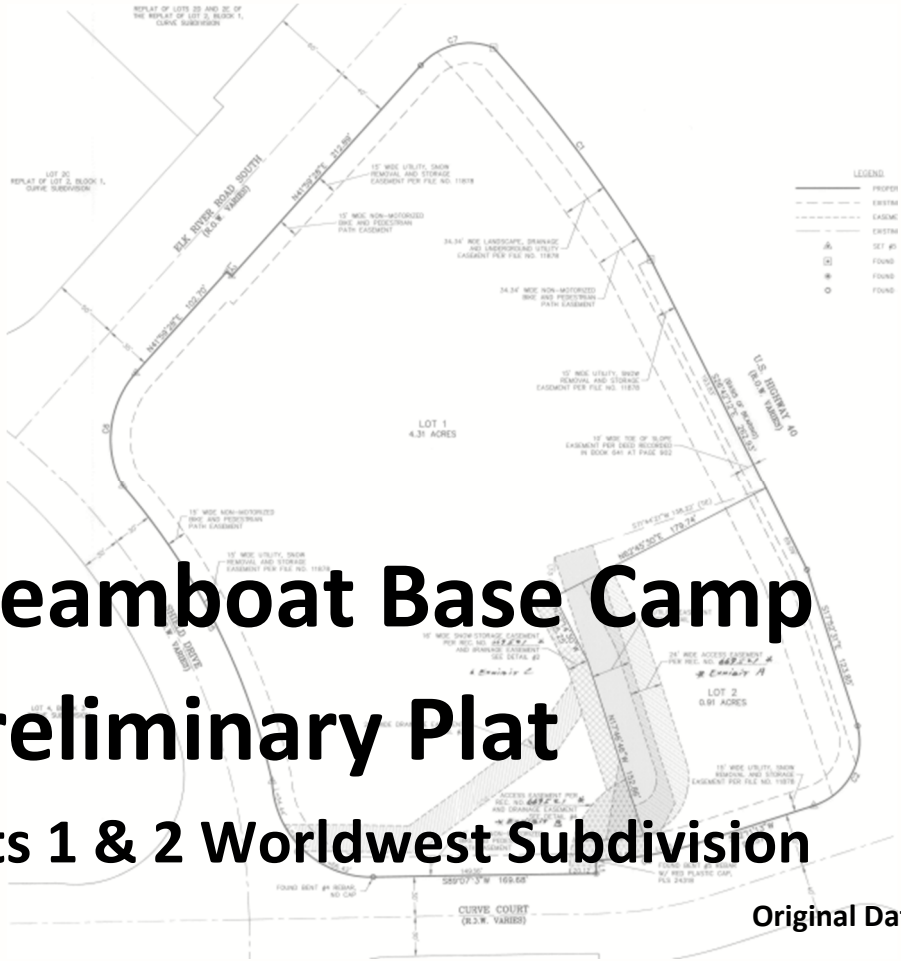
DRAFT

Final Drainage Study and Stormwater Quality Plan



Steamboat Base Camp Preliminary Plat

Lots 1 & 2 Worldwest Subdivision

Original Date: August 10, 2021

Prepared by: Deborah Spaustat, P.E.

Over

NOTE

City of Steamboat Springs plan review and approval is only for general conformance with City design criteria and the City code. The City is not responsible for the accuracy and adequacy of the design, dimensions, and elevations that shall be confirmed and correlated at the job site. The City of Steamboat Springs assumes no responsibility for the completeness or accuracy of this document.

LANDMARK CONSULTANTS, INC.

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Table of Contents

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CERTIFICATION

I hereby affirm that this Final Drainage Study and Stormwater Quality Plan for the Preliminary Plat for Steamboat Basecamp was prepared by me (or under my direct supervision) for the owners thereof and is, to the best of my knowledge, in accordance with the provisions of the City of Steamboat Springs Storm Drainage Criteria and approved variances. I understand that the City of Steamboat Springs does not and will not assume liability for drainage facilities designed by others.

