnesota Statute 116.07, Subd. 4j relating to need for local government approval prior to MPCA permit issuance