MINNEHAHA CREEK
WATERSHED DISTRICT
QUALITY OF WATER, QUALITY OF LIFE

Meeting: Board of Managers
Meeting date: 2/26/2026
Agenda Item #: 10.1
Item type: Permit

Title:	Permit #25-599: Montgomerie Avenue Infiltration Basin Variance and Permit
Applicant:	Calvary Lutheran Church
Prepared by:	Name: Jenna Christenson Phone: (952) 641-4504 jchristenson@minnehahacreek.org

Recommendation:
Approval of Minnehaha Creek Watershed District (MCWD) permit application #25-599 in accordance with the submitted plans and the following condition:

- Applicant must submit a maintenance instrument for stormwater management facility maintenance for MCWD review and, after MCWD approval, file for registration with Hennepin County.

Summary and Background:
Project Location and Hydrology:
The project area is located at 18360 Minnetonka Boulevard and within adjacent public right-of-way (ROW) in the City of Deephaven. The project drains approximately 5.6 acres within the Lake Minnetonka Subwatershed. Runoff from the site and surrounding areas is conveyed via storm sewer infrastructure to an outlet discharging west to Lake Louise, which flows into Robinson's Bay, part of Lake Minnetonka. Under existing conditions, stormwater from the contributing drainage area is conveyed through this system with minimal treatment, and no volume control, contributing to localized flooding, and the delivery of untreated runoff to receiving waters. The Calvary Church property contains an existing riprap Best Management Practice (BMP) designed to collect runoff from the site, and promote the settling of suspended sediments; however, this practice does not provide stormwater management for runoff originating from the surrounding subwatershed.

Project Purpose and Scope:
The City of Deephaven, in coordination with Calvary Lutheran Church (Applicant), proposes to install a stormwater infiltration basin on the Applicant's property to reduce localized flooding and improve water quality. Construction of the infiltration basin requires reconfiguring on-site parking, reducing the existing approximately 34-36 parking stalls to about 20 stalls. To partially offset this reduction, a smaller parking area consisting of approximately 8-10 stalls is proposed to the northeast of the church. The proposed improvements are projected to reduce phosphorus loading into Lake Louise by an estimated 5.7 pounds per year and remove approximately 1,034.2 pounds per year of total suspended solids (TSS).

Regulatory Framework:
The MCWD's Erosion Control and Stormwater Management Rules apply to the project. MCWD permitting staff and District Engineer have reviewed the Project and find that it meets the applicable MCWD rules except for Section 6 of the Stormwater Management rule, from which the Applicant is seeking a variance. The application is before the Board of Managers because it is receiving funding through MCWD's Land and Water Partnership Program, and because a variance is required.

MCWD Rule Analysis:

Erosion Control Rule:

MCWD's Erosion Control Rule applies to projects that propose to disturb more than 5,000 square feet of ground surface or move 50 cubic yards or more of material. The Project proposes to disturb 30,200 square feet as well as both excavate and fill using 700 cubic yards of material; therefore, the rule is applicable. The Project proposes an Erosion Control Plan, shown on page 7 of Attachment B. This plan includes sod for permanent stabilization, a rock construction entrance, perimeter control downgradient of proposed work, inlet protection, and erosion control blankets to temporarily stabilize exposed soils. Staff have reviewed the permit application and have found it to be complete and compliant with all Erosion Control Rule requirements.

Stormwater Management Rule:

MCWD's Stormwater Management Rule applies to development based on site size, extent of disturbance, and changes in impervious surface, as outlined in Table 1 of the rule. The Project is located on a 3.04-acre site, will disturb less than 40 percent of the site, and will result in a net decrease of 0.46% of impervious surface. Under these conditions, the rule requires incorporation of a stormwater best management practice (BMP). Staff and the District Engineer have reviewed the permit application and find it to be complete and compliant with all applicable Stormwater Management Rule requirements, except for section 6, for which the applicant seeks a variance.

The proposed Project's primary purpose is to install an infiltration basin to reduce nutrient loading and local flooding; this practice also satisfies the BMP required by the Stormwater Management Rule. The Applicant proposes to construct an aboveground infiltration basin to the north of the church and to the east of the parking lot. The infiltration basin is designed to receive runoff from the full 5.6 acre contributing drainage area, including both on-site and off-site areas. Of this drainage area, approximately 127,630 square feet of impervious surface in the proposed condition will be treated. Pretreatment of runoff will be provided by a riprap swale and vegetated filter strip prior to infiltration. The practice provides water quality and volume reduction benefits that exceed minimum rule requirements.

Volume Control:

As outlined in Table 1 of the rule, volume control is not required for this project due to the site size, limited extent of disturbance, and net decrease in impervious surface. Although not required, the Applicant proposes to construct an infiltration basin that provides runoff volume abstraction. For comparison, if the project were subject to volume control standards applicable to larger developments, it would be required to treat one inch of runoff from the site's contributing impervious surface area. Based on the contributing impervious area of 127,630 square feet, this would equate to approximately 10,635 cubic feet of storage. The proposed infiltration basin provides approximately 16,904 cubic feet of storage, exceeding that benchmark and further reducing runoff volume.

Water Quality:

Although phosphorus control is not specifically required, the proposed infiltration basin is designed to provide water quality benefits through volume abstraction and pollutant removal. The infiltration practice is estimated to reduce total phosphorus (TP) loading to Lake Louise by approximately 5.7 pounds per year. This reduction is achieved through infiltration of runoff and pretreatment provided by the riprap swale and vegetated filter strip prior to the runoff entering the basin.

Rate Control:

As outlined in Table 1 of the Stormwater Management Rule, Rate Control is not required for this project due to the site size, extent of disturbance, and net decrease in impervious surface. Although rate control is not required, the proposed project does not increase peak runoff rates from the site. As described on page 6 of Attachment A, modeling demonstrates that post-project runoff rates during 2-year, 10-year, and 100-year design storm events would decrease compared to existing conditions. No increase in peak discharge is proposed at any point of site discharge; therefore the project meets rate control standards.

Freeboard Requirements:

Section 6 of the rule requires two feet of vertical separation between the 100-year high water elevation of a waterbody or stormwater practice and the low opening of any structure, unless the structure opening is hydraulically disconnected

from the waterbody or practice. The proposed project does not meet this requirement and the applicant requests a variance from this section of the rule, as explained in greater detail under the "Variance Request" section.

Section 7(b) of the rule also provides that there may be no increase in bounce for design storm events, no increase in inundation period for 1-year, 2-year, 10-year, and 100-year design storm events, and no permitted runout control elevation changes. The proposed project conforms to all of these standards.

Section 10(c) of the rule requires that the property owner file a maintenance declaration on the deed establishing perpetual maintenance for the stormwater facilities. This agreement has been recommended as a condition for permit issuance.

Variance Request:
Under the Variances and Exceptions Rule, an applicant requesting a variance must demonstrate that strict compliance with an identified provision of the District rules creates a practical difficulty as a result of unusual features of the property or its setting. The Board of Managers, in its judgment, will decide whether a practical difficulty has been shown, and whether a variance to relieve this practical difficulty may be granted. The District's Variance rule states that the Board's decision whether to grant a variance will rest on the following:

1. The cause of the difficulty, and whether the applicant played a role in creating it;
2. Whether the proposal reasonably may be modified to avoid the need for a variance, or there otherwise is a practical way to avoid the difficulty
3. The extent to which the applicant seeks to diverge from the rule, and the extent to which the divergence would cause impact to water resources; and
4. Whether the variance would shift a burden to a neighboring property or to the broader public.

Practical Difficulty:
The cause of the difficulty resulting in the variance request is a combination of the site's existing drainage patterns and topography, the low opening elevation of the existing house located at 3525 Montgomerie Avenue, and regulatory requirements from MCWD. The proposed infiltration basin is located upgradient from and at a higher elevation than the surrounding homes on Montgomerie Avenue. Because the basin is situated above these structures, achieving two feet of vertical separation between the 100-year high water level of the basin and the low opening of the adjacent residence at 3525 Montgomerie Avenue is not feasible without substantially altering existing drainage patterns. These conditions reflect existing site constraints and surrounding development and are not the result of actions taken by the Applicant.

Rule Divergence:
Section 6 of the Stormwater Management rule states that "there must be two feet of vertical separation between the 100-year high water elevation of a waterbody or stormwater practice and the low opening of any structure, unless the structure opening is hydraulically disconnected from the waterbody or practice". The proposed 100-year high water elevation of the basin is 972.8 ft, while the low opening elevation of the existing residence at 3525 Montgomerie Avenue is 969.8 ft. Because the basin is located upgradient from and at a higher elevation than the residence, compliance with the two-foot separation standard is not feasible. In these circumstances, District review focuses on whether the stormwater practice is hydraulically disconnected from nearby structures. The Applicant has proposed a berm at 973 ft containing the 100-year HWL of the basin and routing the overflow to the northwest corner of the parking lot into the 972.2 ft emergency overflow (EOF) path. The EOF is then directed west until it reaches the east side of Montgomerie Avenue as it leaves the site. The Project reduces discharge rates and volumes of water prior to leaving the site. As the overflow continues down the east side of Montgomerie Avenue, it reaches a low point which outlets through a catch basin at 967.8 ft, and overtops the road in larger events at 968.2 ft. Although analysis indicates that roadway overtopping would occur at a lower elevation before runoff could reach the 969.8 ft low opening elevation of the residence, the off-site patterns do not present adequate hydraulic disconnection as there is no physical barrier blocking flow from reaching the low opening of the home. While the Project does not meet the freeboard or hydraulic disconnection requirements of Section 6, the roadway acts as a longitudinal weir controlling overflow. The separation between the low opening of the residence and the roadway overflow point is approximately 1.6 feet. Additionally, a

graded swale along the northwest portion of the residential property would direct any water away from the low opening of the residence. These factors, coupled with the fact that the Project decreases flood risk from the existing condition represents a minimal departure from the rule and maintains the rule's intent to protect structures from flooding.

Variance Avoidance:
Site constraints significantly limit feasible alternatives to avoid the requested variance. The Project site is situated at elevations higher than those of adjacent parcels. To meet the two-foot freeboard requirement of the Stormwater Management Rule, the basin's 100-year high water elevation would need to be lowered substantially. Achieving this would require extensive additional excavation, in amounts which are not practicable. Alternatively, expanding the basin footprint to lower the 100-year elevation would result in the loss of necessary parking area for Calvary Church, creating undue impacts to the function of the property. Establishing hydraulic disconnection through the construction of a physical berm was also evaluated. However, the northern side of the residential property receives a large portion of the drainage from the eastern and southeastern sides of the residence. Installation of a berm would obstruct this existing drainage pathway and likely increase flood risk to that property rather than reduce it. Based on these considerations, staff find that avoidance alternatives to achieve full compliance with the Stormwater Management Rule requirements are not feasible.

Burden to Others or Public:
The requested variance does not shift the burden onto any neighboring properties or to the public. Modeling demonstrates that the Project will reduce runoff volume and peak flows and will not increase the right-of-way outlet elevation during rainfall events, compared to existing conditions. The Project therefore represents an improvement in flood risk and water quality outcomes for surrounding properties.

The decision to grant a variance lies within the judgment of the Board of Managers. MCWD Staff and the District Engineer have reviewed the application and find that the proposed condition does not increase flood risk to adjacent properties. The need for the requested variance is due to existing site constraints, and the variance would allow implementation of a project that provides measurable water resource benefits.

Summary:
The Applicant has applied for a Minnehaha Creek Watershed District permit under the Erosion Control and Stormwater Management Rules. MCWD staff and District Engineer have evaluated the proposed impervious surface reconfiguration and infiltration basin and find that the Project meets all applicable MCWD rules except Section 6 of the Stormwater Management Rule, for which the applicant is requesting a variance. Staff and District Engineer have presented the technical basis for variance approval, which lies within the judgment of the Board of Managers.

Attachments:
A: Stormwater Report
B: Site Plans

ATTACHMENT A

City of Deephaven
Montgomerie Ave Drainage Improvements

Notice of Intent / Stormwater Management Report

December 18, 2025

Revised: January 16, 2026

Prepared for:

City of Deephaven
20225 Cottagewood Road
Deephaven, MN 55331

Prepared by:

Stantec
One Carlson Parkway North, Suite 100
Plymouth, MN 55447

Stantec Consulting Services Inc.
One Carlson Parkway North, Suite 100, Plymouth, MN 55447

Date Line
File: 193807469

Re: **MCWD Notice of Intent**

Montgomerie Ave Drainage Improvements

To Whom it May Concern,

On behalf of the City of Deephaven, thank you for the opportunity to submit the Notice of Intent for the Montgomerie Avenue Drainage Improvements. The City of Deephaven is excited to undertake this regionally beneficial stormwater project.

Regards,

Stantec Consulting Services Inc.

Steven Hegland P.E.
City Engineer

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1.0 STATEMENT OF INTENT

The City of Deephaven is proposing to install a stormwater infiltration basin (BMP) on a portion of the Calvary Church property. The project is proposing to relocate to a smaller footprint the lower parking lot and install an infiltration stormwater basin east and south of the relocated parking area. The existing lower parking area, which has approximately 34 to 36 stalls, would lose approximately 14 to 16 stalls. An additional parking area for approximately 8-10 stalls would be added to the northeast of the church. The purpose of the BMP is to alleviate sudden, severe flooding in the areas surrounding the church during rainfall events and provide cost effective water quality benefits to downstream waters.

Hydraulic and hydrologic (H&H) modeling and water quality modeling were done to determine feasibility for the project. It is estimated that the infiltration basin will be able to remove 5.7 pounds of total phosphorus (TP) and 1034.2 pounds of total suspended solids (TSS) per year.

The partnership efforts of the project so far have strengthened relationships between the City, Calvary Church, the MCWD, and Hennepin County. Through these partnerships, the project's goals have been refined to include lighting improvements for community events and safety and an educational interpretive sign.

The City has received financial commitments for the project from various sources and believes the revised approach meets the original water quality goals of the project and provides mitigation to the downstream impacts from this watershed. The project currently has funding support from Hennepin County in the amount of $45,034, from MCWD in the amount of $125,000 and BWSR in the amount of $200,000.

2.0 EXISTING DRAINAGE CONDITIONS

This project is located within the Lake Minnetonka subwatershed of the MCWD. The 5.4-acre drainage area to the project location consists of several residential properties, the Calvary Church property, and City streets.

Runoff from Calvary Church and surrounding areas collects at a low point on Montgomerie Avenue with one inlet and a 12" pipe crossing the roadway, the runoff then goes west and northwest through existing yards, through a 15" HDPE storm sewer pipe running under a driveway, and finally connecting to the City's public storm sewer manhole on Hamilton Avenue. This untreated stormwater ultimately discharges into Lake Louise, which is upstream of Lake Minnetonka.

The current conditions cause large amounts of water to pool in the roadway on Montgomerie Avenue and cause significant concerns for property owners downstream due to the volume and frequency of the runoff. Montgomerie Avenue storm sewer is non-typical; the inlet appears to be custom-made and is significantly smaller than a standard inlet grate. The pipe under the roadway is also shallower than a typical storm sewer culvert so in many events the runoff collects and overtops the roadway before it drains downstream as it had historically done.

There is an existing riprap BMP located on the Calvary Church property. It was designed to collect runoff from the church property, allow suspended sediment to settle, and direct conveyance away from existing

side yards. This channel was designed to provide a collection point for sediment from the church lot and is not a volume reduction BMP and has minimal impacts on the downstream properties.

Additionally, the existing residential lot to the north of the church parking lot has a small stormwater BMP that was required of the City as part of the CUP process for the lot. The BMP will remain in place and is ongoing maintenance is the responsibility of the property owner.

Figure 1 is attached to this report showing the existing drainage areas.

3.0 HYDROLOGIC AND HYDRAULIC MODELING

3.1 RATE CONTROL

HydroCAD was used for feasibility-level Hydraulic and Hydrologic (H&H) modeling of the project. The HydroCAD report is included in (Appendix A**)**. As more detailed information becomes available during the final design of the project, the HydroCAD model will be updated accordingly. Updated modeling calculations will be sent to the MCWD as the design is refined and through the permitting portion of the LWP program.

There is an existing riprap BMP located on the Calvary Church property. It was designed to collect runoff from the site, allow suspended sediment to settle, and direct conveyance away from existing side yard . It is modeled in both HydroCAD models as 'Riprap BMP (existing)'. It is not a volume reduction BMP and has a small footprint, so its ability to significantly address flooding and water quality issues downstream has been minimal.

The reconstructed parking lot and the proposed aboveground infiltration basin, which will be located north of the church and to the east of the parking lot, will capture on-site and off-site drainage as shown in the proposed drainage in Figure 2. Water will be collected and routed to the BMP as shown in Figure 3 of this report. Existing grade and infiltration capacity at the site are anticipated to accommodate an infiltration basin. The water quality is 16,904 cubic feet between the outlet elevation of the system (971.2') and the bottom of the basin at elevation 968.0', which is mediated by an outlet control structure.

A summary of existing versus proposed offsite rates is presented in the table below. The reported rates are at the point of discharge to the west of Montgomerie Avenue represented by node/link 1L in the HydroCAD models.

Offsite Rate Control Summary (Node 1L)

	2-year	10-year	100-year
Existing Rate (CFS)	*12.50*	*18.67*	*35.20*
Proposed Rate (CFS)	*4.61*	*9.64*	*34.06*

The existing inlet and 12" pipe beneath Montgomerie Avenue are undersized for the 10-year event such that water overflows via the single catch basin inlet out to the ditch west of Montgomerie. *In addition, the models demonstrate a 0.01' decrease in the 100-year HWL at the Montgomerie low point, Pond 1P, which includes the proposed replacement of the storm sewer, and also maintaining the road overtopping*

to the west ditch which occurs at 968.2. The HWL in the existing conditions at the low point is 968.66. The HWL in the proposed conditions at the low point is 968.65.

3.2 WATER QUALITY

Water quality modeling was done via the MIDS Calculator; a report of results is shown in (Appendix B). The MIDS Calculator was selected for water quality modeling in this project due to its ability to conveniently summarize removals on an annual basis, its applicability to the site's watershed's size and complexity, and its intended use for low impact development techniques such as this project's infiltration system. This TP reduction does not seek to meet any regulatory requirement by the MCWD Stormwater Management Rule.

The following table summarizes the water quality results from MIDS of the proposed infiltration system which is estimated to provide 5.4 lbs/yr of Phosphorus removal and 973.8 lbs/yr of TSS removal.

Load Reduction Estimates

	Load from watershed (lbs/yr)	Load retained in BMP (lbs/yr)	Outflow load (lbs/yr)	Retained %
TP	**5.82**	**5.69**	**0.13**	**98%**
Dissolved P	**2.62**	**2.56**	**0.06**	**98%**
Particulate P	**3.20**	**3.13**	**0.07**	**98%**
TSS	**1058.0**	**1034.2**	**23.8**	**98%**

3.3 VOLUME ABSTRACTION

An infiltration basin has been modeled as Pond 2P in the proposed HydroCAD model, see (Appendix A). Existing grade and infiltration capacity will accommodate an infiltration basin based on the presence of sandy soils designated as Hydrologic Soil Group Type A with an assumed infiltration rate of 0.80 in/hr based on the Minnesota Stormwater Manual. The bottom of the basin is at elevation 968.0', and the water quality elevation is set at 971.2' which provides 3.2' of infiltration drawdown depth. This depth meets the 48 hour drawdown requirement demonstrated by the below calculation:

$$Drawdown\ Time = \frac{3.2\ ft}{0.8\ \frac{in}{hr} * \frac{1\ ft}{12\ in}} = \frac{3.2\ ft}{0.067\ ft/hr} = 48\ hrs$$

The total volume of abstraction provided by the system (below the outlet, 971.2') is 16,904 cubic feet. This calculation is supported by the HydroCAD stage-storage table for node 2P in (Appendix A).

4.0 COST ANALYSIS

4.1 CAPITAL COSTS

The total capital cost for this project is estimated to be approximately $543,873. This total includes the infiltration system, addition of inlets and storm sewer, improvements to the drainage swale, surface lot improvements, lighting, and interpretive signage. The construction contingency, permitting and legal costs, and indirect costs are included in the project total as a percentage of the estimated construction cost (in accordance with MCWD's LWP Guidance). These costs are presented in the summary table below; a detailed Opinion of Probable Cost (OPC) with major project components is provided in Appendix C.

Estimated Construction Cost	$319,925
Contingency (1)	$95,978
Legal, Eng, Admin (1)	$95,977
Permitting (1)	31,993
Total Project Costs	**$543,873**

(1) Per WCWD Guidance

As seen in the OPC and summary table above, the water quality project capital cost total is $525,000. Water quality components were identified to be critical components of the design that will support the function of the infiltration basin (including respective construction contingency, permitting and legal, and indirect costs). Items not considered to be water quality components include the lighting and interpretive sign. This distinction is important; in accordance with MCWD guidance, the lifecycle cost/benefit analysis only considers the water quality components when calculating cost per pound of TP removed over the project's 25-year lifecycle.

4.2 LIFECYCLE COSTS

Annual maintenance costs are estimated to be approximately $1,500 per year.

Per the MCWD's LWP Partner Guidance, components of the project that are not directly related to or required to successfully implement the project have been itemized and excluded from the capital cost total that is used in the lifecycle cost calculation. Only schedules A through D in the OPC ($525,000) are used in this calculation. Using an annual inflation rate of 2.3 percent and an annual discount rate of 3.5 percent, the total present worth of costs within the 25-year lifecycle of the system is $557,338. This calculation is detailed in the following table. It is assumed that no maintenance will be needed in the first year.

Lifecycle Cost Calculator

Water Quality Componenets		Age	Year	Present Worth
Inputs		0	2025	$ 525,000.00
Start Year	2025	1	2026	$ 1,482.61
Annual Inflation	2.30%	2	2027	$ 1,465.42
Annual Discount Rate	3.50%	3	2028	$ 1,448.43
Capital Cost (year 0)	$ 525,000.00	4	2029	$ 1,431.64
Annual Cost	$ 1,500.00	5	2030	$ 1,415.04
		6	2031	$ 1,398.63
		7	2032	$ 1,382.41
		8	2033	$ 1,366.39
		9	2034	$ 1,350.54
		10	2035	$ 1,334.89
		11	2036	$ 1,319.41
		12	2037	$ 1,304.11
		13	2038	$ 1,288.99
		14	2039	$ 1,274.05
		15	2040	$ 1,259.27
		16	2041	$ 1,244.67
		17	2042	$ 1,230.24
		18	2043	$ 1,215.98
		19	2044	$ 1,201.88
		20	2045	$ 1,187.95
		21	2046	$ 1,174.17
		22	2047	$ 1,160.56
		23	2048	$ 1,147.10
		24	2049	$ 1,133.80
		25	2050	$ 1,120.66
		Total Present Worth		$ 557,338.85

The project is estimated to remove 5.7 lb TP/yr over an assumed lifecycle of 25 years. The lifecycle cost is $557,338; therefore, the cost/benefit is $3,911/lb TP over the project's lifecycle.

5.0 OPERATIONS AND MAINTENANCE COSTS

The City and Calvary Church will enter into a maintenance agreement for the system; the City will be responsible for long-term maintenance of the system.

This site will be added to the City's list of stormwater maintenance facilities. For annual maintenance requirements and less-frequent major maintenance, the City will comply with best management practices as recommended by the Minnesota Stormwater Manual.

- As needed
  - Prune and weed to maintain appearance
  - Stabilize or replace mulch when erosion is evident
  - Remove trash and debris

    - Replace vegetation whenever percent cover of acceptable vegetation falls below 90 percent or project specific performance requirements are not met. If vegetation suffers for no apparent reason, consult with horticulturist and/or test soil as needed
- Semi-annually
    - Inspect inflow and pretreatment systems for clogging (off-line systems) and remove any sediment
    - Inspect filter strip/grass channel for erosion or gullying. Sod as necessary
    - Herbaceous vegetation, trees and shrubs should be inspected to evaluate their health and replanted as appropriate to meet project goals
    - Remove any dead or severely diseased vegetation
- Annually in fall
    - Inspect and remove any sediment and debris build-up in pretreatment areas
    - Inspect inflow points and infiltration surface for buildup of road sand associated with spring melt period, remove as necessary, and replant areas that have been impacted by sand/salt build up
- Annually in spring
    - Cut back and remove previous year's plant material and remove accumulated leaves if needed (or controlled burn where appropriate)

For an above ground infiltration system, the annual maintenance will be much more achievable than previous alternatives which were considered. By simplifying the maintenance activities, it will help ensure that they are done on an annual basis and prolong the life of the BMP. The City understands that performing maintenance activities is critical to ensuring successful system functioning and reducing cost long-term.

The City will be able to self perform the bulk of the maintenance on the BMP and will consult with engineering and contractors as necessary on any maintenance activities which they are unable to perform.

Annual maintenance costs are estimated to be approximately $1,500 per year. The City plans to utilize funds from its stormwater funds to complete necessary maintenance over the system's lifecycle.

6.0 GEOTECHNICAL

An onsite geotechnical investigation was performed by WSB in May of 2024. A copy of the geotechnical report is provided in Appendix D.

The soil borings demonstrate the sand, SP, layer starting at elevation 967 to 966 in borings 2 and 3 respectively.

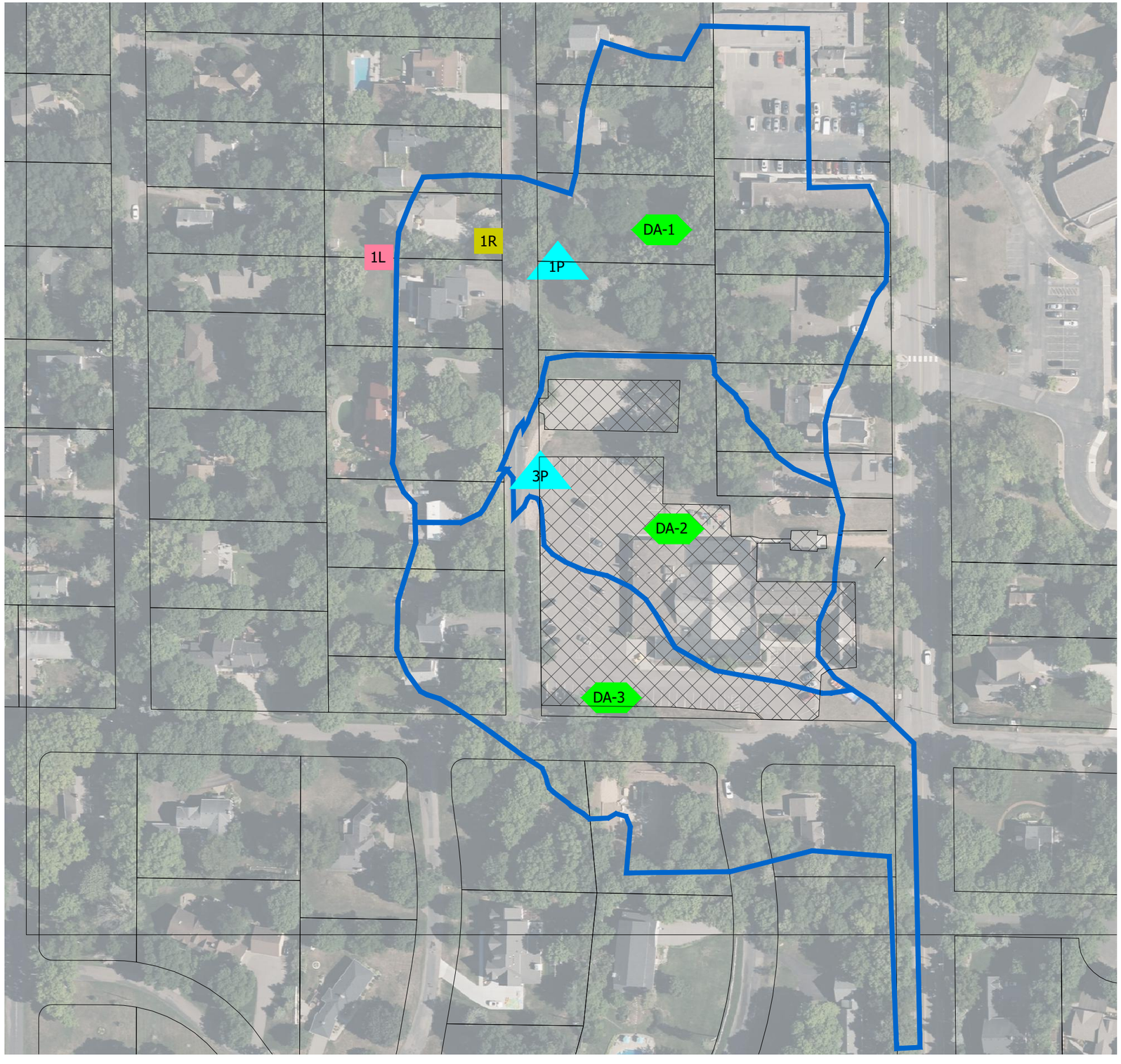
As a result, the project is planning to over-excavate and replace with engineered backfill to ensure the site remains adequate for infiltration.

7.0 PROJECT SCHEDULE

The City of Deephaven is excited for this project and would like to complete the proposed improvements in 2025 if possible to ensure that the City and stakeholders can capitalize on a shared vision for these improvements. We proposed the following schedule for the implementation of the project. With any project, schedules may be subject to change as additional information becomes available.

- August 2025: Complete NOI & feasibility for MCWD
- Fall/Winter 2025: Final design and public engagement
- Fall/Winter 2025: Permitting and agreements for both MCWD/Calvary
- Winter 2025: Project Bidding
- Spring 2026: Project Construction

Figure 1 Existing Drainage



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LEGEND

- HENNEPIN COUNTY PARCELS
- EXISTING STORM SEWER
- 901 EXISTING MINOR CONTOUR
- 900 EXISTING MAJOR CONTOUR
- DRAINAGE BOUNDARY
- IMPERVIOUS AREA

DRAINAGE AREA SUMMARY

	IMPERVIOUS	PERVIOUS	AREA SUBTOTAL
DA-1	1.3	1.8	3.1
DA-2	1.17	0.83	2
DA-3	1.61	1.69	3.3
OVERALL	4.08	4.32	8.4

IMPERVIOUS AREA SUMMARY

	Site Area	Impervious Area	Pervious Area
Existing	132,260.00	87,064.00	45,196.00
Proposed	132,260.00	86,666.00	45,594.00
Net	-	(398.00)	398.00

Stantec

733 MARQUETTE AVE
SUITE 1000
MINNEAPOLIS MN, 55402
PHONE: 612-712-2000
WWW.STANTEC.COM

CLIENT:

CITY OF DEEPHAVEN

20225 Cottagewood Road
Deephaven, MN 55331

PROJECT TITLE: CALVARY CHURCH STORMWATER
DEEPHAVEN, HENNEPIN COUNTY, MINNESOTA

ISSUE NO.:

DESCRIPTION:

DATE:

CERTIFICATION:

NOT FOR CONSTRUCTION

PROJECT NO.: 193807063

DWN BY: BRJ | CHK'D BY: | APP'D BY:

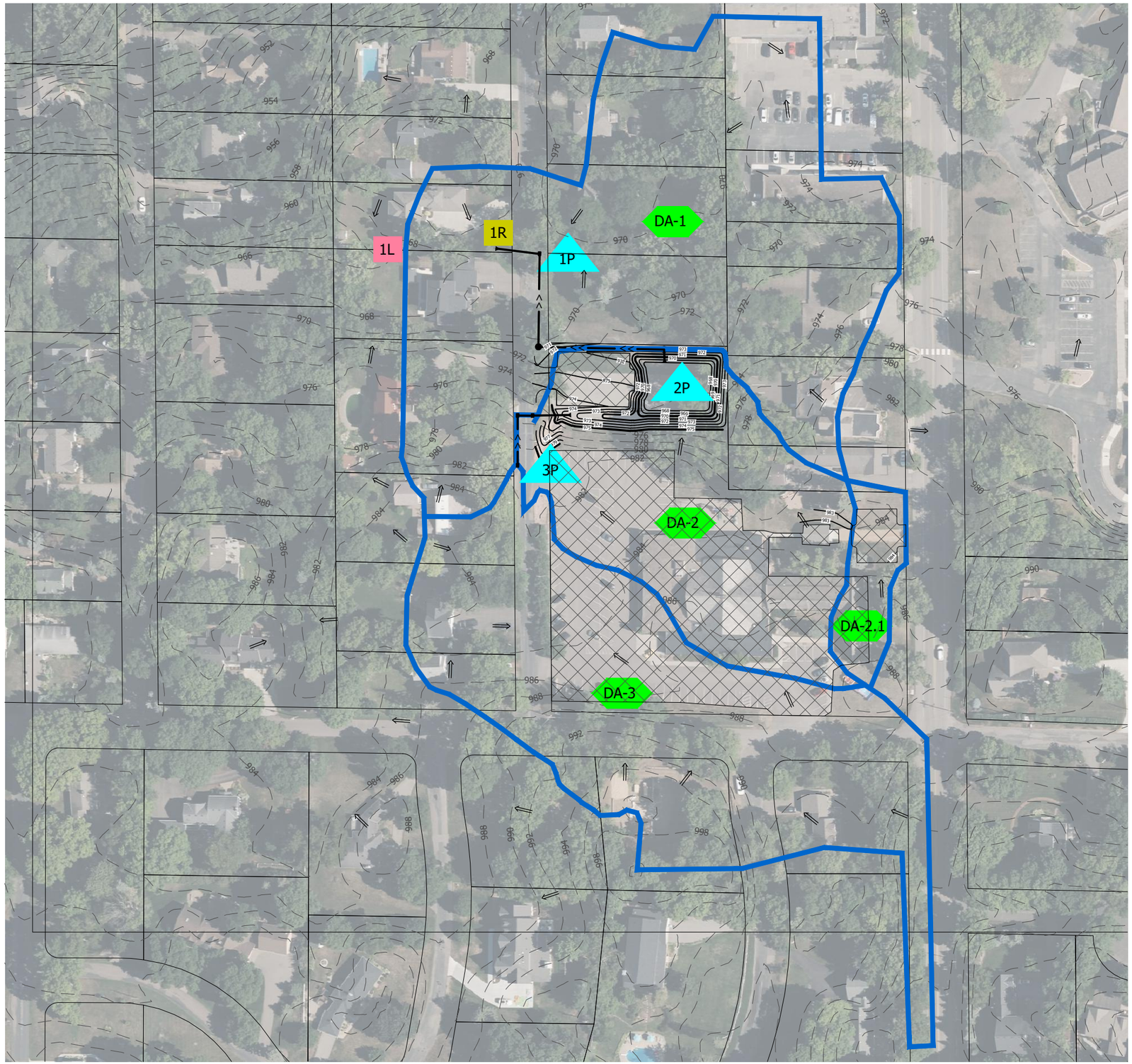
ISSUE DATE: 7/9/2025

ISSUE NO.: 1

SHEET TITLE: EXISTING DRAINAGE

SHEET NO.: EX-1

Figure 2 Proposed Drainage



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0 60' 120'

LEGEND

- HENNEPIN COUNTY PARCELS
- EXISTING STORM SEWER
- 901 EXISTING MINOR CONTOUR
- 900 EXISTING MAJOR CONTOUR
- DRAINAGE BOUNDARY
- PROPOSED STORM SEWER
- 901 PROPOSED MINOR CONTOUR
- 900 PROPOSED MAJOR CONTOUR
- IMPERVIOUS AREA

HYDROCAD DRAINAGE AREA SUMMARY

	IMPERVIOUS	PERVIOUS	AREA SUBTOTAL
DA-1	1.3	1.8	3.1
DA-2	1.16	0.84	2
DA-2.1	0.16	0.13	0.29
DA-3	1.61	1.69	3.3
OVERALL	4.23	4.46	8.69

MIDS DRAINAGE AREA SUMMARY

	IMPERVIOUS	PERVIOUS	AREA SUBTOTAL
DA-2	1.16	0.84	2
DA-2.1	0.16	0.13	0.29
DA-3	1.61	1.69	3.3
OVERALL	2.93	2.66	5.59

IMPERVIOUS AREA SUMMARY

	Site Area	Impervious Area	Pervious Area
Existing	132,260.00	87,064.00	45,196.00
Proposed	132,260.00	86,666.00	45,594.00
Net	-	(398.00)	398.00

Stantec
733 MARQUETTE AVE
SUITE 1000
MINNEAPOLIS MN, 55402
PHONE: 612-712-2000
WWW.STANTEC.COM

CLIENT:
Deephaven EST. 1888
CITY OF DEEPHAVEN
20225 Cottagewood Road
Deephaven, MN 55331

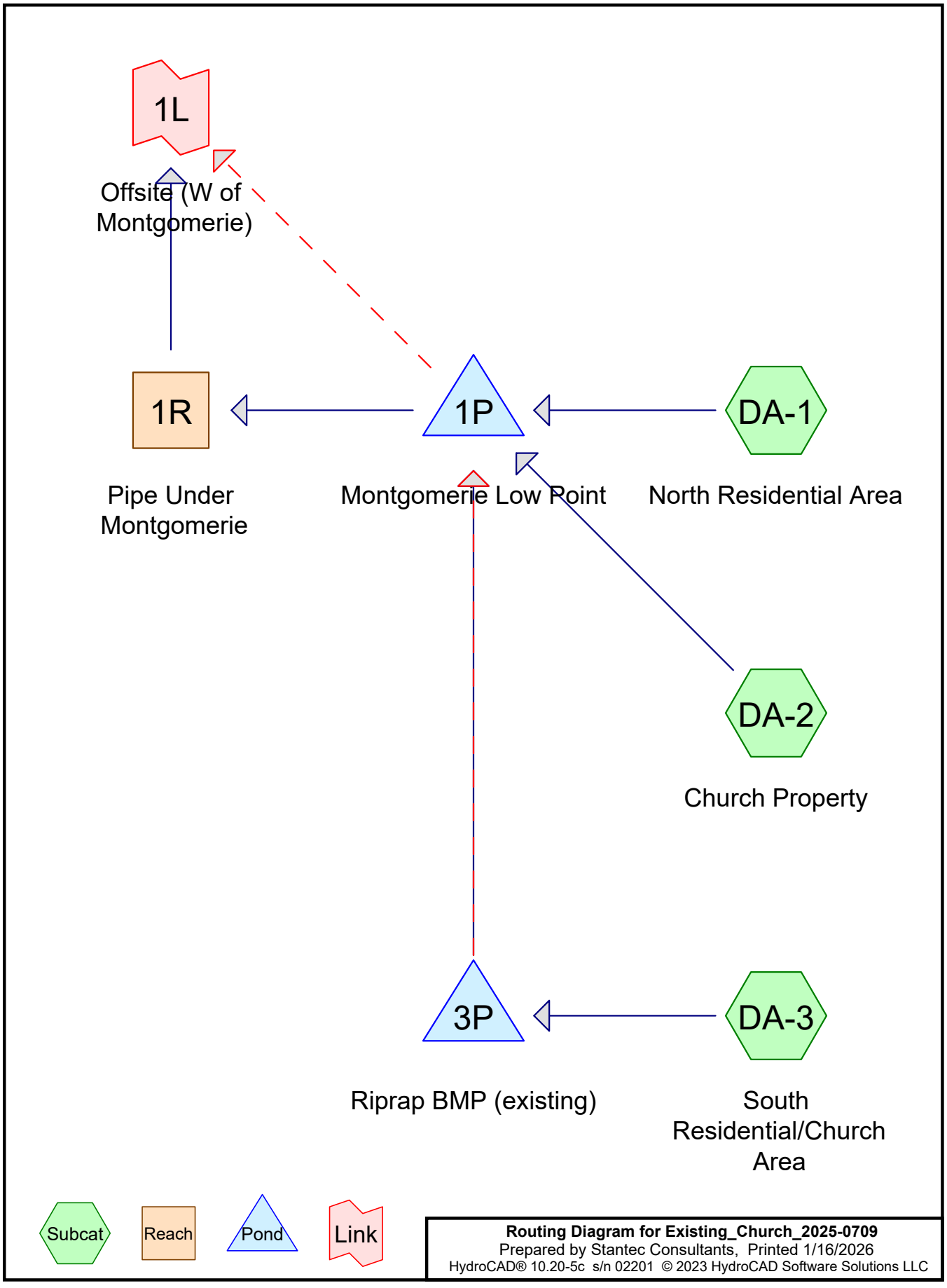
PROJECT TITLE: CALVARY CHURCH STORMWATER
DEEPHAVEN,
HENNEPIN COUNTY, MINNESOTA

ISSUE NO.:
DESCRIPTION:
DATE:

CERTIFICATION:
NOT FOR CONSTRUCTION

PROJECT NO.: 193807063
DWN BY: BRJ | CHK'D BY: | APP'D BY:
ISSUE DATE: 7/9/2025
ISSUE NO.: 1
SHEET TITLE: PROPOSED DRAINAGE
SHEET NO.: EX-2

Appendix A HydroCAD Reports



Routing Diagram for Existing_Church_2025-0709
Prepared by Stantec Consultants, Printed 1/16/2026

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 5327 MN Hennepin

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	MSE 24-hr	3	Default	24.00	1	2.86	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.26	2
3	100-Year	MSE 24-hr	3	Default	24.00	1	7.32	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.320	39	>75% Grass cover, Good, HSG A (DA-1, DA-2, DA-3)
4.080	98	Paved parking, HSG A (DA-1, DA-2, DA-3)
8.400	**68**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
8.400	HSG A	DA-1, DA-2, DA-3
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
8.400		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
4.320	0.000	0.000	0.000	0.000	4.320	>75% Grass cover, Good	DA-1, DA-2, DA-3
4.080	0.000	0.000	0.000	0.000	4.080	Paved parking	DA-1, DA-2, DA-3
8.400	**0.000**	**0.000**	**0.000**	**0.000**	**8.400**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1R	967.50	967.09	57.0	0.0072	0.012	0.0	15.0	0.0	
2	1P	966.48	965.93	40.0	0.0138	0.025	0.0	12.0	0.0	
3	3P	975.89	975.34	77.0	0.0071	0.013	0.0	12.0	0.0	

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA-1: North Residential Area Runoff Area=3.100 ac 41.94% Impervious Runoff Depth=1.10"
Tc=16.0 min CN=39/98 Runoff=3.84 cfs 0.285 af

Subcatchment DA-2: Church Property Runoff Area=2.000 ac 58.50% Impervious Runoff Depth=1.54"
Tc=16.0 min CN=39/98 Runoff=3.45 cfs 0.256 af

Subcatchment DA-3: South Runoff Area=3.300 ac 48.79% Impervious Runoff Depth=1.28"
Tc=10.0 min CN=39/98 Runoff=5.81 cfs 0.353 af

Reach 1R: Pipe Under Montgomerie Avg. Flow Depth=0.46' Max Vel=4.19 fps Inflow=1.72 cfs 0.548 af
15.0" Round Pipe n=0.012 L=57.0' S=0.0072 '/' Capacity=5.94 cfs Outflow=1.72 cfs 0.548 af

Pond 1P: Montgomerie Low Point Peak Elev=968.42' Storage=1,356 cf Inflow=12.58 cfs 0.894 af
Primary=1.72 cfs 0.548 af Secondary=10.78 cfs 0.346 af Outflow=12.50 cfs 0.894 af

Pond 3P: Riprap BMP (existing) Peak Elev=981.43' Storage=118 cf Inflow=5.81 cfs 0.353 af
Primary=5.79 cfs 0.353 af Secondary=0.00 cfs 0.000 af Outflow=5.79 cfs 0.353 af

Link 1L: Offsite (W of Montgomerie) Inflow=12.50 cfs 0.894 af
Primary=12.50 cfs 0.894 af

Total Runoff Area = 8.400 ac Runoff Volume = 0.894 af Average Runoff Depth = 1.28"
51.43% Pervious = 4.320 ac 48.57% Impervious = 4.080 ac

Summary for Subcatchment DA-1: North Residential Area

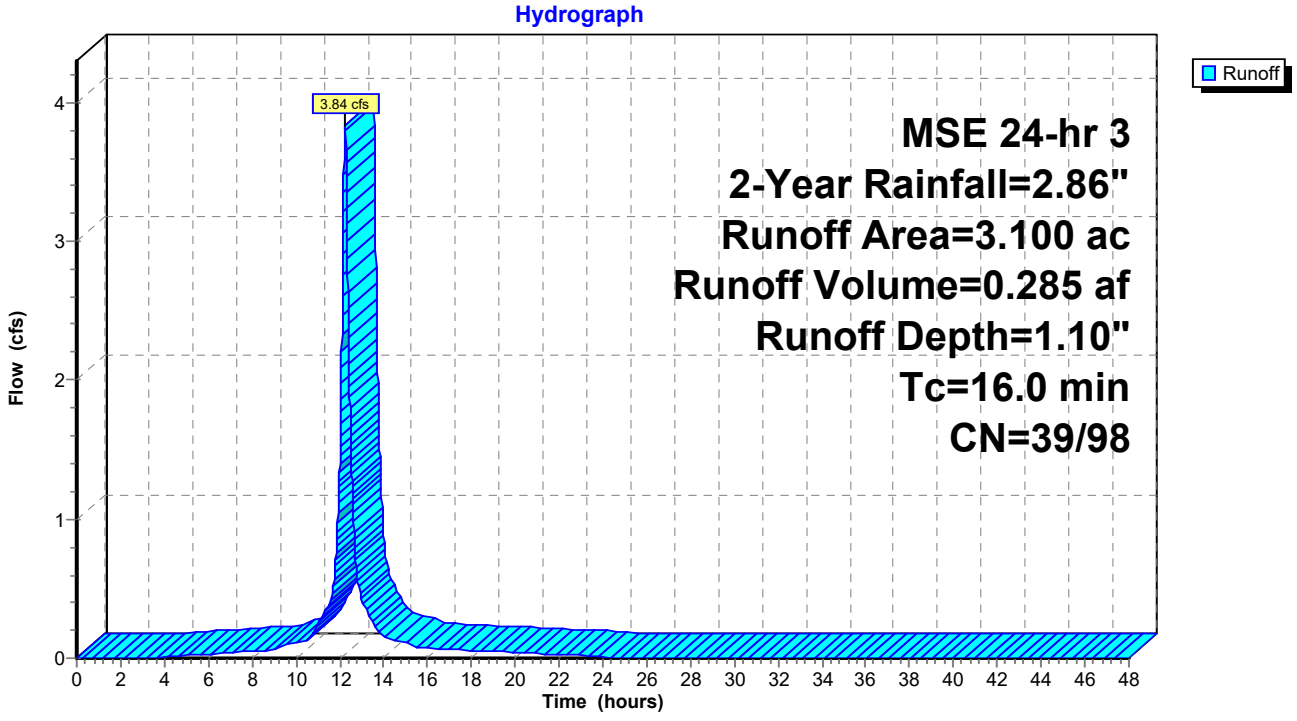
Runoff = 3.84 cfs @ 12.24 hrs, Volume= 0.285 af, Depth= 1.10"
Routed to Pond 1P : Montgomerie Low Point