Deborah Spaustat, P.E.
State of Colorado No. 0041286

INTRODUCTION AND LOCATION

The purpose of this report is to estimate peak stormwater runoff, evaluate existing infrastructure and design required infrastructure to manage the existing stormwater experienced onsite and the incremental stormwater generated by the proposed Steamboat Basecamp (the Project). This report includes all the base data, methods, assumptions, and calculations used by Landmark Consultants, Inc. (Landmark) to design the stormwater management system for the project. It was prepared in concurrence with the Development Plan application.

The subject property, Lot 1 and Lot 2 of the Worldwest Subdivision, are a 5.22-acres of land located on the west side of Steamboat Springs. The properties is bordered by US Highway 40 (Lincoln Ave) to the west, Curve Court to the south, Shield Drive to the west and Elk River Road South to the north. Lot 1 currently contains a 22,120-square foot commercial building that used to house the Steamboat Pilot and Today newspaper offices production facilities. It also has a large, paved parking area. The northeast portion of the site is undeveloped. The Lot 2 is also undeveloped.

The project proposes to replat the two lots to form a total of 6 lots, named Lots 1 through 6. An access drive will be constructed bisecting the properties from north to south. Infrastructure including water, sewer and storm sewer will be installed in the road to provide for future improvements on Lots 1-6. An extended detention basin is proposed south of the existing building in Lot 1 to provide detention and water quality and is designed to accommodate full future development for all six lots.

The property is zoned Commercial Services, EC, AO. There is no proposed change in zoning or use.

Landmark prepared this report in accordance with City of Steamboat Springs Drainage Criteria for the purpose of designing the storm water infrastructure required by the project at the time of this report. This report may not be used by other parties without the express written consent of Landmark.

The facts and opinions expressed in this report are based on Landmark's understanding of the project and data gathered from:

- Site visits
- FEMA FIRM Map Number 08107C0883D and FIS Study
- NRCS soil maps
- Field survey by Landmark Consultants, Inc.
- Citywide Stormwater Masterplan by SEH
- Final Drainage Report for US 40 & Elk River Road Intersection Improvements
- References listed at the end of this report

The location of the project is shown on Figure 1: Vicinity Map.