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-48.00 hrs, dt= 0.01
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (ac)	CN	Description
1.300	98	Paved parking, HSG A
1.800	39	>75% Grass cover, Good, HSG A
3.100	64	Weighted Average
1.800	39	58.06% Pervious Area
1.300	98	41.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0					**Direct Entry,**

Subcatchment DA-1: North Residential Area



Summary for Subcatchment DA-2: Church Property

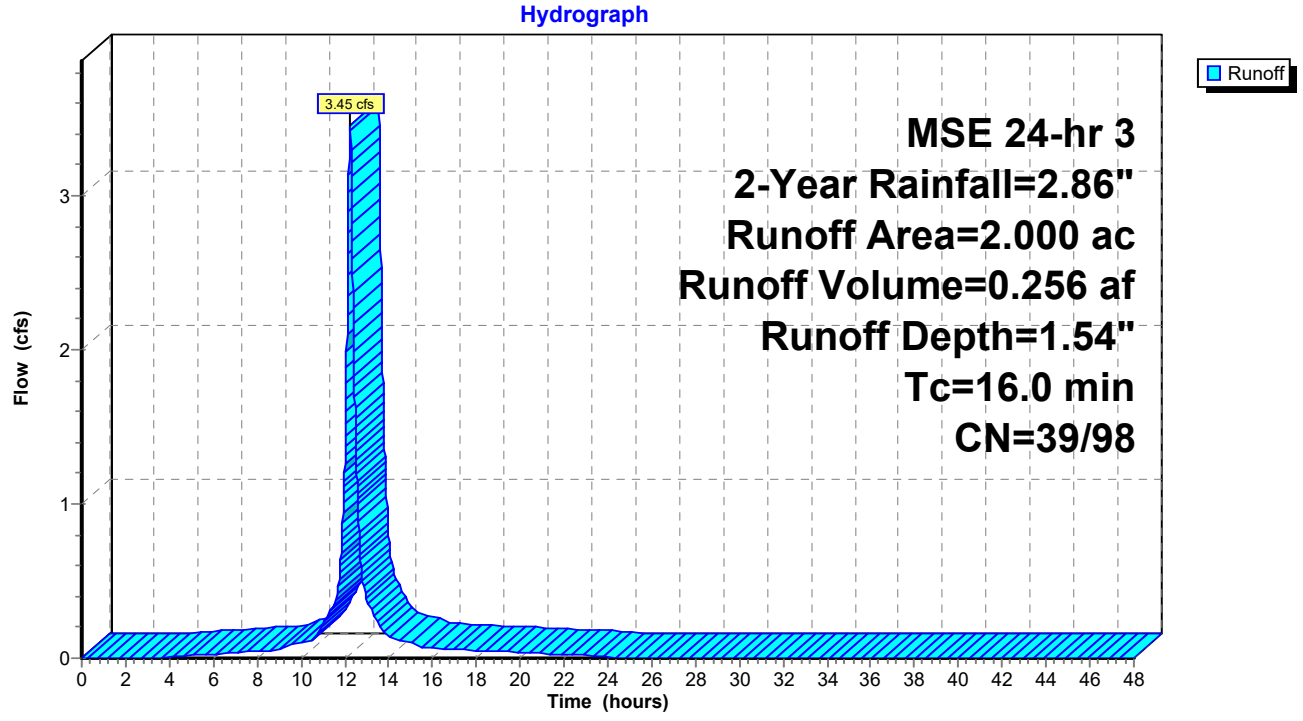
Runoff = 3.45 cfs @ 12.24 hrs, Volume= 0.256 af, Depth= 1.54"
Routed to Pond 1P : Montgomerie Low Point

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-48.00 hrs, dt= 0.01
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (ac)	CN	Description
0.830	39	>75% Grass cover, Good, HSG A
1.170	98	Paved parking, HSG A
2.000	74	Weighted Average
0.830	39	41.50% Pervious Area
1.170	98	58.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0					**Direct Entry,**

Subcatchment DA-2: Church Property



Summary for Subcatchment DA-3: South Residential/Church Area

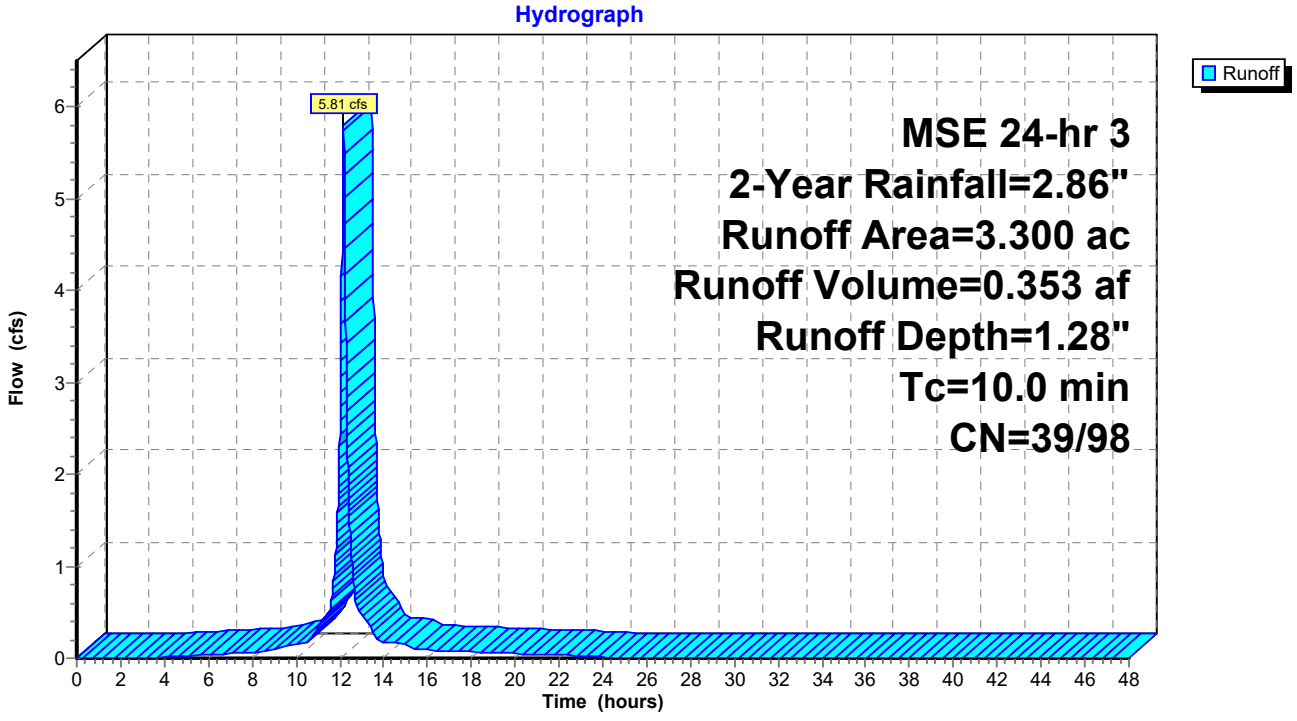
Runoff = 5.81 cfs @ 12.17 hrs, Volume= 0.353 af, Depth= 1.28"
Routed to Pond 3P : Riprap BMP (existing)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-48.00 hrs, dt= 0.01
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (ac)	CN	Description
1.610	98	Paved parking, HSG A
1.690	39	>75% Grass cover, Good, HSG A
3.300	68	Weighted Average
1.690	39	51.21% Pervious Area
1.610	98	48.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-3: South Residential/Church Area



Summary for Reach 1R: Pipe Under Montgomerie

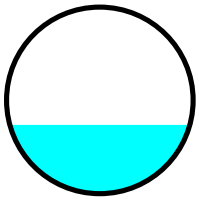
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 8.400 ac, 48.57% Impervious, Inflow Depth = 0.78" for 2-Year event
Inflow = 1.72 cfs @ 12.21 hrs, Volume= 0.548 af
Outflow = 1.72 cfs @ 12.21 hrs, Volume= 0.548 af, Atten= 0%, Lag= 0.2 min
Routed to Link 1L : Offsite (W of Montgomerie)

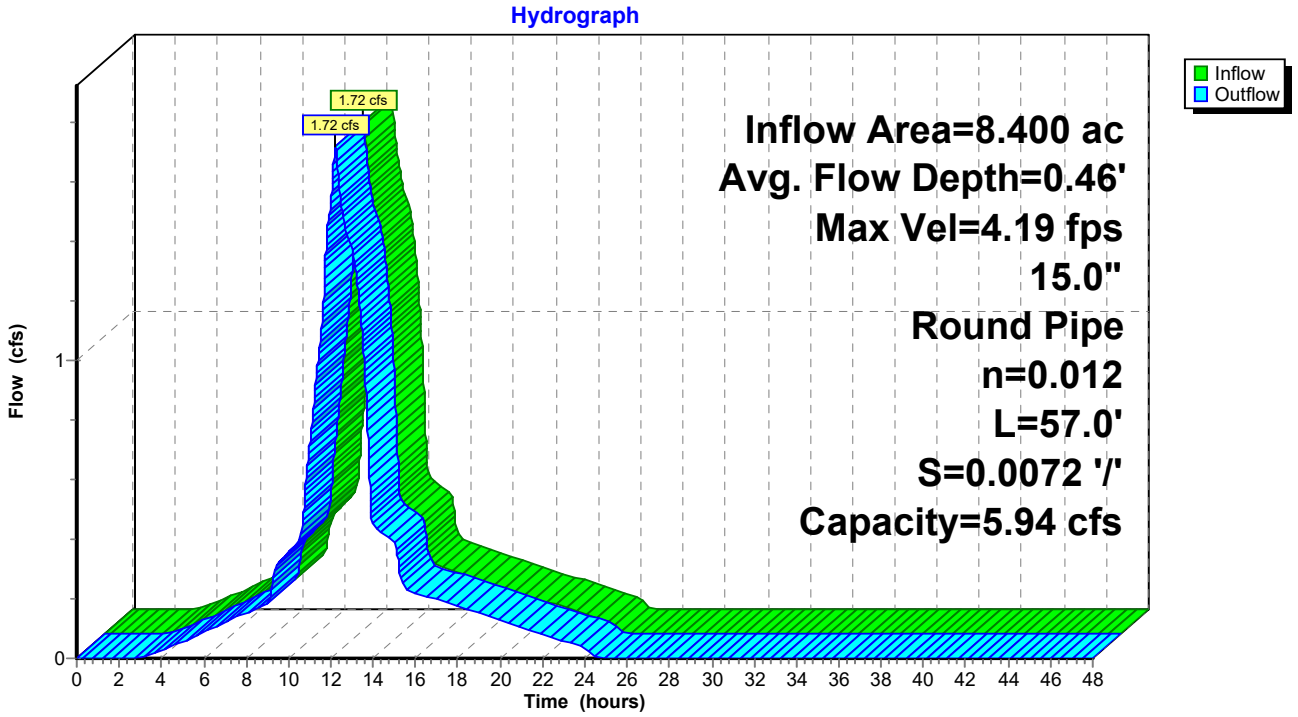
Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.19 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.18 fps, Avg. Travel Time= 0.4 min

Peak Storage= 23 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.46' , Surface Width= 1.21'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 5.94 cfs

15.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 57.0' Slope= 0.0072 '/'
Inlet Invert= 967.50', Outlet Invert= 967.09'



Reach 1R: Pipe Under Montgomerie



Summary for Pond 1P: Montgomerie Low Point

Inflow Area = 8.400 ac, 48.57% Impervious, Inflow Depth = 1.28" for 2-Year event
Inflow = 12.58 cfs @ 12.20 hrs, Volume= 0.894 af
Outflow = 12.50 cfs @ 12.21 hrs, Volume= 0.894 af, Atten= 1%, Lag= 0.8 min
Primary = 1.72 cfs @ 12.21 hrs, Volume= 0.548 af
Routed to Reach 1R : Pipe Under Montgomerie
Secondary = 10.78 cfs @ 12.21 hrs, Volume= 0.346 af
Routed to Link 1L : Offsite (W of Montgomerie)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 968.42' @ 12.21 hrs Surf.Area= 3,498 sf Storage= 1,356 cf

Plug-Flow detention time= 2.9 min calculated for 0.894 af (100% of inflow)
Center-of-Mass det. time= 2.9 min (763.9 - 761.1)

Volume	Invert	Avail.Storage	Storage Description
#1	967.70'	28,909 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

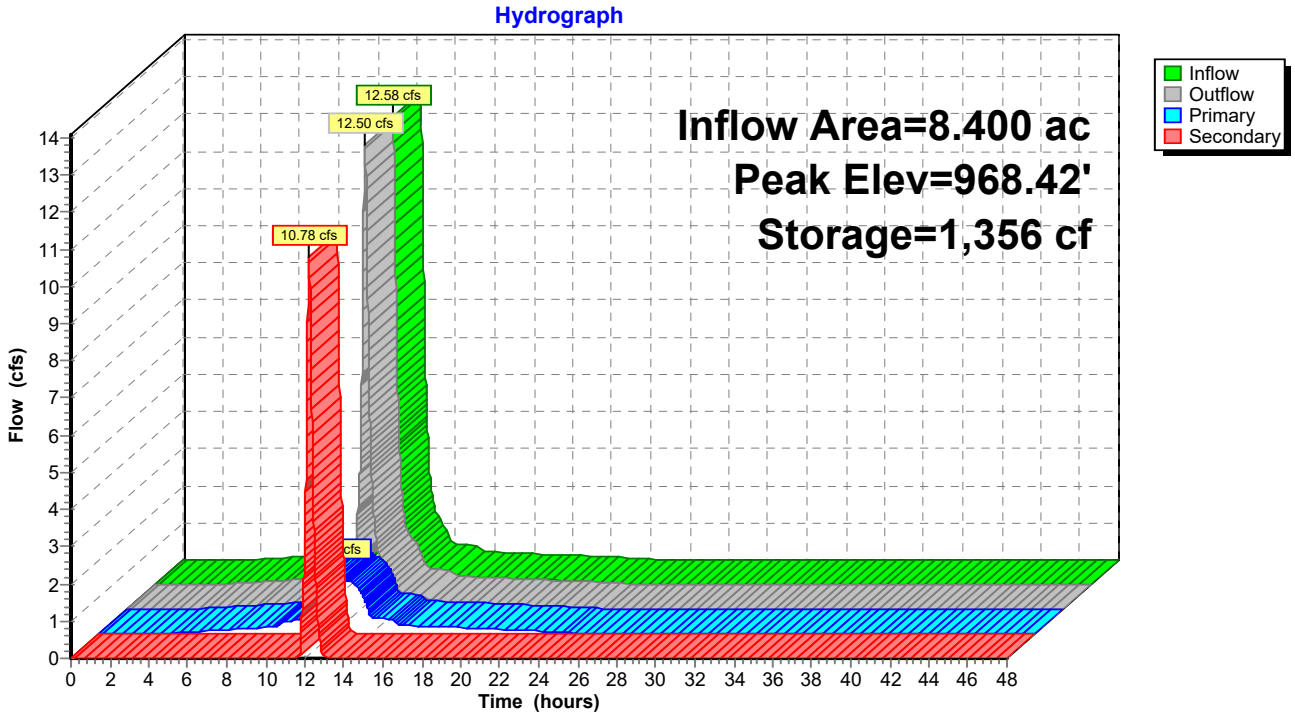
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
967.70	10	0	0
968.00	1,750	264	264
969.00	5,950	3,850	4,114
970.00	9,320	7,635	11,749
971.00	25,000	17,160	28,909

Device	Routing	Invert	Outlet Devices
#1	Primary	966.48'	**12.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 966.48' / 965.93' S= 0.0138 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Device 1	967.70'	**15.0" x 1.5" Horiz. Orifice/Grate** X 6 rows C= 0.600 in 15.0" x 15.0" Grate (60% open area) Limited to weir flow at low heads
#3	Secondary	968.20'	**40.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.72 cfs @ 12.21 hrs HW=968.42' TW=967.96' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 1.72 cfs @ 2.19 fps)
↑—**2=Orifice/Grate** (Passes 1.72 cfs of 3.05 cfs potential flow)

Secondary OutFlow Max=10.78 cfs @ 12.21 hrs HW=968.42' TW=0.00' (Dynamic Tailwater)
↑—**3=Broad-Crested Rectangular Weir** (Weir Controls 10.78 cfs @ 1.25 fps)

Pond 1P: Montgomerie Low Point



Summary for Pond 3P: Riprap BMP (existing)

Inflow Area = 3.300 ac, 48.79% Impervious, Inflow Depth = 1.28" for 2-Year event
Inflow = 5.81 cfs @ 12.17 hrs, Volume= 0.353 af
Outflow = 5.79 cfs @ 12.18 hrs, Volume= 0.353 af, Atten= 0%, Lag= 0.3 min
Primary = 5.79 cfs @ 12.18 hrs, Volume= 0.353 af
Routed to Pond 1P : Montgomerie Low Point
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 1P : Montgomerie Low Point

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 981.43' @ 12.18 hrs Surf.Area= 351 sf Storage= 118 cf

Plug-Flow detention time= 0.8 min calculated for 0.353 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (758.1 - 757.5)

Volume	Invert	Avail.Storage	Storage Description
#1	981.00'	5,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

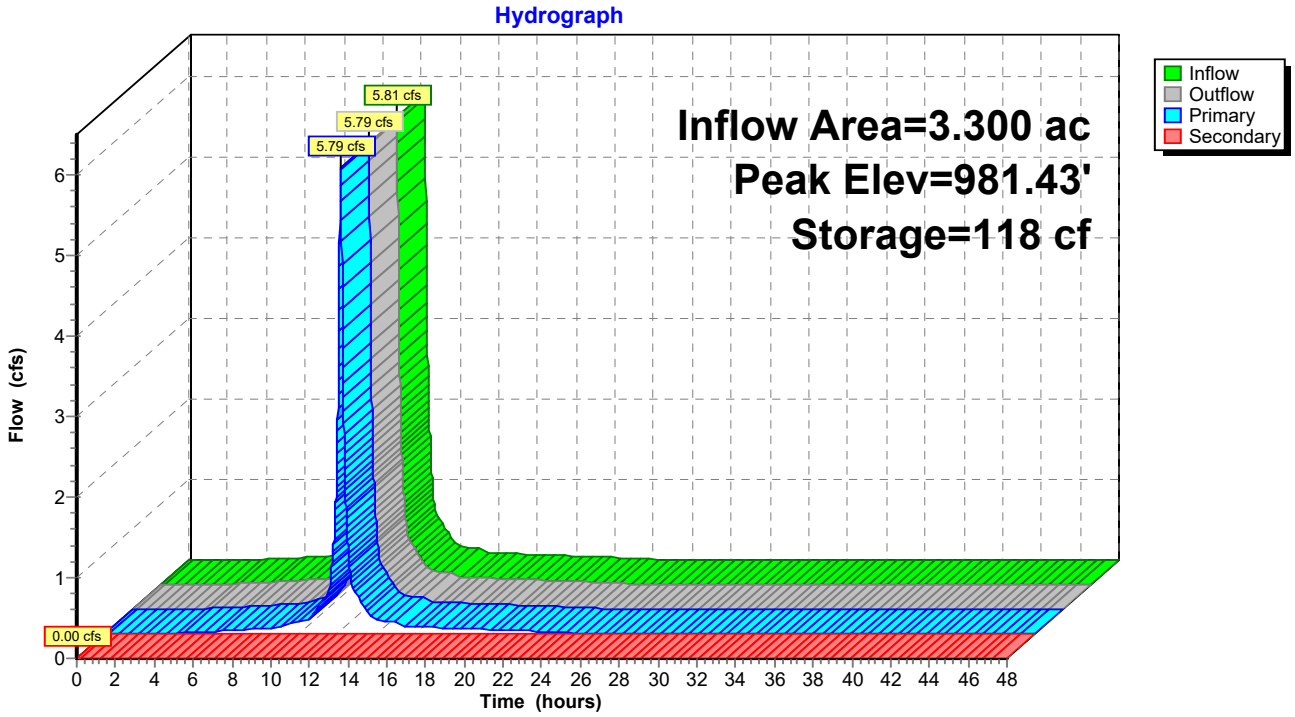
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
981.00	200	0	0
982.00	550	375	375
983.00	2,700	1,625	2,000
984.00	5,000	3,850	5,850

Device	Routing	Invert	Outlet Devices
#1	Primary	975.89'	**12.0" Round Culvert** L= 77.0' Ke= 0.500 Inlet / Outlet Invert= 975.89' / 975.34' S= 0.0071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	981.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	982.00'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=5.79 cfs @ 12.18 hrs HW=981.43' TW=968.41' (Dynamic Tailwater)
└**1=Culvert** (Passes 5.79 cfs of 7.18 cfs potential flow)
└**2=Orifice/Grate** (Weir Controls 5.79 cfs @ 2.14 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=981.00' TW=967.70' (Dynamic Tailwater)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Riprap BMP (existing)

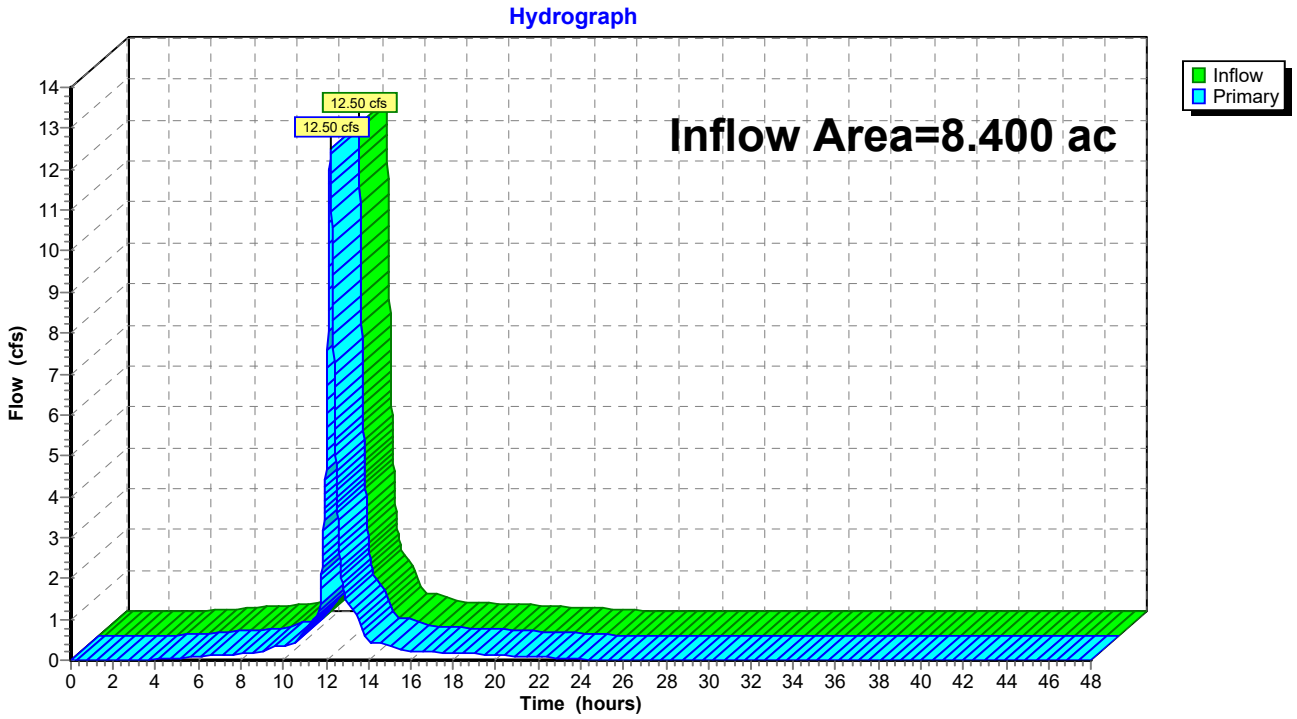


Summary for Link 1L: Offsite (W of Montgomerie)

Inflow Area = 8.400 ac, 48.57% Impervious, Inflow Depth = 1.28" for 2-Year event
Inflow = 12.50 cfs @ 12.21 hrs, Volume= 0.894 af
Primary = 12.50 cfs @ 12.21 hrs, Volume= 0.894 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: Offsite (W of Montgomerie)



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA-1: North Residential Area Runoff Area=3.100 ac 41.94% Impervious Runoff Depth=1.73"
Tc=16.0 min CN=39/98 Runoff=5.77 cfs 0.447 af

Subcatchment DA-2: Church Property Runoff Area=2.000 ac 58.50% Impervious Runoff Depth=2.39"
Tc=16.0 min CN=39/98 Runoff=5.19 cfs 0.398 af

Subcatchment DA-3: South Runoff Area=3.300 ac 48.79% Impervious Runoff Depth=2.00"
Tc=10.0 min CN=39/98 Runoff=8.72 cfs 0.551 af

Reach 1R: Pipe Under Montgomerie Avg. Flow Depth=0.48' Max Vel=4.26 fps Inflow=1.82 cfs 0.768 af
15.0" Round Pipe n=0.012 L=57.0' S=0.0072 '/' Capacity=5.94 cfs Outflow=1.82 cfs 0.768 af

Pond 1P: Montgomerie Low Point Peak Elev=968.49' Storage=1,628 cf Inflow=18.85 cfs 1.396 af
Primary=1.82 cfs 0.768 af Secondary=16.85 cfs 0.628 af Outflow=18.67 cfs 1.396 af

Pond 3P: Riprap BMP (existing) Peak Elev=982.05' Storage=404 cf Inflow=8.72 cfs 0.551 af
Primary=7.61 cfs 0.550 af Secondary=0.56 cfs 0.001 af Outflow=8.17 cfs 0.551 af

Link 1L: Offsite (W of Montgomerie) Inflow=18.67 cfs 1.396 af
Primary=18.67 cfs 1.396 af

Total Runoff Area = 8.400 ac Runoff Volume = 1.396 af Average Runoff Depth = 1.99"
51.43% Pervious = 4.320 ac 48.57% Impervious = 4.080 ac

Summary for Subcatchment DA-1: North Residential Area

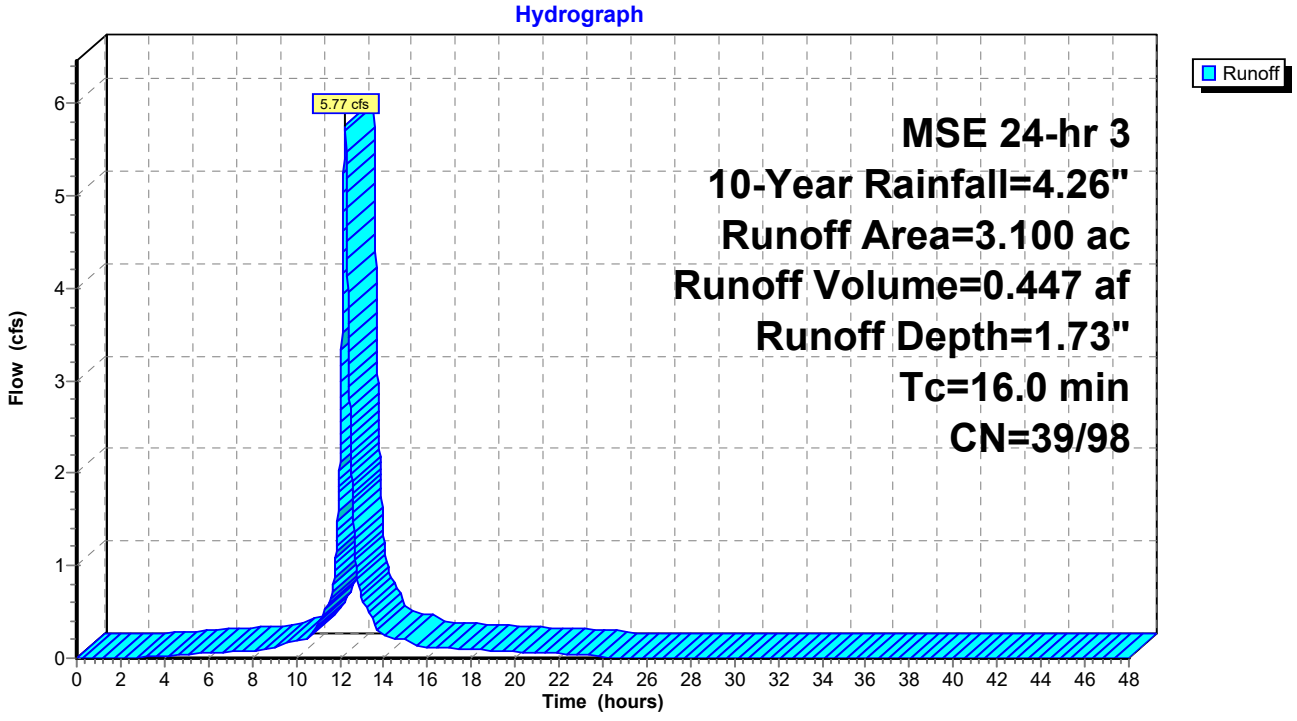
Runoff = 5.77 cfs @ 12.24 hrs, Volume= 0.447 af, Depth= 1.73"
Routed to Pond 1P : Montgomerie Low Point

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-48.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
1.300	98	Paved parking, HSG A
1.800	39	>75% Grass cover, Good, HSG A
3.100	64	Weighted Average
1.800	39	58.06% Pervious Area
1.300	98	41.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0					**Direct Entry,**

Subcatchment DA-1: North Residential Area



Summary for Subcatchment DA-2: Church Property

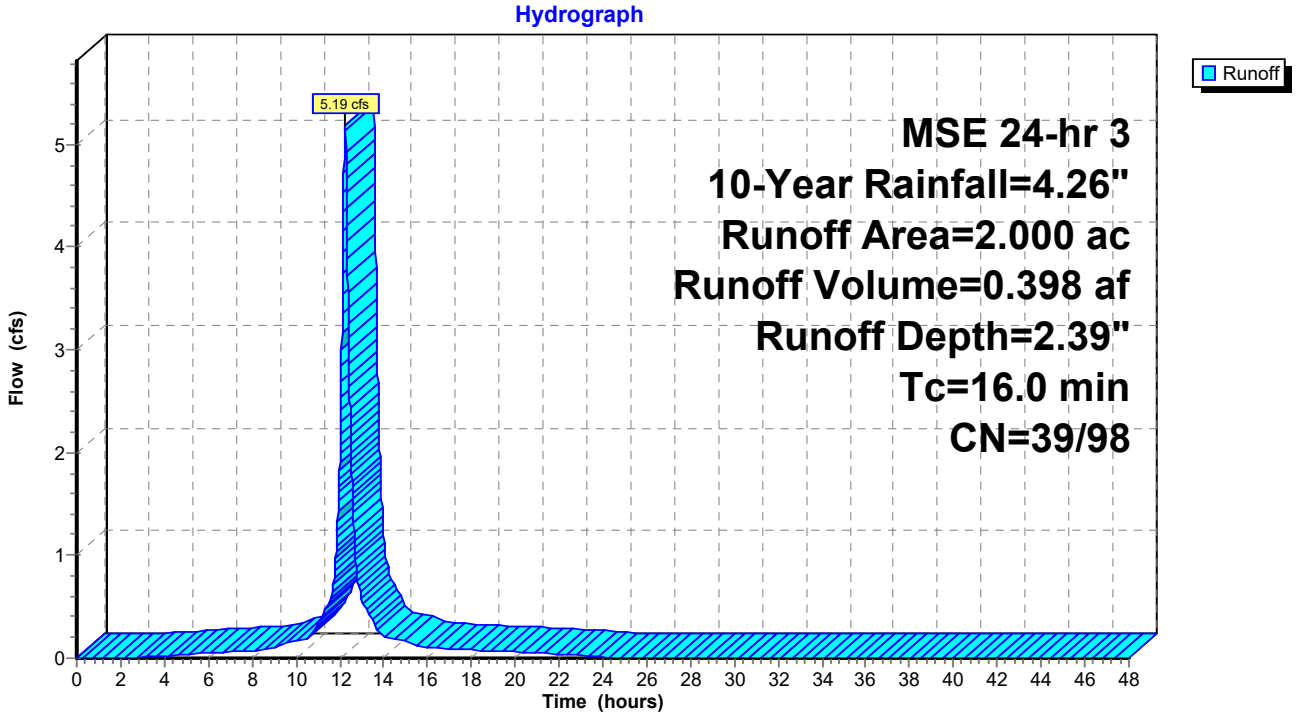
Runoff = 5.19 cfs @ 12.24 hrs, Volume= 0.398 af, Depth= 2.39"
Routed to Pond 1P : Montgomerie Low Point

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-48.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
0.830	39	>75% Grass cover, Good, HSG A
1.170	98	Paved parking, HSG A
2.000	74	Weighted Average
0.830	39	41.50% Pervious Area
1.170	98	58.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0					**Direct Entry,**

Subcatchment DA-2: Church Property



Summary for Subcatchment DA-3: South Residential/Church Area

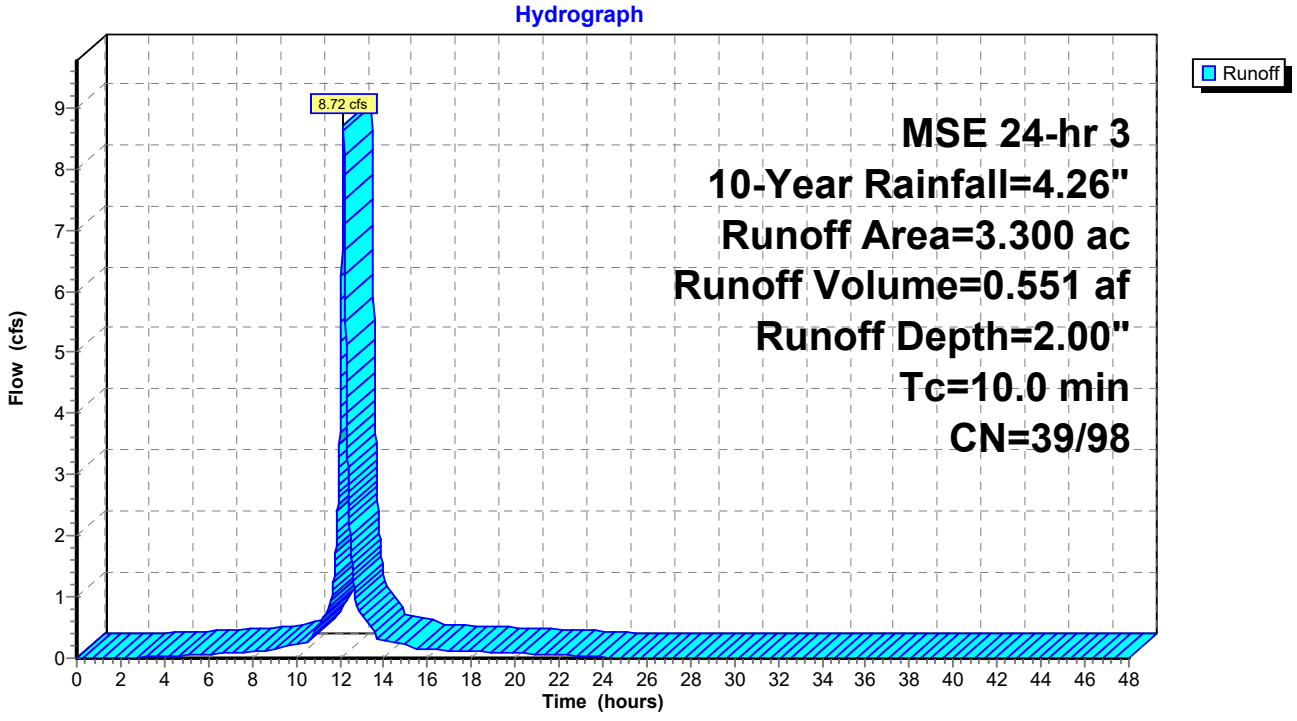
Runoff = 8.72 cfs @ 12.17 hrs, Volume= 0.551 af, Depth= 2.00"
Routed to Pond 3P : Riprap BMP (existing)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-48.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
1.610	98	Paved parking, HSG A
1.690	39	>75% Grass cover, Good, HSG A
3.300	68	Weighted Average
1.690	39	51.21% Pervious Area
1.610	98	48.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-3: South Residential/Church Area



Summary for Reach 1R: Pipe Under Montgomerie

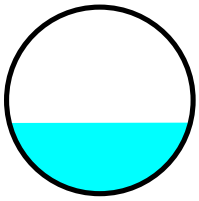
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 8.400 ac, 48.57% Impervious, Inflow Depth = 1.10" for 10-Year event
Inflow = 1.82 cfs @ 12.22 hrs, Volume= 0.768 af
Outflow = 1.82 cfs @ 12.23 hrs, Volume= 0.768 af, Atten= 0%, Lag= 0.3 min
Routed to Link 1L : Offsite (W of Montgomerie)

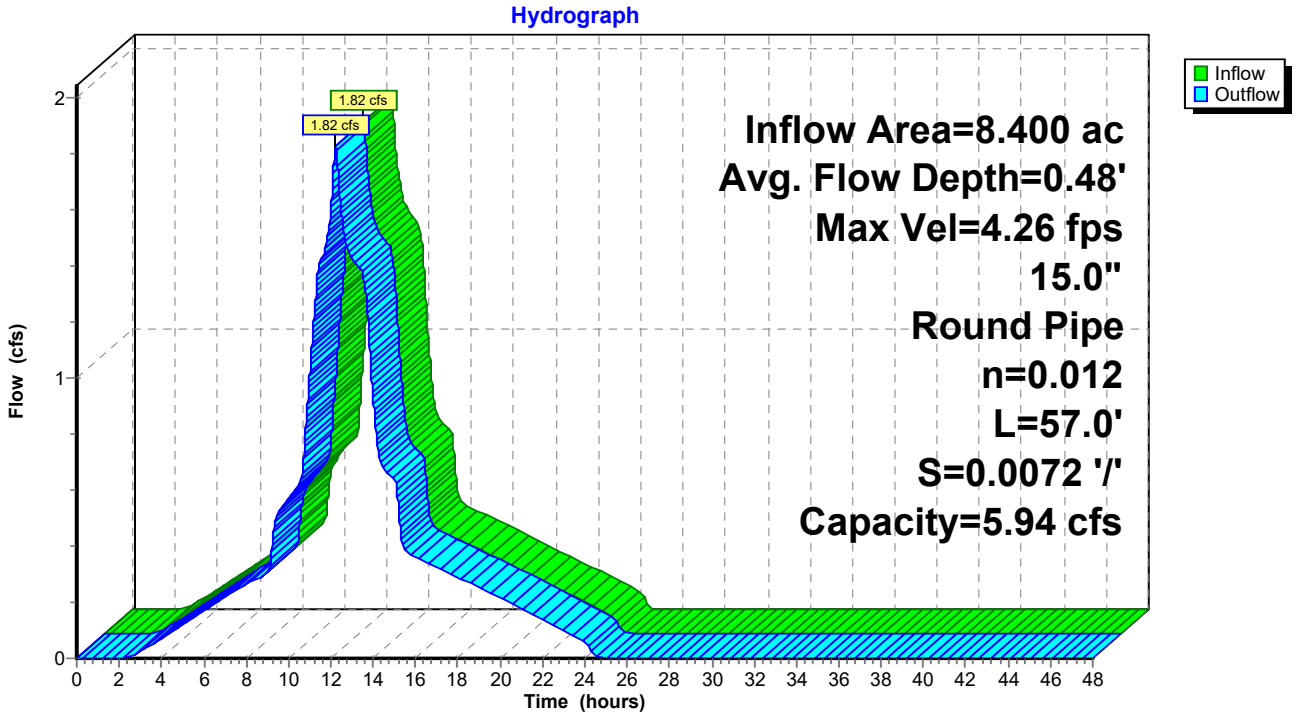
Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.26 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.46 fps, Avg. Travel Time= 0.4 min

Peak Storage= 24 cf @ 12.23 hrs
Average Depth at Peak Storage= 0.48' , Surface Width= 1.21'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 5.94 cfs

15.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 57.0' Slope= 0.0072 '/'
Inlet Invert= 967.50', Outlet Invert= 967.09'



Reach 1R: Pipe Under Montgomerie



Summary for Pond 1P: Montgomerie Low Point

Inflow Area = 8.400 ac, 48.57% Impervious, Inflow Depth = 1.99" for 10-Year event
Inflow = 18.85 cfs @ 12.21 hrs, Volume= 1.396 af
Outflow = 18.67 cfs @ 12.22 hrs, Volume= 1.396 af, Atten= 1%, Lag= 0.8 min
Primary = 1.82 cfs @ 12.22 hrs, Volume= 0.768 af
Routed to Reach 1R : Pipe Under Montgomerie
Secondary = 16.85 cfs @ 12.22 hrs, Volume= 0.628 af
Routed to Link 1L : Offsite (W of Montgomerie)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 968.49' @ 12.22 hrs Surf.Area= 3,810 sf Storage= 1,628 cf

Plug-Flow detention time= 2.8 min calculated for 1.396 af (100% of inflow)
Center-of-Mass det. time= 2.8 min (762.7 - 759.9)

Volume	Invert	Avail.Storage	Storage Description
#1	967.70'	28,909 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

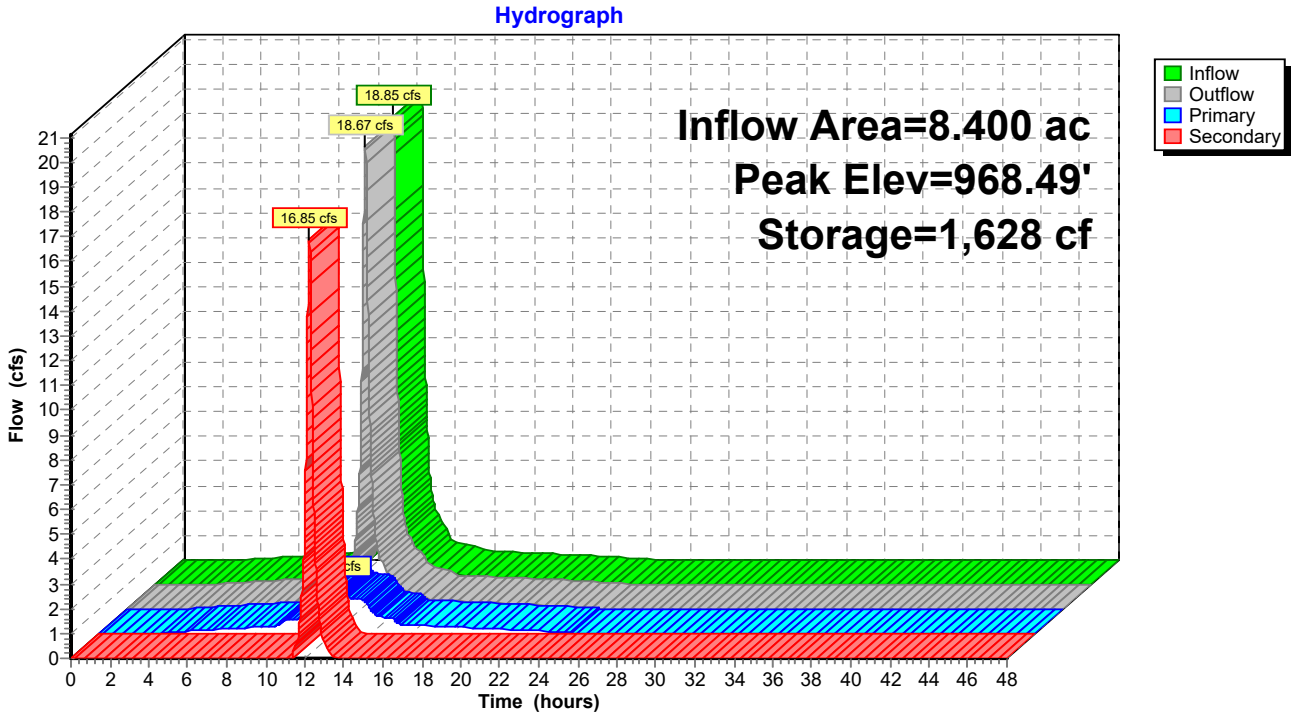
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
967.70	10	0	0
968.00	1,750	264	264
969.00	5,950	3,850	4,114
970.00	9,320	7,635	11,749
971.00	25,000	17,160	28,909

Device	Routing	Invert	Outlet Devices
#1	Primary	966.48'	**12.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 966.48' / 965.93' S= 0.0138 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Device 1	967.70'	**15.0" x 1.5" Horiz. Orifice/Grate** X 6 rows C= 0.600 in 15.0" x 15.0" Grate (60% open area) Limited to weir flow at low heads
#3	Secondary	968.20'	**40.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.82 cfs @ 12.22 hrs HW=968.49' TW=967.98' (Dynamic Tailwater)
↑**1=Culvert** (Outlet Controls 1.82 cfs @ 2.32 fps)
↑**2=Orifice/Grate** (Passes 1.82 cfs of 3.24 cfs potential flow)

Secondary OutFlow Max=16.82 cfs @ 12.22 hrs HW=968.49' TW=0.00' (Dynamic Tailwater)
↑**3=Broad-Crested Rectangular Weir** (Weir Controls 16.82 cfs @ 1.45 fps)

Pond 1P: Montgomerie Low Point



Summary for Pond 3P: Riprap BMP (existing)

Inflow Area = 3.300 ac, 48.79% Impervious, Inflow Depth = 2.00" for 10-Year event
Inflow = 8.72 cfs @ 12.17 hrs, Volume= 0.551 af
Outflow = 8.17 cfs @ 12.20 hrs, Volume= 0.551 af, Atten= 6%, Lag= 2.0 min
Primary = 7.61 cfs @ 12.20 hrs, Volume= 0.550 af
Routed to Pond 1P : Montgomerie Low Point
Secondary = 0.56 cfs @ 12.20 hrs, Volume= 0.001 af
Routed to Pond 1P : Montgomerie Low Point