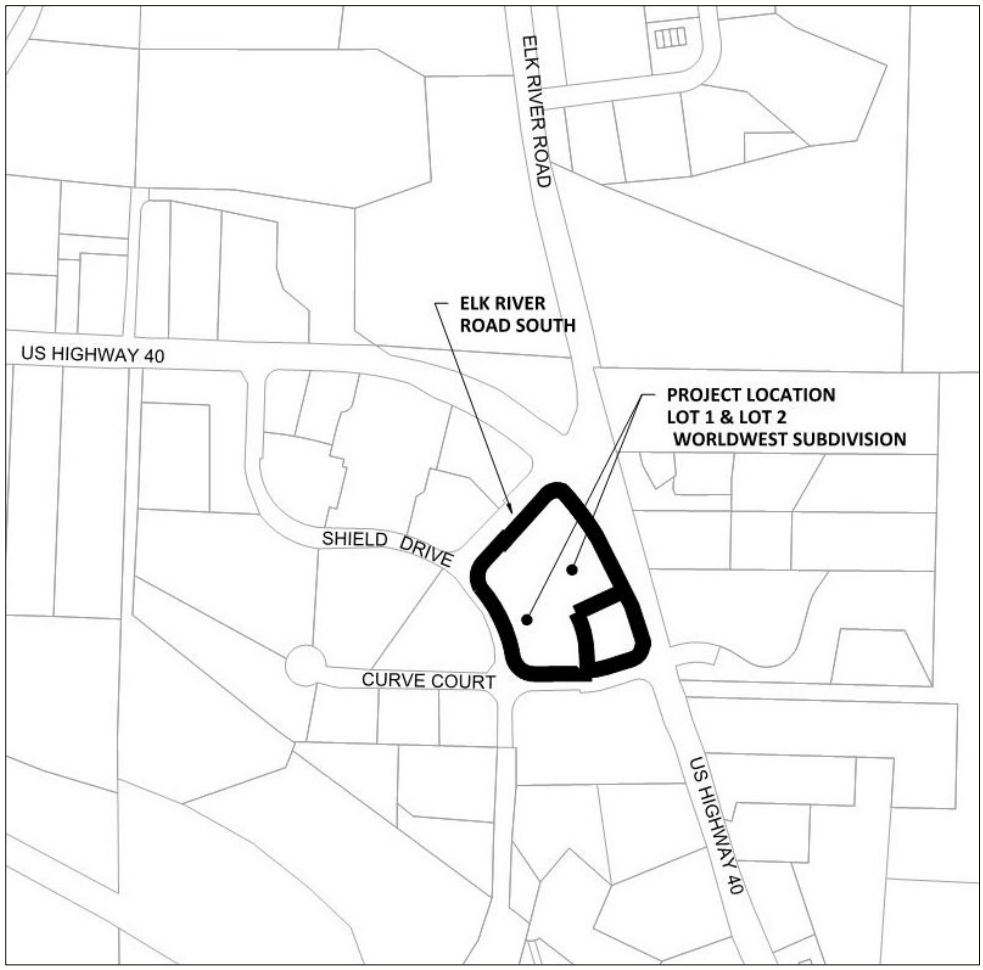

Figure 1- Vicinity Map

DRAINAGE CRITERIA AND METHODOLOGY

Landmark prepared this report in accordance with City of Steamboat Springs, Colorado Drainage Criteria, effective July 2019. The methods used by Landmark are described below and the actual calculations are presented in the Appendices. The scope of this report is limited to flow determinations related to the described hydrological storm event. This report does not attempt to model subsurface flows nor is it intended to be used in the design of structure features including foundation drains and roof drains.

Design Rainfall and Runoff Frequency

Landmark used the Rational Method to determine peak runoff of small basins to design the on-site storm water runoff infrastructure associated with this project. The 5-year, 24 hour storm was used to analyze the minor storm event and the 100-year, 24 hour storm was used to analyze the major storm event. The methods developed by the Mile High Flood District were used in calculating the water quality capture volume for the proposed BMP.

Storm Sewer Design

Autodesk Storm and Sanitary Sewer Analysis was used to design and analyze the proposed storm sewer systems. The storm sewers were designed so that the HGL of the minor storm does not exceed ground elevation.

Detention

Required detention volumes were determined using the FAA Method and storage is provided in a combined stormwater quality/detention extended detention basin (EDB).

Stormwater Quality

The project will meet the WQCV standard using the methods outlined in USDCM Vol. 3. An extended detention basin was designed to provide water quality for the Preliminary Plat as well as future potential development.

EXISTING SITE CONDITIONS

In this report the term "historic condition" refers to the conditions of the site at the time of this report and may also be referred to as "pre-development condition" or "existing condition". Lot 1 (4.31-acres) is currently about 60% developed containing a 22.120-square foot commercial building, parking areas and landscaping. Lot 2 (0.91-acres) is undeveloped. There is a six-foot concrete sidewalk located in a public access easement that circumnavigates both lots.

Runoff from the developed western portion of Lot 1 generally drains to the perimeter of the lot where it flows via roadside swale to an existing 21-inch x 27-inch CMP arch culvert at the corner of Shield Drive and Curve Court. A swale on the east side of the building collects runoff from the undeveloped portion of the Lot 1 and Lot 2 and directs it to the culvert as well. This culvert discharges to the ditch that runs east/west along Curve Court and makes its way to a large wetlands area west of the Combined Law Enforcement Facility and eventually the Yampa River. This culvert is shown in the Citywide Stormwater Masterplan by SEH (2013) and is not flagged as needing maintenance or replacement. In addition, none of the downstream culverts require immediate maintenance or replacement.