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 982.05' @ 12.20 hrs Surf.Area= 654 sf Storage= 404 cf

Plug-Flow detention time= 0.6 min calculated for 0.551 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (756.9 - 756.2)

Volume	Invert	Avail.Storage	Storage Description
#1	981.00'	5,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

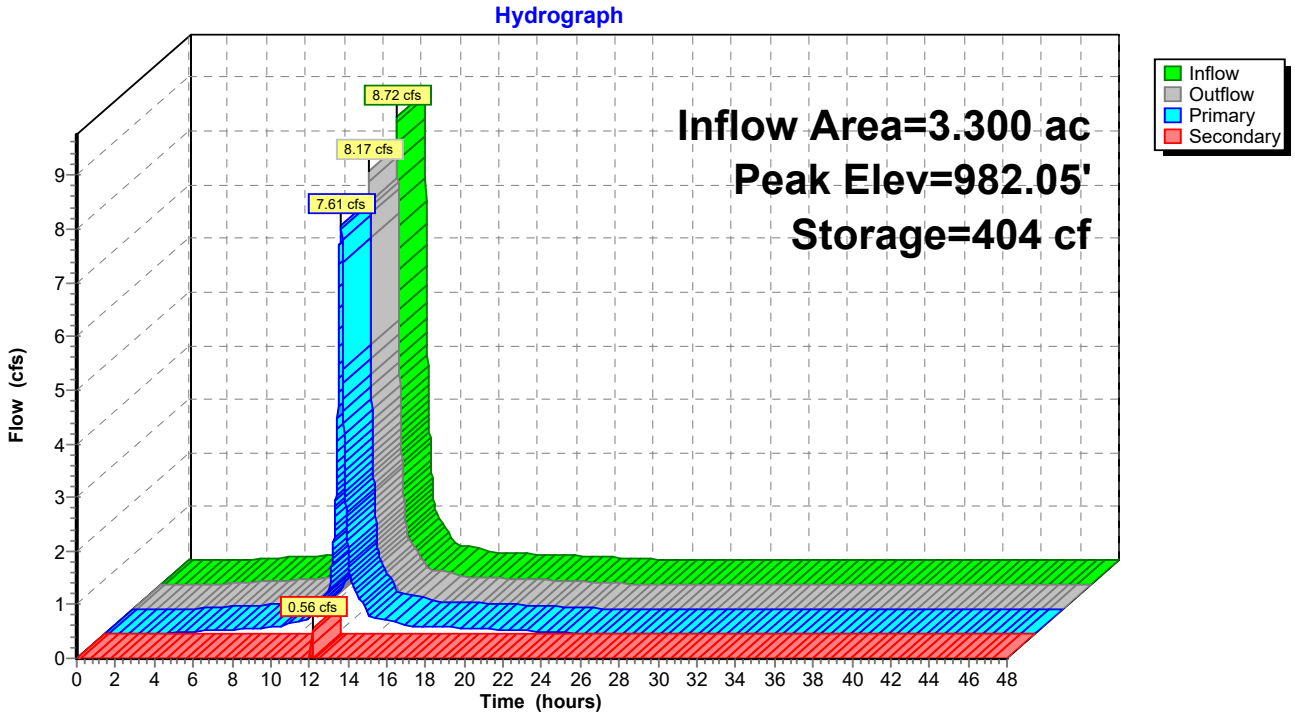
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
981.00	200	0	0
982.00	550	375	375
983.00	2,700	1,625	2,000
984.00	5,000	3,850	5,850

Device	Routing	Invert	Outlet Devices
#1	Primary	975.89'	**12.0" Round Culvert** L= 77.0' Ke= 0.500 Inlet / Outlet Invert= 975.89' / 975.34' S= 0.0071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	981.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	982.00'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=7.61 cfs @ 12.20 hrs HW=982.04' TW=968.48' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 7.61 cfs @ 9.68 fps)
↑**2=Orifice/Grate** (Passes 7.61 cfs of 15.46 cfs potential flow)

Secondary OutFlow Max=0.51 cfs @ 12.20 hrs HW=982.05' TW=968.48' (Dynamic Tailwater)
↑**3=Broad-Crested Rectangular Weir** (Weir Controls 0.51 cfs @ 0.57 fps)

Pond 3P: Riprap BMP (existing)

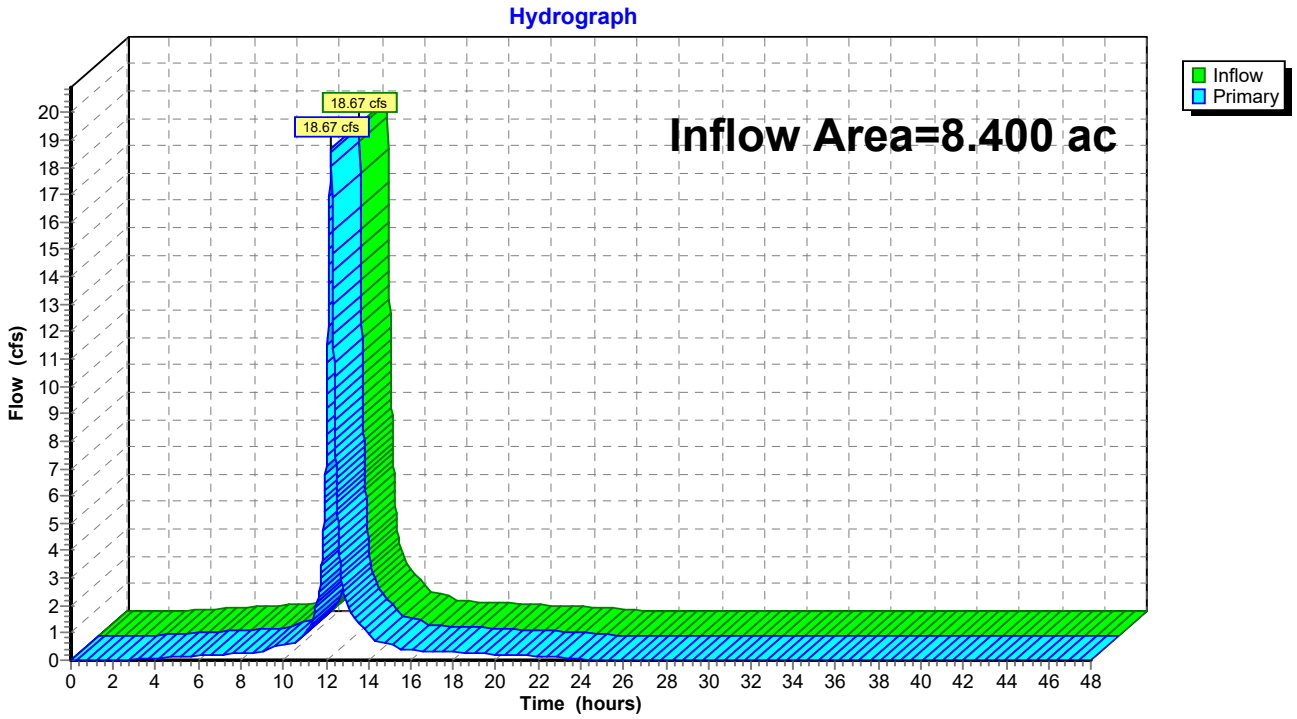


Summary for Link 1L: Offsite (W of Montgomerie)

Inflow Area = 8.400 ac, 48.57% Impervious, Inflow Depth = 1.99" for 10-Year event
Inflow = 18.67 cfs @ 12.22 hrs, Volume= 1.396 af
Primary = 18.67 cfs @ 12.22 hrs, Volume= 1.396 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: Offsite (W of Montgomerie)



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA-1: North Residential Area Runoff Area=3.100 ac 41.94% Impervious Runoff Depth=3.48"
Tc=16.0 min CN=39/98 Runoff=11.05 cfs 0.900 af

Subcatchment DA-2: Church Property Runoff Area=2.000 ac 58.50% Impervious Runoff Depth=4.51"
Tc=16.0 min CN=39/98 Runoff=9.46 cfs 0.752 af

Subcatchment DA-3: South Runoff Area=3.300 ac 48.79% Impervious Runoff Depth=3.91"
Tc=10.0 min CN=39/98 Runoff=16.38 cfs 1.075 af

Reach 1R: Pipe Under Montgomerie Avg. Flow Depth=0.51' Max Vel=4.39 fps Inflow=2.05 cfs 1.235 af
15.0" Round Pipe n=0.012 L=57.0' S=0.0072 '/' Capacity=5.94 cfs Outflow=2.05 cfs 1.235 af

Pond 1P: Montgomerie Low Point Peak Elev=968.66' Storage=2,312 cf Inflow=35.39 cfs 2.726 af
Primary=2.05 cfs 1.235 af Secondary=33.16 cfs 1.491 af Outflow=35.20 cfs 2.726 af

Pond 3P: Riprap BMP (existing) Peak Elev=982.29' Storage=629 cf Inflow=16.38 cfs 1.075 af
Primary=7.77 cfs 0.969 af Secondary=8.55 cfs 0.106 af Outflow=16.32 cfs 1.075 af

Link 1L: Offsite (W of Montgomerie) Inflow=35.20 cfs 2.726 af
Primary=35.20 cfs 2.726 af

Total Runoff Area = 8.400 ac Runoff Volume = 2.726 af Average Runoff Depth = 3.89"
51.43% Pervious = 4.320 ac 48.57% Impervious = 4.080 ac

Summary for Subcatchment DA-1: North Residential Area

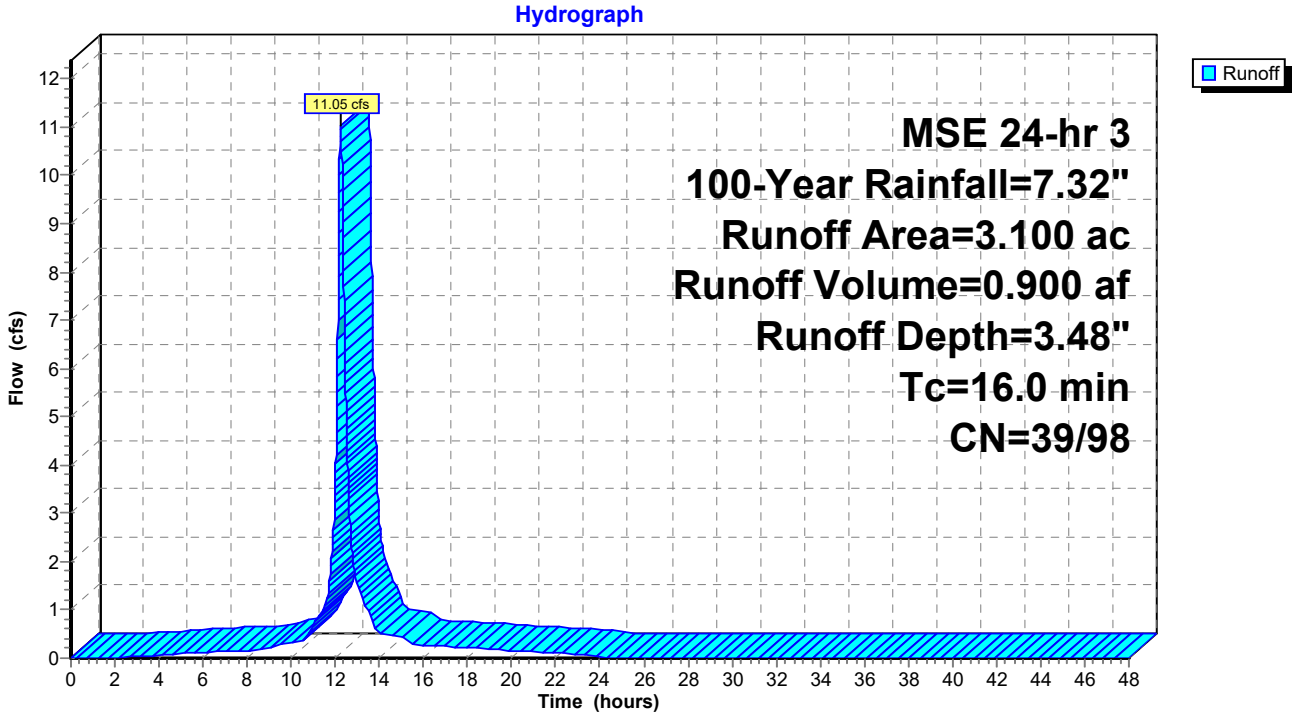
Runoff = 11.05 cfs @ 12.25 hrs, Volume= 0.900 af, Depth= 3.48"
Routed to Pond 1P : Montgomerie Low Point

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-48.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
1.300	98	Paved parking, HSG A
1.800	39	>75% Grass cover, Good, HSG A
3.100	64	Weighted Average
1.800	39	58.06% Pervious Area
1.300	98	41.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0					**Direct Entry,**

Subcatchment DA-1: North Residential Area



Summary for Subcatchment DA-2: Church Property

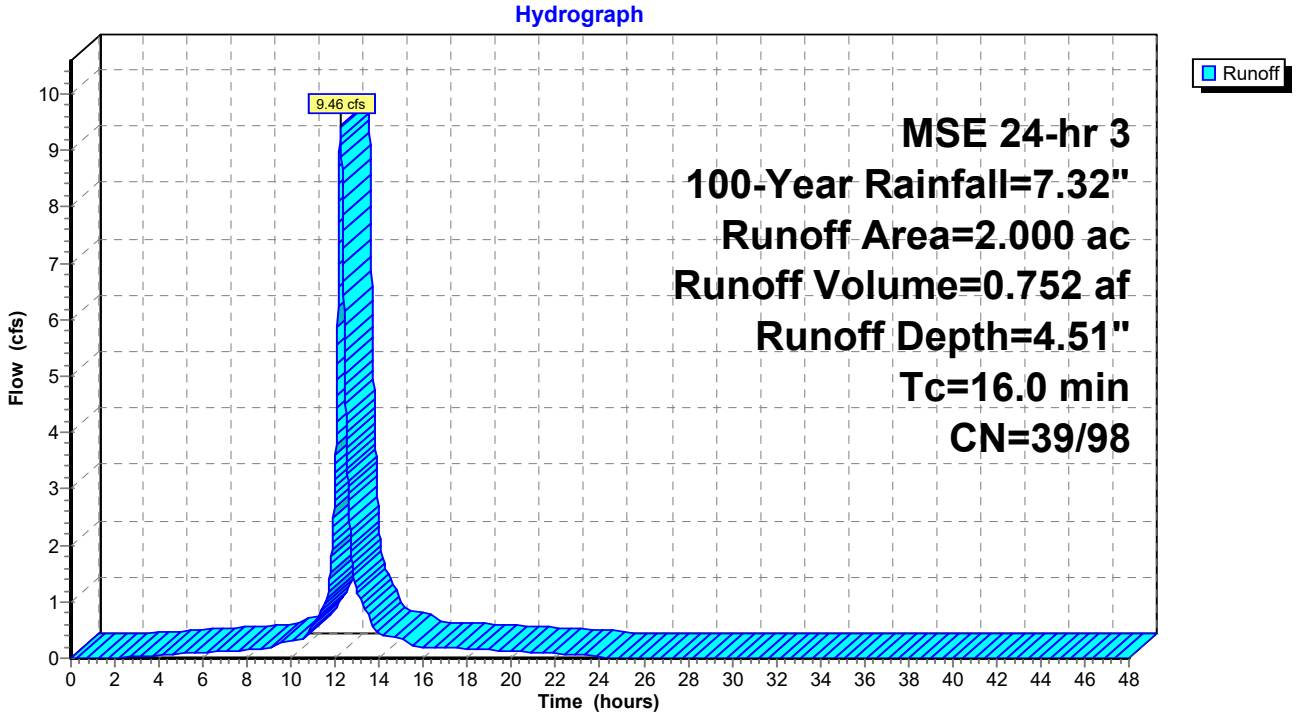
Runoff = 9.46 cfs @ 12.24 hrs, Volume= 0.752 af, Depth= 4.51"
Routed to Pond 1P : Montgomerie Low Point

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-48.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
0.830	39	>75% Grass cover, Good, HSG A
1.170	98	Paved parking, HSG A
2.000	74	Weighted Average
0.830	39	41.50% Pervious Area
1.170	98	58.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0					**Direct Entry,**

Subcatchment DA-2: Church Property



Summary for Subcatchment DA-3: South Residential/Church Area

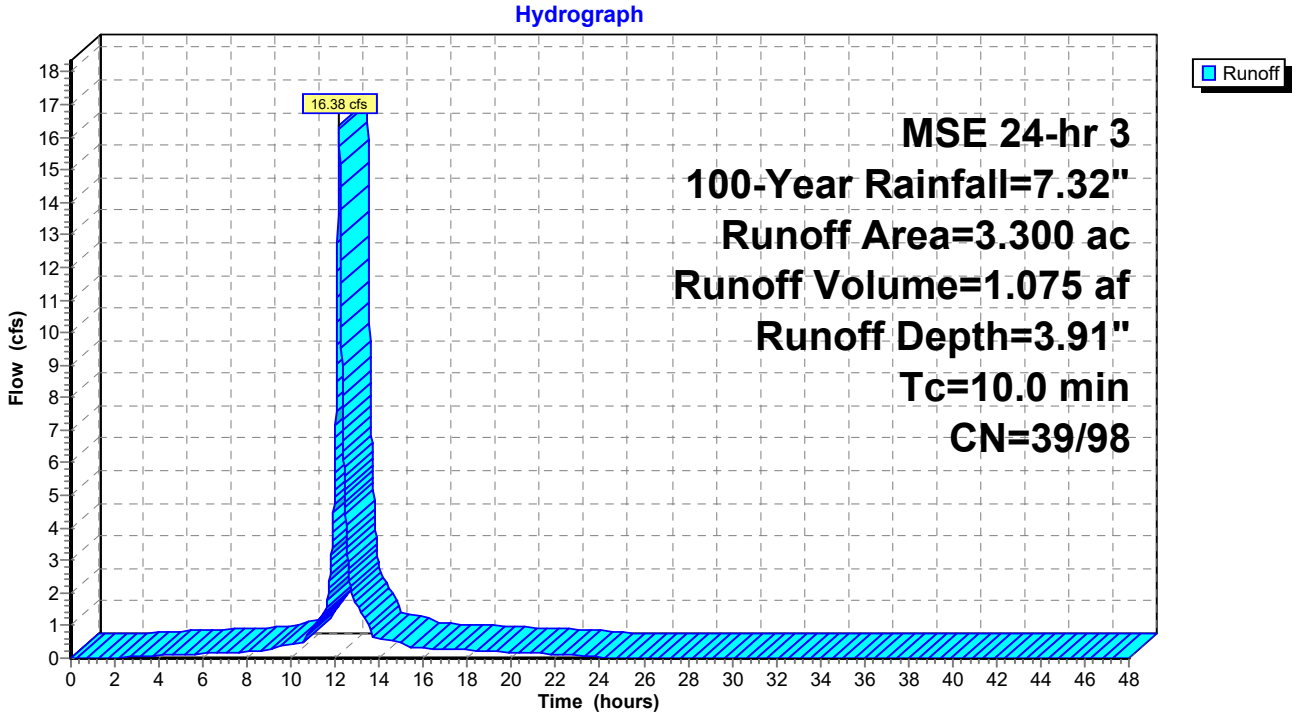
Runoff = 16.38 cfs @ 12.17 hrs, Volume= 1.075 af, Depth= 3.91"
Routed to Pond 3P : Riprap BMP (existing)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-48.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
1.610	98	Paved parking, HSG A
1.690	39	>75% Grass cover, Good, HSG A
3.300	68	Weighted Average
1.690	39	51.21% Pervious Area
1.610	98	48.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-3: South Residential/Church Area



Summary for Reach 1R: Pipe Under Montgomerie

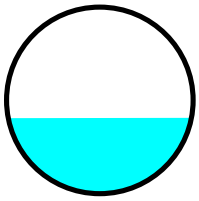
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 8.400 ac, 48.57% Impervious, Inflow Depth = 1.76" for 100-Year event
Inflow = 2.05 cfs @ 12.22 hrs, Volume= 1.235 af
Outflow = 2.05 cfs @ 12.22 hrs, Volume= 1.235 af, Atten= 0%, Lag= 0.2 min
Routed to Link 1L : Offsite (W of Montgomerie)

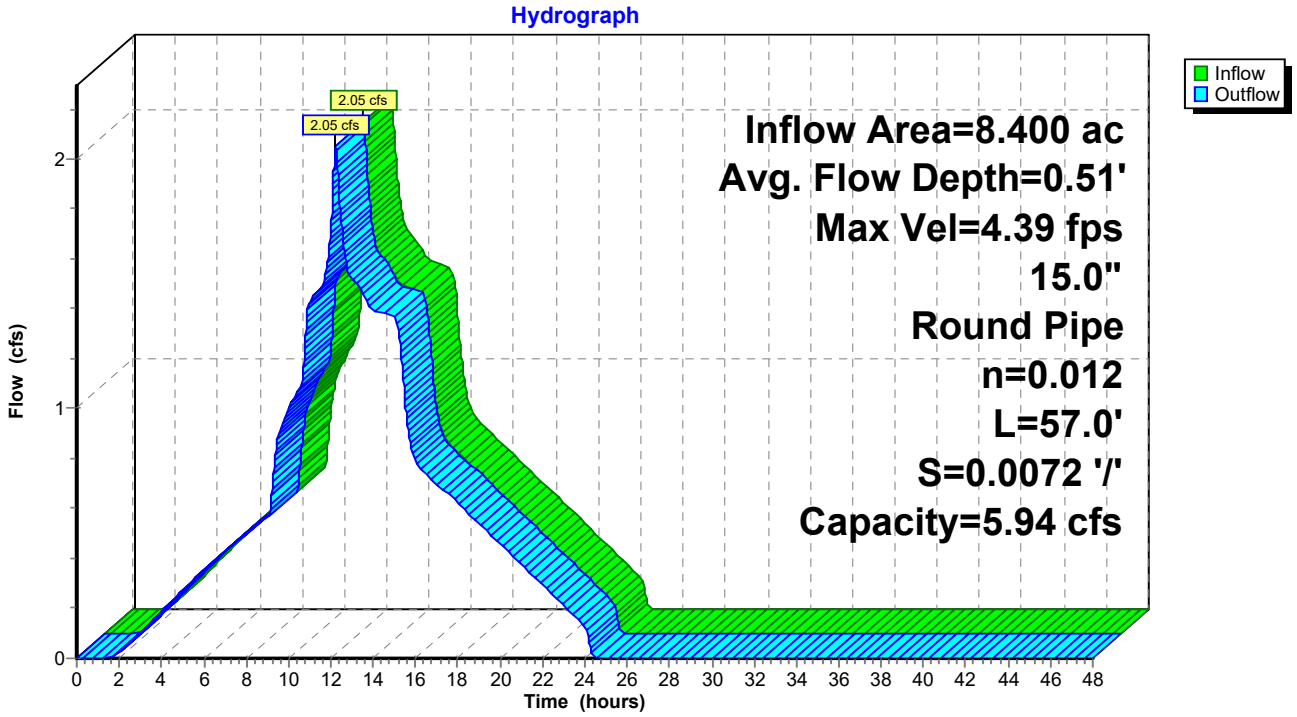
Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.39 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.90 fps, Avg. Travel Time= 0.3 min

Peak Storage= 27 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.51' , Surface Width= 1.23'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 5.94 cfs

15.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 57.0' Slope= 0.0072 '/'
Inlet Invert= 967.50', Outlet Invert= 967.09'



Reach 1R: Pipe Under Montgomerie



Summary for Pond 1P: Montgomerie Low Point

Inflow Area = 8.400 ac, 48.57% Impervious, Inflow Depth = 3.89" for 100-Year event
Inflow = 35.39 cfs @ 12.21 hrs, Volume= 2.726 af
Outflow = 35.20 cfs @ 12.22 hrs, Volume= 2.726 af, Atten= 1%, Lag= 0.7 min
Primary = 2.05 cfs @ 12.22 hrs, Volume= 1.235 af
Routed to Reach 1R : Pipe Under Montgomerie
Secondary = 33.16 cfs @ 12.22 hrs, Volume= 1.491 af
Routed to Link 1L : Offsite (W of Montgomerie)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 968.66' @ 12.22 hrs Surf.Area= 4,501 sf Storage= 2,312 cf

Plug-Flow detention time= 2.7 min calculated for 2.726 af (100% of inflow)
Center-of-Mass det. time= 2.7 min (766.4 - 763.7)

Volume	Invert	Avail.Storage	Storage Description
#1	967.70'	28,909 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

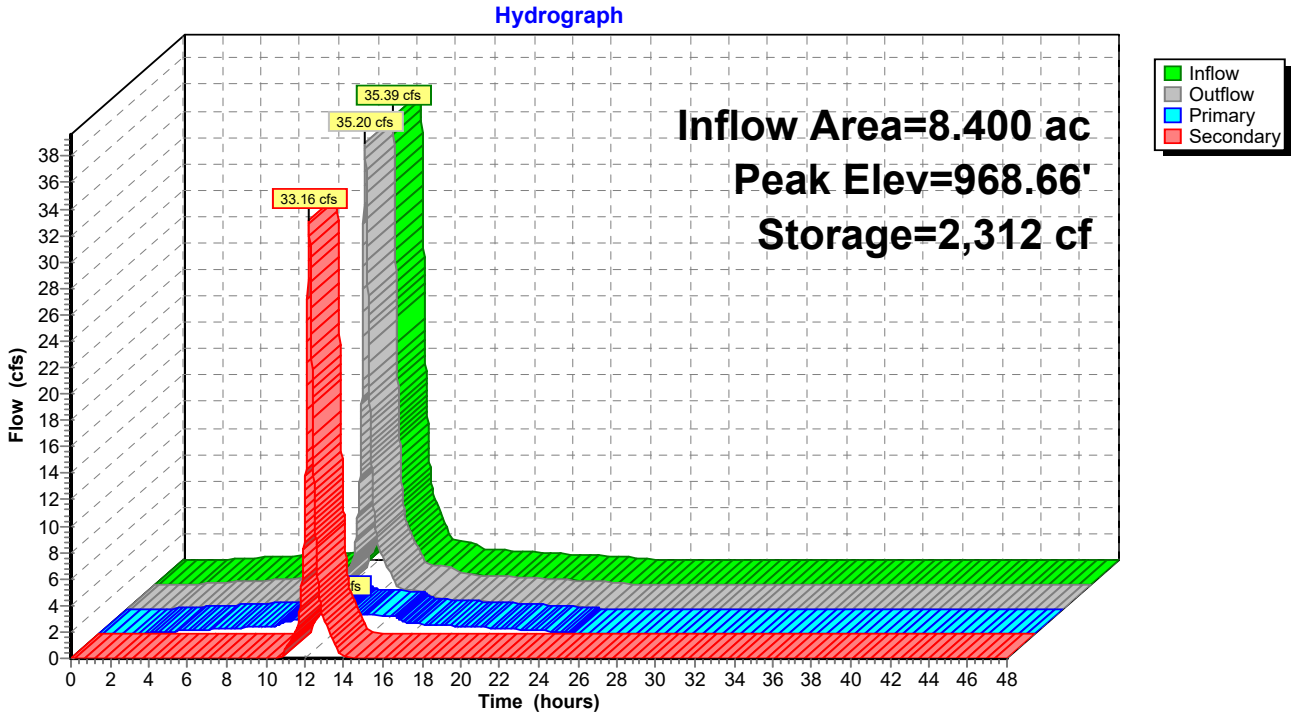
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
967.70	10	0	0
968.00	1,750	264	264
969.00	5,950	3,850	4,114
970.00	9,320	7,635	11,749
971.00	25,000	17,160	28,909

Device	Routing	Invert	Outlet Devices
#1	Primary	966.48'	**12.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 966.48' / 965.93' S= 0.0138 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Device 1	967.70'	**15.0" x 1.5" Horiz. Orifice/Grate** X 6 rows C= 0.600 in 15.0" x 15.0" Grate (60% open area) Limited to weir flow at low heads
#3	Secondary	968.20'	**40.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=2.05 cfs @ 12.22 hrs HW=968.65' TW=968.01' (Dynamic Tailwater)
↑**1=Culvert** (Outlet Controls 2.05 cfs @ 2.61 fps)
↑**2=Orifice/Grate** (Passes 2.05 cfs of 3.64 cfs potential flow)

Secondary OutFlow Max=33.13 cfs @ 12.22 hrs HW=968.65' TW=0.00' (Dynamic Tailwater)
↑**3=Broad-Crested Rectangular Weir** (Weir Controls 33.13 cfs @ 1.82 fps)

Pond 1P: Montgomerie Low Point



Summary for Pond 3P: Riprap BMP (existing)

Inflow Area = 3.300 ac, 48.79% Impervious, Inflow Depth = 3.91" for 100-Year event
Inflow = 16.38 cfs @ 12.17 hrs, Volume= 1.075 af
Outflow = 16.32 cfs @ 12.18 hrs, Volume= 1.075 af, Atten= 0%, Lag= 0.5 min
Primary = 7.77 cfs @ 12.18 hrs, Volume= 0.969 af
Routed to Pond 1P : Montgomerie Low Point
Secondary = 8.55 cfs @ 12.18 hrs, Volume= 0.106 af
Routed to Pond 1P : Montgomerie Low Point

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 982.29' @ 12.18 hrs Surf.Area= 1,181 sf Storage= 629 cf

Plug-Flow detention time= 0.6 min calculated for 1.075 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (760.6 - 760.0)

Volume	Invert	Avail.Storage	Storage Description
#1	981.00'	5,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

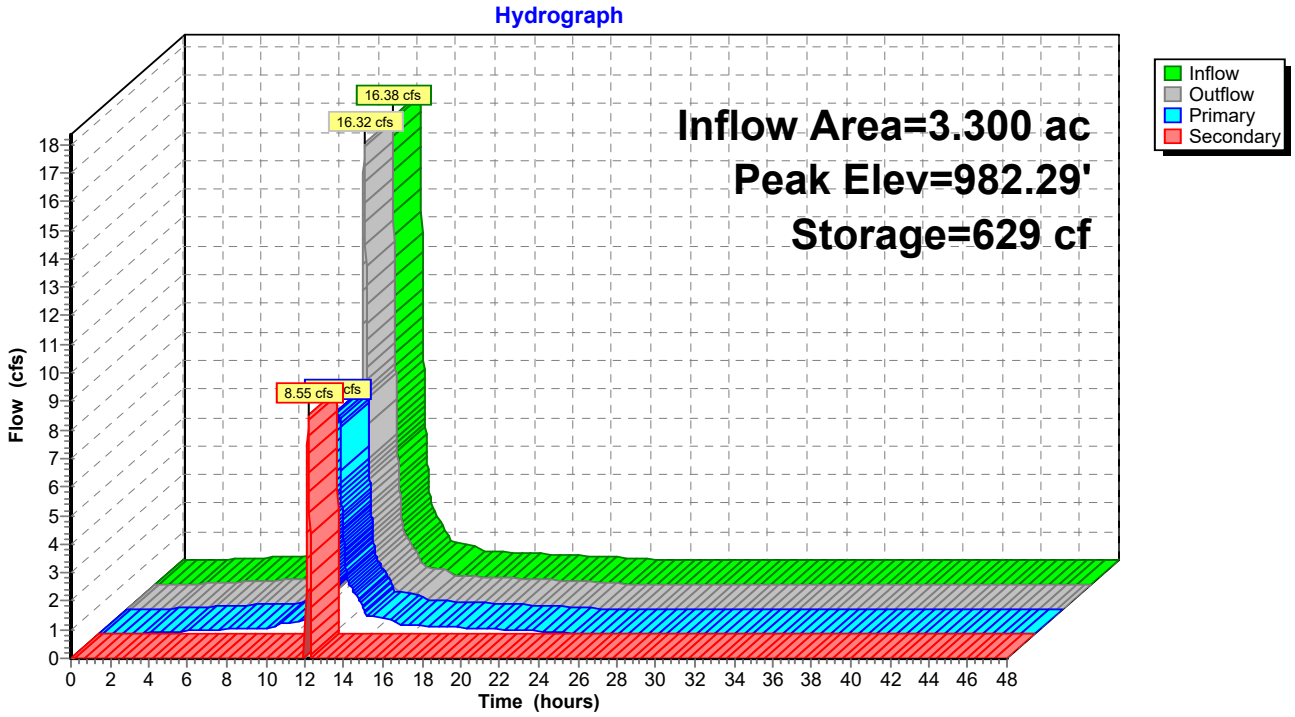
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
981.00	200	0	0
982.00	550	375	375
983.00	2,700	1,625	2,000
984.00	5,000	3,850	5,850

Device	Routing	Invert	Outlet Devices
#1	Primary	975.89'	**12.0" Round Culvert** L= 77.0' Ke= 0.500 Inlet / Outlet Invert= 975.89' / 975.34' S= 0.0071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	981.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	982.00'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=7.77 cfs @ 12.18 hrs HW=982.29' TW=968.64' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 7.77 cfs @ 9.89 fps)
↑**2=Orifice/Grate** (Passes 7.77 cfs of 17.20 cfs potential flow)

Secondary OutFlow Max=8.53 cfs @ 12.18 hrs HW=982.29' TW=968.64' (Dynamic Tailwater)
↑**3=Broad-Crested Rectangular Weir** (Weir Controls 8.53 cfs @ 1.46 fps)

Pond 3P: Riprap BMP (existing)

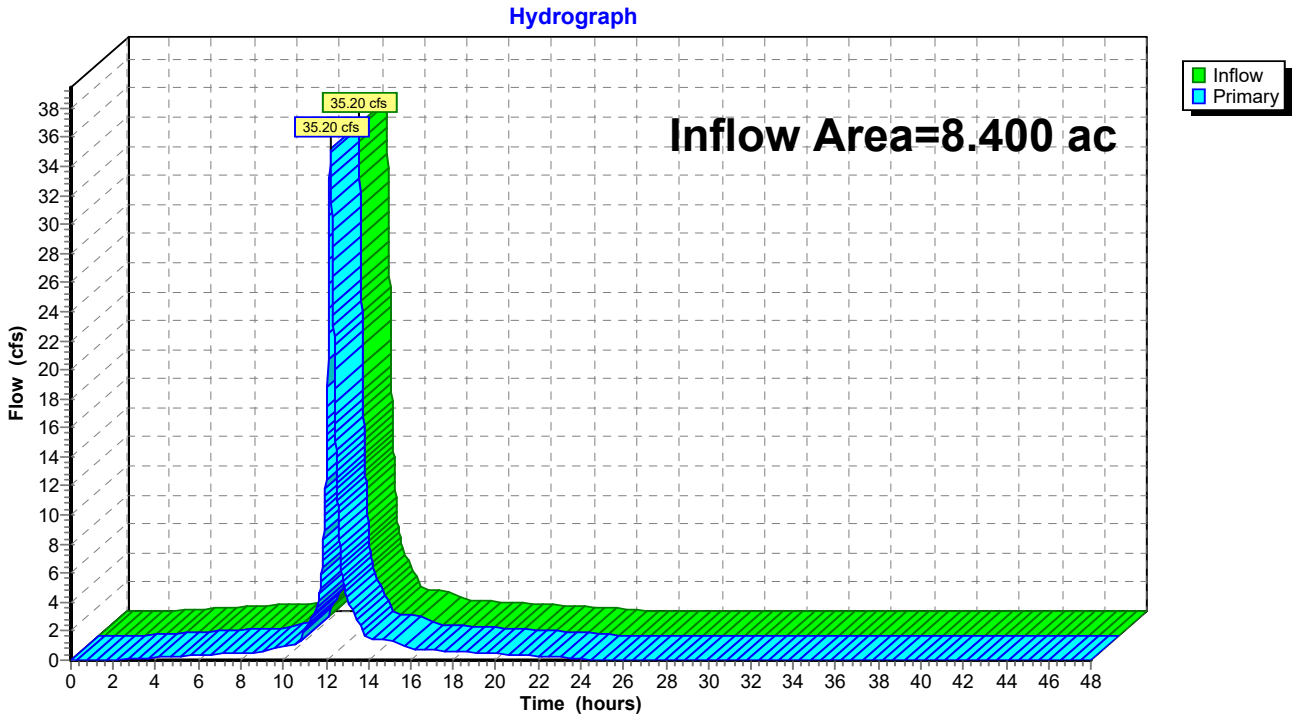


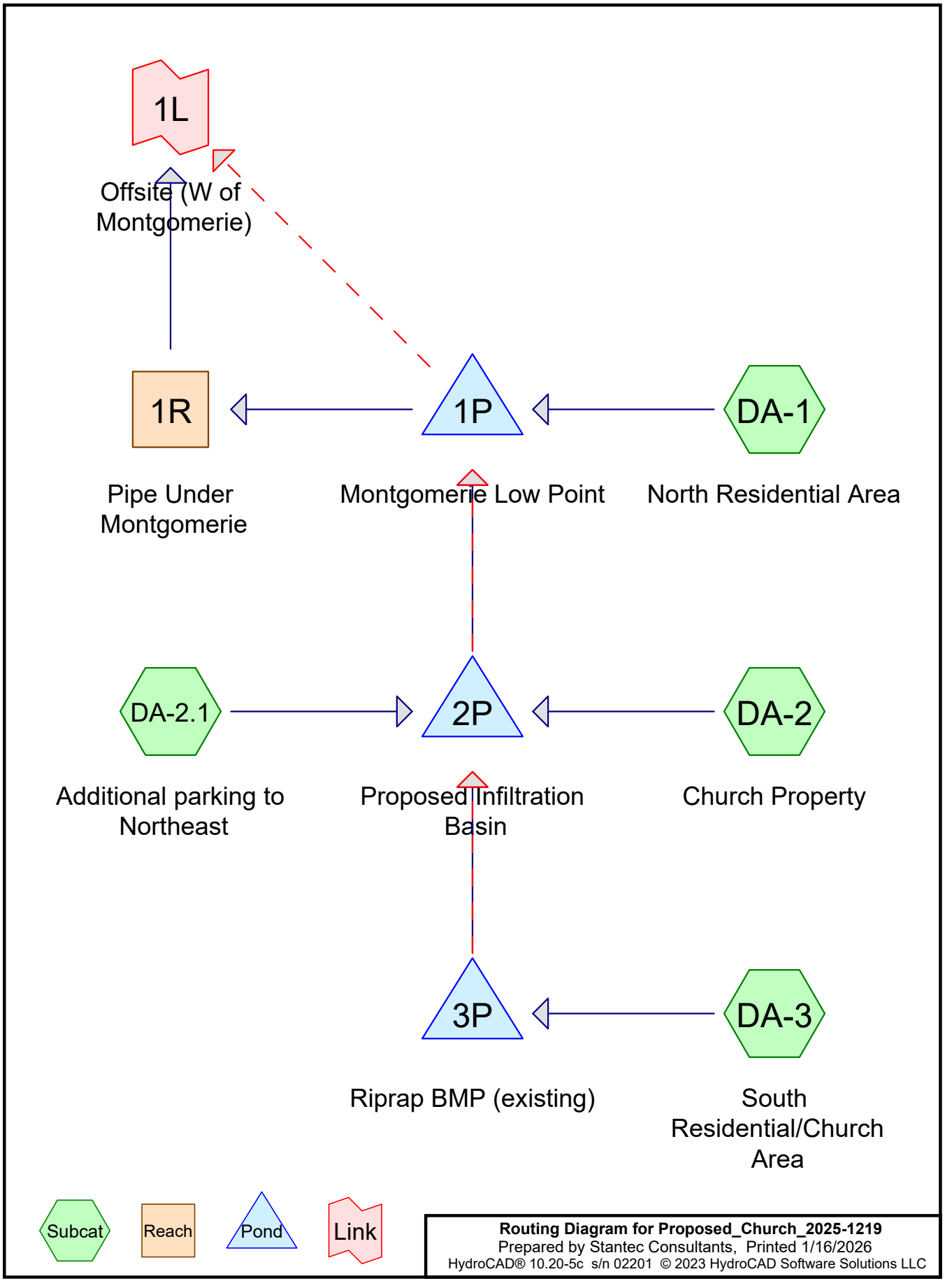
Summary for Link 1L: Offsite (W of Montgomerie)

Inflow Area = 8.400 ac, 48.57% Impervious, Inflow Depth = 3.89" for 100-Year event
Inflow = 35.20 cfs @ 12.22 hrs, Volume= 2.726 af
Primary = 35.20 cfs @ 12.22 hrs, Volume= 2.726 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: Offsite (W of Montgomerie)





Routing Diagram for Proposed_Church_2025-1219
Prepared by Stantec Consultants, Printed 1/16/2026

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 5327 MN Hennepin

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	MSE 24-hr	3	Default	24.00	1	2.86	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.26	2
3	100-Year	MSE 24-hr	3	Default	24.00	1	7.32	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.128	49	50-75% Grass cover, Fair, HSG A (DA-2.1)
4.330	39	>75% Grass cover, Good, HSG A (DA-1, DA-2, DA-3)
4.230	98	IMPERVIOUS (DA-1, DA-2, DA-2.1, DA-3)
8.688	**68**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
4.458	HSG A	DA-1, DA-2, DA-2.1, DA-3
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
4.230	Other	DA-1, DA-2, DA-2.1, DA-3
8.688		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.128	0.000	0.000	0.000	0.000	0.128	50-75% Grass cover, Fair	DA-2.1
4.330	0.000	0.000	0.000	0.000	4.330	>75% Grass cover, Good	DA-1, DA-2, DA-3
0.000	0.000	0.000	0.000	4.230	4.230	IMPERVIOUS	DA-1, DA-2, DA-2.1, DA-3
4.458	**0.000**	**0.000**	**0.000**	**4.230**	**8.688**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1R	967.50	967.09	57.0	0.0072	0.012	0.0	15.0	0.0	
2	1P	966.11	965.90	43.0	0.0049	0.025	0.0	12.0	0.0	
3	2P	969.00	968.30	140.0	0.0050	0.013	0.0	12.0	0.0	
4	3P	975.89	975.34	77.0	0.0071	0.013	0.0	12.0	0.0	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA-1: North Residential Area Runoff Area=3.100 ac 41.94% Impervious Runoff Depth=1.10"
Tc=10.0 min CN=39/98 Runoff=4.69 cfs 0.285 af

Subcatchment DA-2: Church Property Runoff Area=2.000 ac 58.00% Impervious Runoff Depth=1.52"
Tc=10.0 min CN=39/98 Runoff=4.18 cfs 0.254 af

Subcatchment DA-2.1: Additional parking Runoff Area=0.288 ac 55.56% Impervious Runoff Depth=1.48"
Tc=7.0 min CN=49/98 Runoff=0.65 cfs 0.036 af

Subcatchment DA-3: South Runoff Area=3.300 ac 48.79% Impervious Runoff Depth=1.28"
Tc=10.0 min CN=39/98 Runoff=5.81 cfs 0.353 af

Reach 1R: Pipe Under Montgomerie Avg. Flow Depth=0.43' Max Vel=4.03 fps Inflow=1.50 cfs 0.344 af
15.0" Round Pipe n=0.012 L=57.0' S=0.0072 '/' Capacity=5.94 cfs Outflow=1.50 cfs 0.344 af

Pond 1P: Montgomerie Low Point Peak Elev=968.29' Storage=891 cf Inflow=4.69 cfs 0.392 af
Primary=1.50 cfs 0.344 af Secondary=3.11 cfs 0.048 af Outflow=4.61 cfs 0.392 af

Pond 2P: Proposed Infiltration Basin Peak Elev=971.36' Storage=18,047 cf Inflow=10.55 cfs 0.642 af
Discarded=0.14 cfs 0.535 af Primary=0.83 cfs 0.107 af Secondary=0.00 cfs 0.000 af Outflow=0.96 cfs 0.642 af

Pond 3P: Riprap BMP (existing) Peak Elev=981.43' Storage=118 cf Inflow=5.81 cfs 0.353 af
Primary=5.79 cfs 0.353 af Secondary=0.00 cfs 0.000 af Outflow=5.79 cfs 0.353 af

Link 1L: Offsite (W of Montgomerie) Inflow=4.61 cfs 0.392 af
Primary=4.61 cfs 0.392 af

Total Runoff Area = 8.688 ac Runoff Volume = 0.927 af Average Runoff Depth = 1.28"
51.31% Pervious = 4.458 ac 48.69% Impervious = 4.230 ac

Summary for Subcatchment DA-1: North Residential Area

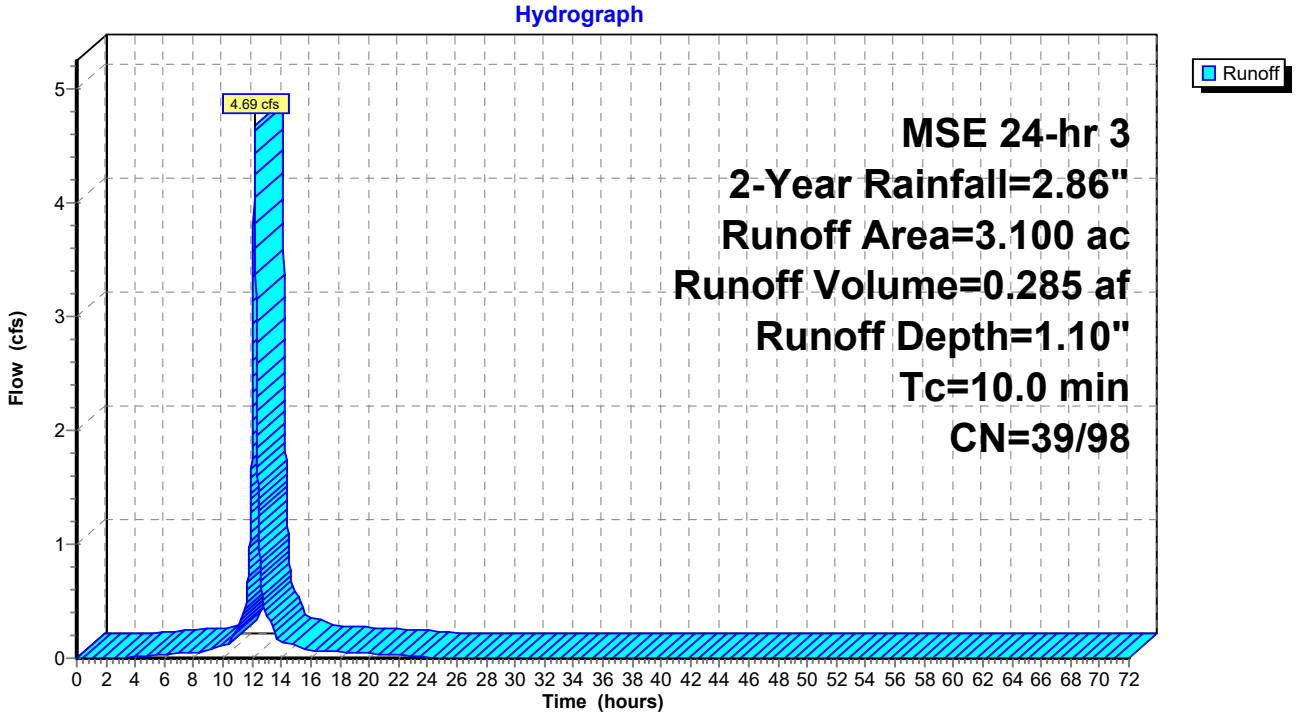
Runoff = 4.69 cfs @ 12.17 hrs, Volume= 0.285 af, Depth= 1.10"
Routed to Pond 1P : Montgomerie Low Point

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 2-Year Rainfall=2.86"

	Area (ac)	CN	Description
*	1.300	98	IMPERVIOUS
	1.800	39	>75% Grass cover, Good, HSG A
	3.100	64	Weighted Average
	1.800	39	58.06% Pervious Area
	1.300	98	41.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-1: North Residential Area



Summary for Subcatchment DA-2: Church Property

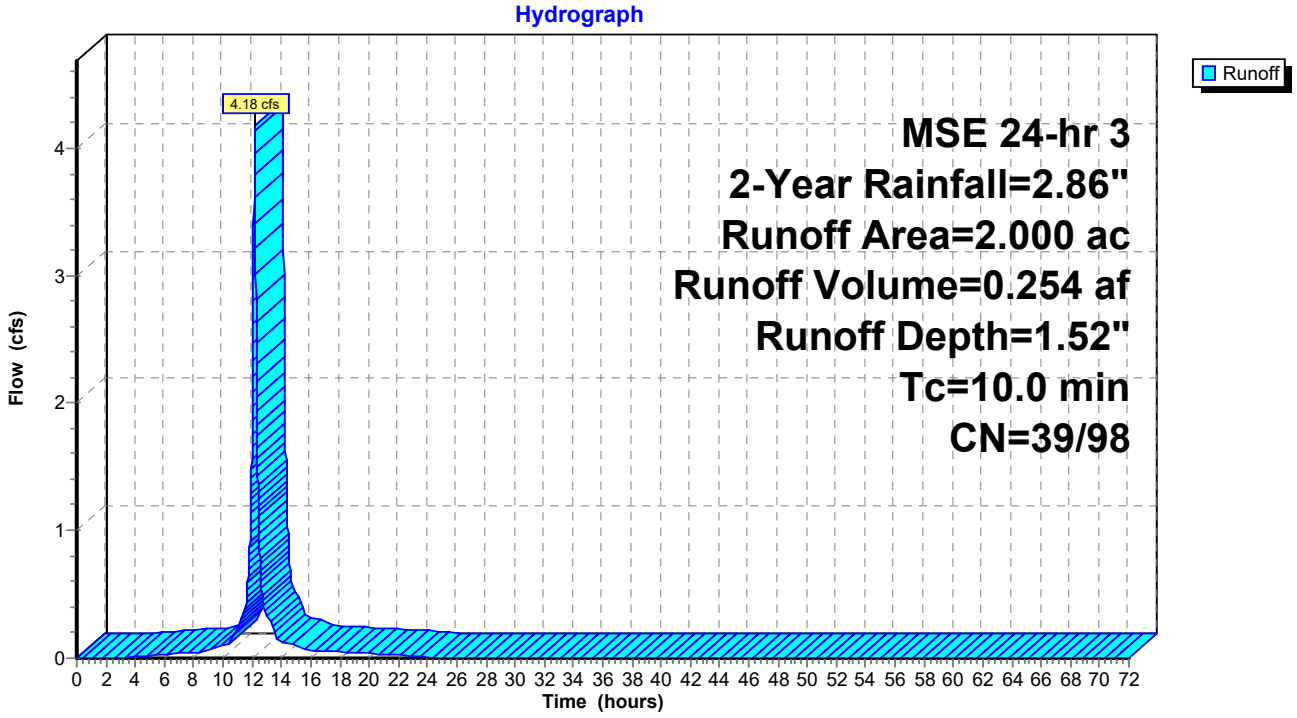
Runoff = 4.18 cfs @ 12.17 hrs, Volume= 0.254 af, Depth= 1.52"
Routed to Pond 2P : Proposed Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (ac)	CN	Description
1.160	98	IMPERVIOUS
0.840	39	>75% Grass cover, Good, HSG A
2.000	73	Weighted Average
0.840	39	42.00% Pervious Area
1.160	98	58.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-2: Church Property



Summary for Subcatchment DA-2.1: Additional parking to Northeast

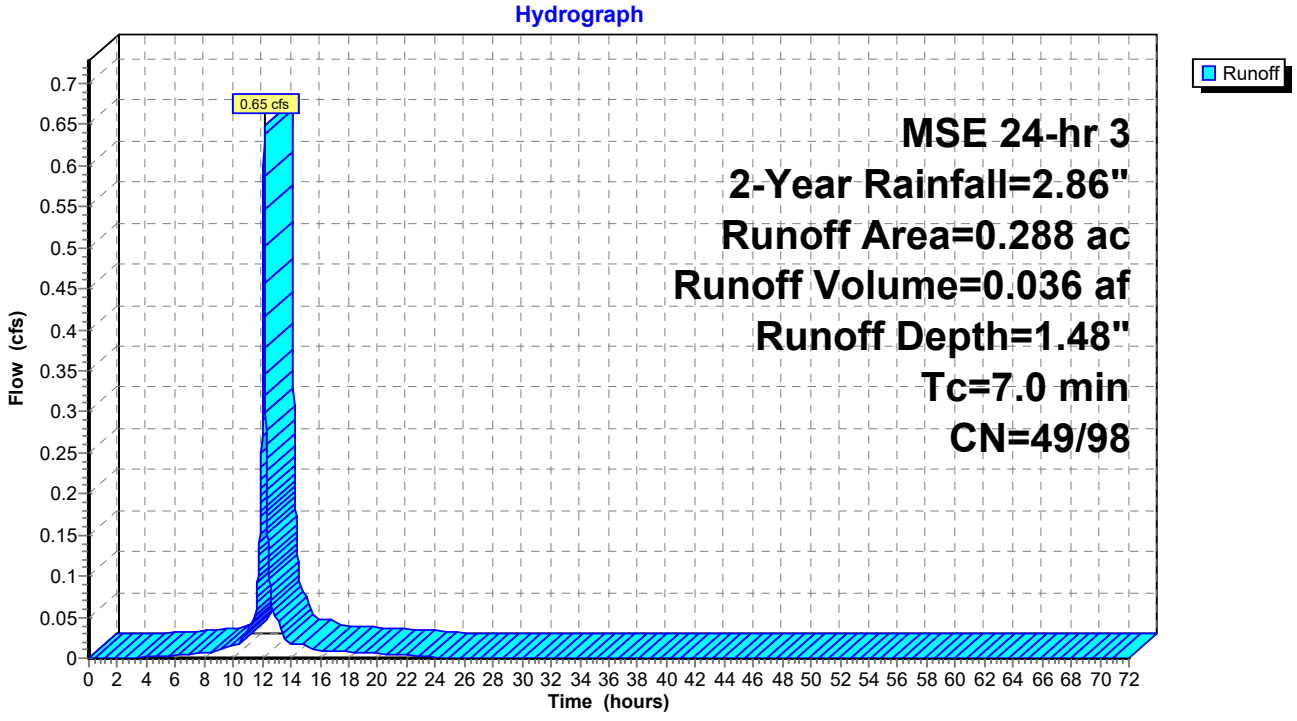
Runoff = 0.65 cfs @ 12.14 hrs, Volume= 0.036 af, Depth= 1.48"
Routed to Pond 2P : Proposed Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 2-Year Rainfall=2.86"

	Area (ac)	CN	Description
*	0.160	98	IMPERVIOUS
	0.128	49	50-75% Grass cover, Fair, HSG A
	0.288	76	Weighted Average
	0.128	49	44.44% Pervious Area
	0.160	98	55.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment DA-2.1: Additional parking to Northeast



Summary for Subcatchment DA-3: South Residential/Church Area

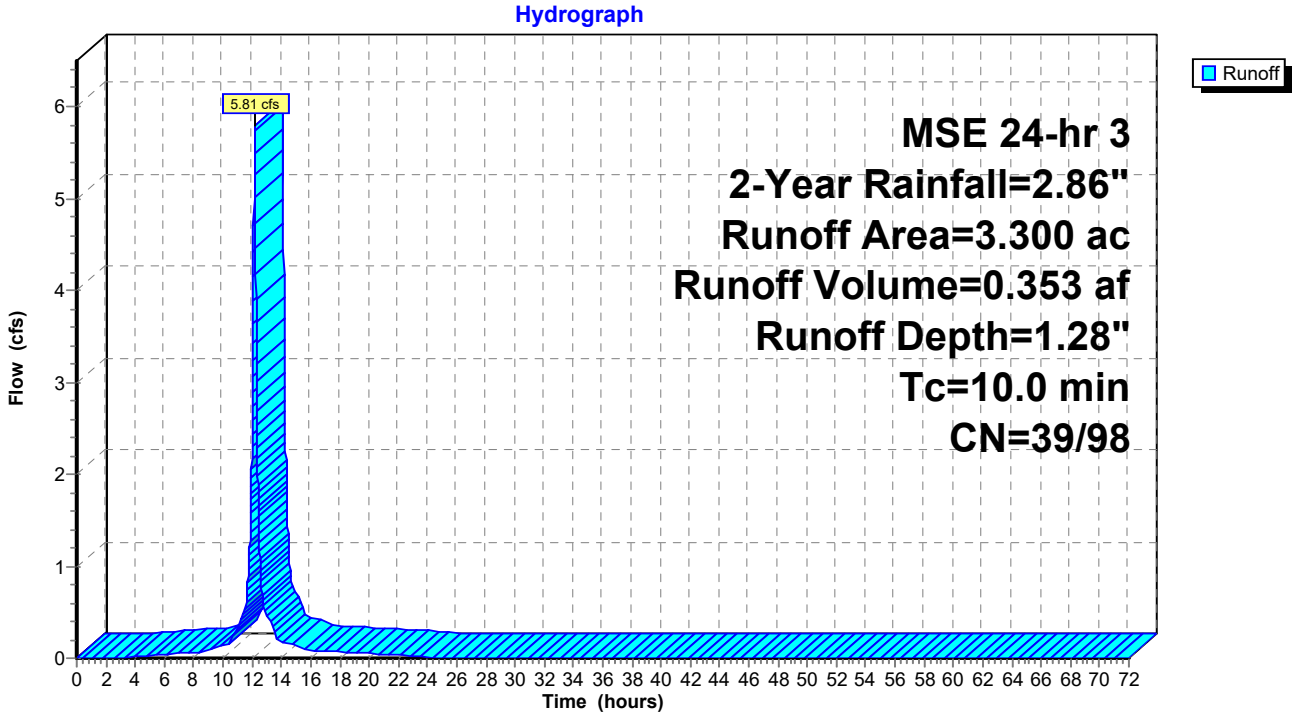
Runoff = 5.81 cfs @ 12.17 hrs, Volume= 0.353 af, Depth= 1.28"
Routed to Pond 3P : Riprap BMP (existing)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (ac)	CN	Description
1.610	98	IMPERVIOUS
1.690	39	>75% Grass cover, Good, HSG A
3.300	68	Weighted Average
1.690	39	51.21% Pervious Area
1.610	98	48.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-3: South Residential/Church Area



Summary for Reach 1R: Pipe Under Montgomerie

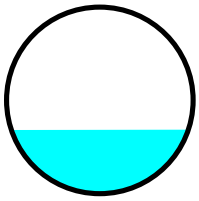
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 8.688 ac, 48.69% Impervious, Inflow Depth = 0.47" for 2-Year event
Inflow = 1.50 cfs @ 12.19 hrs, Volume= 0.344 af
Outflow = 1.50 cfs @ 12.19 hrs, Volume= 0.344 af, Atten= 0%, Lag= 0.2 min
Routed to Link 1L : Offsite (W of Montgomerie)

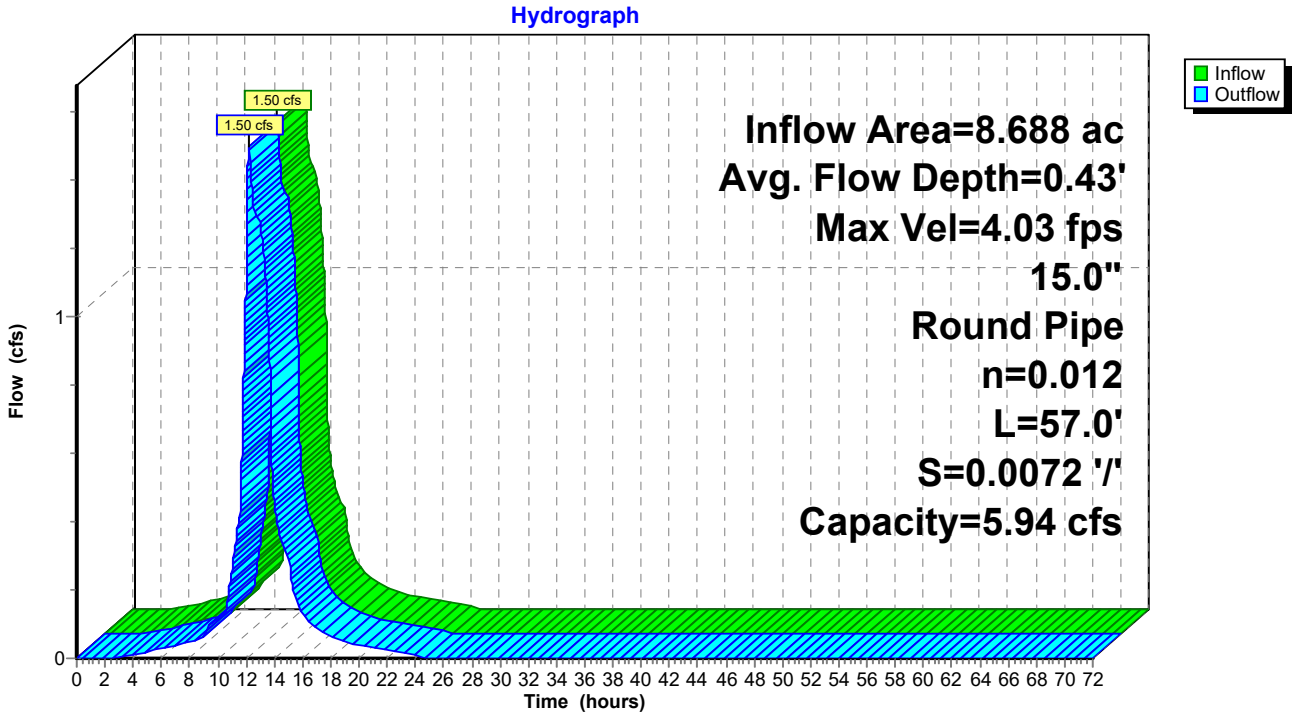
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.03 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.74 fps, Avg. Travel Time= 0.5 min

Peak Storage= 21 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.43' , Surface Width= 1.19'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 5.94 cfs

15.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 57.0' Slope= 0.0072 '/'
Inlet Invert= 967.50', Outlet Invert= 967.09'



Reach 1R: Pipe Under Montgomerie



Summary for Pond 1P: Montgomerie Low Point

Inflow Area = 8.688 ac, 48.69% Impervious, Inflow Depth = 0.54" for 2-Year event
Inflow = 4.69 cfs @ 12.17 hrs, Volume= 0.392 af
Outflow = 4.61 cfs @ 12.19 hrs, Volume= 0.392 af, Atten= 2%, Lag= 1.0 min
Primary = 1.50 cfs @ 12.19 hrs, Volume= 0.344 af
Routed to Reach 1R : Pipe Under Montgomerie
Secondary = 3.11 cfs @ 12.19 hrs, Volume= 0.048 af
Routed to Link 1L : Offsite (W of Montgomerie)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 968.29' @ 12.19 hrs Surf.Area= 2,987 sf Storage= 891 cf

Plug-Flow detention time= 3.6 min calculated for 0.392 af (100% of inflow)
Center-of-Mass det. time= 3.6 min (779.2 - 775.6)

Volume	Invert	Avail.Storage	Storage Description
#1	967.78'	28,839 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

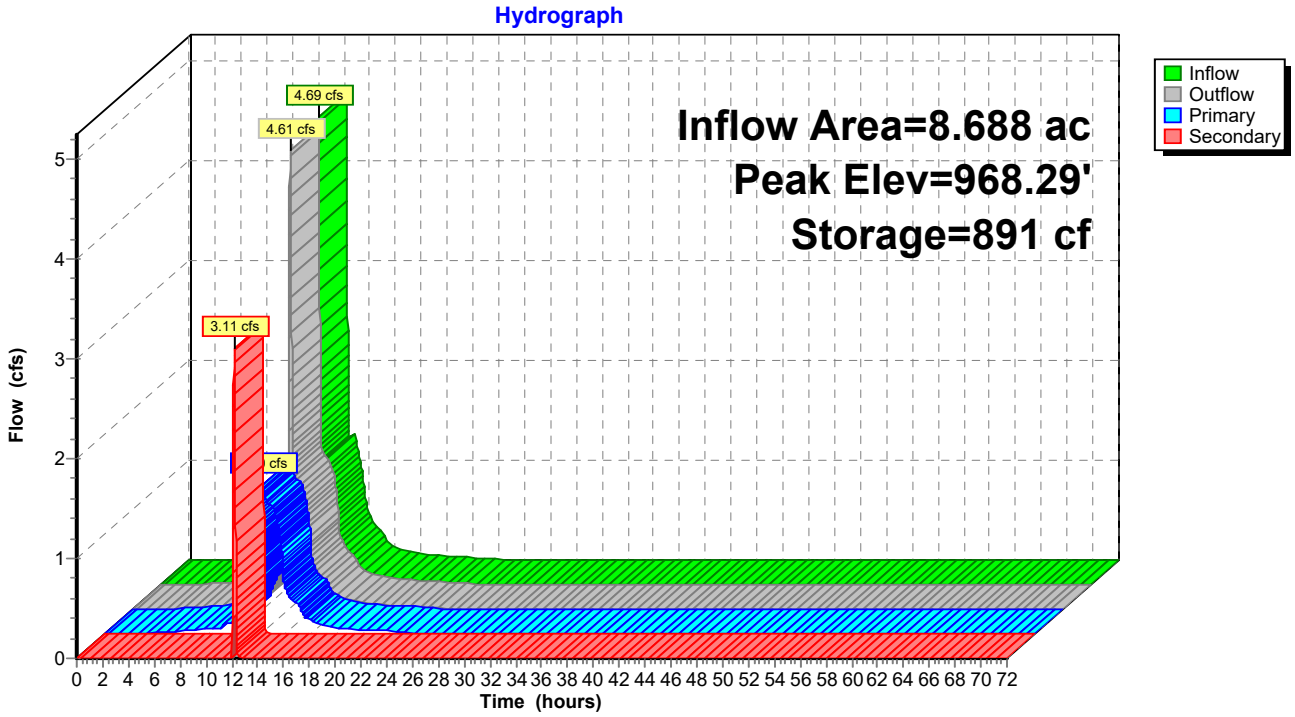
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
967.78	10	0	0
968.00	1,750	194	194
969.00	5,950	3,850	4,044
970.00	9,320	7,635	11,679
971.00	25,000	17,160	28,839

Device	Routing	Invert	Outlet Devices
#1	Primary	966.11'	**12.0" Round Culvert** L= 43.0' Ke= 0.500 Inlet / Outlet Invert= 966.11' / 965.90' S= 0.0049 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Device 1	967.78'	**15.0" x 1.5" Horiz. Orifice/Grate** X 6 rows C= 0.600 in 15.0" x 15.0" Grate (60% open area) Limited to weir flow at low heads
#3	Secondary	968.20'	**40.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.50 cfs @ 12.19 hrs HW=968.29' TW=967.93' (Dynamic Tailwater)
1=Culvert (Outlet Controls 1.50 cfs @ 1.91 fps)
2=Orifice/Grate (Passes 1.50 cfs of 2.73 cfs potential flow)

Secondary OutFlow Max=3.11 cfs @ 12.19 hrs HW=968.29' TW=0.00' (Dynamic Tailwater)
3=Broad-Crested Rectangular Weir (Weir Controls 3.11 cfs @ 0.82 fps)

Pond 1P: Montgomerie Low Point



Summary for Pond 2P: Proposed Infiltration Basin

Inflow Area = 5.588 ac, 52.43% Impervious, Inflow Depth = 1.38" for 2-Year event
Inflow = 10.55 cfs @ 12.17 hrs, Volume= 0.642 af
Outflow = 0.96 cfs @ 12.87 hrs, Volume= 0.642 af, Atten= 91%, Lag= 41.8 min
Discarded = 0.14 cfs @ 12.87 hrs, Volume= 0.535 af
Primary = 0.83 cfs @ 12.87 hrs, Volume= 0.107 af
Routed to Pond 1P : Montgomerie Low Point
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 1P : Montgomerie Low Point

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 971.36' @ 12.87 hrs Surf.Area= 7,358 sf Storage= 18,047 cf

Plug-Flow detention time= 1,141.6 min calculated for 0.642 af (100% of inflow)
Center-of-Mass det. time= 1,141.7 min (1,899.6 - 757.9)

Volume	Invert	Avail.Storage	Storage Description
#1	968.00'	45,911 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)
968.00	3,847	251.0	0	0	3,847
969.00	4,672	279.0	4,253	4,253	5,057
970.00	5,580	305.0	5,119	9,372	6,300
971.00	6,738	399.0	6,150	15,522	11,578
972.00	8,535	560.0	7,619	23,141	23,874
973.00	12,374	658.0	10,395	33,536	33,392
974.00	12,375	659.0	12,374	45,911	34,059

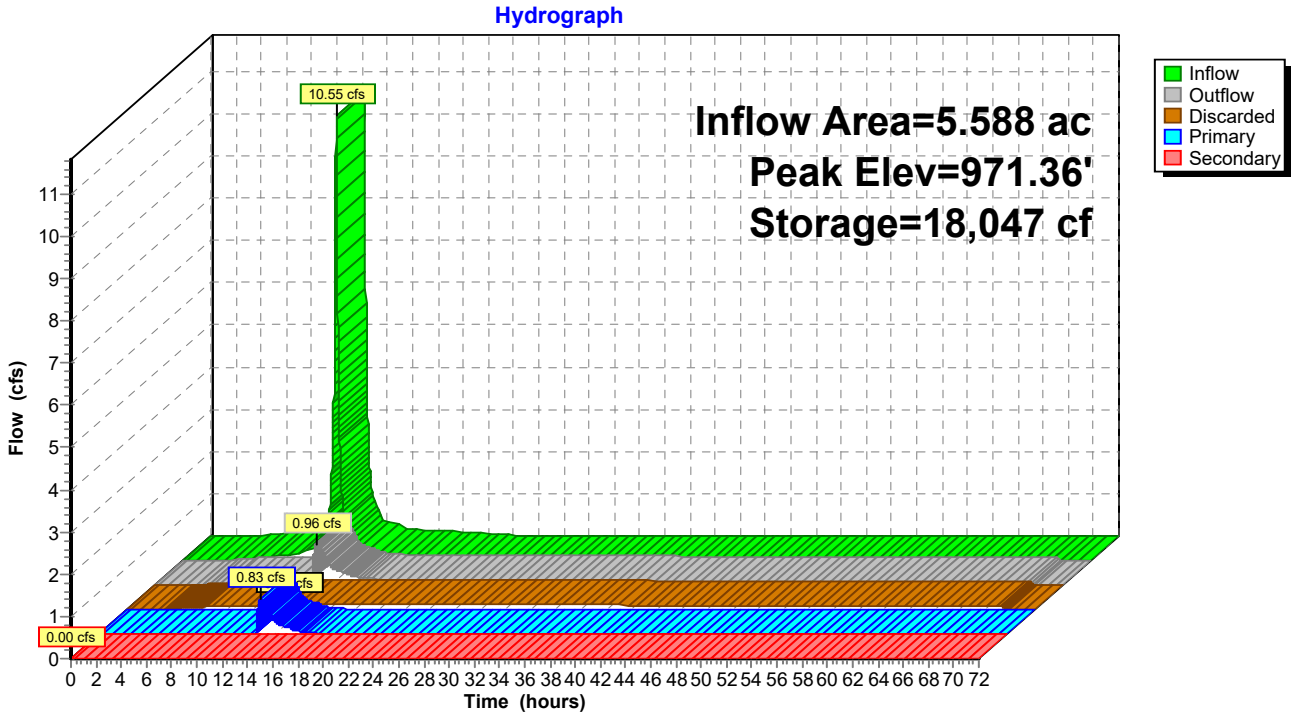
Device	Routing	Invert	Outlet Devices
#1	Primary	969.00'	**12.0" Round 12" RCP Storm Sewer** L= 140.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 969.00' / 968.30' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	971.20'	**4.0' long x 1.65' rise Weir overflow** Cv= 2.62 (C= 3.28)
#3	Secondary	972.18'	**15.0' long x 5.0' breadth Curb Parking Lot EOF** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#4	Secondary	973.00'	**50.0' long x 5.0' breadth Top Berm** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#5	Discarded	968.00'	**0.800 in/hr Infiltraiton - 0.80 in/hr over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.14 cfs @ 12.87 hrs HW=971.36' (Free Discharge)
└**5=Infiltraiton - 0.80 in/hr** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.83 cfs @ 12.87 hrs HW=971.36' TW=968.17' (Dynamic Tailwater)
└**1=12" RCP Storm Sewer** (Passes 0.83 cfs of 3.82 cfs potential flow)
└**2=Weir overflow** (Weir Controls 0.83 cfs @ 1.30 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=968.00' TW=967.78' (Dynamic Tailwater)
└**3=Curb Parking Lot EOF** (Controls 0.00 cfs)
└**4=Top Berm** (Controls 0.00 cfs)

Pond 2P: Proposed Infiltration Basin



Summary for Pond 3P: Riprap BMP (existing)

Inflow Area = 3.300 ac, 48.79% Impervious, Inflow Depth = 1.28" for 2-Year event
Inflow = 5.81 cfs @ 12.17 hrs, Volume= 0.353 af
Outflow = 5.79 cfs @ 12.18 hrs, Volume= 0.353 af, Atten= 0%, Lag= 0.3 min
Primary = 5.79 cfs @ 12.18 hrs, Volume= 0.353 af
Routed to Pond 2P : Proposed Infiltration Basin
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 2P : Proposed Infiltration Basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 981.43' @ 12.18 hrs Surf.Area= 351 sf Storage= 118 cf

Plug-Flow detention time= 0.8 min calculated for 0.353 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (758.1 - 757.5)

Volume	Invert	Avail.Storage	Storage Description
#1	981.00'	5,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

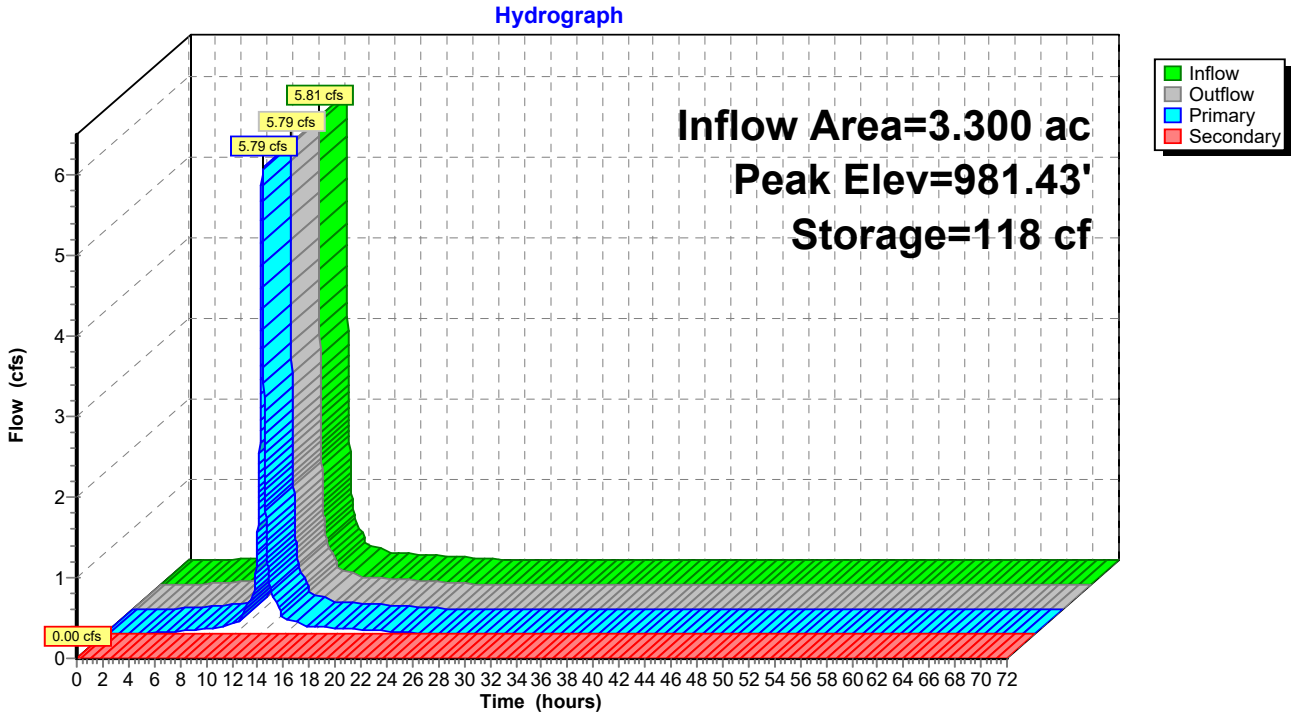
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
981.00	200	0	0
982.00	550	375	375
983.00	2,700	1,625	2,000
984.00	5,000	3,850	5,850

Device	Routing	Invert	Outlet Devices
#1	Primary	975.89'	**12.0" Round Culvert** L= 77.0' Ke= 0.500 Inlet / Outlet Invert= 975.89' / 975.34' S= 0.0071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	981.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	982.00'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=5.79 cfs @ 12.18 hrs HW=981.43' TW=970.33' (Dynamic Tailwater)
↑**1=Culvert** (Passes 5.79 cfs of 7.18 cfs potential flow)
↑**2=Orifice/Grate** (Weir Controls 5.79 cfs @ 2.14 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=981.00' TW=968.00' (Dynamic Tailwater)
↑**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Riprap BMP (existing)

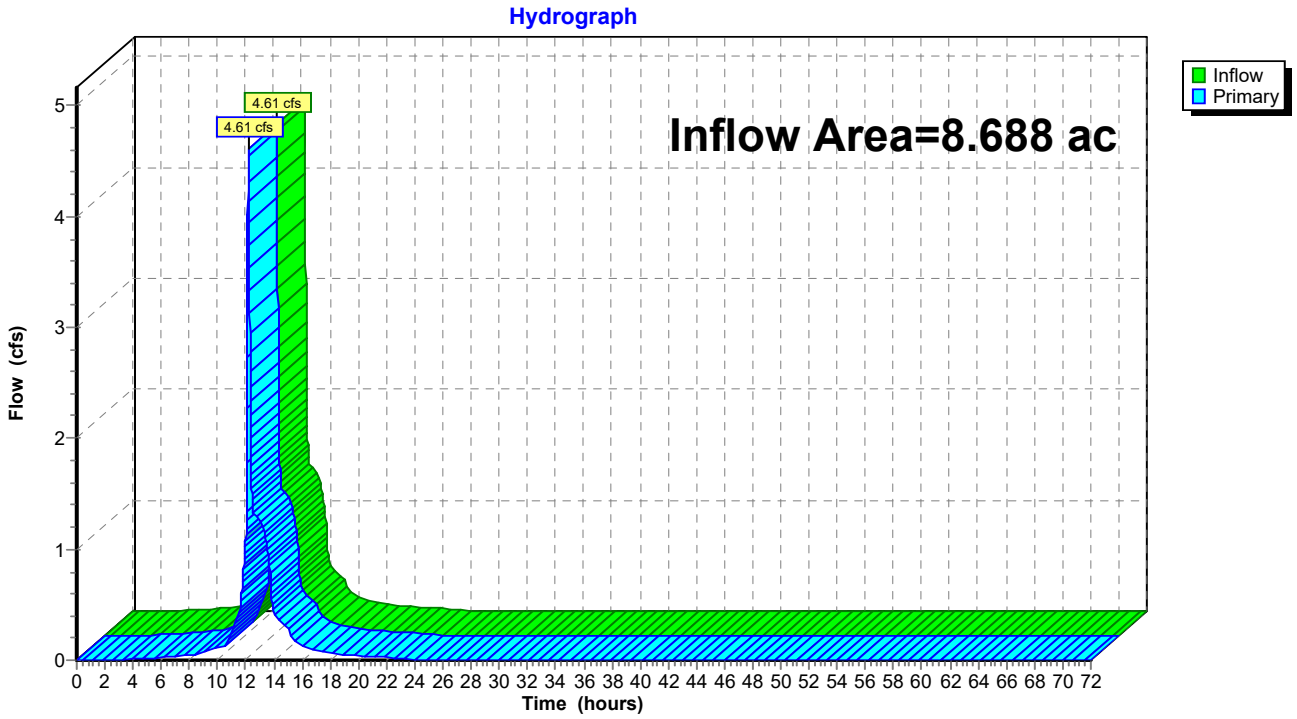


Summary for Link 1L: Offsite (W of Montgomerie)

Inflow Area = 8.688 ac, 48.69% Impervious, Inflow Depth = 0.54" for 2-Year event
Inflow = 4.61 cfs @ 12.19 hrs, Volume= 0.392 af
Primary = 4.61 cfs @ 12.19 hrs, Volume= 0.392 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: Offsite (W of Montgomerie)



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA-1: North Residential Area Runoff Area=3.100 ac 41.94% Impervious Runoff Depth=1.73"
Tc=10.0 min CN=39/98 Runoff=7.04 cfs 0.447 af

Subcatchment DA-2: Church Property Runoff Area=2.000 ac 58.00% Impervious Runoff Depth=2.37"
Tc=10.0 min CN=39/98 Runoff=6.28 cfs 0.394 af

Subcatchment DA-2.1: Additional parking Runoff Area=0.288 ac 55.56% Impervious Runoff Depth=2.40"
Tc=7.0 min CN=49/98 Runoff=1.01 cfs 0.058 af

Subcatchment DA-3: South Runoff Area=3.300 ac 48.79% Impervious Runoff Depth=2.00"
Tc=10.0 min CN=39/98 Runoff=8.72 cfs 0.551 af

Reach 1R: Pipe Under Montgomerie Avg. Flow Depth=0.45' Max Vel=4.12 fps Inflow=1.62 cfs 0.519 af
15.0" Round Pipe n=0.012 L=57.0' S=0.0072 '/' Capacity=5.94 cfs Outflow=1.62 cfs 0.519 af

Pond 1P: Montgomerie Low Point Peak Elev=968.38' Storage=1,153 cf Inflow=9.86 cfs 0.886 af
Primary=1.62 cfs 0.519 af Secondary=8.01 cfs 0.367 af Outflow=9.64 cfs 0.886 af

Pond 2P: Proposed Infiltration Basin Peak Elev=971.98' Storage=22,931 cf Inflow=14.81 cfs 1.003 af
Discarded=0.16 cfs 0.564 af Primary=4.36 cfs 0.439 af Secondary=0.00 cfs 0.000 af Outflow=4.52 cfs 1.003 af

Pond 3P: Riprap BMP (existing) Peak Elev=982.05' Storage=404 cf Inflow=8.72 cfs 0.551 af
Primary=7.61 cfs 0.550 af Secondary=0.56 cfs 0.001 af Outflow=8.17 cfs 0.551 af

Link 1L: Offsite (W of Montgomerie) Inflow=9.64 cfs 0.886 af
Primary=9.64 cfs 0.886 af

Total Runoff Area = 8.688 ac Runoff Volume = 1.450 af Average Runoff Depth = 2.00"
51.31% Pervious = 4.458 ac 48.69% Impervious = 4.230 ac

Summary for Subcatchment DA-1: North Residential Area

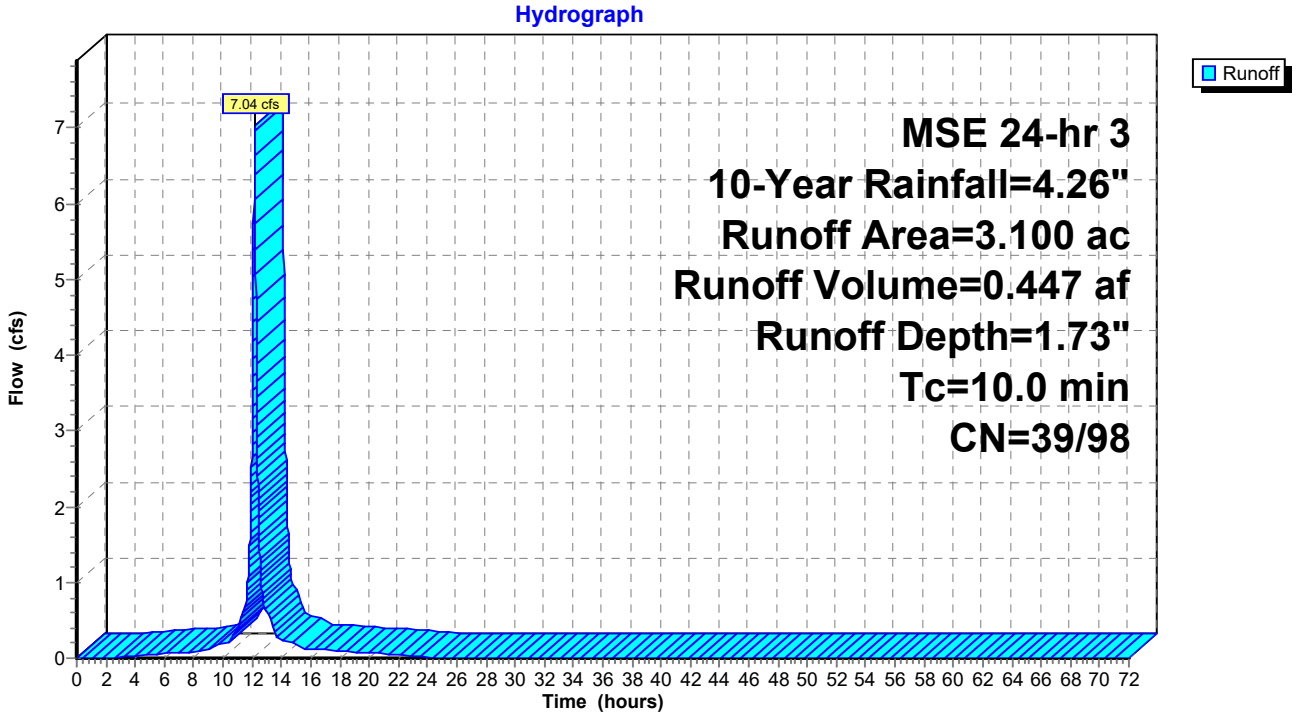
Runoff = 7.04 cfs @ 12.17 hrs, Volume= 0.447 af, Depth= 1.73"
Routed to Pond 1P : Montgomerie Low Point

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

	Area (ac)	CN	Description
*	1.300	98	IMPERVIOUS
	1.800	39	>75% Grass cover, Good, HSG A
	3.100	64	Weighted Average
	1.800	39	58.06% Pervious Area
	1.300	98	41.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-1: North Residential Area



Summary for Subcatchment DA-2: Church Property

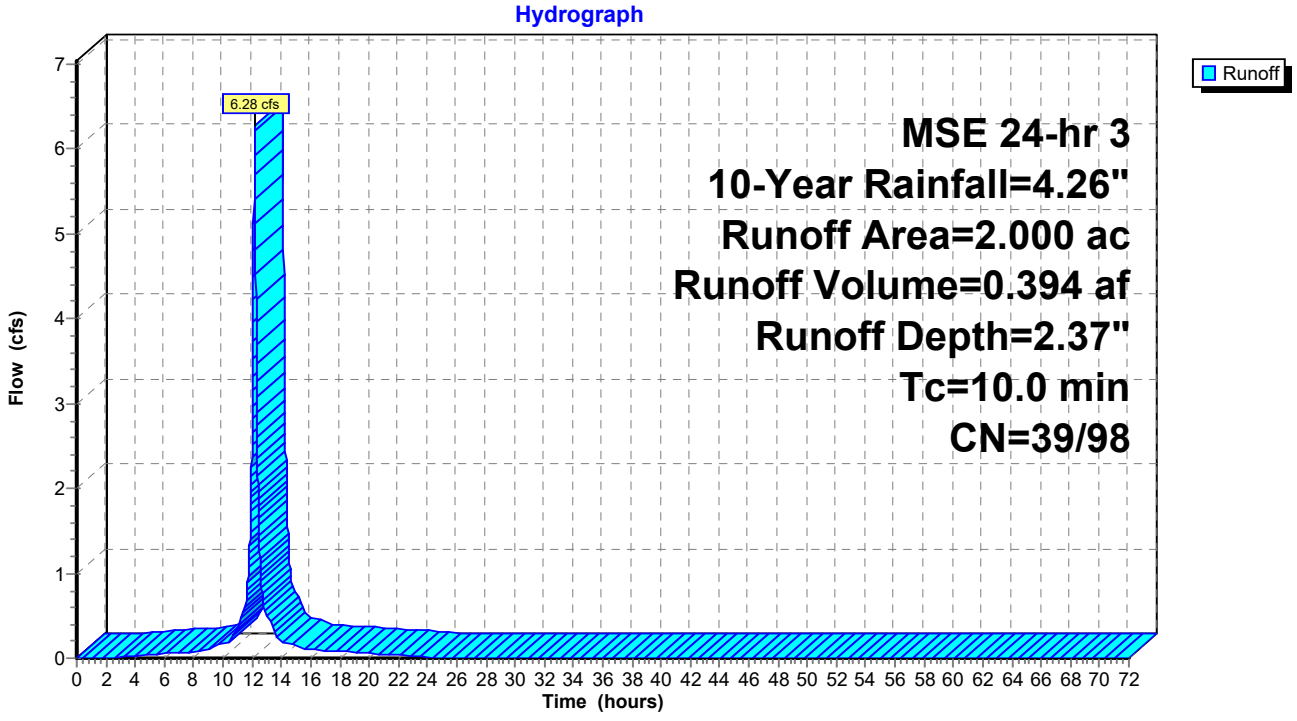
Runoff = 6.28 cfs @ 12.17 hrs, Volume= 0.394 af, Depth= 2.37"
Routed to Pond 2P : Proposed Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
1.160	98	IMPERVIOUS
0.840	39	>75% Grass cover, Good, HSG A
2.000	73	Weighted Average
0.840	39	42.00% Pervious Area
1.160	98	58.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-2: Church Property



Summary for Subcatchment DA-2.1: Additional parking to Northeast

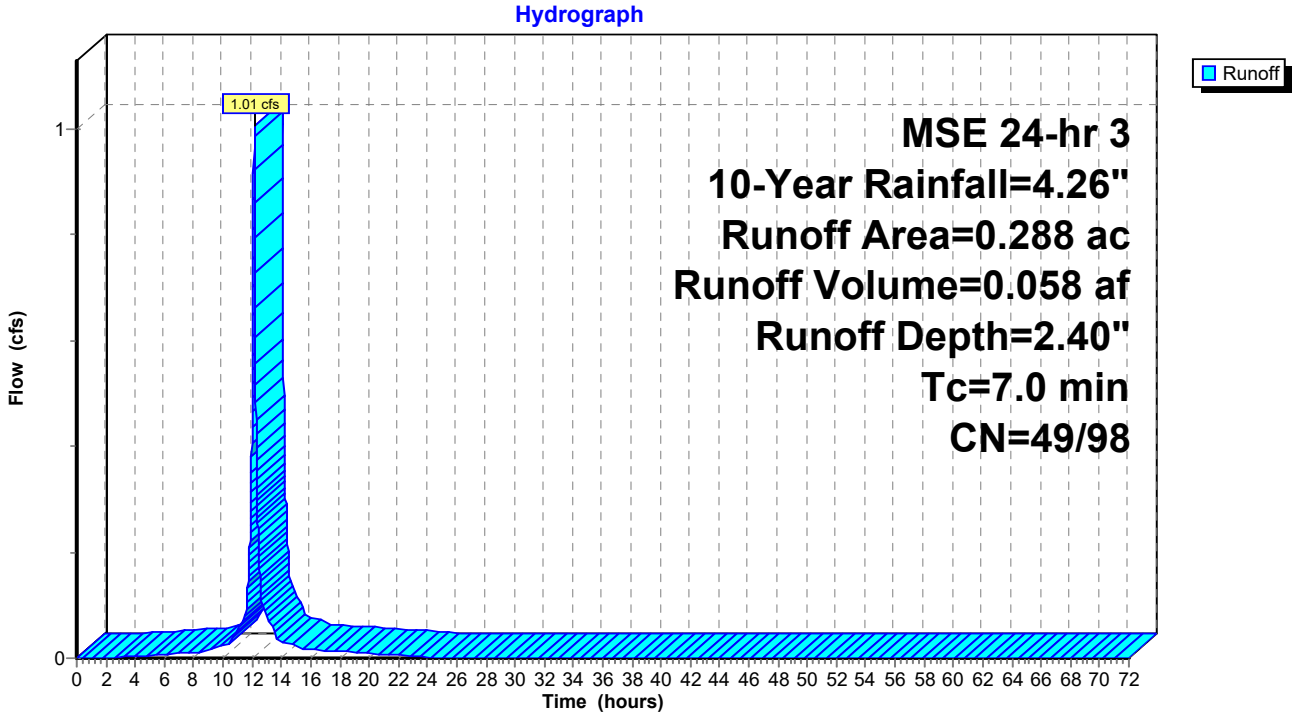
Runoff = 1.01 cfs @ 12.14 hrs, Volume= 0.058 af, Depth= 2.40"
Routed to Pond 2P : Proposed Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