Two existing basins P-114R and P-123R were included in the Final Drainage Report for US 40 & Elk River Road Intersection Improvements and are shown on the existing conditions map. These basins receive minimal water from the property.

Analysis of the existing culvert using HY-8 indicates that this culvert has a capacity of approximately 15.3-cfs before overtopping the road. Overflow runoff will overtop Shield drive and make its way to the roadside ditch along Curve Court.

The soils onsite are an Elkhead clay loam with a hydrologic soil group of D. The property is very flat with slopes of between 0 and 4%. No flows from offsite basins enter the site.

Drainage Basins

The contributing drainage basin was analyzed four onsite basins H1, H2, H3 and H4 as well as two offsite basins, P-114R and P-203R, which were replicated from the Final Drainage Report for US 40 & Elk River Road Intersection Improvements (see Figure 2: Existing Drainage Conditions). Table 1 shows the existing drainage basin hydrological summary:

Table 1: Existing Basin (H) Hydrological Summary						
Basin	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
1	2.15	0.64	0.79	4.04	10.83	73%
2	2.88	0.15	0.54	1.11	8.80	14%
3	0.88	0.56	0.75	1.30	3.78	64%
4	0.48	0.26	0.59	0.28	1.43	27%
P-203R	0.50	0.86	0.89	1.64	3.74	100%
P-114R	0.89	0.86	0.89	2.93	6.69	100%

Design point "0" quantifies the total flow to the existing arch culvert exiting the site. Design Point "off" is the flow from basins P-203R and P-114R that crosses Elk River Road offsite. Table 2 summarizes the hydrological characteristics at each existing conditions design point:

Table 2: Existing Design Point (H) Hydrological Summary						
Design Point	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
0	6.39	0.38	0.66	6.26	23.65	42%
off	1.39	0.86	0.89	4.57	10.43	100%

Easements

The existing swale is located in a 16-foot and a 20-foot drainage easement as shown in Figure 2. There is a 34.3-foot-wide landscape, drainage and underground utility easement running along the ease side of Lot 1 and Lot 2. Multiple other easements existing onsite as shown in drawing number C.003 in the Preliminary Plat application set.

FEMA Floodplain

FEMA FIRM Number 08107C0876D dated February 4, 2005, was reviewed and no portions of the property are within a Floodway or SFHA.

PROPOSED SITE CONDITIONS

The project proposes to replat the two lots to form a total of 6 lots, named Lots 1 through 6. An access drive will be constructed bisecting the properties from north to south. Infrastructure including water, sewer and storm sewer will be installed in the road to provide for future improvements on Lots 1-6. An extended detention basin is proposed south of the existing building in Lot 1 to provide detention and water quality and is designed to accommodate full future development for all six lots.

Along with onsite improvements, the project will relocate the public transit stop on Elk River Road to accommodate the new access driveway entrance.

The new access driveway will have a zero lateral slope for most of its length, but will be crowned in the middle with runoff flowing west to a 12" Duraslot Drain or east to a swale. Both the Duraslot

Drain and the swale will convey runoff south to the new EDB for water quality treatment and attenuation. The Duraslot Drain will connect to a 24" storm sewer. 12" and 18" storm laterals will be provided for future connections.

Drainage Basins

The proposed site was broken into seven drainage basins as shown in Figure 3: Proposed Drainage Conditions. Basin PP1 is largely unchanged from existing except for the new access driveway intersection and the addition of the Transit Stop. Basins PP2.1 – PP2.4 comprise the bulk of the proposed improvements including the access driveway and the EDB. Basins PP3 and PP4 are also largely unchanged.