	Area (ac)	CN	Description
*	0.160	98	IMPERVIOUS
	0.128	49	50-75% Grass cover, Fair, HSG A
	0.288	76	Weighted Average
	0.128	49	44.44% Pervious Area
	0.160	98	55.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment DA-2.1: Additional parking to Northeast



Summary for Subcatchment DA-3: South Residential/Church Area

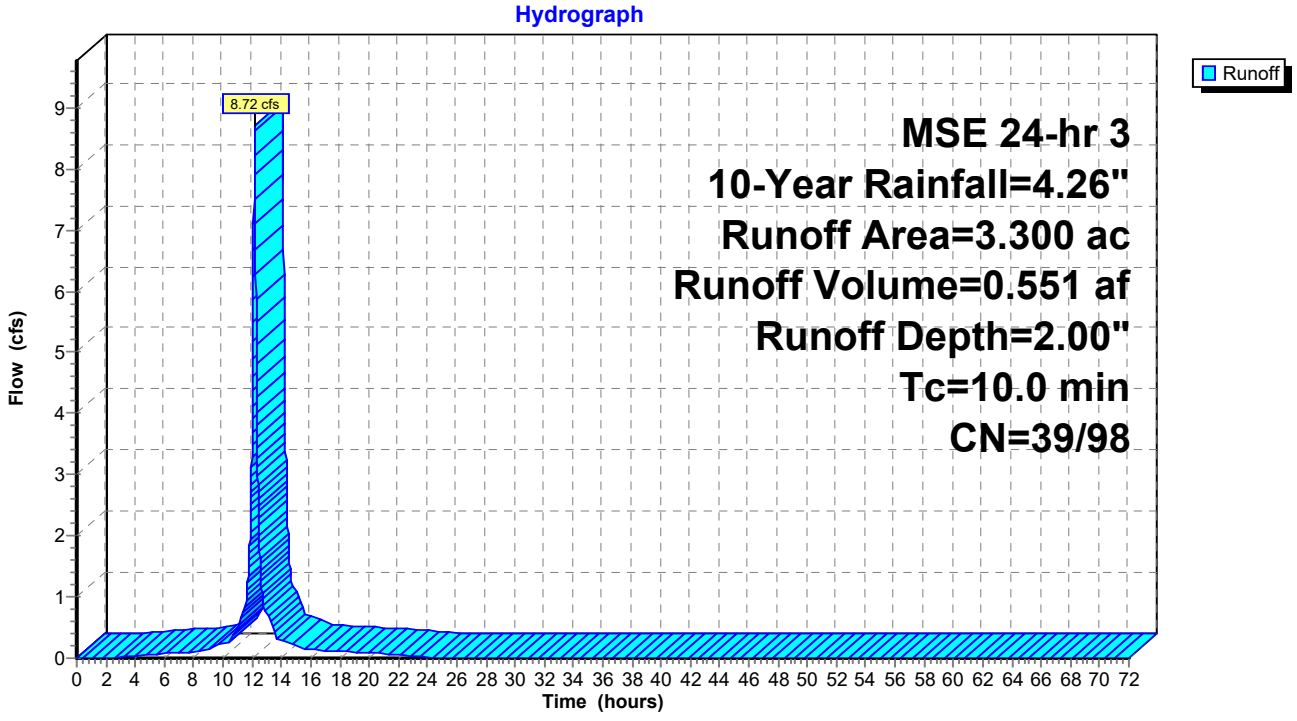
Runoff = 8.72 cfs @ 12.17 hrs, Volume= 0.551 af, Depth= 2.00"
Routed to Pond 3P : Riprap BMP (existing)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
1.610	98	IMPERVIOUS
1.690	39	>75% Grass cover, Good, HSG A
3.300	68	Weighted Average
1.690	39	51.21% Pervious Area
1.610	98	48.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-3: South Residential/Church Area



Summary for Reach 1R: Pipe Under Montgomerie

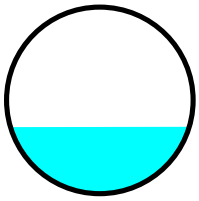
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 8.688 ac, 48.69% Impervious, Inflow Depth = 0.72" for 10-Year event
Inflow = 1.62 cfs @ 12.24 hrs, Volume= 0.519 af
Outflow = 1.62 cfs @ 12.24 hrs, Volume= 0.519 af, Atten= 0%, Lag= 0.2 min
Routed to Link 1L : Offsite (W of Montgomerie)

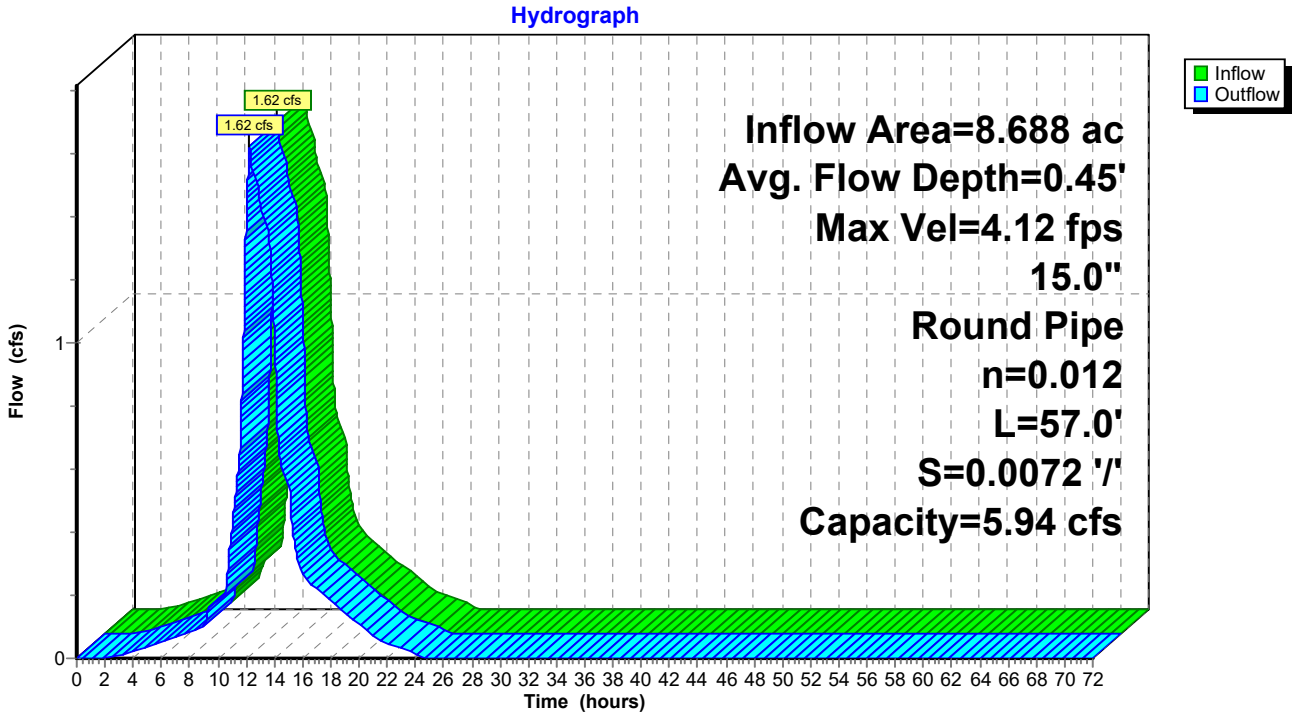
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.12 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.05 fps, Avg. Travel Time= 0.5 min

Peak Storage= 22 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.45' , Surface Width= 1.20'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 5.94 cfs

15.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 57.0' Slope= 0.0072 '/'
Inlet Invert= 967.50', Outlet Invert= 967.09'



Reach 1R: Pipe Under Montgomerie



Summary for Pond 1P: Montgomerie Low Point

Inflow Area = 8.688 ac, 48.69% Impervious, Inflow Depth = 1.22" for 10-Year event
Inflow = 9.86 cfs @ 12.23 hrs, Volume= 0.886 af
Outflow = 9.64 cfs @ 12.24 hrs, Volume= 0.886 af, Atten= 2%, Lag= 0.7 min
Primary = 1.62 cfs @ 12.24 hrs, Volume= 0.519 af
Routed to Reach 1R : Pipe Under Montgomerie
Secondary = 8.01 cfs @ 12.24 hrs, Volume= 0.367 af
Routed to Link 1L : Offsite (W of Montgomerie)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 968.38' @ 12.24 hrs Surf.Area= 3,335 sf Storage= 1,153 cf

Plug-Flow detention time= 2.9 min calculated for 0.886 af (100% of inflow)
Center-of-Mass det. time= 2.9 min (783.1 - 780.2)

Volume	Invert	Avail.Storage	Storage Description
#1	967.78'	28,839 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

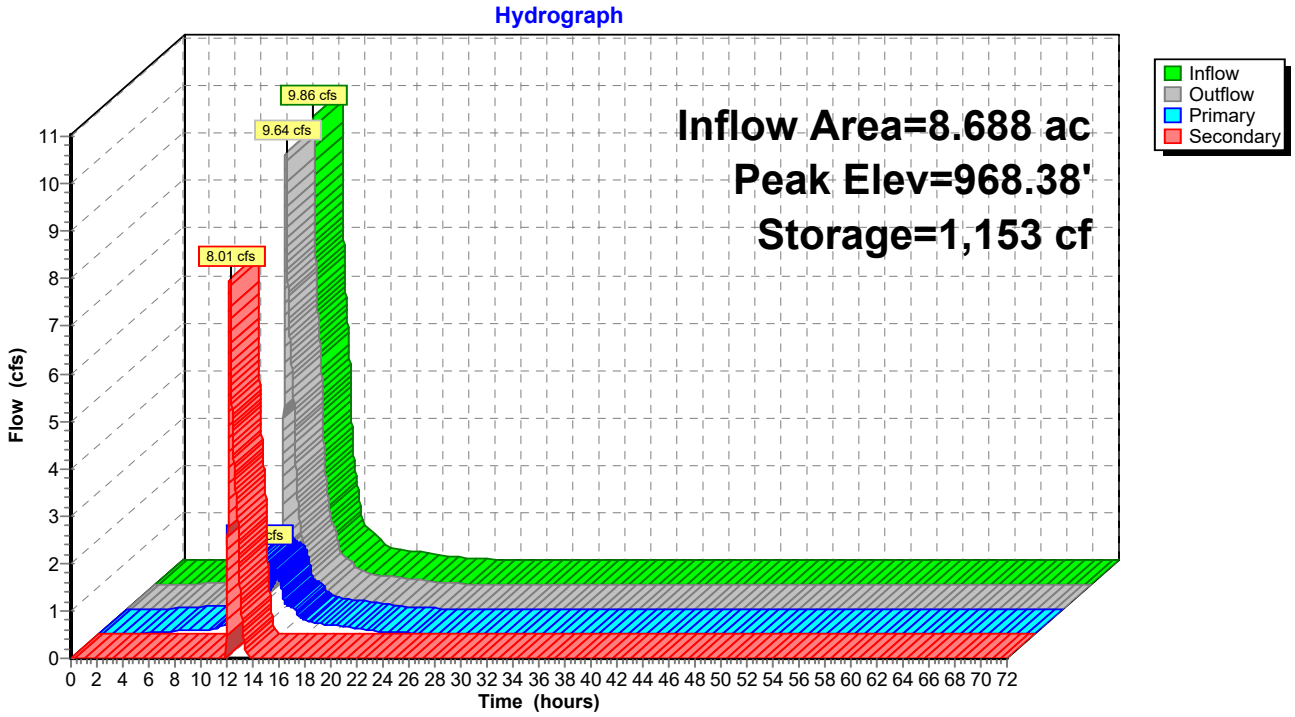
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
967.78	10	0	0
968.00	1,750	194	194
969.00	5,950	3,850	4,044
970.00	9,320	7,635	11,679
971.00	25,000	17,160	28,839

Device	Routing	Invert	Outlet Devices
#1	Primary	966.11'	**12.0" Round Culvert** L= 43.0' Ke= 0.500 Inlet / Outlet Invert= 966.11' / 965.90' S= 0.0049 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Device 1	967.78'	**15.0" x 1.5" Horiz. Orifice/Grate** X 6 rows C= 0.600 in 15.0" x 15.0" Grate (60% open area) Limited to weir flow at low heads
#3	Secondary	968.20'	**40.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.62 cfs @ 12.24 hrs HW=968.38' TW=967.95' (Dynamic Tailwater)
↑**1=Culvert** (Outlet Controls 1.62 cfs @ 2.07 fps)
↑**2=Orifice/Grate** (Passes 1.62 cfs of 2.96 cfs potential flow)

Secondary OutFlow Max=8.00 cfs @ 12.24 hrs HW=968.38' TW=0.00' (Dynamic Tailwater)
↑**3=Broad-Crested Rectangular Weir** (Weir Controls 8.00 cfs @ 1.13 fps)

Pond 1P: Montgomerie Low Point



Summary for Pond 2P: Proposed Infiltration Basin

Inflow Area = 5.588 ac, 52.43% Impervious, Inflow Depth = 2.15" for 10-Year event
Inflow = 14.81 cfs @ 12.20 hrs, Volume= 1.003 af
Outflow = 4.52 cfs @ 12.42 hrs, Volume= 1.003 af, Atten= 70%, Lag= 13.5 min
Discarded = 0.16 cfs @ 12.42 hrs, Volume= 0.564 af
Primary = 4.36 cfs @ 12.42 hrs, Volume= 0.439 af
Routed to Pond 1P : Montgomerie Low Point
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 1P : Montgomerie Low Point

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 971.98' @ 12.42 hrs Surf.Area= 8,488 sf Storage= 22,931 cf

Plug-Flow detention time= 786.2 min calculated for 1.003 af (100% of inflow)
Center-of-Mass det. time= 786.5 min (1,542.6 - 756.1)

Volume	Invert	Avail.Storage	Storage Description
#1	968.00'	45,911 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)
968.00	3,847	251.0	0	0	3,847
969.00	4,672	279.0	4,253	4,253	5,057
970.00	5,580	305.0	5,119	9,372	6,300
971.00	6,738	399.0	6,150	15,522	11,578
972.00	8,535	560.0	7,619	23,141	23,874
973.00	12,374	658.0	10,395	33,536	33,392
974.00	12,375	659.0	12,374	45,911	34,059

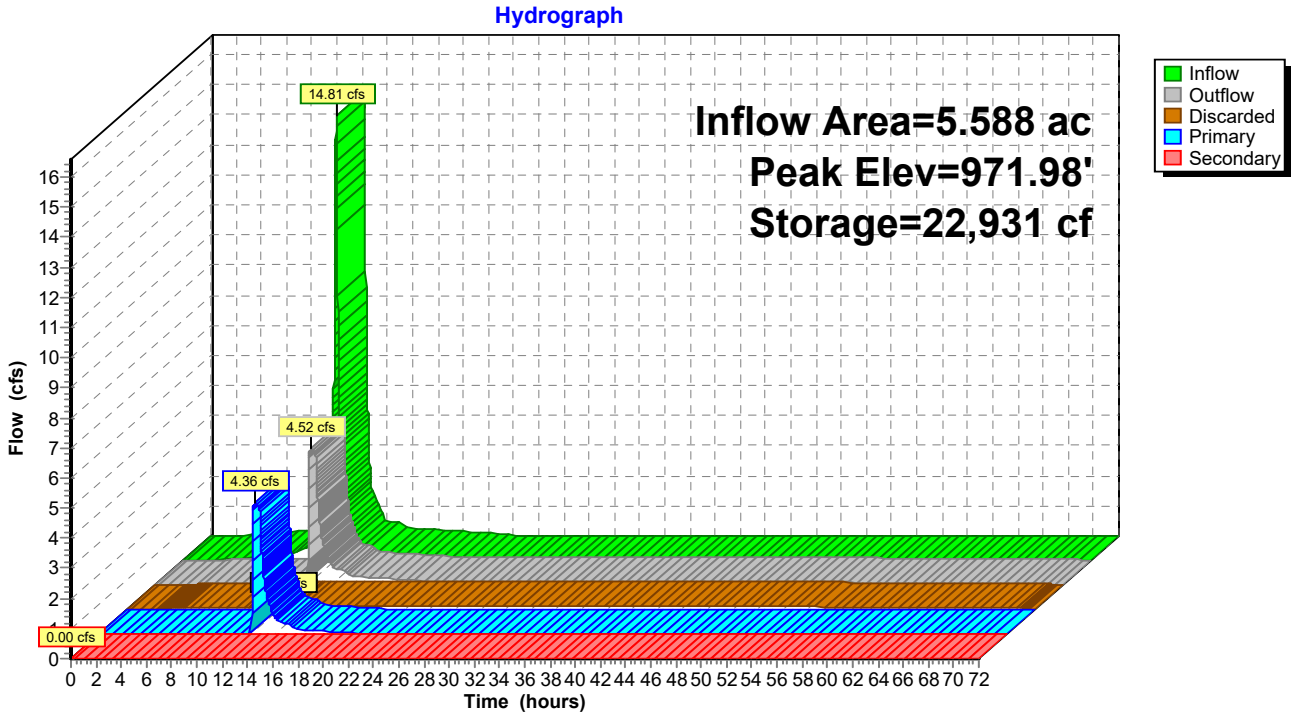
Device	Routing	Invert	Outlet Devices
#1	Primary	969.00'	**12.0" Round 12" RCP Storm Sewer** L= 140.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 969.00' / 968.30' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	971.20'	**4.0' long x 1.65' rise Weir overflow** Cv= 2.62 (C= 3.28)
#3	Secondary	972.18'	**15.0' long x 5.0' breadth Curb Parking Lot EOF** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#4	Secondary	973.00'	**50.0' long x 5.0' breadth Top Berm** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#5	Discarded	968.00'	**0.800 in/hr Infiltraiton - 0.80 in/hr over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.16 cfs @ 12.42 hrs HW=971.98' (Free Discharge)
└**5=Infiltraiton - 0.80 in/hr** (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=4.36 cfs @ 12.42 hrs HW=971.98' TW=968.33' (Dynamic Tailwater)
└**1=12" RCP Storm Sewer** (Barrel Controls 4.36 cfs @ 5.55 fps)
└**2=Weir overflow** (Passes 4.36 cfs of 8.94 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=968.00' TW=967.78' (Dynamic Tailwater)
└**3=Curb Parking Lot EOF** (Controls 0.00 cfs)
└**4=Top Berm** (Controls 0.00 cfs)

Pond 2P: Proposed Infiltration Basin



Summary for Pond 3P: Riprap BMP (existing)

Inflow Area = 3.300 ac, 48.79% Impervious, Inflow Depth = 2.00" for 10-Year event
Inflow = 8.72 cfs @ 12.17 hrs, Volume= 0.551 af
Outflow = 8.17 cfs @ 12.20 hrs, Volume= 0.551 af, Atten= 6%, Lag= 2.0 min
Primary = 7.61 cfs @ 12.20 hrs, Volume= 0.550 af
Routed to Pond 2P : Proposed Infiltration Basin
Secondary = 0.56 cfs @ 12.20 hrs, Volume= 0.001 af
Routed to Pond 2P : Proposed Infiltration Basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 982.05' @ 12.20 hrs Surf.Area= 654 sf Storage= 404 cf

Plug-Flow detention time= 0.6 min calculated for 0.551 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (756.9 - 756.2)

Volume	Invert	Avail.Storage	Storage Description
#1	981.00'	5,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

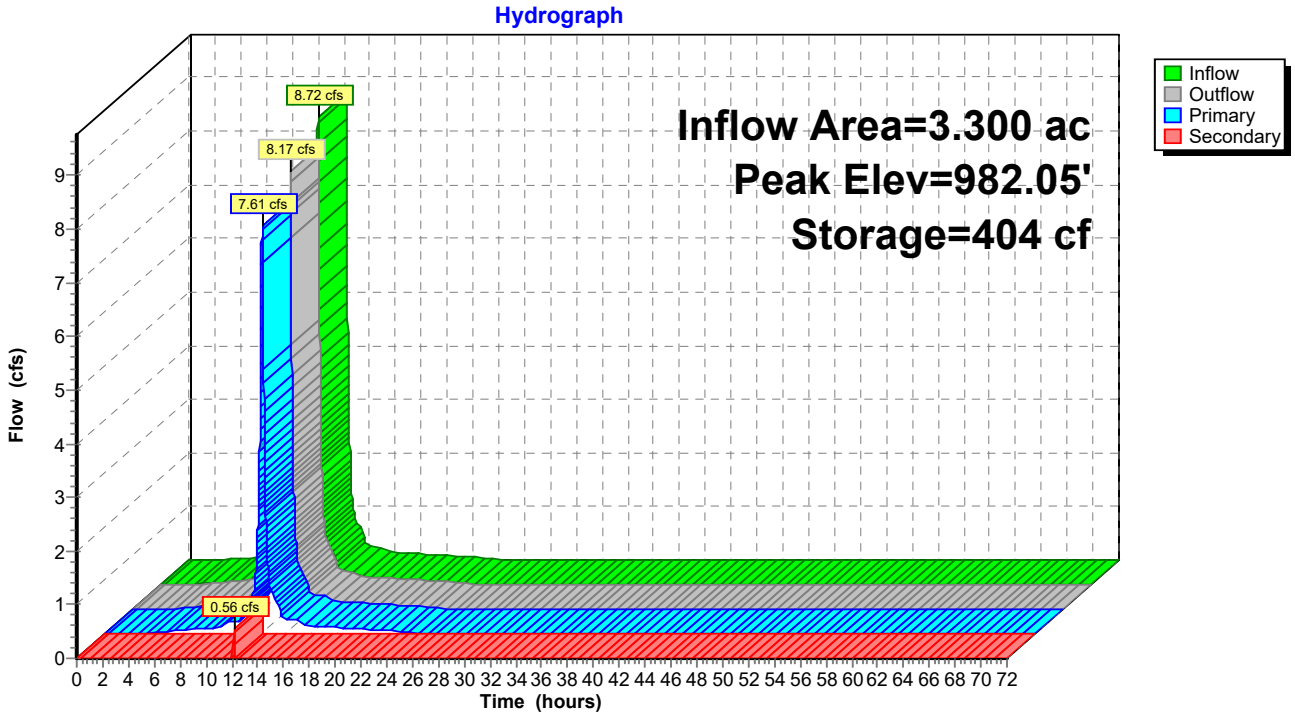
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
981.00	200	0	0
982.00	550	375	375
983.00	2,700	1,625	2,000
984.00	5,000	3,850	5,850

Device	Routing	Invert	Outlet Devices
#1	Primary	975.89'	**12.0" Round Culvert** L= 77.0' Ke= 0.500 Inlet / Outlet Invert= 975.89' / 975.34' S= 0.0071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	981.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	982.00'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=7.61 cfs @ 12.20 hrs HW=982.04' TW=971.55' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 7.61 cfs @ 9.68 fps)
↑**2=Orifice/Grate** (Passes 7.61 cfs of 15.46 cfs potential flow)

Secondary OutFlow Max=0.51 cfs @ 12.20 hrs HW=982.05' TW=971.55' (Dynamic Tailwater)
↑**3=Broad-Crested Rectangular Weir** (Weir Controls 0.51 cfs @ 0.57 fps)

Pond 3P: Riprap BMP (existing)

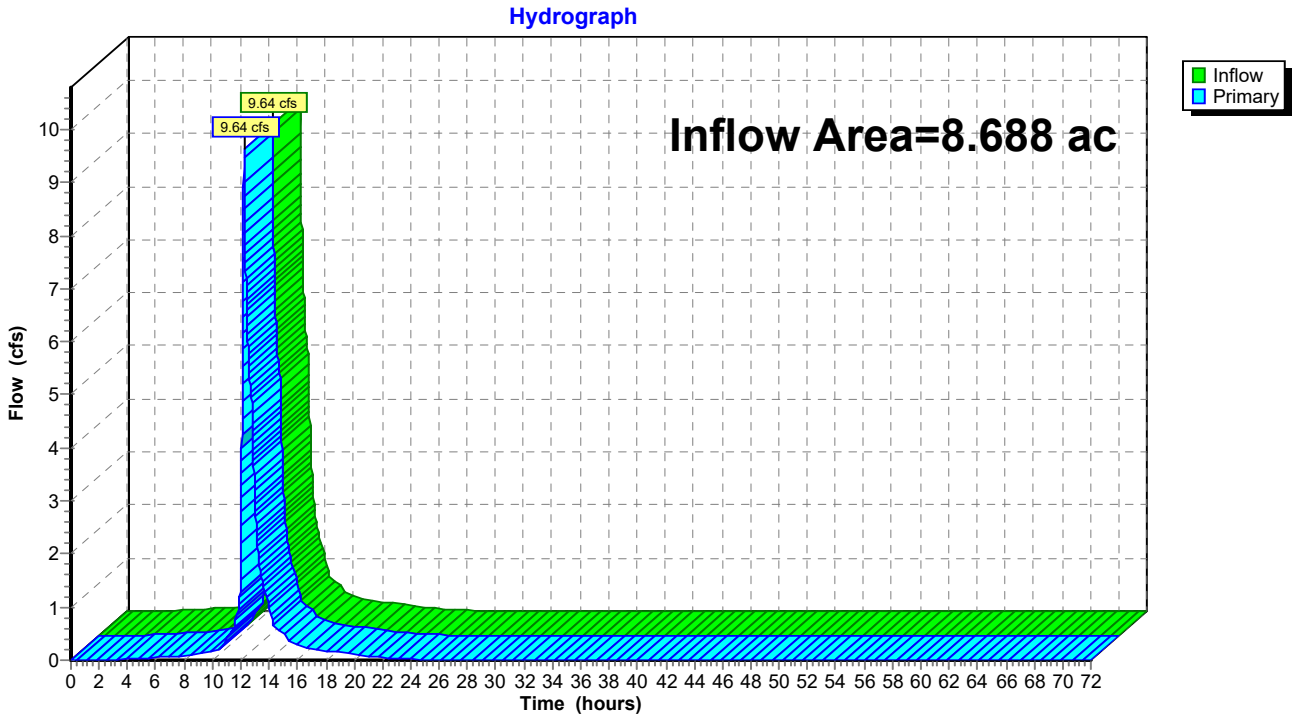


Summary for Link 1L: Offsite (W of Montgomerie)

Inflow Area = 8.688 ac, 48.69% Impervious, Inflow Depth = 1.22" for 10-Year event
Inflow = 9.64 cfs @ 12.24 hrs, Volume= 0.886 af
Primary = 9.64 cfs @ 12.24 hrs, Volume= 0.886 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: Offsite (W of Montgomerie)



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA-1: North Residential Area Runoff Area=3.100 ac 41.94% Impervious Runoff Depth=3.48"
Tc=10.0 min CN=39/98 Runoff=13.57 cfs 0.900 af

Subcatchment DA-2: Church Property Runoff Area=2.000 ac 58.00% Impervious Runoff Depth=4.48"
Tc=10.0 min CN=39/98 Runoff=11.50 cfs 0.746 af

Subcatchment DA-2.1: Additional parking Runoff Area=0.288 ac 55.56% Impervious Runoff Depth=4.71"
Tc=7.0 min CN=49/98 Runoff=2.05 cfs 0.113 af

Subcatchment DA-3: South Runoff Area=3.300 ac 48.79% Impervious Runoff Depth=3.91"
Tc=10.0 min CN=39/98 Runoff=16.38 cfs 1.075 af

Reach 1R: Pipe Under Montgomerie Avg. Flow Depth=0.50' Max Vel=4.36 fps Inflow=1.99 cfs 0.903 af
15.0" Round Pipe n=0.012 L=57.0' S=0.0072 '/' Capacity=5.94 cfs Outflow=1.99 cfs 0.903 af

Pond 1P: Montgomerie Low Point Peak Elev=968.65' Storage=2,197 cf Inflow=34.29 cfs 2.241 af
Primary=1.99 cfs 0.903 af Secondary=32.07 cfs 1.338 af Outflow=34.06 cfs 2.241 af

Pond 2P: Proposed Infiltration Basin Peak Elev=972.76' Storage=30,735 cf Inflow=29.58 cfs 1.934 af
Discarded=0.21 cfs 0.593 af Primary=4.96 cfs 0.931 af Secondary=17.98 cfs 0.410 af Outflow=23.15 cfs 1.934 af

Pond 3P: Riprap BMP (existing) Peak Elev=982.29' Storage=629 cf Inflow=16.38 cfs 1.075 af
Primary=7.77 cfs 0.969 af Secondary=8.55 cfs 0.106 af Outflow=16.32 cfs 1.075 af

Link 1L: Offsite (W of Montgomerie) Inflow=34.06 cfs 2.241 af
Primary=34.06 cfs 2.241 af

Total Runoff Area = 8.688 ac Runoff Volume = 2.834 af Average Runoff Depth = 3.91"
51.31% Pervious = 4.458 ac 48.69% Impervious = 4.230 ac

Summary for Subcatchment DA-1: North Residential Area

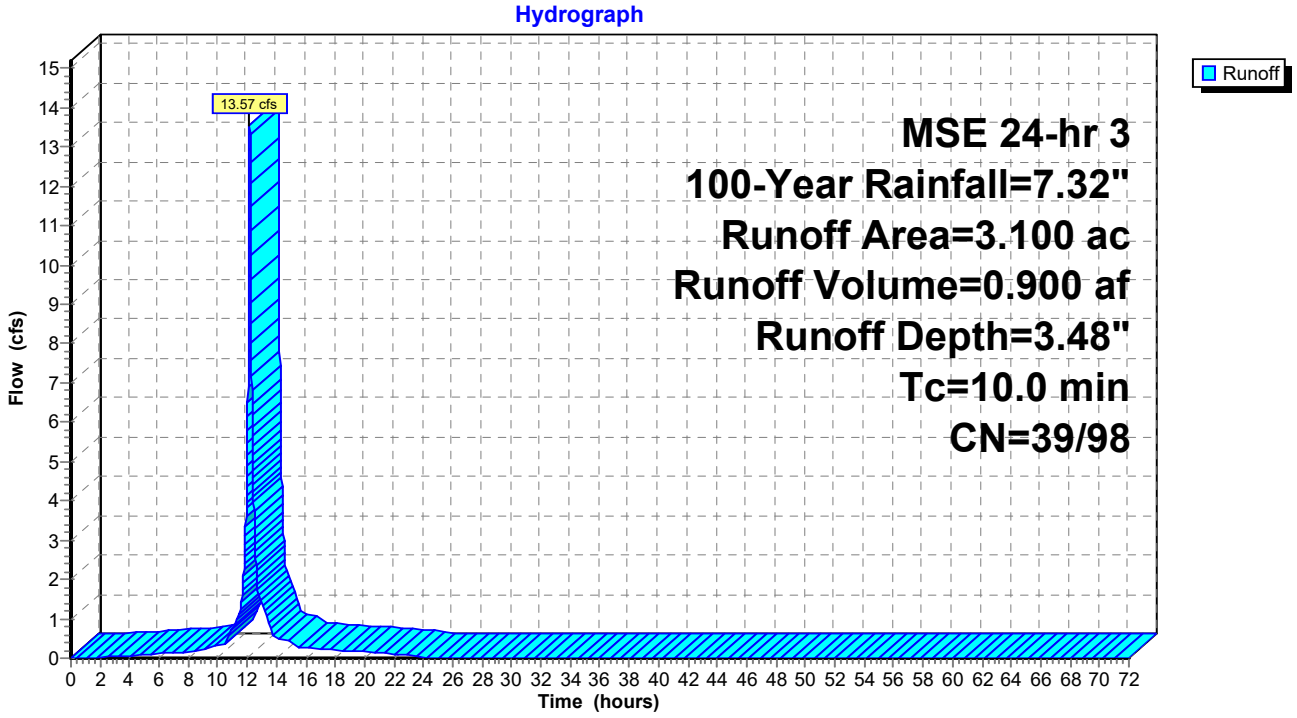
Runoff = 13.57 cfs @ 12.18 hrs, Volume= 0.900 af, Depth= 3.48"
Routed to Pond 1P : Montgomerie Low Point

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

	Area (ac)	CN	Description
*	1.300	98	IMPERVIOUS
	1.800	39	>75% Grass cover, Good, HSG A
	3.100	64	Weighted Average
	1.800	39	58.06% Pervious Area
	1.300	98	41.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-1: North Residential Area



Summary for Subcatchment DA-2: Church Property

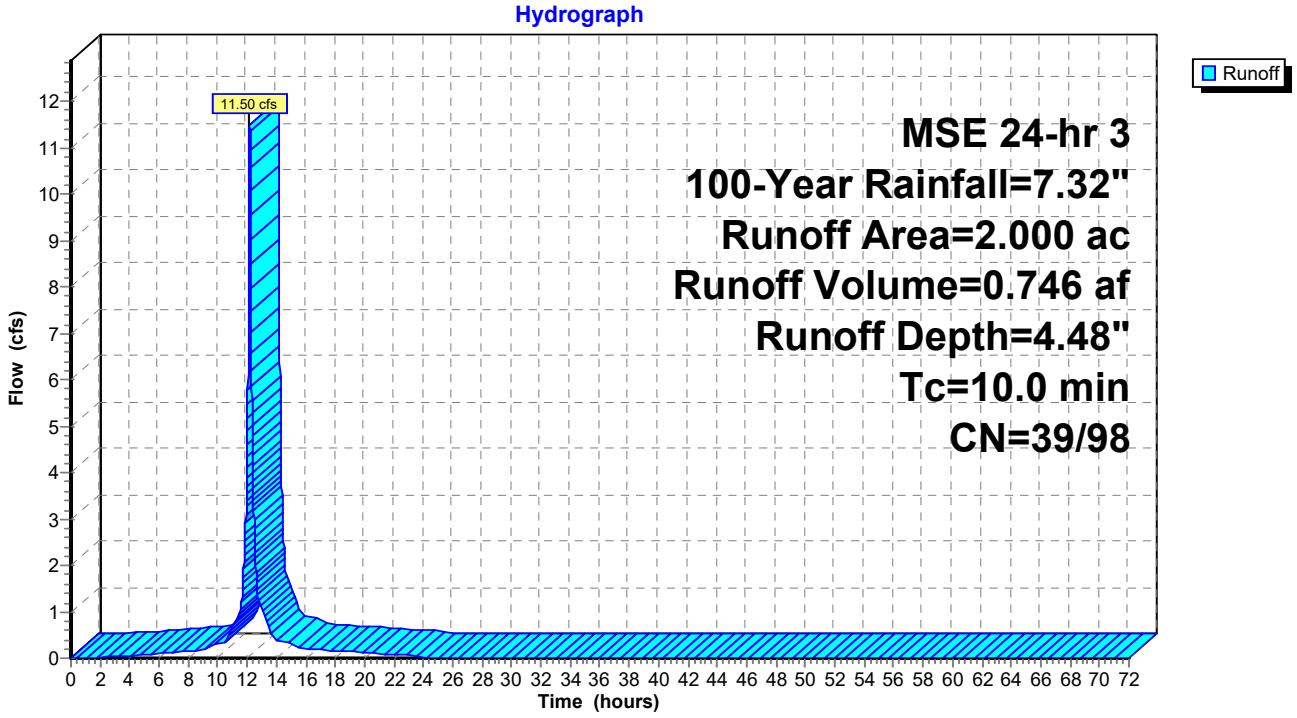
Runoff = 11.50 cfs @ 12.17 hrs, Volume= 0.746 af, Depth= 4.48"
Routed to Pond 2P : Proposed Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
1.160	98	IMPERVIOUS
0.840	39	>75% Grass cover, Good, HSG A
2.000	73	Weighted Average
0.840	39	42.00% Pervious Area
1.160	98	58.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-2: Church Property



Summary for Subcatchment DA-2.1: Additional parking to Northeast

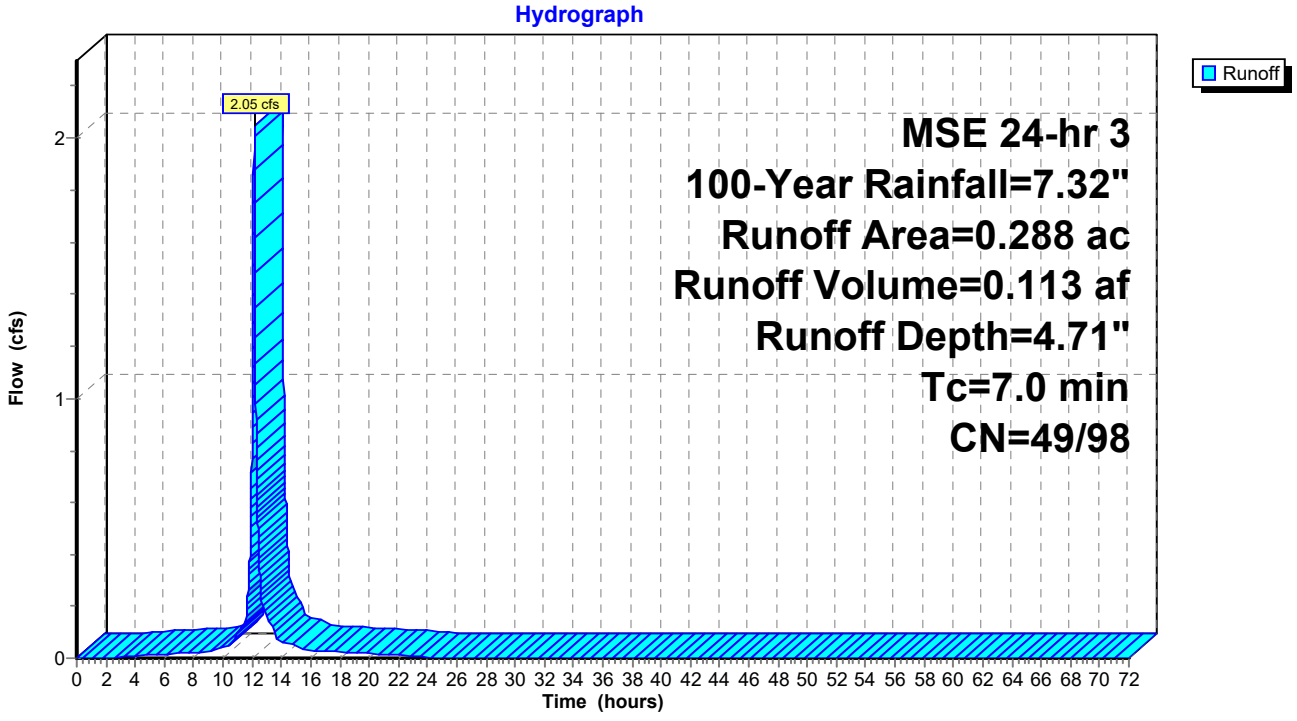
Runoff = 2.05 cfs @ 12.14 hrs, Volume= 0.113 af, Depth= 4.71"
Routed to Pond 2P : Proposed Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

	Area (ac)	CN	Description
*	0.160	98	IMPERVIOUS
	0.128	49	50-75% Grass cover, Fair, HSG A
	0.288	76	Weighted Average
	0.128	49	44.44% Pervious Area
	0.160	98	55.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry,**

Subcatchment DA-2.1: Additional parking to Northeast



Summary for Subcatchment DA-3: South Residential/Church Area

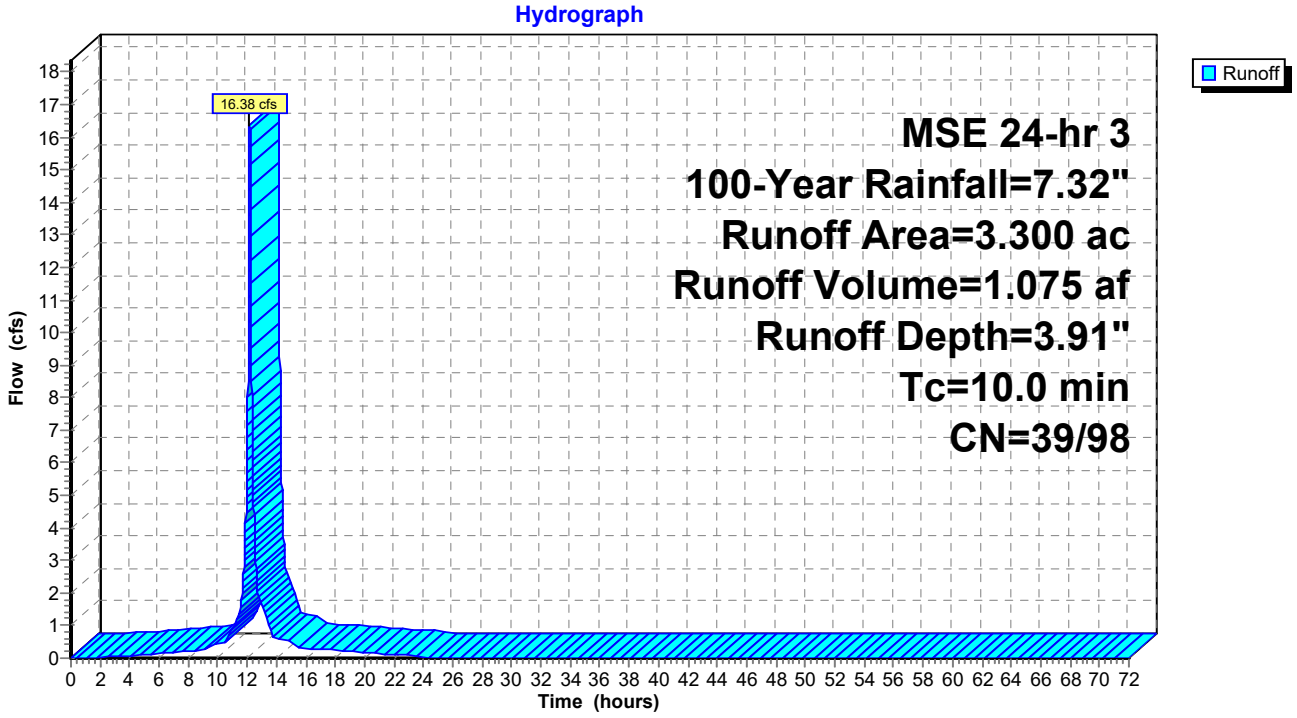
Runoff = 16.38 cfs @ 12.17 hrs, Volume= 1.075 af, Depth= 3.91"
Routed to Pond 3P : Riprap BMP (existing)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-72.00 hrs, dt= 0.01
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
1.610	98	IMPERVIOUS
1.690	39	>75% Grass cover, Good, HSG A
3.300	68	Weighted Average
1.690	39	51.21% Pervious Area
1.610	98	48.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment DA-3: South Residential/Church Area



Summary for Reach 1R: Pipe Under Montgomerie

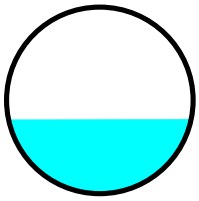
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 8.688 ac, 48.69% Impervious, Inflow Depth = 1.25" for 100-Year event
Inflow = 1.99 cfs @ 12.23 hrs, Volume= 0.903 af
Outflow = 1.99 cfs @ 12.24 hrs, Volume= 0.903 af, Atten= 0%, Lag= 0.2 min
Routed to Link 1L : Offsite (W of Montgomerie)

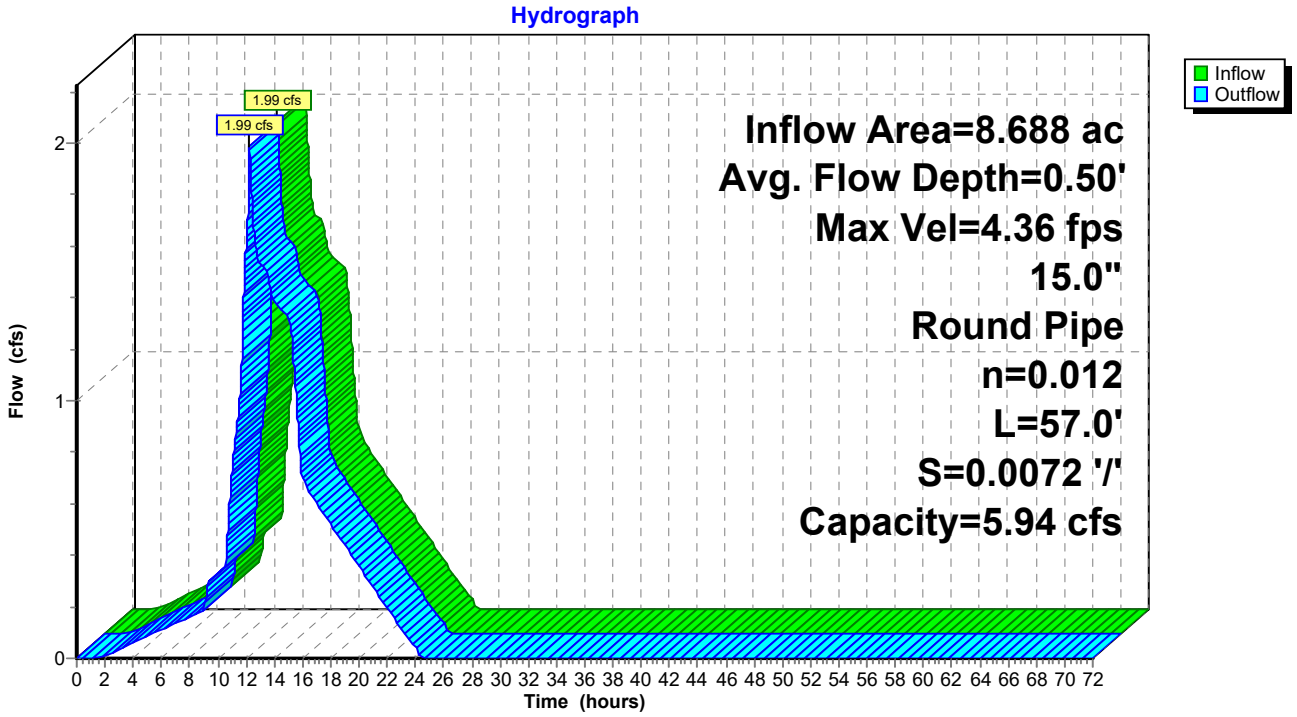
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.36 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.52 fps, Avg. Travel Time= 0.4 min

Peak Storage= 26 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.50' , Surface Width= 1.22'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 5.94 cfs

15.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 57.0' Slope= 0.0072 '/'
Inlet Invert= 967.50', Outlet Invert= 967.09'



Reach 1R: Pipe Under Montgomerie



Summary for Pond 1P: Montgomerie Low Point

Inflow Area = 8.688 ac, 48.69% Impervious, Inflow Depth = 3.09" for 100-Year event
Inflow = 34.29 cfs @ 12.22 hrs, Volume= 2.241 af
Outflow = 34.06 cfs @ 12.23 hrs, Volume= 2.241 af, Atten= 1%, Lag= 0.7 min
Primary = 1.99 cfs @ 12.23 hrs, Volume= 0.903 af
Routed to Reach 1R : Pipe Under Montgomerie
Secondary = 32.07 cfs @ 12.23 hrs, Volume= 1.338 af
Routed to Link 1L : Offsite (W of Montgomerie)

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 968.65' @ 12.23 hrs Surf.Area= 4,460 sf Storage= 2,197 cf

Plug-Flow detention time= 2.3 min calculated for 2.240 af (100% of inflow)
Center-of-Mass det. time= 2.3 min (791.7 - 789.4)

Volume	Invert	Avail.Storage	Storage Description
#1	967.78'	28,839 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

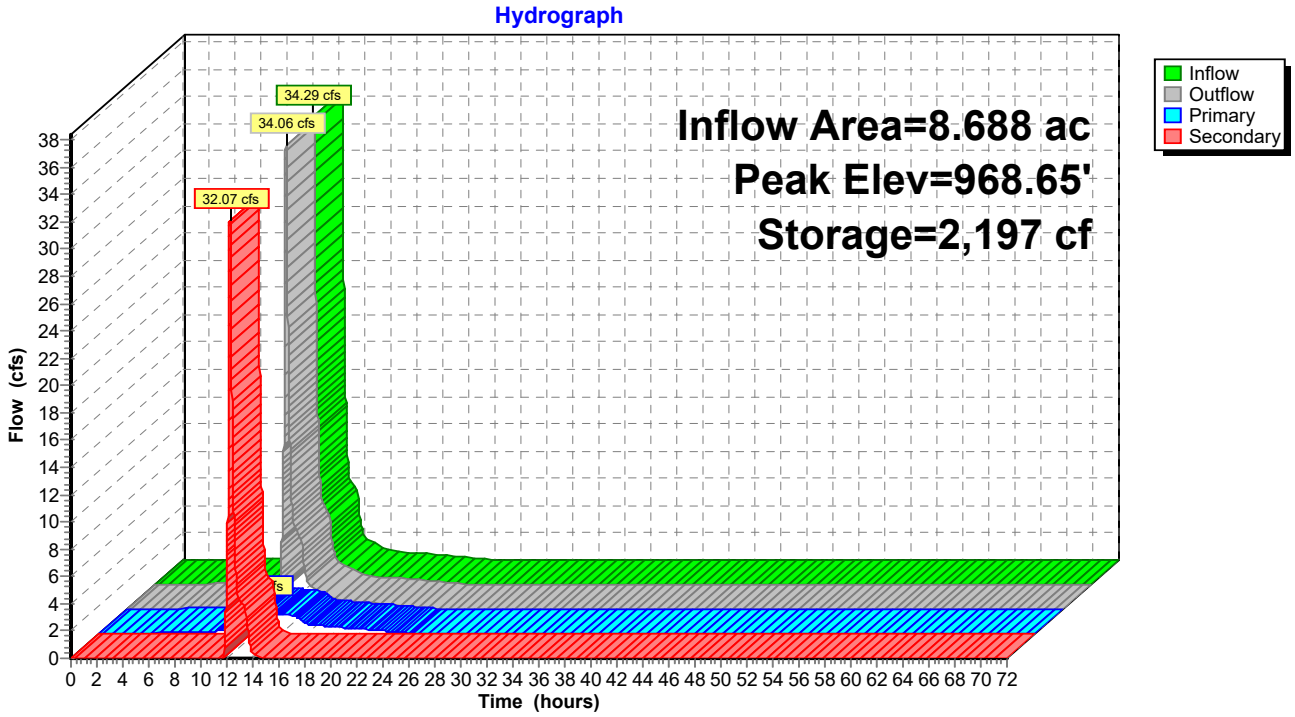
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
967.78	10	0	0
968.00	1,750	194	194
969.00	5,950	3,850	4,044
970.00	9,320	7,635	11,679
971.00	25,000	17,160	28,839

Device	Routing	Invert	Outlet Devices
#1	Primary	966.11'	**12.0" Round Culvert** L= 43.0' Ke= 0.500 Inlet / Outlet Invert= 966.11' / 965.90' S= 0.0049 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Device 1	967.78'	**15.0" x 1.5" Horiz. Orifice/Grate** X 6 rows C= 0.600 in 15.0" x 15.0" Grate (60% open area) Limited to weir flow at low heads
#3	Secondary	968.20'	**40.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.99 cfs @ 12.23 hrs HW=968.64' TW=968.00' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 1.99 cfs @ 2.53 fps)
↑—**2=Orifice/Grate** (Passes 1.99 cfs of 3.63 cfs potential flow)

Secondary OutFlow Max=32.03 cfs @ 12.23 hrs HW=968.64' TW=0.00' (Dynamic Tailwater)
↑—**3=Broad-Crested Rectangular Weir** (Weir Controls 32.03 cfs @ 1.80 fps)

Pond 1P: Montgomerie Low Point



Summary for Pond 2P: Proposed Infiltration Basin

Inflow Area = 5.588 ac, 52.43% Impervious, Inflow Depth = 4.15" for 100-Year event
Inflow = 29.58 cfs @ 12.18 hrs, Volume= 1.934 af
Outflow = 23.15 cfs @ 12.24 hrs, Volume= 1.934 af, Atten= 22%, Lag= 4.1 min
Discarded = 0.21 cfs @ 12.24 hrs, Volume= 0.593 af
Primary = 4.96 cfs @ 12.24 hrs, Volume= 0.931 af
Routed to Pond 1P : Montgomerie Low Point
Secondary = 17.98 cfs @ 12.24 hrs, Volume= 0.410 af
Routed to Pond 1P : Montgomerie Low Point

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 972.76' @ 12.24 hrs Surf.Area= 11,405 sf Storage= 30,735 cf

Plug-Flow detention time= 443.0 min calculated for 1.934 af (100% of inflow)
Center-of-Mass det. time= 442.7 min (1,201.2 - 758.5)

Volume	Invert	Avail.Storage	Storage Description
#1	968.00'	45,911 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)
968.00	3,847	251.0	0	0	3,847
969.00	4,672	279.0	4,253	4,253	5,057
970.00	5,580	305.0	5,119	9,372	6,300
971.00	6,738	399.0	6,150	15,522	11,578
972.00	8,535	560.0	7,619	23,141	23,874
973.00	12,374	658.0	10,395	33,536	33,392
974.00	12,375	659.0	12,374	45,911	34,059

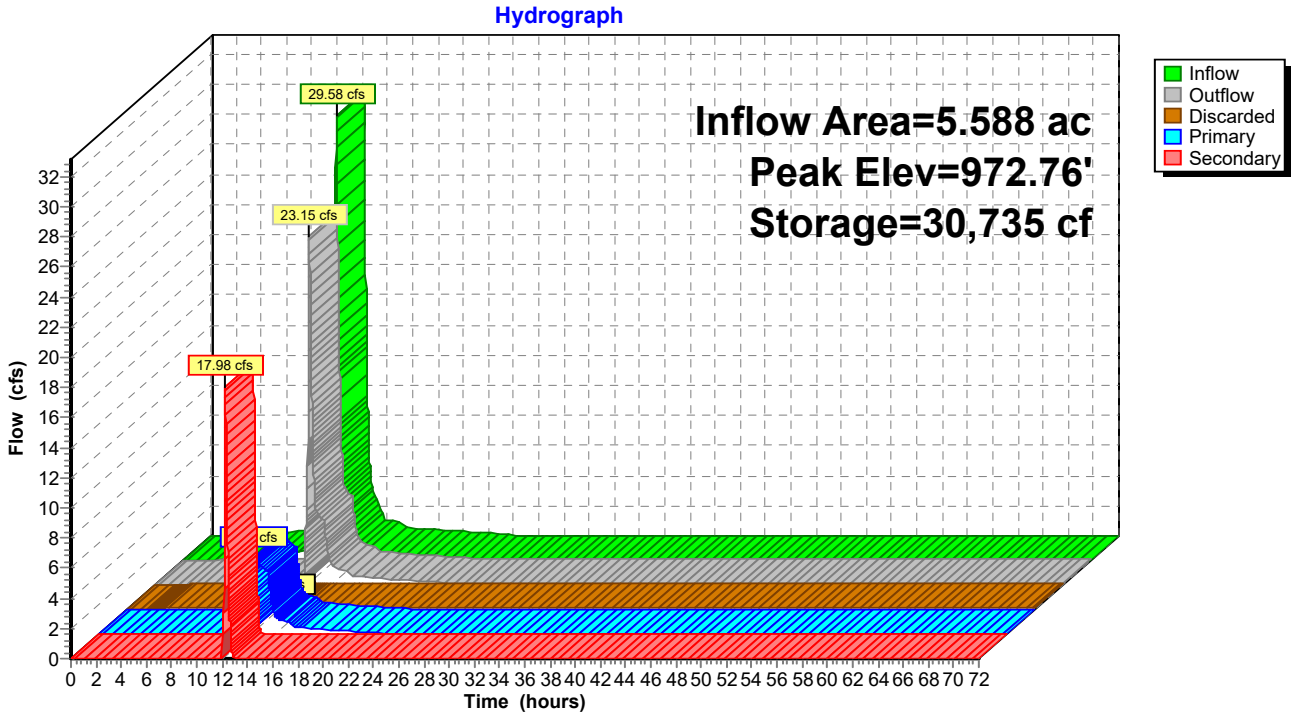
Device	Routing	Invert	Outlet Devices
#1	Primary	969.00'	**12.0" Round 12" RCP Storm Sewer** L= 140.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 969.00' / 968.30' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	971.20'	**4.0' long x 1.65' rise Weir overflow** Cv= 2.62 (C= 3.28)
#3	Secondary	972.18'	**15.0' long x 5.0' breadth Curb Parking Lot EOF** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#4	Secondary	973.00'	**50.0' long x 5.0' breadth Top Berm** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#5	Discarded	968.00'	**0.800 in/hr Infiltraiton - 0.80 in/hr over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.21 cfs @ 12.24 hrs HW=972.76' (Free Discharge)
└**5=Infiltraiton - 0.80 in/hr** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=4.96 cfs @ 12.24 hrs HW=972.76' TW=968.64' (Dynamic Tailwater)
└**1=12" RCP Storm Sewer** (Barrel Controls 4.96 cfs @ 6.31 fps)
└**2=Weir overflow** (Passes 4.96 cfs of 25.62 cfs potential flow)

Secondary OutFlow Max=17.96 cfs @ 12.24 hrs HW=972.76' TW=968.64' (Dynamic Tailwater)
└**3=Curb Parking Lot EOF** (Weir Controls 17.96 cfs @ 2.05 fps)
└**4=Top Berm** (Controls 0.00 cfs)

Pond 2P: Proposed Infiltration Basin



Summary for Pond 3P: Riprap BMP (existing)

Inflow Area = 3.300 ac, 48.79% Impervious, Inflow Depth = 3.91" for 100-Year event
Inflow = 16.38 cfs @ 12.17 hrs, Volume= 1.075 af
Outflow = 16.32 cfs @ 12.18 hrs, Volume= 1.075 af, Atten= 0%, Lag= 0.5 min
Primary = 7.77 cfs @ 12.18 hrs, Volume= 0.969 af
Routed to Pond 2P : Proposed Infiltration Basin
Secondary = 8.55 cfs @ 12.18 hrs, Volume= 0.106 af
Routed to Pond 2P : Proposed Infiltration Basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 982.29' @ 12.18 hrs Surf.Area= 1,181 sf Storage= 629 cf

Plug-Flow detention time= 0.8 min calculated for 1.075 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (760.6 - 760.0)

Volume	Invert	Avail.Storage	Storage Description
#1	981.00'	5,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

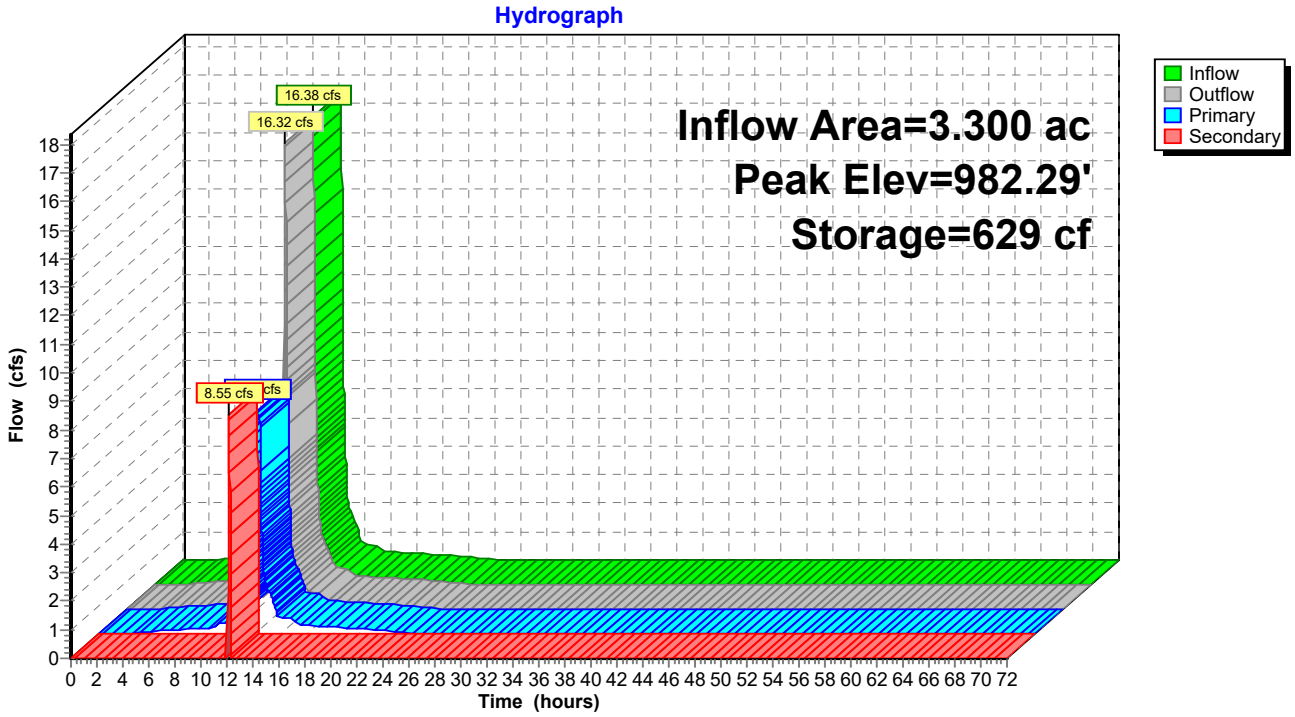
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
981.00	200	0	0
982.00	550	375	375
983.00	2,700	1,625	2,000
984.00	5,000	3,850	5,850

Device	Routing	Invert	Outlet Devices
#1	Primary	975.89'	**12.0" Round Culvert** L= 77.0' Ke= 0.500 Inlet / Outlet Invert= 975.89' / 975.34' S= 0.0071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	981.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	982.00'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=7.77 cfs @ 12.18 hrs HW=982.29' TW=972.66' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 7.77 cfs @ 9.89 fps)
↑**2=Orifice/Grate** (Passes 7.77 cfs of 17.20 cfs potential flow)

Secondary OutFlow Max=8.53 cfs @ 12.18 hrs HW=982.29' TW=972.66' (Dynamic Tailwater)
↑**3=Broad-Crested Rectangular Weir** (Weir Controls 8.53 cfs @ 1.46 fps)

Pond 3P: Riprap BMP (existing)

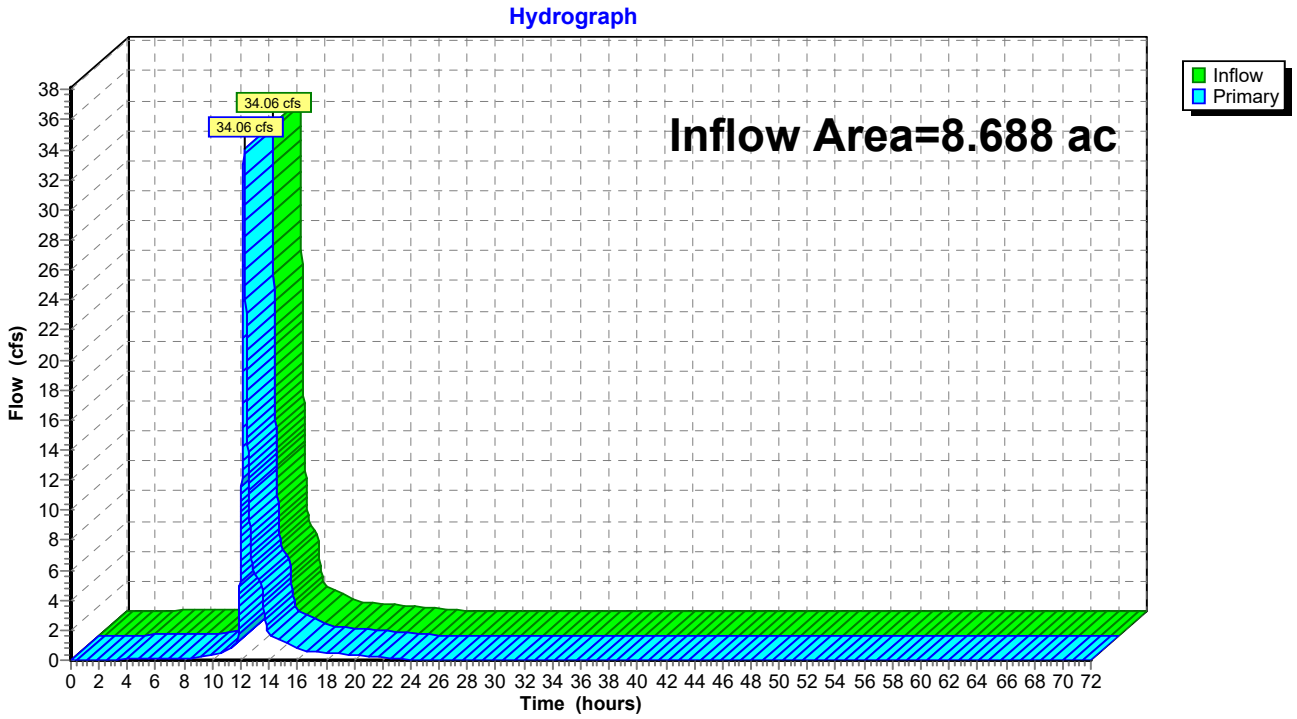


Summary for Link 1L: Offsite (W of Montgomerie)

Inflow Area = 8.688 ac, 48.69% Impervious, Inflow Depth = 3.09" for 100-Year event
Inflow = 34.06 cfs @ 12.23 hrs, Volume= 2.241 af
Primary = 34.06 cfs @ 12.23 hrs, Volume= 2.241 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: Offsite (W of Montgomerie)



Appendix B MIDS Modeling

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Deephaven WQ
User Name / Company Name:	Stantec
Date:	2025-0925
Project Description:	
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55391
Annual Rainfall (inches):	29.9
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed	2.66				2.66
			Impervious Area (acres)		2.93
				Total Area (acres)	5.59

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed	2.66				2.66
			Impervious Area (acres)		2.93
				Total Area (acres)	5.59

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	11699	ft3
Volume removed by BMPs towards performance goal:	11699	ft^3
Percent volume removed towards performance goal	**100**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	7.1368	acre-ft
Annual runoff volume removed by BMPs:	6.9769	acre-ft
Percent annual runoff volume removed:	**98**	**%**
Post development annual particulate P load:	3.203	lbs
Annual particulate P removed by BMPs:	3.131	lbs
Post development annual dissolved P load:	2.621	lbs
Annual dissolved P removed by BMPs:	2.562	lbs
Total P removed by BMPs	5.693	lbs
Percent annual total phosphorus removed:	**98**	**%**
Post development annual TSS load:	1058	lbs
Annual TSS removed by BMPs:	1034.2	lbs
Percent annual TSS removed:	**98**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Infiltration basin/Infiltration trench (abc	17483	11699	11699	0	100

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Infiltration basin/Infiltration trench (abc	7.1368	0	6.9769	0.1599	98

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Infiltration basin/Infiltration trench (abc	3.203	0	3.1312	0.0718	98

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Infiltration basin/Infiltration trench (abc	2.6206	0	2.5619	0.0587	98

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Infiltration basin/Infiltration trench (abc	5.8236	0	5.6931	0.1305	98

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Infiltration basin/Infiltration trench (abc	1057.95	0	1034.25	23.7	98

BMP Schematic

1 - Infiltration basin/
Infiltration trench

Appendix C Opinion of Probably Costs

OPINION OF PROBABLE COST
City of Deephaven
Calvary Church Stormwater Improvements
193807469
NOI APPLICATION
June 14, 2025

Stantec

NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
BASE BID SCHEDULE					
SCHEDULE A - REMOVALS, EARTHWORK, AND RESTORATION					
1	MOBILIZATION	LS	1	$ 12,000.00	$ 12,000.00
2	CLEARING & GRUBBING	EACH	8	$ 500.00	$ 4,000.00
3	TRAFFIC CONTROL	LS	1	$ 1,500.00	$ 1,500.00
4	REMOVE DRAINAGE STRUCTURE	EACH	2	$ 500.00	$ 1,000.00
5	SAWING BIT PAVEMENT (FULL DEPTH)	L F	100	$ 7.00	$ 700.00
6	SAWING CONCRETE PAVEMENT (FULL DEPTH)	L F	10	$ 10.00	$ 100.00
7	REMOVE SEWER PIPE (STORM)	L F	35	$ 15.00	$ 525.00
8	REMOVE BITUMINOUS PAVEMENT	S Y	1425	$ 10.00	$ 14,250.00
9	REMOVE EXISTING STAIRS	LS	1	$ 1,000.00	$ 1,000.00
10	SALVAGE AND REINSTALL LANDSCAPE STRUCTURES	L S	1	$ 3,500.00	$ 3,500.00
11	STREET SWEEPER (WITH PICKUP BROOM)	HOUR	4	$ 200.00	$ 800.00
12	STORM DRAIN INLET PROTECTION	EACH	5	$ 200.00	$ 1,000.00
13	SEDIMENT CONTROL LOG TYPE WOOD FIBER	L F	400	$ 4.00	$ 1,600.00
14	FERTILIZER TYPE 3	LB	40	$ 10.00	$ 400.00
15	COMMON TOPSOIL BORROW	C Y	125	$ 40.00	$ 5,000.00
16	SODDING TYPE LAWN	S Y	600	$ 12.00	$ 7,200.00
17	SEEDING	ACRE	0.25	$ 6,500.00	$ 1,625.00
18	INFILTRATION BASIN SEED MIX	LB	75	$ 85.00	$ 6,375.00
19	HYDRAULIC MULCH MATRIX	LB	200	$ 4.00	$ 800.00
SUBTOTAL SCHEDULE A					$ 63,375.00
SCHEDULE B - PARKING LOT AND ROADWAY					
19	AGGREGATE BASE (CV) CLASS 5	C Y	350	$ 50.00	$ 17,500.00
20	TYPE SP 9.5 WEARING COURSE (2,B)	TON	150	$ 130.00	$ 19,500.00
21	TYPE SP 9.5 NON-WEARING COURSE (2,B)	TON	150	$ 150.00	$ 22,500.00
22	STRIPING	LS	1	$ 1,000.00	$ 1,000.00
23	RANDOM RIPRAP CLASS III	C Y	10	$ 160.00	$ 1,600.00
24	CONCRETE CURB & GUTTER	L F	175	$ 50.00	$ 8,750.00
25	6" CONCRETE DRIVEWAY PAVEMENT	S Y	20	$ 120.00	$ 2,400.00
26	PEDESTRIAN CROSSING STRUCTURE	EA	1	$ 3,500.00	$ 3,500.00
27	STAIRWAY	EA	1	$ 5,000.00	$ 5,000.00
SUBTOTAL SCHEDULE B					$ 81,750.00
SCHEDULE C - STORMWATER SYSTEM					
28	EXCAVATION - COMMON	C Y	1150	$ 30.00	$ 34,500.00
29	SUBGRADE PREPARATION	LS	1	$ 2,500.00	$ 2,500.00
30	DITCH GRADING	L S	1	$ 2,000.00	$ 2,000.00
31	EXCAVATION - SUBGRADE	C Y	250	$ 30.00	$ 7,500.00
32	GRANULAR BORROW (CV)	C Y	250	$ 35.00	$ 8,750.00
33	12" RC PIPE APRON	EACH	3	$ 1,750.00	$ 5,250.00
34	12" RCP PIPE SEWER	L F	430	$ 60.00	$ 25,800.00
35	CASTING ASSEMBLY	EACH	6	$ 750.00	$ 4,500.00
36	CONST DRAINAGE STRUCTURE DESIGN SPECIAL (27")	EACH	2	$ 2,500.00	$ 5,000.00
37	CONST DRAINAGE STRUCTURE DESIGN SPEC (2'X3')	EACH	3	$ 2,750.00	$ 8,250.00
38	CONST DRAINAGE STRUCTURE DESIGN 48-4020	EACH	1	$ 9,000.00	$ 9,000.00
39	RIP RAP CLASS III (FIELD STONE)	C Y	10	$ 160.00	$ 1,600.00
SUBTOTAL SCHEDULE C					$ 114,650.00

SCHEDULE D - ALT PARKING LOT					
40	EXCAVATION - COMMON	C Y	280	$ 30.00	$ 8,400.00
44	AGGREGATE BASE (CV) CLASS 5	C Y	240	$ 55.00	$ 13,200.00
45	TYPE SP 9.5 WEARING COURSE (2,B)	TON	80	$ 140.00	$ 11,200.00
46	TYPE SP 9.5 NON-WEARING COURSE (2,B)	S Y	80	$ 155.00	$ 12,400.00
47	COMMON TOPSOIL BORROW	C Y	20	$ 40.00	$ 800.00
48	SEEDING	ACRE	0.10	$ 7,500.00	$ 750.00
49	6" CONCRETE DRIVEWAY PAVEMENT	S Y	20	$ 120.00	$ 2,400.00
SUBTOTAL SCHEDULE D					$ 49,150.00

SCHEDULE E - ADDITIONAL ITEMS					
50	PARKING LOT LIGHTING	LS	1	$ 7,500.00	$ 7,500.00
51	INTERPRETIVE SIGNAGE	LS	1	$ 3,500.00	$ 3,500.00
SUBTOTAL SCHEDULE D					$ 11,000.00

	SUBTOTAL	$ 319,925.00
	[30%] CONTINGENCY	$ 95,977.50
	TOTAL CONSTRUCTION COST	$ 415,902.50
	30% LEGAL, ENGINEERING, ADMIN, FINANCE	$ 95,977.50
	10% Permitting	$ 31,992.50
	TOTAL PROJECT COSTS	$ 543,872.50

Appendix D Geotechnical Report

GEOTECHNICAL REPORT

MONTGOMERIE AVE DRAINAGE STUDY

DEEPHAVEN, MINNESOTA

June 3, 2024

Prepared for:
City of Deephaven
20225 Cottagewood Road
Deephaven, MN 55331

WSB PROJECT NO. 020518-000

GEOTECHNICAL REPORT

MONTGOMERIE AVENUE DRAINAGE STUDY

FOR
CITY OF DEEPHAVEN

June 3, 2024

CERTIFICATION

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.

Mark W. Osborn, PE

Date: June 3, 2024 Lic. No. 41362

June 3, 2024

City of Deephaven
20225 Cottagewood Road
Deephaven, Minnesota 55331

Re: Geotechnical Report
Montgomerie Avenue Drainage Study
WSB Project No.: 020518-000

We have conducted a geotechnical subsurface exploration program for the above referenced project. This report contains our soil boring logs, an evaluation of the conditions encountered in the borings and our recommendations for underground stormwater management, infiltration, subgrade improvements, underground utilities, pavement design, and other geotechnical related design and construction considerations.

If you have questions concerning this report or our recommendations, or for construction material testing for this project, please call us at 952.737.4660.

Sincerely,

WSB

Mark Osborn, PE
Senior Geotechnical Engineer

Alex Wacek, EIT
Graduate Geotechnical Engineer

Attachment:
Geotechnical Report

MWO/tw

540 GATEWAY BLVD | BURNSVILLE, MN | 55337 | 952.737.4660 | WSBENG.COM

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Project Location

The site is located 150 feet north of 18360 Minnetonka Boulevard, Wayzata, Minnesota. The approximate soil boring locations can be found on the Soil Boring Exhibit in ***Appendix A***.

1.2 Project Description

It is proposed to construct an underground stormwater treatment system, replacement of the existing bituminous parking lot as well as construction of a limited storm sewer improvement.

We understand that the vertical and horizontal alignment of the parking lot will remain similar to existing conditions.

WSB has developed recommendations for this project in consideration of the proposed layout and configurations as understood at this time. When the designer develops additional information about final design or other significant factors, the recommendations presented herein may no longer apply. WSB should be made aware of the revised or additional information in order to evaluate the recommendations for continued applicability.

1.3 Purpose and Project Scope of Services

The City of Deephaven authorized this scope of service. In order to assist the design team in preparing plans and specifications, we have developed recommendations for designing utilities and pavements. As such, we have completed a subsurface exploration program and prepared a geotechnical report for the referenced site. This stated purpose was a significant factor in determining the scope and level of service provided. Should the purpose of the report change the report immediately ceases to be valid and use of it without WSB's prior review and written authorization should be at the user's sole risk.

Our authorized scope of work has been limited to:

1. Clearing underground utilities utilizing Gopher State One Call.
2. Mobilization / demobilization of a truck mounted drill rig.
3. Drilling 3 standard penetration borings to about 15-foot depths.
4. Sealing the borings per Minnesota Department of Health procedures.
5. Perform soil classification and analysis.
6. Review of available project information and geologic data.
7. Providing this geotechnical report containing:
    a. Summary of our findings.
    b. Discussion of subsurface soil and groundwater conditions and how they may affect the proposed utilities and pavements.
    c. Estimated R-value of the soils.
    d. Recommended pavement section.
    e. A discussion of soils for use as structural fill and site fill.

2. PROCEDURES

2.1 Boring Layout and Soil Sampling Procedures

WSB completed 3 standard penetration soil borings at the project site. WSB recommended the boring depths and selected the desired locations. Our field crew staked the borings using the supplied site plan. The approximate boring locations are shown on the Soil Boring Exhibit in ***Appendix A*** which is an aerial photo.

We completed the borings on May 1, 2024, with a truck-mounted CME-55 drill rig operated by a two-person crew. The drill crew advanced the borings using continuous hollow stem augers. The drilling information is provided on the boring logs.

Generally, the drill crew sampled the soil in advance of the auger tip at two and one-half (2 ½) foot intervals to a depth of approximately 15 feet. The soil samples were obtained using a split-barrel sampler which was driven into the ground during standard penetration tests in accordance with ASTM D 1586, Standard Method of Penetration Test and Split-Barrel Sampling of Soils. The materials encountered were described on field logs and representative samples were containerized and transported to our laboratory for further observation and testing.

The samples were visually observed to estimate the distribution of grain sizes, plasticity, consistency, moisture condition, color, presence of lenses and seams, and apparent geologic origin. We classified the soils according to type using the Unified Soil Classification System (USCS). A chart describing the USCS is included in ***Appendix A***.

2.2 Groundwater Measurements and Borehole Abandonment

The drill crew observed the borings for free groundwater while drilling and after completion of the borings. These observations and measurements are noted on the boring logs. The crew then backfilled the borings to comply with Minnesota Department of Health regulations.

2.3 Boring Log Procedures and Qualifications

The subsurface conditions encountered by the borings are illustrated on the Logs of Test Borings in ***Appendix A***. Similar soils were grouped into the strata shown on the boring logs, and the appropriate estimated USCS classification symbols were also added. The depths and thickness of the subsurface strata indicated on the boring logs were estimated from the drilling results.

The transition between materials (horizontal and vertical) is approximate and is usually far more gradual than shown. Information on actual subsurface conditions exists only at the specific locations indicated and is relevant only to the time exploration was performed. Subsurface conditions and groundwater levels at other locations may differ from conditions found at the indicated locations. The nature and extent of these conditions would not become evident until exposed by construction excavation. These stratification lines were used for our analytical purposes and due to the aforementioned limitations, should not be used as a basis of design or construction cost estimates.

3. EXPLORATION RESULTS

3.1 Site and Geology

The borings were drilled directly in greenspace.

The boring elevations ranged from 972 feet to 975 feet, with higher elevations on the south side of the existing parking lot.

Geologic origins can be difficult to determine solely from boring samples. We referenced online geologic data of the area and used our experience to help determine geologic origin of the soils, however only a detailed geologic exploration would accurately determine the geologic history of the site.

The Hennepin County Geologic Atlas indicates the surficial geology of the area is lacustrine deposits overlying glacial outwash. The lacustrine deposits consist of loose/soft fine-grained sands, silts, and clays. The glacial deposits consist of granular material, ranging from fine-grained sand to gravel.

3.2 Subsurface Soil and Groundwater Conditions

The boring profile generally consisted of topsoil overlying fill materials followed by both lacustrine and glacial deposits.

Topsoil

The topsoil encountered in the borings consisted of clayey sands that were dark brown in color and ranged from 2 – 9 inches in thickness.

Fills

The fills encountered in the borings generally consisted of a mixture of clayey sands and were 2 – 8 feet in thickness where encountered.

Lacustrine

The lacustrine deposits encountered in the borings consisted of lean clays, clayey sands, and sands. The lean clays and clayey sands were brown in color and were wet. The sands were brown in color and were moist.

Glacial Outwash

The glacial deposits encountered in the borings consisted of clean sands that were brown in color and were moist.

Boring Profiles

Table 1 below presents the existing subgrade profiles.

Table 1: Existing Profiles

Boring No.	Topsoil Thickness (inches)	Subgrade Soils (Upper 4 feet)
B-1	2	Clayey Sand (fill)
B-2	2	Clayey Sand (fill), Lean Clay
B-3	9	Sandy Lean Clay, Lean Clay

3.3 Strength Characteristics

The penetration resistance N-values of the materials encountered were recorded during drilling and are indicated as blows per foot (BPF). Those values provide an indication of soil strength characteristics and are located on the boring log sheets. Also, visual-manual classification techniques and apparent moisture contents were also utilized to make an engineering judgment of the consistency of the materials.

Table 2 presents a summary of the penetration resistances (N-value which are indicated by Blows Per Foot BPF) in the soils for the borings completed and remarks regarding the material strengths of the soils.

Table 2: Penetration Resistances

Soil Type	Classification	Penetration Resistances	Remarks
Fill	SC	5 BPF	Loose
Lacustrine (cohesionless)	SP, SC	4 – 7 BPF	Very loose to loose
Lacustrine (cohesive)	CL	3 – 4 BPF	Very soft
Glacial Outwash	SP	12 – 23 BPF	Medium dense

The preceding is a generalized description of soil conditions at this site. Variations from the generalized profile exist and should be assessed from the boring logs, the normal geologic character of the deposits, and the soils uncovered during site excavation.

3.4 Groundwater Conditions

WSB took groundwater level readings in the exploratory borings, reviewed the data obtained, and discussed its interpretation of the data in the text of the report. Note that groundwater levels may fluctuate due to seasonal variations (e.g. precipitation, snowmelt and rainfall) and/or other factors not evident at the time of measurement.

No groundwater was encountered during the drilling process; however, moist to wet soils were noted.

The bore holes were only left open a short period of time, and groundwater levels may not have stabilized.

It should be noted that groundwater readings are difficult to obtain in cohesive soils such as the lean clays indicated in the boring logs. These soils have a low permeability and take a long period of time to obtain groundwater readings in. If more accurate subsurface water levels are needed, we recommend piezometers be installed to determine the groundwater level over several months. Monitoring of the groundwater table elevation could occur up to the time of construction. This work was outside our scope of services.

4. ENGINEERING ANALYSIS AND RECOMMENDATIONS

4.1 Discussion

The soils encountered are generally suitable for pavement areas. Where infiltration areas are planned, the clean sands appear suitable for infiltration. The borings completed did not encounter groundwater.

Organic soils and vegetated root zones are not suitable for structural support and should be removed from the construction areas.

Based on the results of our borings, the native soil deposits generally appear capable of supporting the utilities and pavement.

Generally, the soils in the upper 4 feet of the subgrade influence pavement performance the most. The soils within the pavement subgrade consist of clayey soils, which are frost susceptible soils. Consideration should be given to partially subcutting these soils and replacing with a non-frost susceptible granular fill to reduce the potential frost heave below the pavement section.

4.2 Backfill and Fill Selection and Compaction

The on-site non-organic soils may be reused as backfill and fill provided they are moisture conditioned and can be compacted to their specified densities. Wet soils that are excavated would need to be dried before reused as an engineered fill. We recommend use of a minimum of 2 feet of clean coarse sand with less than 50 percent passing the #40 sieve and less than 5 percent passing the #200 sieve when backfilling the bottom of a wet excavation.

Gravel or cobbles larger than 2 inches in diameter should not be placed within 2 feet of grading grade or utilities. We recommend that clayey soils be moisture conditioned to within +/-2 percent of the optimum moisture content as determined from their standard Proctor tests (ASTM D-698). Granular fills should be moisture conditioned to between -4% and +2% of the optimum moisture content. Fill should be spread in lifts of 6 inches, depending on the size and type of compaction equipment used.

Table 3 provides the recommended compaction levels.

Table 3: Recommended Level of Compaction for Backfill and Fill

Area	Percent of Standard Proctor Maximum Dry Density
Pavement: Within 3 feet of bottom of aggregate base	100
Pavement: Greater than 3 feet below aggregate base	95
Utility Trench and Utility Structure Backfill	100
Landscaping (non-structural)	90

4.3 Pavement Subgrade Preparation and Stability

We recommend excavation of organics below the pavement areas.

The soils at the bottom of the excavation should be prepared in accordance with MnDOT Specification 2112, Subgrade Preparation. Before placement of the sand subbase, the final subgrade should have proper stability within three vertical feet of grading grade (grade which contacts the bottom of the aggregate base). This will generally be achieved in fill areas with proper compaction of embankment materials and in cut areas through proper subgrade preparation. The stability of the pavement subgrade should be evaluated prior to placement of the sand subbase using the test roll procedure (MnDOT 2111), except a fully loaded tandem axle dump truck or a full water truck should be utilized for the test roll. If

unstable soils are found under the test roll, these soils should be improved by means of scarification, moisture conditioning, and re-compaction, or by subcutting and replacement.

4.4 Pavement Area

Once the site has been prepared as recommended, we anticipate the prepared subgrade soils will consist mostly of clayey sands. Based on the MnDOT Flexible Pavement Guide from 2020, the R-values of the subgrade soils would be approximately 20. We used a design R-value of 20 for the parking lot.

Based on the site being a church that is about 1.0 acres in area, we estimate average annual daily traffic to be less than 50 vehicles.

Based on the above traffic loads, we estimated the Equivalent Single Axle Loads (ESAL's) for roadway design to be less than 50,000. Our design is based on a standard twenty (20) year design life of the pavement section and a 10-ton road design.

Based on MnDOT's FlexPave excel design utilizing granular equivalent charts, we recommend the granular equivalent be a minimum of 12.74. However, a select granular layer below the aggregate base would provide reduced frost heaving and extend the life of the pavement. Our recommended pavement section is indicated below in Table 4 which includes the optional select granular.

Table 4: Recommended Flexible Pavement Section

Section	Thickness (inches)	Granular Equivalent
Bituminous Course, MnDOT 2360 SPWEA340C	2	4.5
Bituminous Course, MnDOT 2360 SPNWB340C	2	4.5
Aggregate Base, MnDOT 3138 (Class 5)	8	8
OPTIONAL: Select Granular, MnDOT 3149.2.B.2	18	9
Geotextile Fabric, MnDOT 3733.1, Type 9	Yes	-
Subgrade Preparation, MnDOT 2112	Yes	-
TOTAL	-	26

Aggregate base placement for pavement support should meet the gradation and quality requirements for Class 5 per MnDOT specification 3138. Aggregate base material should be compacted to 100 percent of its standard Proctor maximum dry density.

Within several years after initial paving, some thermal shrinkage cracks will develop. We recommend routine maintenance be performed to improve pavement performance and increase pavement life. Pavement should be sealed with a liquid bitumen sealer to retard water intrusion into the base course and subgrade. Localized patch failures may also develop where trucks or buses turn on the pavement. When these occur, they should be cut out and patch repaired.

The pavement sections above provide options to meet the ESAL requirements. Other pavement design options would be acceptable as well as long as they meet the minimum requirements for bituminous thickness, aggregate base thickness, and can meet the ESAL requirements.

Drainage of the sand subbase is recommended. Drainage of the sand subbase may be accomplished by daylighting to adjacent ditches or the use of drain tile. Drain tile wrapped in a sock should be placed at the base of the sand subbase and tied into catch basins.

4.5 Infiltration

In general, the clayey soils encountered in the borings taken at the site would be considered poor for construction of infiltration ponds. We recommend they be removed from below the infiltration area.

We utilized real test data to estimate the infiltration rate of the in-place soils. Table 5 below presents the estimated infiltration rates of soils based on the Kozeny-Carmen equation.

Table 5: Estimated Infiltration Rates

Boring No.	Depth to sand layer (feet)	Kozeny-Carmen Estimated Infiltration Rate (Inches / Hour)	Hazen Equation Estimated Infiltration Rate (Inches / Hour)	Minnesota Stormwater Manual Estimated Infiltration Rate (Inches / Hour)
B-1	10	326.34	88.58	0.8
B-2	7	51.19	78.01	0.8
B-3	8	33.25	56.47	0.8

4.6 Utilities

Invert elevations for the culverts are anticipated to be within 5 feet of existing grades. Based on the borings, the subgrade soils for the utilities will consist chiefly of clayey sands and lean clays.

Underground utilities are expected to be installed by backhoes completing the excavations and placing fills. Soil compactors should be used to compact the fill in even lifts to the specified densities.

The borings encountered clayey soils, are considered somewhat corrosive to metallic pipes. Where such soils exist along the alignment, we recommend mitigation measures to help reduce corrosion potential. A common option would be to utilize a granular bedding around the pipe. Another option would be for polyethylene encasement for the metal pipes in highly corrosive soils. Trench backfill above this point may consist of the non-organic excavated soils once moisture conditioned as recommended.

4.7 Construction Considerations

Good surface drainage should be maintained throughout the work so that the site is not vulnerable to ponding during or after a rainfall. If water enters the excavations, it should be promptly removed prior to further construction activities. Under no circumstances should fill or concrete be placed into standing water.

Soil corrections at this site for subgrades may not be continuous. We recommend tapering the fills back to native soils at a ten to one (10H:1V) slope.

It is important to review the fill limits and total depth of fill when placing structures upon compacted materials and when filling the excavation. The location of the structures should allow for at least a one to one (1:1) slope from the bottom of the footing to the outside limits of the engineered fill.

4.8 Construction Safety

All excavations should comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P "Excavations and Trenches". This document states that excavation safety is the responsibility of the contractor. Reference to this OSHA requirement should be included in the job specifications.

The responsibility to provide safe working conditions on this site, for earthwork, building construction, or any associated operations is solely that of the contractor. This responsibility is not borne in any manner by WSB.

4.9 Cold Weather Construction

It is our understanding that construction is unlikely to occur during the winter months. However, if the construction does continue into the winter months we recommend the following guidelines.

Roadbeds should not be constructed during periods when the material freezes while being placed and compacted, nor should material be placed on soil that is frozen to a depth greater than 4 inches. When the soils are frozen to a depth exceeding 4 inches, at a time when weather conditions are such that construction could be continued without the material freezing as it is being placed and compacted, the contractor may be permitted to excavate the frozen soil and proceed with the construction for so long as the weather will permit. The frozen soils should be pulverized or replaced with other suitable soils. Only unfrozen fill should be used.

Placement of fill should not be permitted on frozen soil, and the bearing soils within the subgrade should not be allowed to freeze after soil is placed, because excessive post-construction settlement could occur as the frozen soils thaw.

4.10 Field Observation and Testing

The soil conditions illustrated on the Logs of Test Borings in ***Appendix A*** are indicative of the conditions only at the boring locations. For this reason, we recommend that excavations at this site be observed by a soil engineer or technician prior to fill or backfill placement or construction of foundation elements to determine if the soils are capable of supporting the fill backfill and/or foundation loads. These observations are recommended to judge if the unsuitable materials have been removed from within the planned construction area and an appropriate degree of lateral oversize has been provided.

WSB also recommends a representative number of field density tests be taken in engineered fill and backfill placed to aid in judging its suitability. Fill placement and compaction should be monitored and tested to determine that the resulting fill and backfill conforms to specified density, strength or compressibility requirements. We recommend at least one compaction test for every 2,000 square feet of building area at vertical intervals not exceeding two (2) feet, and one compaction test for every 150 feet of utility trench at a vertical interval of two (2) feet. Prior to use, proposed fill and backfill material should be submitted to the WSB laboratory for testing to verify compliance with recommendations and project specifications.

Dynamic Cone Penetrometer (DCP) tests can be completed in the aggregate base in lieu of density testing. We recommend following MnDOT Specification 2211.3.D.2.c.

WSB would be pleased to provide the advised field observation, monitoring and testing services during construction.

4.11 Plan Review and Remarks

The observations, recommendations and conclusions described in this report are based primarily on information provided to WSB, obtained from our subsurface exploration, our experience, several assumptions and the scopes of service developed for this project and are for the sole use of our client. We recommend that WSB be retained to perform a review of final design drawing and specifications to evaluate that the geotechnical engineering report has not been misinterpreted. Should there be changes in the design or location of the structures related to this project or if there are uncertainties in the report we should be notified. We would be pleased to review project changes and modify the recommendations in this report or provide clarification in writing.

The entire report should be kept together; for example, boring logs should not be removed and placed in the specifications separately.

The boring logs and related information included in this report are indicators of the subsurface conditions only at the specific locations indicated on the Soil Boring Exhibit and times noted on the Logs of Test Boring sheets in ***Appendix A***. The subsurface conditions, including groundwater levels, at other locations on the site may differ significantly from conditions that existed at the time of sampling and at the boring locations.