Table 3 summarizes and compares the hydrological characteristics of the developed basins:

Table 3: Proposed Drainage Basin Hydrological Summary

Basin	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
1	2.07	0.66	0.80	3.78	9.97	76%
2.1	0.67	0.49	0.71	1.27	4.02	56%
2.2	1.94	0.11	0.52	0.56	5.84	9%
2.3	0.26	0.23	0.58	0.23	1.27	23%
2.4	0.29	0.05	0.49	0.06	1.18	2%
3	0.74	0.66	0.80	1.42	3.74	75%
4	0.24	0.49	0.71	0.42	1.32	55%
P-203R	0.70	0.71	0.82	1.90	4.82	82%
P-114R	0.89	0.77	0.85	2.65	6.39	89%

Design point "ud" represents all flow from basins PP1, PP3 and PP4 that will be released from the site undetained. Design point "1" quantifies all flow to the EDB. Table 4 summarizes the historical and developed design points:

Table 4: Proposed Design Point Hydrological Summary

Design Point	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
0	6.20	0.42	0.68	6.59	23.14	46%
1	3.15	0.20	0.57	1.59	9.84	19%
off	1.59	0.75	0.84	4.58	11.24	86%
ud	3.05	0.65	0.79	5.00	13.30	74%

The project will result in an increase in imperviousness from 42% to 46%, which will cause an increase in peak flows from both the minor and major storm events.

Stormsewer

The stormsewer system in basin PP2.1 was designed to accommodate future potential development in Lots 1-6. The main system consists of 24" HDPE storm sewer with a 12" Duraslot

Drain collecting water from most of the new access drive and storm laterals collecting runoff from the undeveloped portion of Lots 2-6. Roof drains from east half of the existing building will also be connected to the system.

The stormsewer has capacity to pass the full buildout minor storm event without surcharging. The stormsewer pipes will likely surcharge during the full buildout major storm event but the inlets calculations indicate that the inlets will not flood. In the event of flooding due to clogging, excess water will flow to the EDB/Detention pond via the new access road.

A 12-inch culvert is proposed at the public transit stop to convey water in the roadside ditch. No outlet protection is required as discharge velocities are below 5-feet per second for both design storms. The calculations for this culvert are included in Appendix B.

Detention

A combined water quality/detention pond will provide the attenuation required to restrict peak flows at the outlet to historic rates. The pond was sized to account for detention needs from potential future development by assuming a 85% imperviousness for basins PP2.1-PP2.3. Table 5 shows the hydrology summary for the assumed future conditions at each design point:

Table 5: Design Point Summary Assumed Future Development

Design Point	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
0	6.20	0.70	0.82	13.39	34.13	81%
1	3.34	0.73	0.83	6.46	16.05	85%
off	1.57	0.80	0.87	4.83	11.44	93%
ud	2.86	0.66	0.80	4.76	12.57	76%

The proposed pond is 4.8-ft in total depth, although the major storm event depth is 3.1-feet. The top of the pond is an area of 5,439-square feet. Table 6 summarizes the detention requirements of the pond for this project and full buildout (future) conditions:

Table 6: EDB/Detention Pond Summary

	WQCV (ft3)	Q_{A5}[1] (cfs)	Q_{A100}[1] (cfs)	V_5 (ft^3)	V_{100} (ft^3)	$V_{provided}$ (ft^3)
Future	4,161	1.50	11.08	5,643	8,831	13,430
Preliminary Plat	1,226	1.26	10.35	250	-385	13,430

1. Allowable Flow (Q_A) = Historic Flow (h1) - Undetained Flow (ud)

The pond outlet will be a concrete structure with orifice plates to restrict flow to the required rates. It will discharge to a swale in the same location as the existing swale and flow to the existing culvert under US highway 40. The overflow will be positioned on the west corner of the pond so any overflow will also be directed into the swale and existing culvert. Maintenance requirements are discussed in the Operations and Maintenance Plan in Appendix D.

Runoff calculations are included in Appendix A. Calculations for storm system capacity are included in Appendix B. Water quality and detention calculations are included in Appendix C. No downstream properties will be impacted by the proposed improvements.