The test borings were completed by WSB solely to obtain indications of subsurface conditions as part of a geotechnical exploration program. No services were performed to evaluate subsurface environmental conditions.

WSB has not performed observations, investigations, explorations, studies or testing that are not specifically listed in the scope of service. WSB should not be liable for failing to discover any condition whose discovery required the performance of services not authorized by the Agreement.

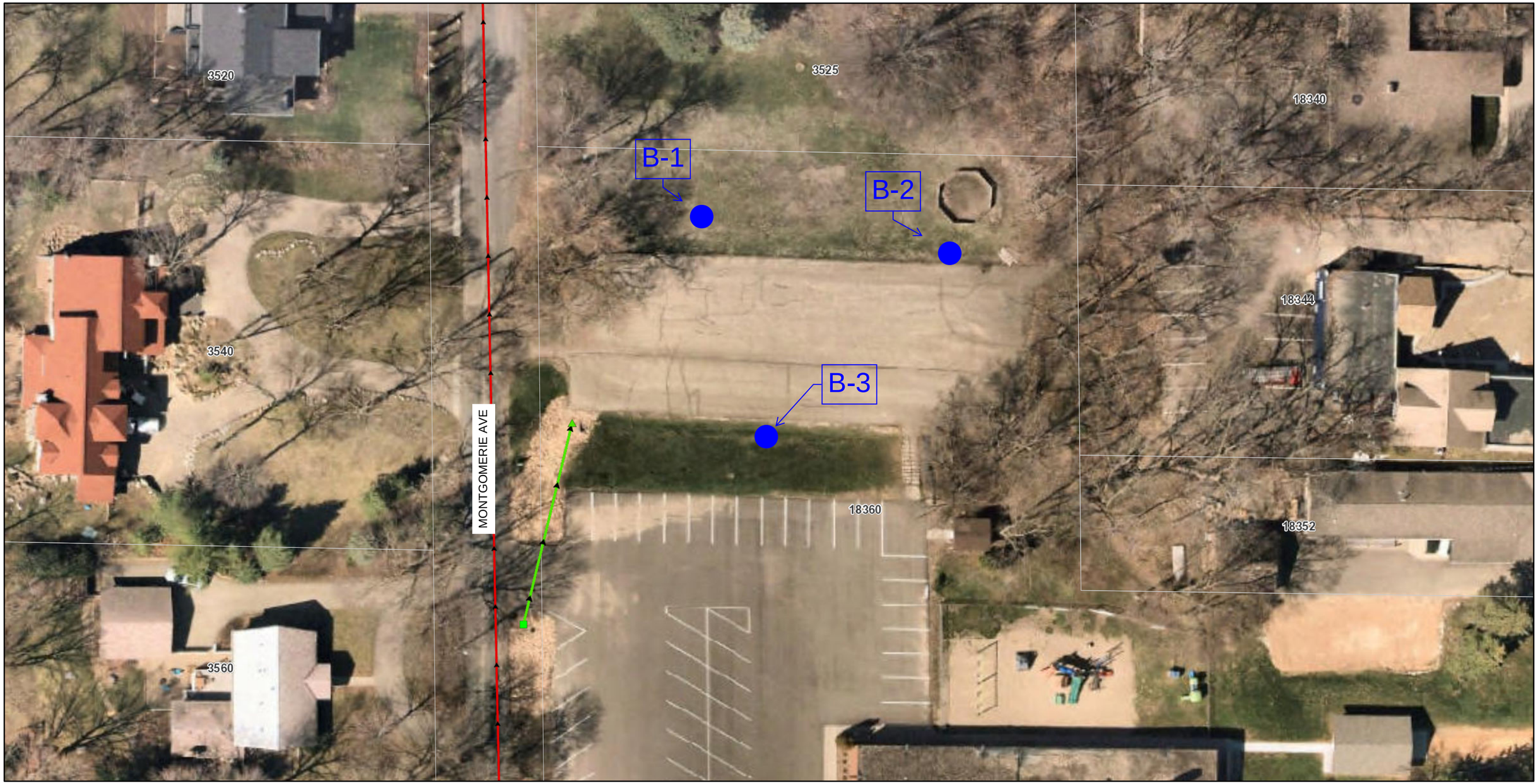
5. STANDARD OF CARE

The recommendations and opinions contained in this report are based on our professional judgment. The soil testing and geotechnical engineering services performed for this project have been performed with the level of skill and diligence ordinarily exercised by reputable members of the same profession under similar circumstances, at the same time and in the same or a similar locale. No warranty, either expressed or implied, is made.

APPENDIX A

Soil Borings Exhibit
Logs of Test Borings
Symbols and Terminology on Test Boring Log
Notice to Report Users Boring Log Information
Unified Soil Classification Sheet (USCS)

Soil Boring Request - Calvary Church Lower Parking Lot - Deephaven, MN



Sewer Manholes
Lift Station
Sewer Gravity Mains
Sewer Pressurized Mains
Inlets
Manholes
Discharge Points
Gravity Mains
Storm Ponds
Address Labels
City Boundary
City Mask

1 in = 50 Ft

N

January 3, 2024

Map Powered By Datafi

DEEPHAVEN
EST. 1900

wsb

LOG OF TEST BORING

wsb

PROJECT NAME: Calvary Church
CLIENT/WSB #: 020518-000

PROJECT LOCATION: Deephaven, Minnesota
SURFACE ELEVATION: 972 ft

BORING NUMBER B-1
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	N	MC %	%Fines	N-Value Plot
0	972	2" TOPSOIL		Topsoil								
		CLAYEY SAND WITH LITTLE GRAVEL, slightly organic, brown, wet		Fill								
1	971						AU	1				
2	970											
3	969						SB	2	5	26		5
4	968						HSA					
5	967						SB	3	5	18		5
6	966											
7	965						HSA					
8	964	LEAN CLAY, brown, wet, soft	CL	Lacustrine			SB	4	4	22		4
9	963						HSA					
10	962	SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, moist, loose to very loose	SP				SB	5	6			6
11	961											
12	960						HSA					
13	959											
14	958						SB	6	4			4

End of Boring 14.5 ft.

WATER LEVEL MEASUREMENTS							START: 5/01/2024	END: 5/01/2024	
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD	Crew Chief: D. Bailey	Logged By: A. Wacek
5/01/2024	11:15 am	14.5	13	10	None		3.25" HSA 0' - 13'	Notes:	

GEOTECHNICAL N-PLOT - WSB.GDT - 5/23/24 10:49 - K:\020518-000\GEOTECH-CMT\GEOTECH\CALVARY CHURCH - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Calvary Church
CLIENT/WSB #: 020518-000

PROJECT LOCATION: Deephaven, Minnesota
SURFACE ELEVATION: 972.5 ft

BORING NUMBER B-2

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	Drilling Operation	SAMPLE TYPE	SAMPLE No.	N	MC %	%Fines
0	972.5	2" TOPSOIL		Topsoil						
		CLAYEY SAND, slightly organic, dark brown and brown, wet		Fill		AU	1			
2	971	LEAN CLAY, brown, wet, very soft	CL	Lacustrine		SB	2	3	30	
3	970									
4	969					HSA				
5	968	CLAYEY SAND, fine to coarse grained, brown, wet, loose	SC			SB	3	7	13	
6	967					HSA				
7	966	SAND WITH LITTLE GRAVEL, fine to coarse grained, brown, moist, medium dense	SP	Glacial Outwash		SB	4	17		
8	965									
9	964					HSA				
10	963					SB	5	14		
11	962									
12	961					HSA				
13	960									
14	959					SB	6	23		

N-Value Plot: 0 — 13.5 — 27; 3 — 7 — 17 — 14 — 23

End of Boring 14.5 ft.

WATER LEVEL MEASUREMENTS

START: 5/01/2024 END: 5/01/2024

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/01/2024	10:30 am	14.5	13	10.5	None		3.25" HSA 0' - 13'

Crew Chief: D. Bailey
Logged By: A. Wacek
Notes:

GEOTECHNICAL N-PLOT - WSB.GDT - 5/23/24 10:49 - K:\020518-000\GEOTECH-CMT\GEOTECH\CALVARY CHURCH - BORING LOG.GPJ

LOG OF TEST BORING

PROJECT NAME: Calvary Church
CLIENT/WSB #: 020518-000

PROJECT LOCATION: Deephaven, Minnesota
SURFACE ELEVATION: 975 ft

BORING NUMBER B-3
PAGE 1 OF 1

DEPTH (ft)	ELEV. (ft)	DESCRIPTION OF MATERIAL	USCS	GEOLOGIC ORIGIN	WL	Drilling Operation	SAMPLE TYPE	SAMPLE No.	N	MC %	%Fines	N-Value Plot
		9" TOPSOIL: Clayey Sand, dark brown and brown, wet		Topsoil								
1	974	SANDY LEAN CLAY, brown, wet	CL	Lacustrine			AU	1		17		
2	973	LEAN CLAY, brown, wet, soft	CL				SB	2	4	24		4
3	972											
4	971	SANDY LEAN CLAY, brown, wet, soft	CL				HSA					
5	970						SB	3	4	21		4
6	969						HSA					
7	968						SB	4	12			12
8	967	SAND, fine to coarse grained, brown, moist, medium dense	SP	Glacial Outwash								
9	966						HSA					
10	965						SB	5	20			20
11	964											
12	963						HSA					
13	962											
14	961						SB	6	22			22

End of Boring 14.5 ft.

WATER LEVEL MEASUREMENTS

START: 5/01/2024 END: 5/01/2024

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER DEPTH	WATER ELEVATION	METHOD
5/01/2024	9:45 am	14.5	13	9.5	None		3.25" HSA 0' - 13'

Crew Chief: D. Bailey
Logged By: A. Wacek
Notes:

SYMBOLS AND TERMINOLOGY ON TEST BORING LOG

SYMBOLS

Drilling and Sampling

Symbol	Description
HSA	3 1/4" LD. Hollow Stem Auger
FA	Flight Auger
HA	Hand Auger
RC	Size A, B, or N rotary casing
CS	Continuous split barrel sampling
DM	Drilling Mud
JW	Jetting Water
SB	2" O.D. split barrel sampling
_L	2 1/2" or 3 1/2" OD split barrel liner sampler
_T	2" or 3" thin walled tube sample
W	Wash sample
B	Bag sample
P	Test Pit sample
_Q	BQ, NQ, or PQ wire line system
_X	AX, BX, or NX double tube barrel
N	Standard penetration test, blow per foot
CR	Core recovery, percent
WL	Water level
n/a	no measurement recorded

Laboratory Testing

Symbol	Description
MC	Moisture content, % (ASTM D2216)
DD	Dry Density, pcf
LL	Liquid Limit (ASTM D4318)
PL	Plastic Limit (ASTM D4318)
	- Inserts in last column
Qu	Unconfined compressive strength, psf (ASTM D2166)
Pq	Penetrometer Reading, tsf (ASTM D1558)
Ts	Torvane Reading, ts
G	Specific Gravity (ASTM D854)
SL	Shrinkage limits (ASTM D427)
OC	Organic Contenct (ASTM D2974)
SP	Swell Pressure, tsf (ASTM D4546)
PS	Percent swell under pressure (ASTM D4546)
FS	Free swell, % (ASTM D4546)
SS	Shrink swell, % (ASTM D4546)
pH	
SC	Sulfate content, parts/million or mg/l
CC	Chloride content, parts/million or mg/l
C	One dimensional consolidation (ASTM D2435)
Qc	Triaxial compression (ASTM D2850 and D4767)
DS	Direct Shear (ASTM D3080)
K	Coefficient of permeability, cm/sec (ASTM D2434)
P	Pinhole Test (ASTM D4647)
DH	Double hydrometer (ASTM D4221)
MA	Particle size analysis (ASTM D422)
R	Laboratory electreical resistivity, ohm-cm (ASTM G57)
VS	Field vane shear (ASTM D2573)
RQD	Rock quality designation, percent
IR	Infiltration Test (ASTM D3385)

TERMINOLOGY

Particle Sizes

Type	Size Range
Boulders	> 12"
Cobbles	3" - 12"
Coarse gravel	3/4" - 3"
Fine gravel	#4 sieve - 3/4"
Coarse sand	#4 sieve - #10 sieve
Medium sand	#10 sieve - #40 sieve
Fine sand	#40 sieve - #200 sieve
Silt	100% passing #200 sieve, and > 0.002mm
Clay	100% passing #200 sieve, and < 0.002mm

Soil Layering and Moisture

Term	Visual Observation
Lenses	Small pockets of different soils
Lamination	< 1/4" thick stratum
Layer	1/4" - 12" thick stratum
Stratified	Altering lenses of varying materials or colors
Varved	Altering laminations of clay, silt, fine sand, or colors
Dry	Powdery, no noticeable water
Moist	Damp, below saturation
Wet	MC above plastic limit
Waterbearing	Pervious soil below water table
Saturated	Cohesive soil with MC above liquit limit

Gravel Content

Coarse-Grained Soils

% Gravel	Description
2 - 15	A little gravel
16 - 30	With gravel
31 - 49	Gravelly

Fine-Grained Soils

% Gravel	Description
2 -5	Trace of gravel
5 -15	a little gravel
16 - 30	with gravel
31 - 49	Gravelly

Standard Pentration Resistance (N-value)

Cohesionless Soils

N-Value	Relative Density
0 - 4	Very loose
5 - 10	Loose
11 - 30	Medium dense
31 - 50	Dense
>50	Very dense

Cohesive Soils

N-Value	Consistency
0 - 4	Very soft
5 - 8	Soft
9 - 15	Firm
16 - 30	Hard
>30	Very hard

NOTICE TO REPORT USERS BORING LOG INFORMATION

Subsurface Profiles

The subsurface stratification lines on the graphic representation of the test borings show an approximate boundary between soil types or rock. The transition between materials is approximate and is usually far more gradual than shown. Estimating excavation depths, soil volumes, and other computations relying on the subsurface strata may not be possible to any degree of accuracy.

Water Level

WSB & Associates, Inc. took groundwater level readings in the exploratory borings, reviewed the data obtained, and discussed its interpretation of the data in the text of this report. The groundwater level may fluctuate due to seasonal variations caused by precipitation, snowmelt, rainfalls, construction or remediation activities, and/or other factors not evident at the time of measurement.

The actual determination of the subsurface water level is an interpretive process. Subsurface water level may not be accurately depicted by the levels indicated on the boring logs. Normally, a subsurface exploration obtains general information regarding subsurface features for design purposes. An accurate determination of subsurface water levels is not possible with a typical scope of work. The use of the subsurface water level information provided for estimating purposes or other site review can present a moderate to high risk of error.

The following information is obtained in the field and noted under "Water Level Measurements" at the bottom of the log.

Sample Depth:	The lowest depth of soil sampling at the time a water level measurement is taken.
Casing Depth:	The depth to the bottom of the casing or hollow stem auger at the time of water level measurement.
Cave-in Depth:	The depth at which a measuring tape stops in the bore hole.
Water Level:	The point in the bore hole at which free-standing water is encountered by a measure device from the surface.

Obstruction Depths

Obstructions and/or obstruction depths may be noted on the boring logs. Obstruction indicates the sampling equipment encountered resistance to penetration. It must be realized that continuation of drilling, the use of other drilling equipment or further exploration may provide information other than that depicted on the logs. The correlation of obstruction depths on the log with construction features such as rock excavation, foundation depths, or buried debris cannot normally be determined with any degree of accuracy. For example, penetration of weathered rock by soil sampling equipment may not correlate with removal by certain types of construction equipment. Using this information for estimating purposes often results in a high degree of misinterpretation.

Accurately identifying the obstruction or estimating depths where hard rock is present over the site requires a scope of service beyond the normal geotechnical exploration program. The risk of using the information noted on the boring logs for estimating purposes must be understood.

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

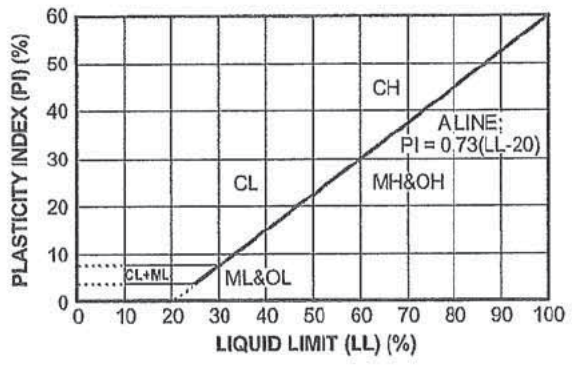
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

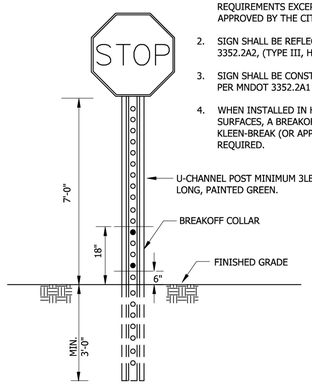
PLASTICITY CHART



ATTACHMENT B

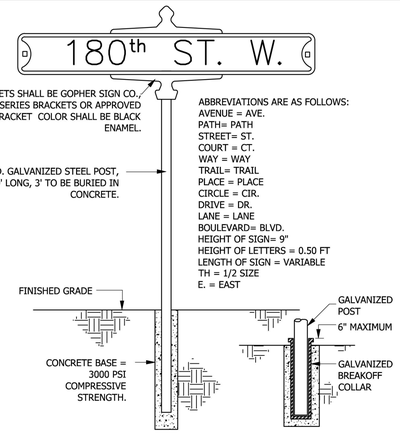
SIGN NAME	DESIGNATION	SIZE
STOP	R1-1	30"X30"
YIELD	R1-2	36"X36"X36"
SPEED LIMIT	R2-1	24"X30"
NO PARKING	N/A	12"X18"

NOTES:
1. DESIGN SHALL CONFORM TO THESE REQUIREMENTS EXCEPT AS OTHERWISE APPROVED BY THE CITY ENGINEER.
2. SIGN SHALL BE RETROREFLECTORIZED AS PER MNDOT 3352.2A2, (TYPE III, HIGH INTENSITY.)
3. SIGN SHALL BE CONSTRUCTED OF ALUMINUM PER MNDOT 3352.2A1
4. WHEN INSTALLED IN HARD OR CONCRETE SURFACES, A BREAKOFF COLLAR SUCH AS KLEEN-BREAK (OR APPROVED EQUAL) SHALL BE REQUIRED.



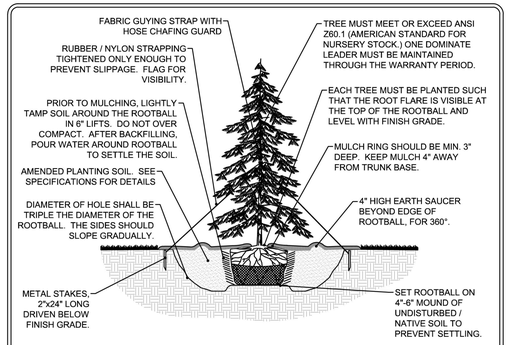
INSTALLATION SHALL BE AS SPECIFIED IN THE LATEST EDITION OF THE MMUTCD REGULATORY SIGN DETAILS

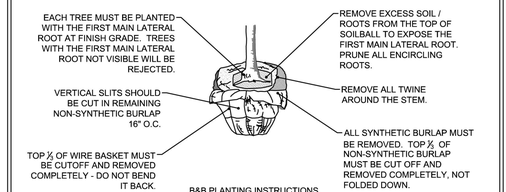
Deephaven EST. 1900 | REGULATORY SIGN | LAST REVISION: MAR. 2021 | PLATE NO. GEN-04



NOTE:
1. NUMBERED STREETS ARE TO BE WRITTEN OUT WHEN THE NUMBER IS NINETEENTH OR LESS.
2. INSTALLATION SHALL BE AS SPECIFIED IN THE LATEST EDITION OF THE MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES.
3. STREETS WITH SPEED LIMIT GREATER THAN 30 MPH, A 0.7' SIGN WITH 0.5' LETTERS IS REQUIRED.
4. SIGN SHALL BE ALUMINUM PLATE WITH REFLECTORIZED BLACK LETTERS ON A WHITE BACKGROUND. TYPE AP BORDER STYLE.
5. SIGN SHALL BE REFLECTORIZED AS PER MNDOT 3352.2A.2 (TYPE III, HIGH INTENSITY.)
6. TYPICALLY INSTALLED AT SOUTHWEST CORNER OF INTERSECTION. ALL EQUALS MUST BE APPROVED BY CITY ENGINEER BEFORE INSTALLATION.
7. SIGN SHALL BE CONSTRUCTED OF ALUMINUM PER MNDOT 3352.2A1

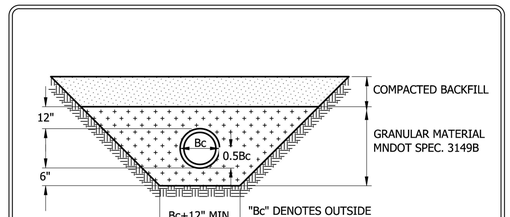
Deephaven EST. 1900 | STREET SIGN DETAIL | LAST REVISION: MAR. 2021 | PLATE NO. GEN-05



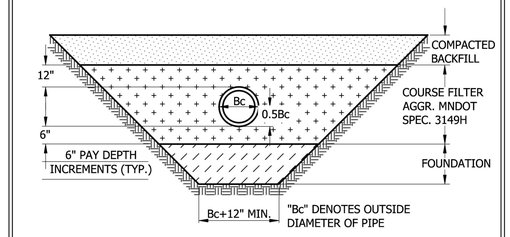


B&B PLANTING INSTRUCTIONS

Deephaven EST. 1900 | CONIFEROUS TREE PLANTING DETAIL | LAST REVISION: MAR. 2021 | PLATE NO. GEN-08



PIPE FOUNDATION & BEDDING IN GOOD SOILS

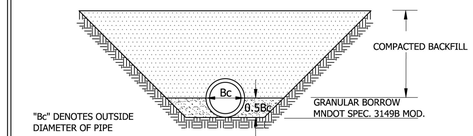


PIPE FOUNDATION & BEDDING IN POOR SOILS

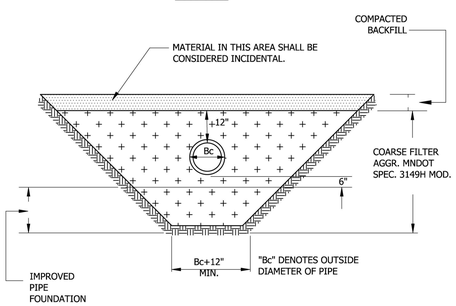
NOTE:
1. FOR POLYPROPYLENE PIPE, SEE MANUFACTURERS RECOMMENDED PIPE BEDDING SECTION.

Deephaven EST. 1900 | FOUNDATION AND PIPE BEDDING FOR PVC | LAST REVISION: MAR. 2021 | PLATE NO. BED-01

190__BED-01.DWG



PIPE FOUNDATION AND BEDDING IN GOOD SOILS

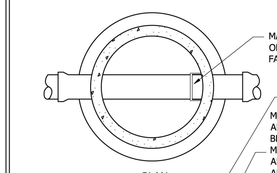


PIPE FOUNDATION AND BEDDING IN POOR SOILS

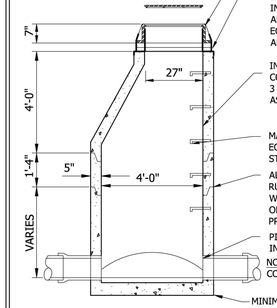
Deephaven EST. 1900 | FOUNDATION AND PIPE BEDDING FOR RCP | LAST REVISION: MAR. 2021 | PLATE NO. BED-03

PRECAST INVERT MUST BE 1/2 DIAMETER OF THE PIPE AND BENCHES SLOPED 2" TOWARD THE INVERT.

CASTING	A	B
R1642B	27"	7"



PLAN

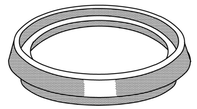


SECTION

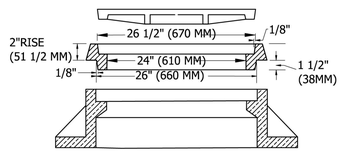
- MANHOLE STEPS SHALL BE PLACED SO THAT OFFSET VERTICAL PORTION OF CONE IS FACING DOWNSTREAM.
- NEENAH R1642B FRAME AND COVER OR EQUAL WITH 2 CONCEALED PICK HOLES. BOLTED IN NON-PAVED AREAS.
- MINIMUM OF 2 AND MAXIMUM OF 5 CONCRETE ADJUSTMENT RINGS WITH FULL BED OF MORTAR BETWEEN EACH. 1 RING WITH MORTAR = 0.2'.
- MORTAR SHALL BE PURE PORTLAND SPEC MIX OR APPROVED EQUAL.
- AN INTERNAL TOP HAT (ESS BROTHERS ALIGNMENT BARRIER OR APPROVED EQUAL) SHALL BE INSTALLED WITH APPROVED WATER PROOF CAULK AND AN EXTERNAL INFI-SHIELD OR APPROVED EQUAL SHALL BE INSTALLED AROUND THE CASTING AND RINGS AND OVER CONE SECTION (2" MIN).
- INTERIOR MANHOLE WALL SHALL BE COMPLETELY LINED WITH HDPE WITHIN 3 MANHOLES OF A DUMP MANHOLE, OR AS OTHERWISE REQUIRED.
- MANHOLE STEPS, NEENAH R1981J OR EQUAL, 16" ON CENTER. ALUMINUM STEPS APPROVED.
- ALL JOINTS IN MANHOLE TO HAVE "O" RING RUBBER GASKETS. WRAP EXTERIOR BARREL JOINT WITH 6" RUBBER MASTIC SEALER (GATOR WRAP OR APPROVED EQUAL).
  PRECAST INVERT IS REQUIRED.
- PIPE SHALL BE CUT OUT FLUSH WITH INSIDE FACE OF WALL.
  NOTE: KOR-N-SEAL MANHOLE OR EQUAL CONSIDERED ACCEPTABLE ALTERNATE.
- MINIMUM SLAB THICKNESS OF PRE CAST BASE IS 6" FOR 14' DEEP OR LESS, AND INCREASE 1" IN THICKNESS FOR EVERY 4' OF DEPTH GREATER THAN 14'

Deephaven EST. 1900 | SANITARY SEWER MANHOLE | LAST REVISION: MAR. 2021 | PLATE NO. SAN-01

NOTE:
ONE PIECE ADJ. RING
24" - NO. R1979 D-1
27" - NO. R1979 M-1



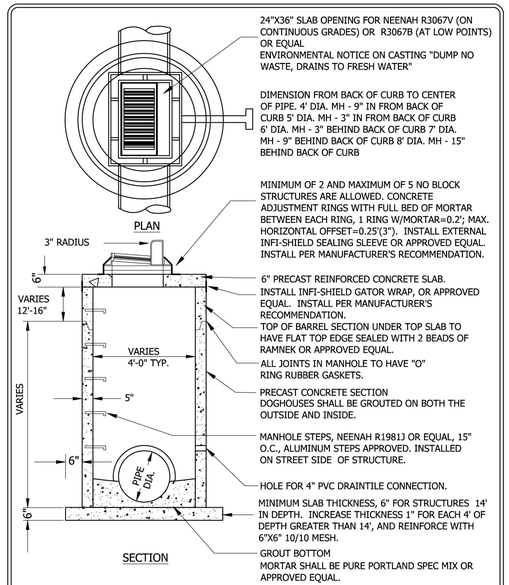
NEENAH ADJUSTING RING
NO SCALE



TYPE A, NEENAH R-1642-B
MANHOLE FRAME (27")

1. INSTALLATION OF ADJUSTMENT RING SHALL INCLUDE EPOXY ADHESIVE PER MANUFACTURER'S RECOMMENDATION.
2. TWO PIECE ADJUSTING RING OR STEEL SPLIT RINGS SHALL NOT BE ALLOWED.
3. TO ACCOMMODATE THE FUTURE 1 1/2" WEAR COURSE, CONTRACTOR SHALL SET THE MANHOLE CASTING 1" BELOW THE BITUMINOUS BINDER COURSE.
4. INSTALLATION OF 2" ADJUSTING RING SHALL INCLUDE THE USE OF OF BOTH EPOXY ADHESIVE AND SET SCREWS TO EXISTING CASTING.
5. INSTALL PER MANUFACTURER SPECIFICATIONS.

Deephaven EST. 1900 | MANHOLE CASTING ADJUSTING RING | LAST REVISION: MAR. 2021 | PLATE NO. SAN-06



PLAN

SECTION

Deephaven EST. 1900 | CATCHBASIN MANHOLE TYPE I | LAST REVISION: MAR. 2021 | PLATE NO. STO-04

Stantec
ONE CARLSON PARKWAY N. SUITE 100
PLYMOUTH, MN 55447
www.stantec.com

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 ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA
PRINT NAME: STEVEN HEGLAND
SIGNATURE: ____ LIC. NO. 59243
DATE: ____ ####

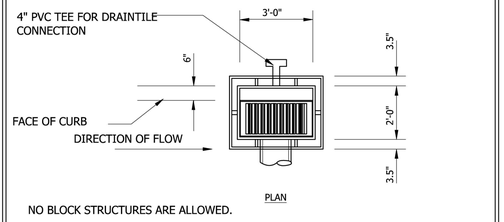
DEEPHAVEN, MINNESOTA
2026 STREET IMPROVEMENT PROJECT
STANDARD DETAILS

NO	REVISION	DATE

SURVEY
DRAWN
DESIGNED
CHECKED
APPROVED
PROJ. NO. 193807541

SHEET NUMBER
C801

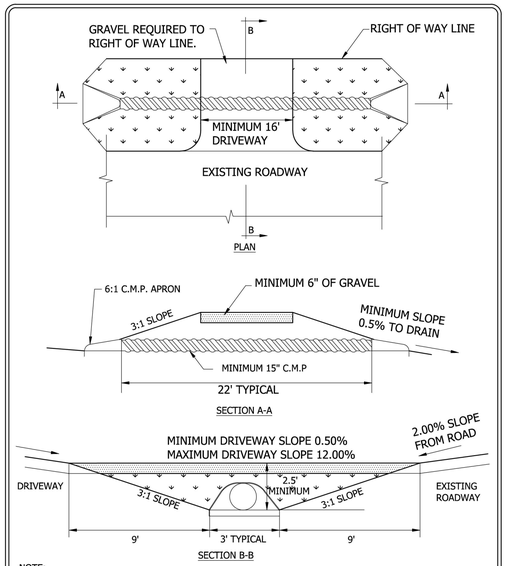
Plot Date: 01/20/2026 - 3:30pm
Plotted By: Steven Hegland (\\US0242-pphsp01\shared_projects\193807541\drafting\03 - DESIGN\1_CAD\3 PLANSHEETS\193807541_C801 Details.dwg
Xrefs: 193807541_Xbase



CATCHBASIN TYPE II

LAST REVISION: MAR. 2021

PLATE NO. STO-05

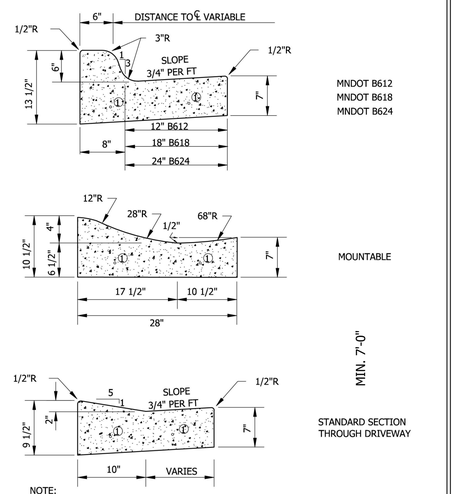


NOTE:
1. HP STORM PIPE (POLYPROPYLENE) MANUFACTURED BY ADS CAN BE USED IN LIEU OF CMP.

RURAL RESIDENTIAL DRIVEWAY

LAST REVISION: MAR. 2021

PLATE NO. STO-14

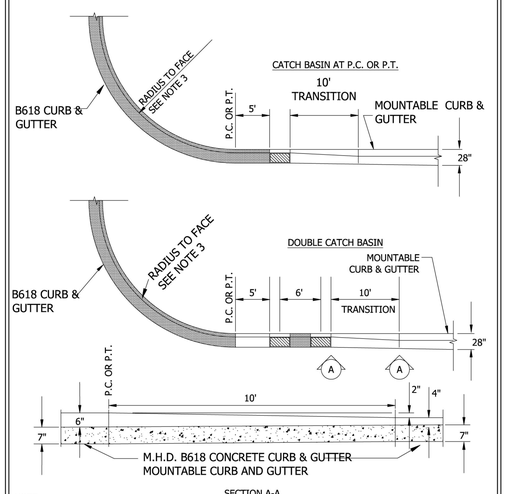


NOTE:
1. PLACE #4 REBAR AS SHOWN, WHERE CURB CROSSES UTILITY TRENCHES, WITH 1 ½" OF COVER.
2. CONCRETE MIX FOR ALL CURB TYPES SHALL BE 3F52C FOR HAND PLACEMENT OR 3F32C FOR MACHINE PLACEMENT

CURB AND GUTTER

LAST REVISION: MAR. 2021

PLATE NO. STR-01

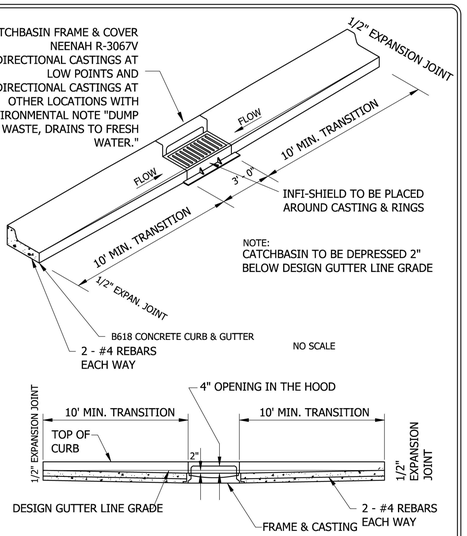


NOTE:
1. ALL RADII ARE MEASURED TO FACE OF CURB.
2. NO CATCH BASINS WILL BE CONSTRUCTED IN THE INTERSECTION RADII.
3. 30' RADII WILL BE REQUIRED AT INTERSECTIONS OF ALL COLLECTOR TO RESIDENTIAL STREETS. 20' RADII WILL BE REQUIRED AT INTERSECTIONS OF ALL RESIDENTIAL TO RESIDENTIAL STREETS.

CONCRETE CURB AND GUTTER TRANSITION

LAST REVISION: MAR. 2021

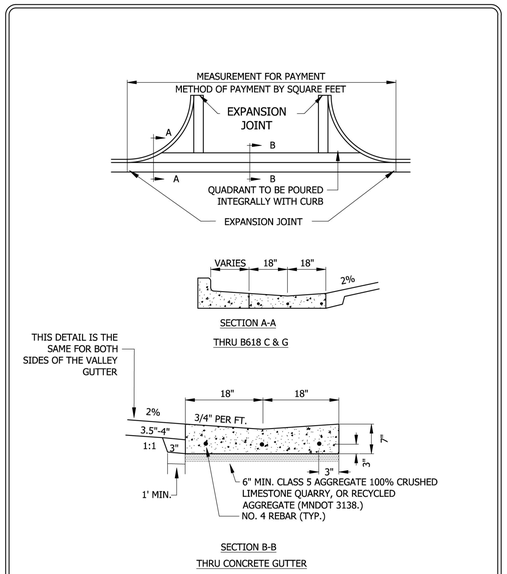
PLATE NO. STR-02



B618 CURB AND GUTTER CONSTRUCTION AT CATCHBASIN

LAST REVISION: MAR. 2021

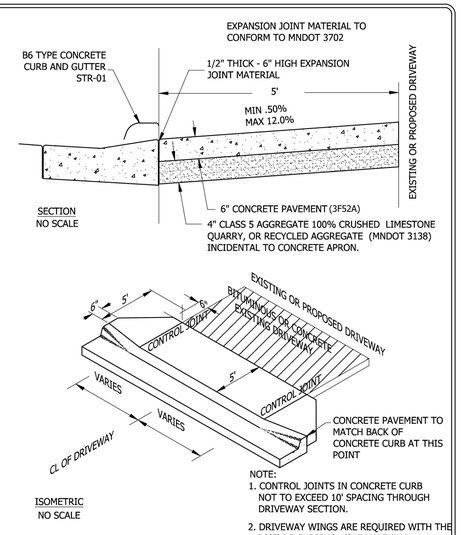
PLATE NO. STR-04



CONCRETE VALLEY GUTTER AND BEDDING METHOD

LAST REVISION: MAR. 2021

PLATE NO. STR-09

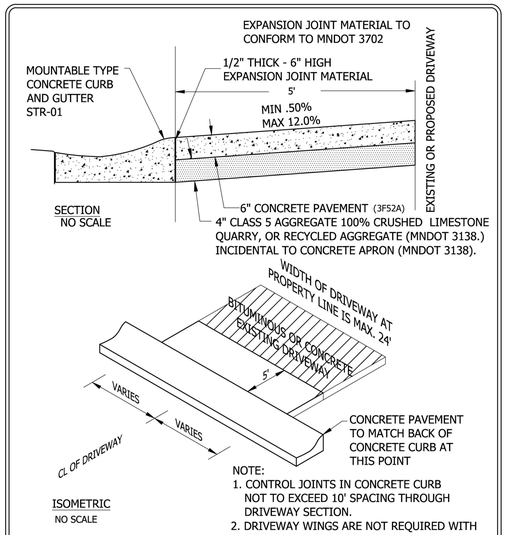


NOTE:
1. CONTROL JOINTS IN CONCRETE CURB NOT TO EXCEED 10' SPACING THROUGH DRIVEWAY SECTION.
2. DRIVEWAY WINGS ARE REQUIRED WITH THE B6STYLE CURBING. THE MAXIMUM DRIVEWAY WIDTH AT THE CURB AND THE PROPERTY LINE IS 24', PLUS THE 3' WINGS. THE MINIMUM WIDTH OF THE DRIVEWAY AT THE CURB AND PROPERTY LINE IS 12'.

RESIDENTIAL CONCRETE DRIVEWAY APRON (B6 TYPE CURB)

LAST REVISION: MAR. 2021

PLATE NO. STR-10



NOTE:
1. CONTROL JOINTS IN CONCRETE CURB NOT TO EXCEED 10' SPACING THROUGH DRIVEWAY SECTION.
2. DRIVEWAY WINGS ARE NOT REQUIRED WITH THE MOUNTABLE STYLE CURBING. THE MAXIMUM DRIVEWAY WIDTH AT THE CURB AND PROPERTY LINE IS 24'. THE MINIMUM WIDTH OF THE DRIVEWAY IS 12'.

RESIDENTIAL CONCRETE DRIVEWAY APRON (MOUNTABLE TYPE CURB)

LAST REVISION: MAR. 2021

PLATE NO. STR-11

Stantec
ONE CARLSON PARKWAY N. SUITE 100
PLYMOUTH, MN 55447
www.stantec.com

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 ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA

PRINT NAME: STEVEN HEGLAND

SIGNATURE: ____ LIC. NO. 59243

DATE: ____ ####

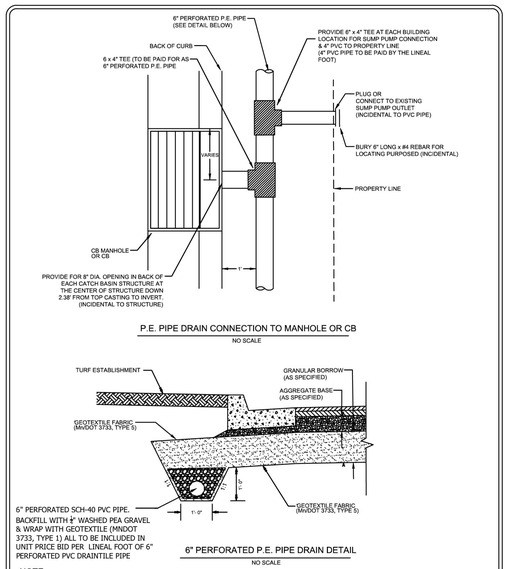
DEEPHAVEN, MINNESOTA
2026 STREET IMPROVEMENT PROJECT
STANDARD DETAILS

NO	REVISION	DATE

SURVEY
DRAWN
DESIGNED
CHECKED
APPROVED
PROJ. NO. 193807541

SHEET NUMBER
C802

Plot Date: 01/20/2026 - 3:29pm
Plotted By: Steven Hegland (US0242-sphsd1)
Xrefs: 193807541_Details



P.E. PIPE DRAIN CONNECTION TO MANHOLE OR CB

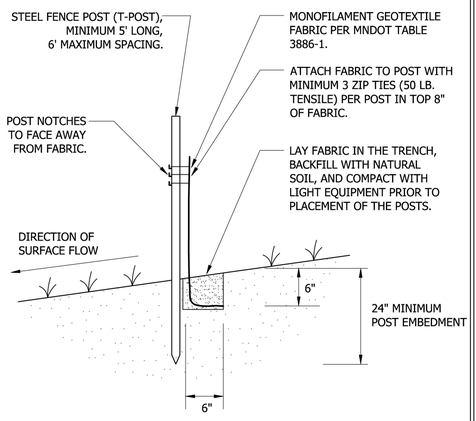
NO SCALE

6" PERFORATED P.E. PIPE DRAIN DETAIL

NO SCALE

NOTE:
1. IF SUMP PUMP DRAINS ARE NOT REQUIRED, 4-INCH PERFORATED DRAINTILE IS ACCEPTABLE.

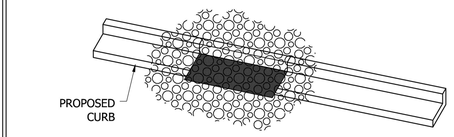
Deephaven EST.1900	PERFORATED DRAIN TILE WITH SUMP PUMP CONNECTIONS	LAST REVISION: MAR. 2021 PLATE NO. STO-19

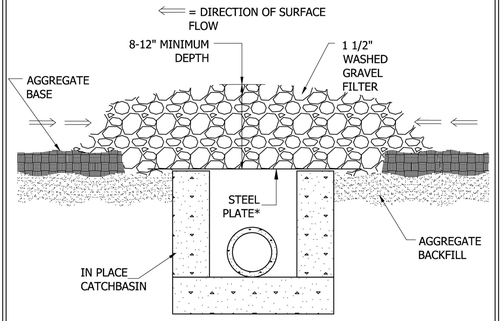


NOTES:
1. SPLICING WILL BE MADE AT OPPOSING SILT FENCE POSTS BY PLACING POSTS AND SILT FENCE NEXT TO EACH OTHER AND ROTATING 360°.
2. HEAVY DUTY SILT FENCE IS MACHINE SLICED TYPE SILT FENCE THAT IS HAND INSTALLED IN AREAS INACCESSIBLE TO EQUIPMENT DUE TO SPACE LIMITATIONS, WET SOILS, STEEP SLOPES, ETC.

Deephaven EST.1900	SILT FENCE HEAVY DUTY	LAST REVISION: MAR. 2021 PLATE NO. ERO-02

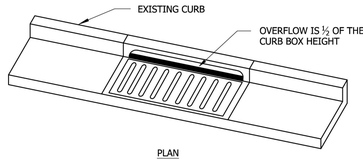
PLAN



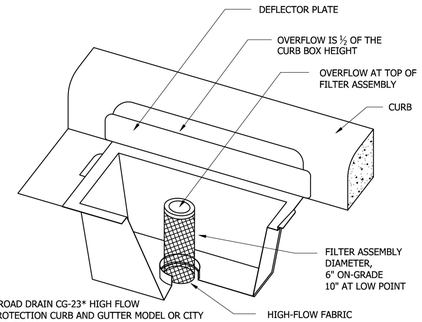


* HOLES SHALL BE DRILLED IN STEEL PLATE TO ALLOW DRAINAGE INTO THE CATCHBASIN.

Deephaven EST.1900	INLET PROTECTION ROCK FILTER FOR CATCH BASIN DURING ROAD CONSTRUCTION	LAST REVISION: MAR. 2021 PLATE NO. ERO-07



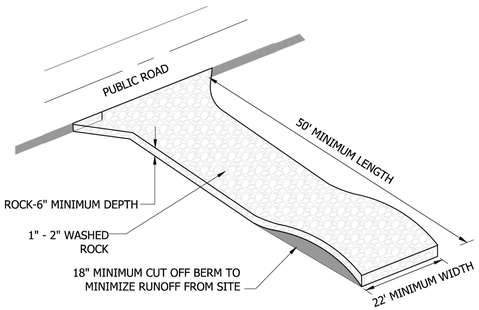
PLAN



WIMCO ROAD DRAIN CG-23* HIGH FLOW INLET PROTECTION CURB AND GUTTER MODEL OR CITY APPROVED EQUAL.

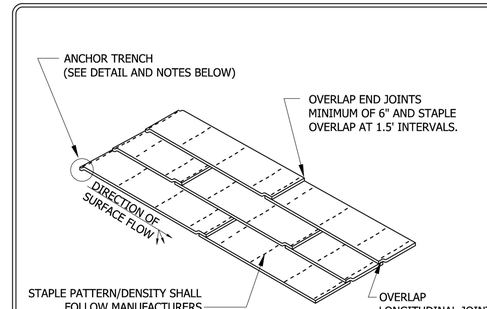
NOTE:
*FOR THE NEW R-3290-VB STANDARD CASTING, INSTALL WIMCO ROAD DRAIN CG-3290 OR CITY APPROVED EQUAL

Deephaven EST.1900	INLET PROTECTION CATCH BASIN INSERT AFTER PAVING	LAST REVISION: MAR. 2021 PLATE NO. ERO-08

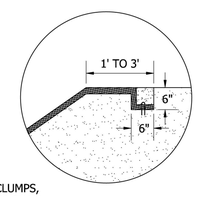


NOTES:
1. MNDOT 3733 TYPE 4 FILTER FABRIC SHALL BE PLACED UNDER ROCK TO STOP MUD MIGRATION THROUGH MATERIAL.
2. FUGITIVE ROCK WILL BE REMOVED FROM ADJACENT ROADWAYS DAILY OR MORE FREQUENTLY AS NECESSARY.
3. CONSTRUCTION ENTRANCE MUST BE CONSTRUCTED PRIOR TO THE COMMENCEMENT OF GRADING OPERATIONS ON THE SITE.
4. THE ENTRANCE MUST BE MAINTAINED IN PROPER CONDITION TO PREVENT TRACKING OF MUD OFF THE SITE. THIS MAY REQUIRE PERIODIC TOPDRESSING WITH ADDITIONAL ROCK OR REMOVAL AND REINSTALLATION OF THE PAD.
5. THIS ENTRANCE WILL BE USED BY ALL VEHICLES ENTERING OR LEAVING THE PROJECT.
6. THE CONSTRUCTION ENTRANCE WILL BE REMOVED PRIOR TO THE PLACEMENT OF BITUMINOUS SURFACING.
7. ENTRANCE WIDTHS TO BE APPROVED BY THE ENGINEER AS REQUIRED.
8. 50' MINIMUM LENGTH OR A LENGTH SUFFICIENT TO ALLOW A MINIMUM OF 5 TIRE ROTATIONS ON THE PROVIDED PAD, WHICHEVER IS LONGER. MINIMAL LENGTHS TO BE CALCULATED USING THE LARGEST TIRE WHICH WILL BE USED IN TYPICAL OPERATIONS.

Deephaven EST.1900	ROCK CONSTRUCTION ENTRANCE	LAST REVISION: MAR. 2021 PLATE NO. ERO-19A

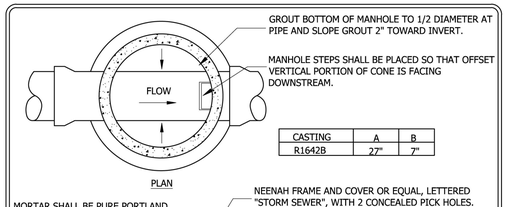


ANCHOR TRENCH
1. DIG 6" X 6" TRENCH
2. LAY BLANKET IN TRENCH
3. STAPLE AT 1.5' INTERVALS
4. BACKFILL WITH NATURAL SOIL AND COMPACT
5. BLANKET LENGTH SHALL NOT EXCEED 100' WITHOUT AN ANCHOR TRENCH



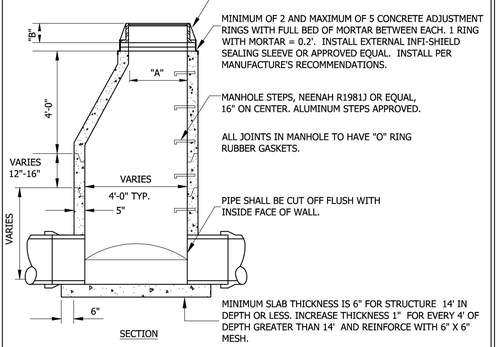
NOTE:
SLOPE SURFACE SHALL BE FREE OF ROCKS, SOIL CLUMPS, STICKS, VEHICLE IMPRINTS, AND GRASS. BLANKETS SHALL HAVE GOOD SOIL CONTACT.

Deephaven EST.1900	EROSION CONTROL BLANKET INSTALLATION	LAST REVISION: MAR. 2021 PLATE NO. ERO-22



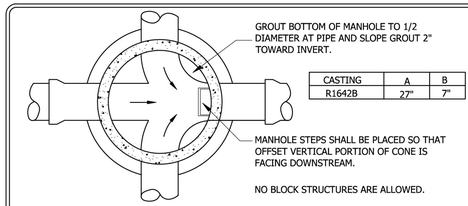
CASTING	A	B
R1642B	27"	7"

PLAN



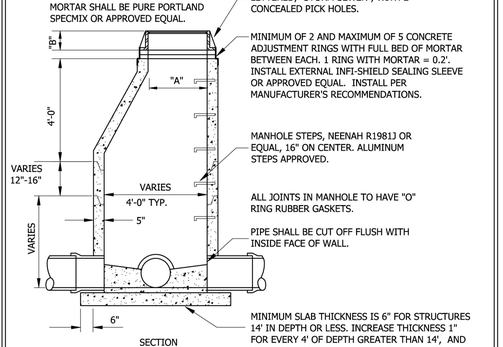
SECTION

Deephaven EST.1900	STORM SEWER MANHOLE	LAST REVISION: MAR. 2021 PLATE NO. STO-01



CASTING	A	B
R1642B	27"	7"

PLAN



SECTION

Deephaven EST.1900	STORM SEWER JUNCTION MANHOLE	LAST REVISION: MAR. 2021 PLATE NO. STO-02

Stantec
ONE CARLSON PARKWAY N. SUITE 100
PLYMOUTH, MN 55447
www.stantec.com

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 ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA

PRINT NAME: STEVEN HEGLAND

SIGNATURE: ____ LIC. NO. 59243

DATE: ____ ####

DEEPHAVEN, MINNESOTA
2026 STREET IMPROVEMENT PROJECT
STANDARD DETAILS

NO	REVISION	DATE

SURVEY
DRAWN
DESIGNED
CHECKED
APPROVED

PROJ. NO. 193807541

SHEET NUMBER
C803

Plot Date: 01/20/2026 - 3:29pm
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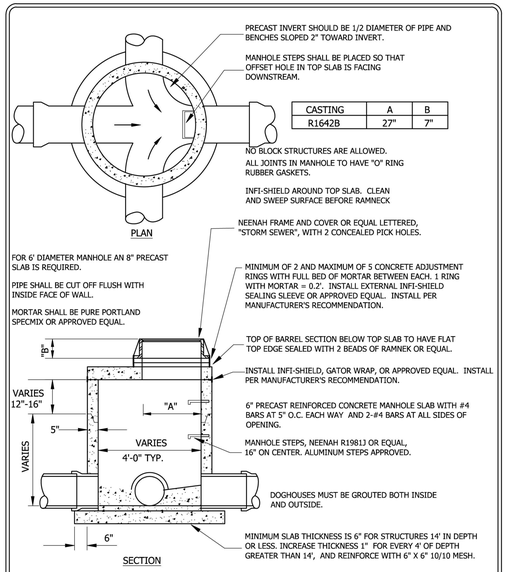
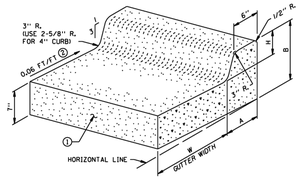


Deephaven EST. 1988

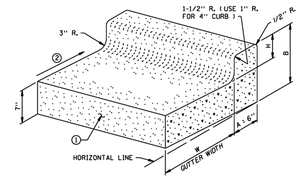
STORM SEWER JUNCTION MANHOLE WITH REINFORCED TOP SLAB

LAST REVISION: MAR. 2021

PLATE NO. STO-03



DESIGN B



DESIGN V

REVERSE SLOPE GUTTER SECTION
(FORMS MAY BE TILTED)

NOTES:
1. LONGITUDINAL JOINT WHEN ADJACENT TO RIGID PAVEMENT OR BASE. SEE STANDARD PLANS MANUAL FOR JOINT INFORMATION.
2. SLOPE 0.06 FT/FT NORMAL, UNLESS OTHERWISE SPECIFIED. IF A DIFFERENT GUTTER SLOPE IS PERMITTED, THE FORM MAY BE TILTED.

DESIGN B			W = 12"			W = 18"			W = 24"			W = 30"			W = 36"		
DIMENSIONS			CONCRETE			CONCRETE			CONCRETE			CONCRETE			CONCRETE		
H	A	B	DESIGN NO.	CU. YDS. PER LIN. FT.	LIN. FT. PER CU. YD.	DESIGN NO.	CU. YDS. PER LIN. FT.	LIN. FT. PER CU. YD.	DESIGN NO.	CU. YDS. PER LIN. FT.	LIN. FT. PER CU. YD.	DESIGN NO.	CU. YDS. PER LIN. FT.	LIN. FT. PER CU. YD.	DESIGN NO.	CU. YDS. PER LIN. FT.	LIN. FT. PER CU. YD.
4	7-3/8"	11-1/2"	B412	0.0421	23.8	B418	0.0529	18.9	B424	0.0637	15.7	B430	0.0745	13.4	B436	0.0853	11.7
6	8"	13-1/2"	B612	0.0474	21.1	B618	0.0582	17.2	B624	0.0690	14.5	B630	0.0798	12.5	B636	0.0906	11.0
8	8-5/8"	15-1/2"	B812	0.0529	18.9	B818	0.0637	15.7	B824	0.0745	13.4	B830	0.0853	11.7	B836	0.0962	10.4
9	9"	16-5/8"	B912	0.0559	17.9	B918	0.0667	15.0	B924	0.0775	12.9	B930	0.0883	11.3	B936	0.0991	10.1
10	9-3/8"	17-5/8"	B1012	0.0589	17.0	B1018	0.0697	14.4	B1024	0.0805	12.4	B1030	0.0913	11.0	B1036	0.1021	9.8

DESIGN V			W = 12"			W = 18"			W = 24"			W = 30"			W = 36"		
DIMENSIONS			CONCRETE			CONCRETE			CONCRETE			CONCRETE			CONCRETE		
H	A	B	DESIGN NO.	CU. YDS. PER LIN. FT.	LIN. FT. PER CU. YD.	DESIGN NO.	CU. YDS. PER LIN. FT.	LIN. FT. PER CU. YD.	DESIGN NO.	CU. YDS. PER LIN. FT.	LIN. FT. PER CU. YD.	DESIGN NO.	CU. YDS. PER LIN. FT.	LIN. FT. PER CU. YD.	DESIGN NO.	CU. YDS. PER LIN. FT.	LIN. FT. PER CU. YD.
4	6"	11-3/8"	V412	0.0396	25.3	V418	0.0504	19.9	V424	0.0612	16.4	V430	0.0720	13.9	V436	0.0828	12.1
6	6"	13-3/8"	V612	0.0426	23.5	V618	0.0534	18.7	V624	0.0642	15.6	V630	0.0750	13.4	V636	0.0858	11.7
8	6"	15-3/8"	V812	0.0457	21.9	V818	0.0565	17.7	V824	0.0673	14.9	V830	0.0781	12.8	V836	0.0889	11.3
9	6"	16-3/8"	V912	0.0472	21.2	V918	0.0580	17.2	V924	0.0688	14.5	V930	0.0796	12.6	V936	0.0904	11.1
10	6"	17-3/8"	V1012	0.0487	20.5	V1018	0.0595	16.8	V1024	0.0703	14.2	V1030	0.0811	12.4	V1036	0.0919	10.9

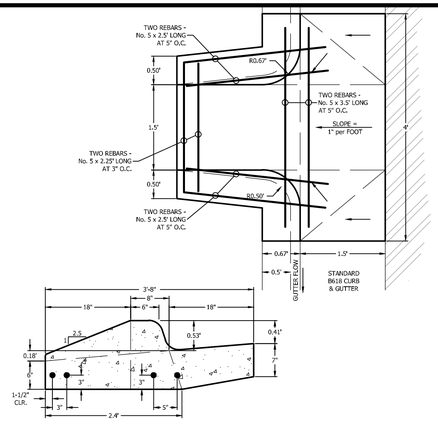
APPROVED MARCH 11, 1994
R.H. Campbell
ACTING STATE DESIGN ENGINEER

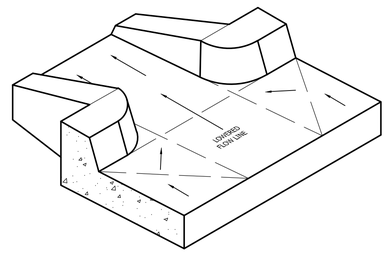
STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

CONCRETE CURB AND GUTTER
DESIGN B AND DESIGN V

SPECIFICATION REFERENCE 2531
REVISION DATE 2-28-05

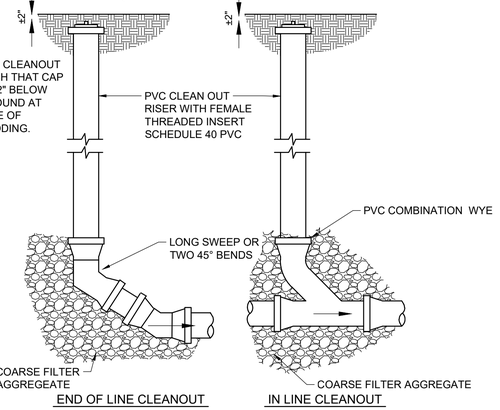
STANDARD PLATE NO. 7100H





CONCRETE INLET, TYPE SP
NOT TO SCALE

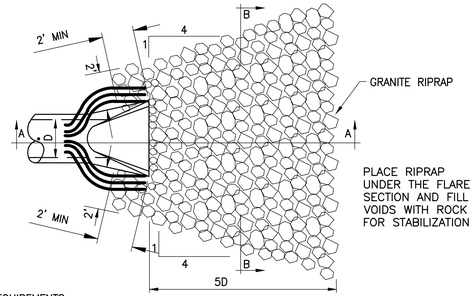
C:\CADD\CTD\MS



NOTE:
1. IF CLEANOUT IS IN DRIVEWAY, CONTRACTOR MUST INSTALL FORD A-1 CASTING, MARKED WITH "SEWER ON LID.
2. IF CLEANOUT IS IN ROADWAY, CONTRACTOR MUST INSTALL TOP SECTION OF A VALVE BOX WITH LID MARKED "SEWER".

REAR-YARD DRAIN TILE NOTES:
1. CLEANOUTS ARE REQUIRED AT MAXIMUM 300' INTERVALS, AT BENDS, AND AT THE END OF THE RUN. IF CLEANOUT IS LOCATED WITHIN 50' OF CATCHBASIN, TIE DRAINTILE INTO CATCHBASIN
2. CLEANOUTS TO BE INSTALLED AT PROPERTY CORNERS.
3. ADDITIONAL CLEANOUTS TO BE INSTALLED AS DIRECTED BY ENGINEER.

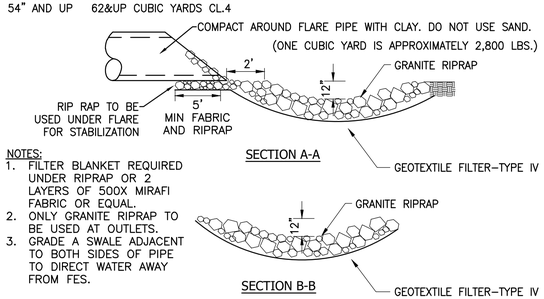
1 C-804 PVC DRAINTILE CLEANOUTS
NOT TO SCALE



RIPRAP REQUIREMENTS

12" TO 18"	8–10 CUBIC YARDS	CL.3
21" TO 27"	12–14 CUBIC YARDS	CL.3
30" TO 36"	16–24 CUBIC YARDS	CL.3
42" TO 48"	30–38 CUBIC YARDS	CL.3
54" AND UP	62&UP CUBIC YARDS	CL.4

PLAN

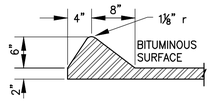


SECTION A-A

SECTION B-B

NOTES:
1. FILTER BLANKET REQUIRED UNDER RIPRAP OR 2 LAYERS OF 500X MIRAFI FABRIC OR EQUAL.
2. ONLY GRANITE RIPRAP TO BE USED AT OUTLETS.
3. GRADE A SWALE ADJACENT TO BOTH SIDES OF PIPE TO DIRECT WATER AWAY FROM FES.

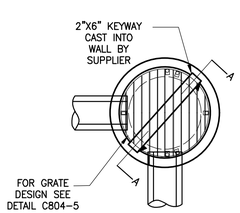
2 C-804 RIPRAP AT OUTLETS
NOT TO SCALE



BITUMINOUS CURB
6" SHOE FORMED

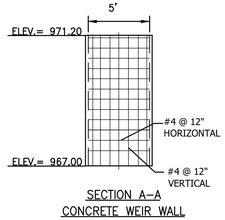
3 C-804 BITUMINOUS CURB
NOT TO SCALE

NOTE: GRATE SHALL BE HAALA POND SKIMMER PLATE STYLE OR APPROVED EQUAL

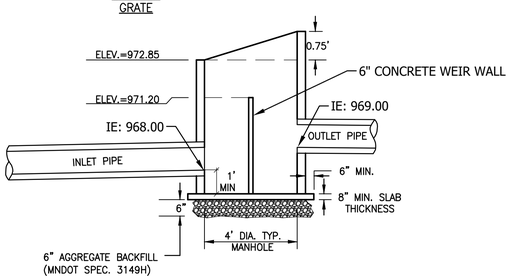


SKIMMER GRATE

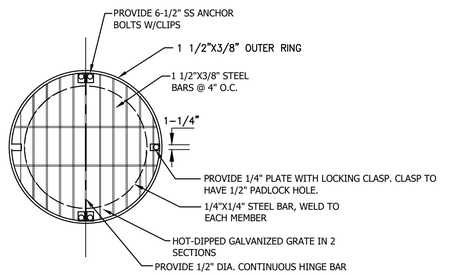
NOTE:
1. WEIR WALL TO BE SINGLE PIECE AND WATERTIGHT.



SECTION A–A
CONCRETE WEIR WALL



4 C-804 OCS WITH CAST IN PLACE WEIR WALL
NOT TO SCALE



GRATE DETAIL

5 C-804 OCS GRATE DETAIL
NOT TO SCALE

Stantec
ONE CARLSON PARKWAY N. SUITE 100
PLYMOUTH, MN 55447
www.stantec.com

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 ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA
PRINT NAME: STEVEN HEGLAND
SIGNATURE:
DATE:
LIC. NO. 59243

DEEPHAVEN, MINNESOTA
2026 STREET IMPROVEMENT PROJECT
STANDARD DETAILS

NO	REVISION	DATE

SURVEY
DRAWN
DESIGNED
CHECKED
APPROVED
PROJ. NO. 193807541

SHEET NUMBER C804

Plot Date: 01/20/2026 - 3:29pm
Drawing name: \\corp.stantec.com\shared_projects\193807541\drafting\03 - DESIGN\1_CAD\3 PLANSHEETS\193807541_C801-Details.dwg
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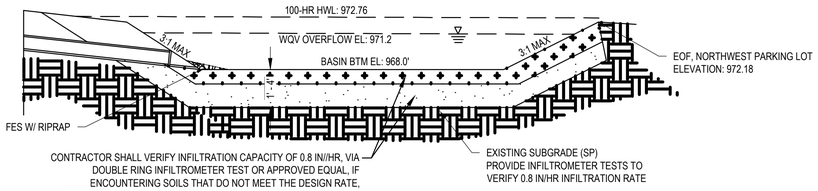
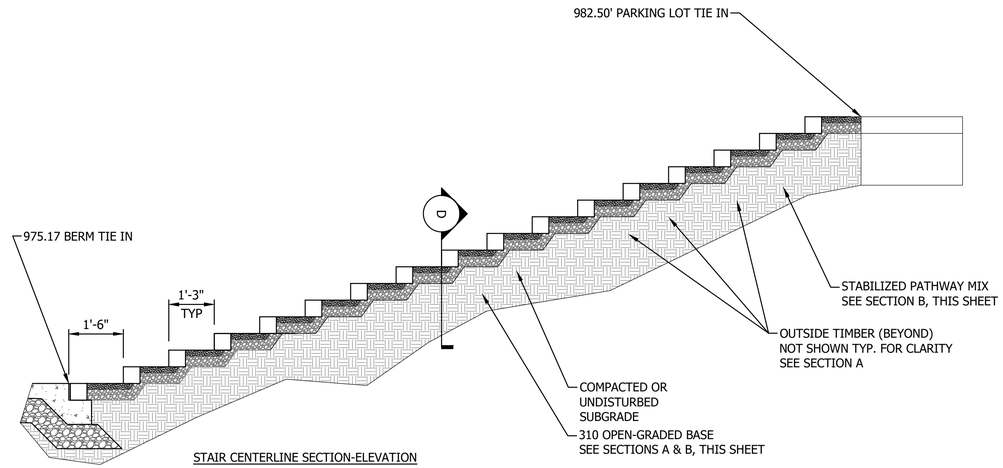


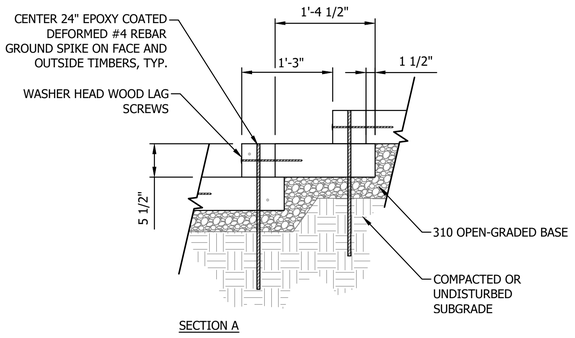
INFILTRATION BASIN NOTES:

1. CONTRACTOR SHALL STAGE CONSTRUCTION APPROPRIATELY AND INSTALL ALL NECESSARY EROSION CONTROL TO PREVENT SEDIMENT WASHING INTO THE INFILTRATION BASIN.
2. FINAL GRADING OF THE BASIN SHALL BE ACCOMPLISHED USING LOW-IMPACT EARTH MOVING EQUIPMENT TO PREVENT COMPACTION. SMALL TRACKED DOZERS AND SKID STEERS ARE RECOMMENDED.
3. MINIMIZE IMPACT TO THE SOILS BELOW THE BOTTOM OF THE PROPOSED CUT ELEVATION.
4. IN THE EVENT THAT SEDIMENT IS INTRODUCED INTO THE INFILTRATION BASIN, THIS MATERIAL WILL NEED TO BE REMOVED PRIOR TO PROCEEDING WITH CONSTRUCTION.
5. INFILTRATION BASIN SHALL BE FREE AND CLEAR OF SEDIMENT UPON FINAL COMPLETION OF CONSTRUCTION.
6. MATERIAL REMOVED FOR THE EXCAVATION OF THE BASIN SHALL BECOME THE PROPERTY OF THE CONTRACTOR TO REMOVE AND DISPOSE OF IN ACCORDANCE WITH LOCAL REGULATIONS OR REDISTRIBUTED ON-SITE IF SUITABLE AND APPROVED BY GEOTECHNICAL ENGINEER.
7. ALL SLOPES WITHIN PERMANENT STORMWATER SYSTEM (INCLUDING SWALES, BASINS, AND PONDS) SHALL BE STABILIZED WITH A EROSION CONTROL BLANKET.
8. THE PROJECT AREA MUST BE STAKED OFF AND MARKED TO KEEP ALL CONSTRUCTION TRAFFIC, EQUIPMENT AND MATERIAL STOCKPILES OUT OF THE PROPOSED INFILTRATION AREAS.
9. INFILTRATION PRACTICES SHALL NOT BE EXCAVATED UNTIL THE CONTRIBUTING DRAINAGE AREAS WITH EXPOSED SOIL HAVE BEEN FULLY STABILIZED AND BITUMINOUS BASE COURSE INSTALLED ON CONTRIBUTING PAVEMENT AREAS. DIVERT UPLAND DRAINAGE AREAS TO PREVENT RUNOFF FROM ENTERING THE EXCAVATED CELL OR INTO THE WORK AREA. DO NOT USE INFILTRATION CELLS AS TEMPORARY SEDIMENT BASINS OR ALLOW CONSTRUCTION RUNOFF INTO THE CELL, WHEN ALTERNATE DRAINAGE ROUTES ARE FEASIBLE.
10. CARE MUST BE TAKEN TO AVOID CONTAMINATION OF INFILTRATION BASIN SOILS WITH SEDIMENT, IN-SITU OR TOPSOIL DURING AND AFTER INSTALLATION. MATERIALS MUST BE SEGREGATED.
11. INSTALLATION WITH DRY SOIL CONDITIONS IS CRITICAL TO PREVENT SMEARING AND COMPACTION.
12. USE BACKHOE WITH TOOTH BUCKET FOR CELL EXCAVATION TO AVOID COMPACTING OR SMEARING OF SOILS. DO NOT USE SKID STEER FROM EXCAVATION WITHIN THE CELL. USE TOOTH BUCKET TO SCARIFY (RIP) UNDERLYING SOILS 6" TO 12" DEEP TO REMOVE COMPACTION. GENTLY MIX THE FIRST LIFT OF INFILTRATION SOILS WITH THE LOOSENED UNDERLYING SOILS TO AVOID STRATIFICATION AND PROMOTE PERMEABILITY. USE EXCAVATOR BUCKET TO PLACE MATERIALS. CONSTRUCTION EQUIPMENT SHALL NOT BE ALLOWED INTO BOTTOM OF BASIN, BUT SHALL OPERATE ON SIDE SLOPES ONLY. LEVELING AND FINAL GRADING WITHIN THE BOTTOM OF THE CELL MUST BE COMPLETED BY HAND.
13. INFILTRATION SOILS SHALL BE 100% FREE DRAINING ONSITE SANDY SOIL WITH HIGH PERMEABILITY RATES (FIELD VERIFY). IF MINIMUM INFILTRATION RATES OF 0.45 IN/HR CANNOT BE ACHIEVED, NOTIFY ENGINEER IMMEDIATELY. THE INFILTRATION SOILS SHALL NOT CONTAIN ANY TOPSOIL OR FILTER AGGREGATE WITH FINES.
14. KEEP INFILTRATION SYSTEMS OFF-LINE BY RESTRICTING STORM WATER INFLOW UNTIL VEGETATION IS WELL ESTABLISHED IN THE CELL AND ALL UP GRADIENT AREAS HAVE BEEN STABILIZED AND IMPERVIOUS SURFACES CLEARED OF CONSTRUCTION SEDIMENT.
15. PROVIDE TOPSOIL AND SEED IN ACCORDANCE WITH THE EROSION CONTROL PLAN AND LANSCAPE PLAN.

1 C802 TYPICAL INFILTRATION BASIN CROSS SECTION
NOT TO SCALE



STAIR CENTERLINE SECTION-ELEVATION



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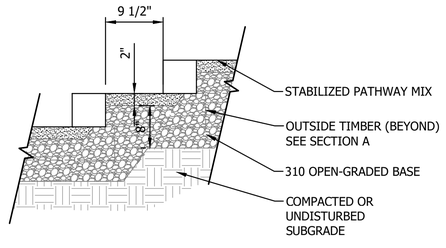

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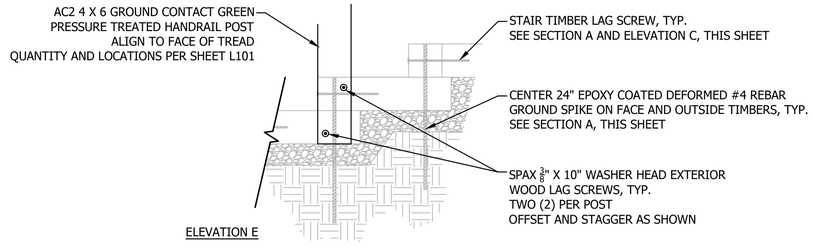

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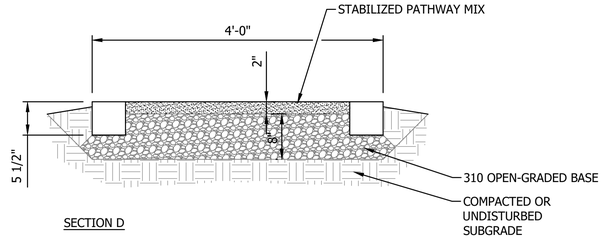

SECTION D

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ONE CARLSON PARKWAY N. SUITE 100
PLYMOUTH, MN 55447
www.stantec.com

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PRINT NAME: STEVEN HEGLAND

SIGNATURE:
DATE:
LIC. NO. 59243

DEEPHAVEN, MINNESOTA
2026 STREET IMPROVEMENT PROJECT
STANDARD DETAILS

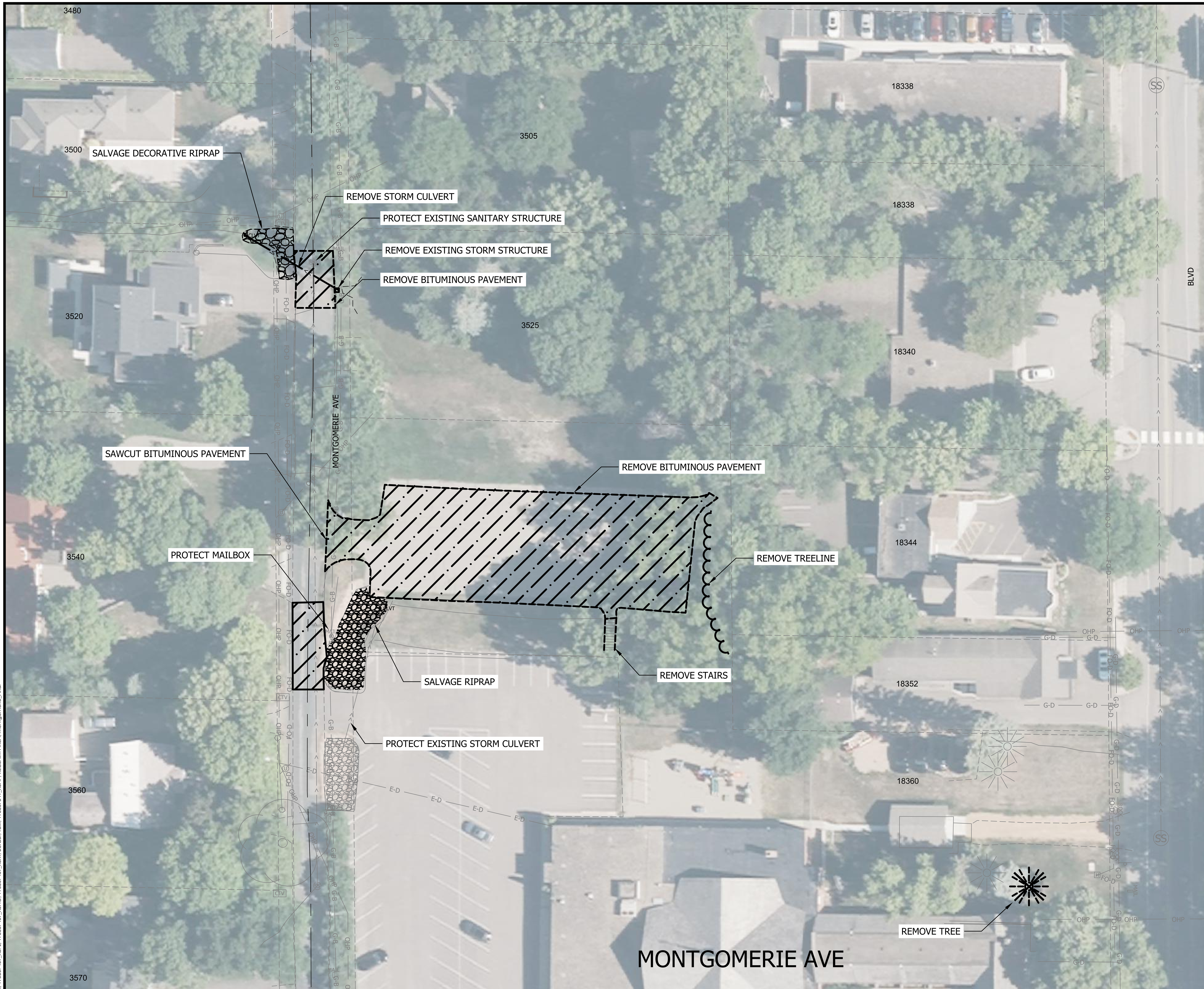
NO	REVISION	DATE

SURVEY	
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
PROJ. NO.	193807541

SHEET NUMBER
C811

Plot Date: 01/20/2026 - 3:33pm
Drawing name: \\us0242-fpfss01\shared_projects\193807541\drafting\03 - DESIGN_CAD\3-PLANSHEETS\193807541_C811.dwg
Xref's Bound

THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING - ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY.



REMOVALS LEGEND

- REMOVE TREE
- REMOVE TREELINE
- ▨ REMOVE BITUMINOUS PAVEMENT
- SALVAGE RIPRAP

N

0 25' 50'

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PLYMOUTH, MN 55447
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PRINT NAME: STEVEN HEGLAND

SIGNATURE:

DATE: #### LIC. NO. 52243

DEEPHAVEN, MINNESOTA

2026 STREET IMPROVEMENT PROJECT

ALTERNATE 3 - CALVARY CHURCH

EXISTING CONDITIONS AND REMOVALS

NO	REVISION	DATE

SURVEY	
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
PROJ. NO.	193807541

SHEET NUMBER
C901

Plot Date: 01/20/2026 - 3:15pm
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EROSION CONTROL LEGEND

- MS — MACHINE SLICED SILT FENCE
- RIP RAP
- INLET PROTECTION
- BLANKET
- SOD
- CONSTRUCTION ENTRANCE / EXIT

N

0 25' 50'

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PRINT NAME: STEVEN HEGLAND

SIGNATURE: ______

DATE: ####   LIC. NO. 52243

DEEPHAVEN, MINNESOTA

2026 STREET IMPROVEMENT PROJECT

ALTERNATE 3 - CALVARY CHURCH
EROSION CONTROL SHEETS

NO	REVISION	DATE

SURVEY	
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
PROJ. NO.	193807541

SHEET NUMBER
C902

Plot Date: 01/20/2026 - 3:10pm
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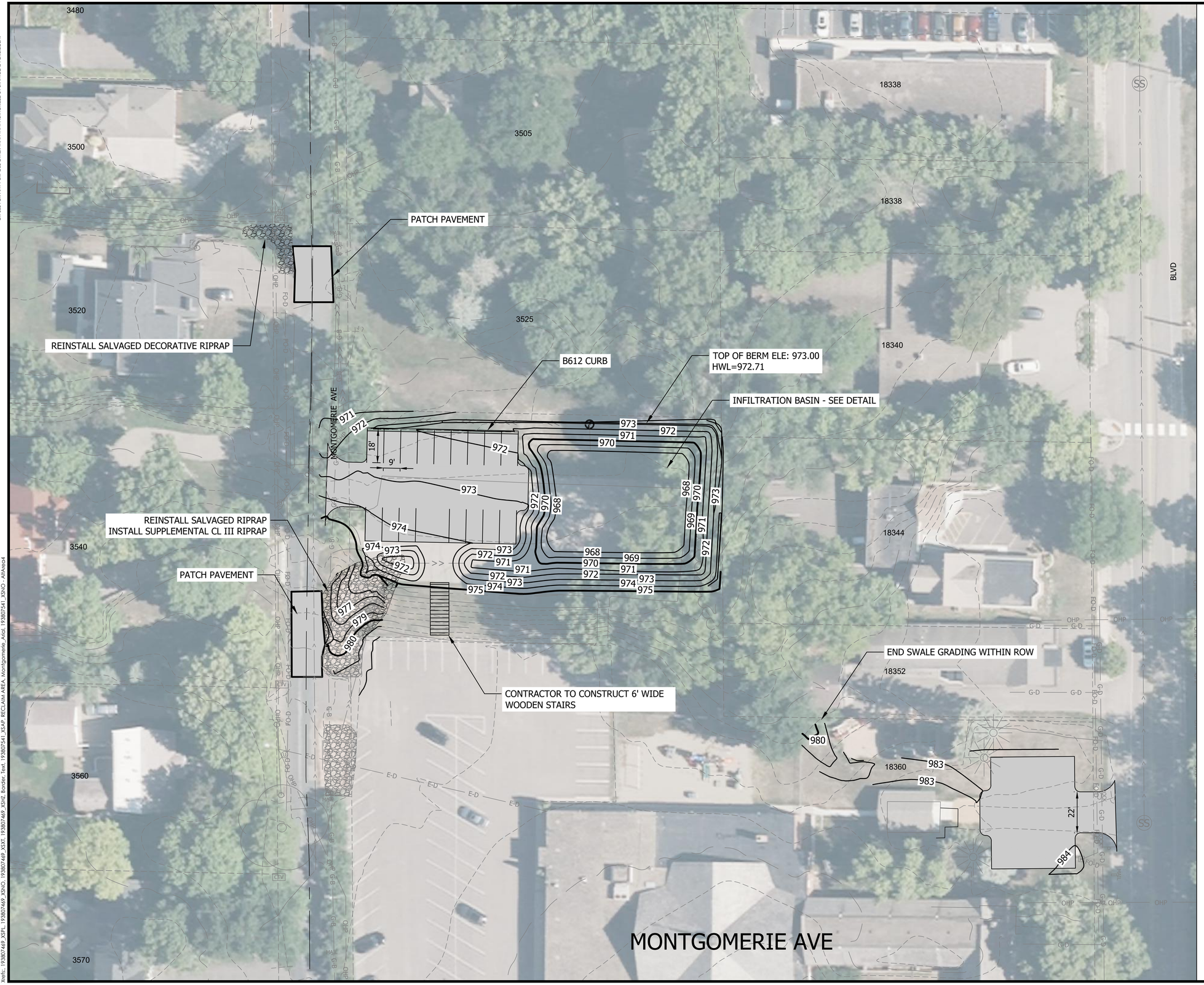

GRADING SHEETS LEGEND

BITUMINOUS PAVING

B612 CURB

N

0 25' 50'

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PRINT NAME: STEVEN HEGLAND

SIGNATURE: ____ LIC. NO. 55243

DATE: ____ ####

DEEPHAVEN, MINNESOTA

2026 STREET IMPROVEMENT PROJECT

ALTERNATE 3 - CALVARY CHURCH

SITE AND GRADING PLAN

NO	REVISION	DATE

SURVEY	
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
PROJ. NO.	193807541

SHEET NUMBER
C903

Plot Date: 01/20/2026 - 3:09pm
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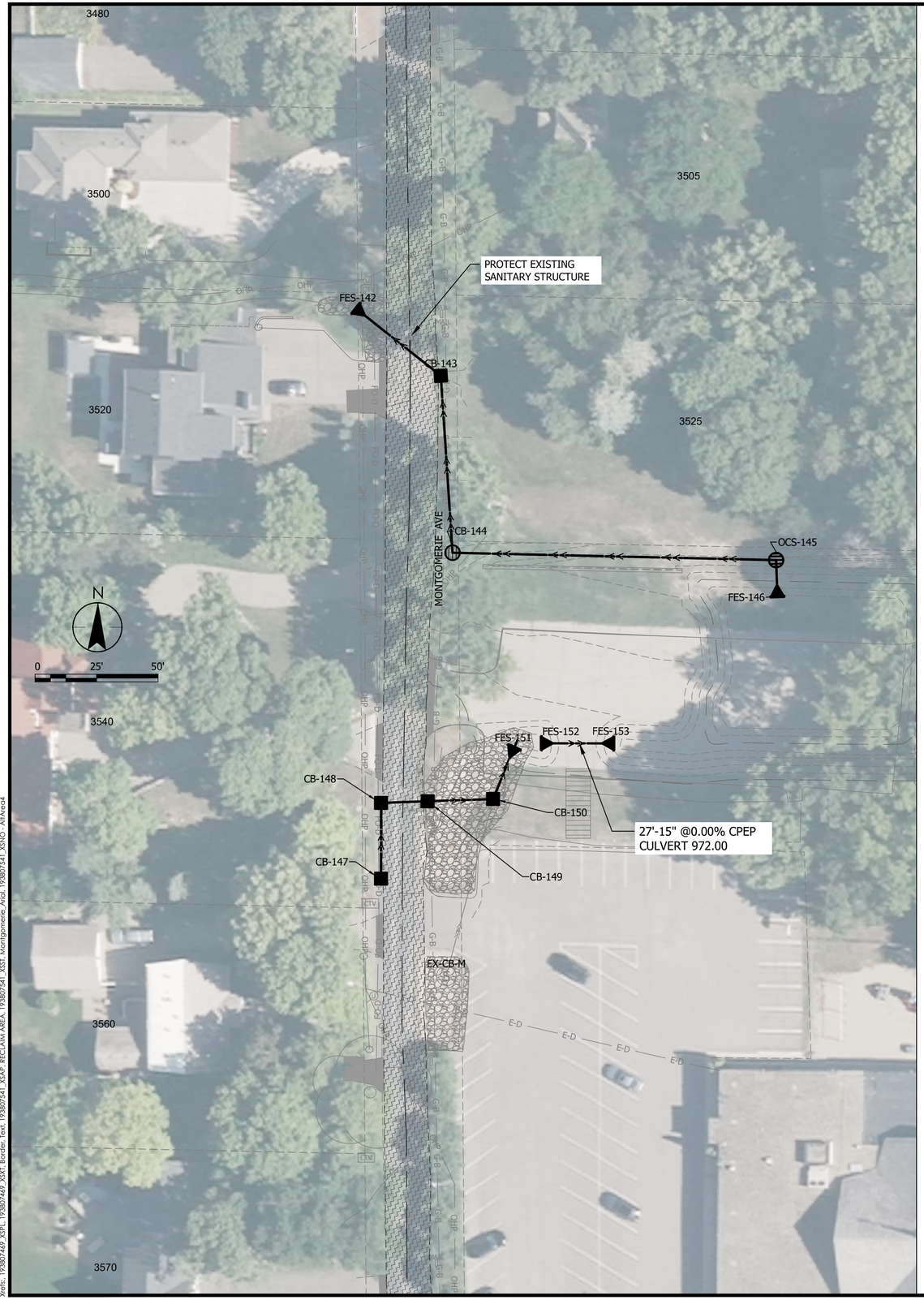

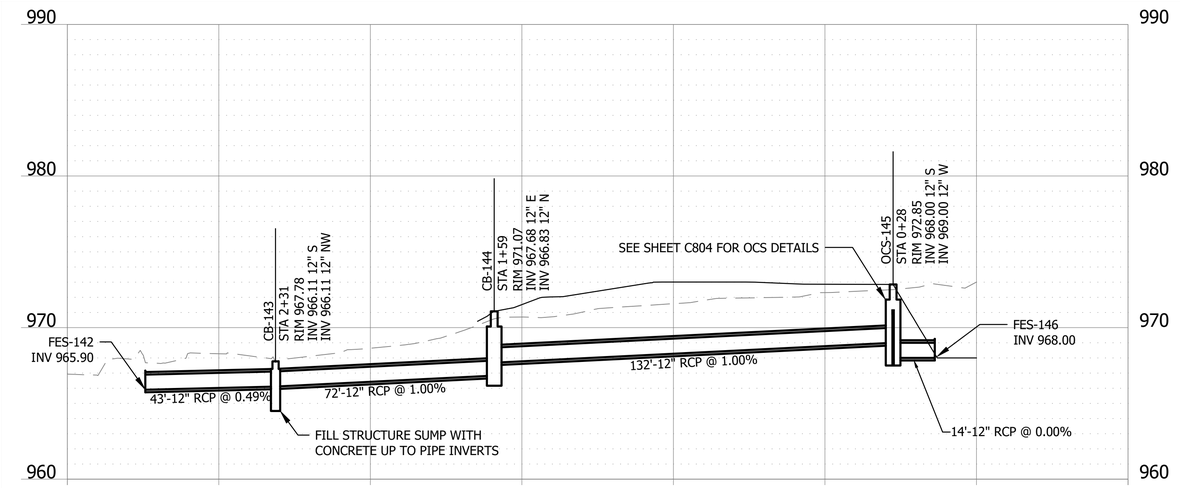

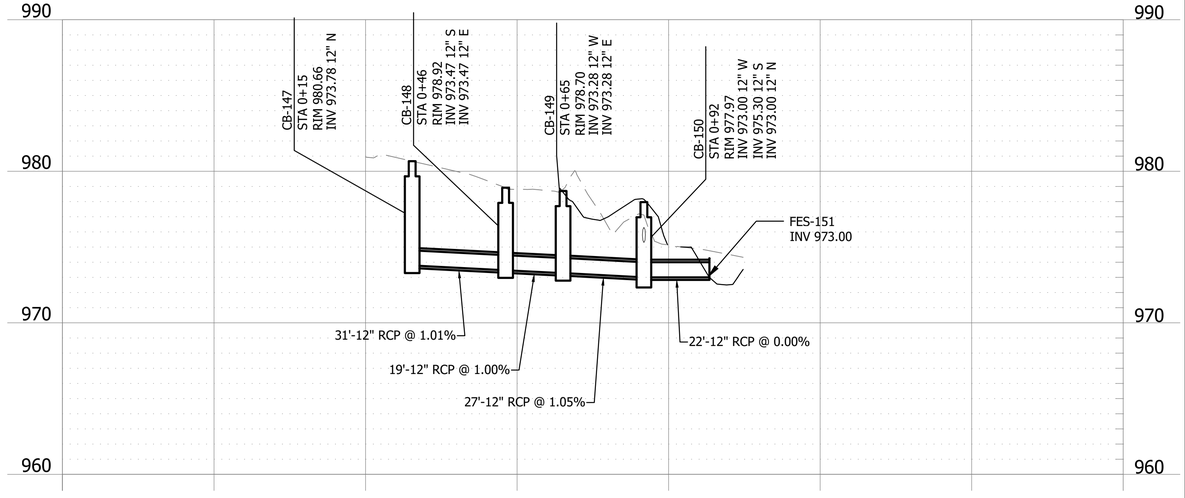

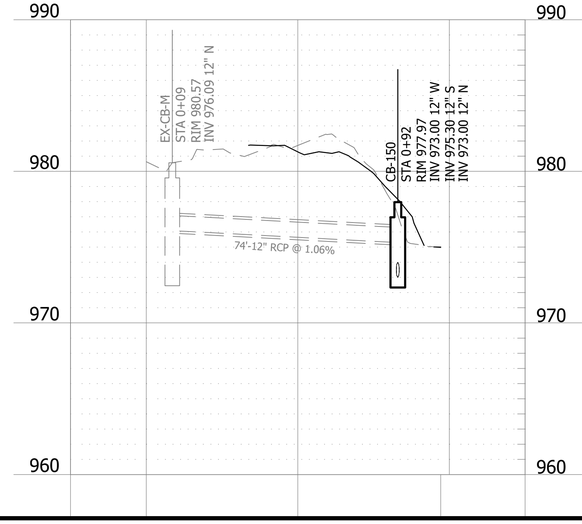

MONTGOMERIE AVE

Stantec
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PRINT NAME: STEVEN HEGLAND

SIGNATURE: _____ LIC. NO. 59243

DATE: _____ ####

DEEPHAVEN, MINNESOTA

2026 STREET IMPROVEMENT PROJECT

ALTERNATE 3 - CALVARY CHURCH

MONTGOMERIE STORMWATER UTILITIES

NO	REVISION	DATE

SURVEY	
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
PROJ. NO.	193807541

SHEET NUMBER
C904

Plot Date: 01/20/2026 - 3:28pm
Drawing: C:\Users\steven.hegland\ONEDRIVE - STANTEC\Documents\Projects\193807541\drafting\03 - DESIGN\1 - CAD\3 PLANSHEETS\193807541_C904-Montgomerie Utilities.dwg
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