Easements

A proposed drainage easement will encompass the EDB/Detention Pond as shown in Figure 3. The Duraslot Drain and 24" Stormsewer main will be located in an access and drainage easement that includes the new access driveway. Additional water and sewer easements are proposed in the locations of the new water and sewer lines.

STORMWATER QUALITY

Water quality in the Yampa River is degraded by the washing off of accumulated deposits on the urban landscape of Steamboat Springs. Metals, salts, sand, gravel, trash, debris, and organics (including oil and gasoline) all accumulate on the streets and in parking lots of Steamboat Springs over the course of time. During a rainstorm event, these pollutants are washed by the runoff into the Yampa River and its tributaries. Water quality problems caused by these pollutants include turbid water, nutrient enrichment, bacterial contamination, reduction in dissolved oxygen, and increased stress on aquatic life. The most prevalent pollutant in Steamboat Springs is sediment. BMP's included in this project are designed to minimize the amount of sediment leaving the site and entering the waterways.

Potential Pollutant Sources: The following are anticipated pollutant sources for this project:

1. Oil and sediment from vehicles
2. Landscaping maintenance
3. Snow removal and related transport of sand, dirt and oils;
4. Trash.

BMP Selection:

BMP selection involves many factors such as physical site characteristics, treatment objectives, aesthetics, safety, maintenance requirements, and costs. As each site is unique, there is not a standard BMP that can be implemented for every application and therefore there may be multiple solutions including standalone BMPs or 'treatment trains' that combine multiple BMPs to achieve the water quality objectives.

Using the MHFD flowchart and based on the site's characteristics, the most appropriate BMP for the site is an extended detention basin (EDB). The EDB was chosen over a rain garden or sand filter because the existing arch culvert that is the outlet for the site creates vertical constraints that make it difficult to accommodate the lower elevation an underdrain would require.

The EDB was sized per the MHFD's design manual to drain the required water quality capture volume for potential full buildout conditions in 40-hrs as well as provide storage for the estimated future full buildout minor and major storm detention. Table 6 above summarizes the WQCV requirements for this EDB.

The outlet structure will be designed to restrict flows to those required as part of this proposed development with the ability to modify the structure in the future for full buildout conditions without having increase the size of the pond. The pond bottom will have a concrete trickle channel for low flow conveyance.

The EDB will treat runoff from all of basin D1. The project will result in the addition of 0.55-acres of impervious area overall. The EDB will treat 0.48-acres of the new impervious area and 0.73-acres of impervious area overall. With the "site" being defined as the total disturbed area of 1.24-acres, and the facility treating 1.04-acres of total area, the facility will treat approximately 84% of the site (see Table 7)

Table 7: Percent of Area Treated

Added Imp. (acres)	Treated Imp. New (acres)	Treated Imp. Total (acres)	Treated Area Total (acres)	Disturbed Area (acres)	Percent Treated	Area not Treated (acres)
0.55	0.48	0.73	1.04	1.24	84%	0.20

The pond will have at least one foot of freeboard above the major storm event water surface elevation. A draft Operation and Maintenance Plan is provided in the appendices of this report. A final O&M Plan will be provided with CD's.

TEMPORARY EROSION AND SEDIMENT CONTROL

The primary source of storm water contaminants in the City of Steamboat Springs are suspended sediments and are most susceptible during construction activities. Temporary erosion and sediment control during construction is the responsibility of the permit holder (including NPDES permitting). Appropriate best management practices (BMP's) for construction activities are detailed in Erosion and Sediment Control During Construction by Routt County, Colorado. It is the responsibility of the permit holder to identify and properly handle all materials that are potential pollution sources prior to mobilization. The following are some common examples of potential pollution sources:

- Stockpiling of materials that can be transported to receiving waterways
- Uncovered trash bins
- Exposed and stored soils, management of contaminated soils
- Off-site tracking of soils and sediment
- Loading and unloading operations
- Outdoor storage of building materials, chemicals, fertilizers, etc.
- Vehicle and equipment maintenance and fueling
- Significant dust or particulate generating processes
- Routine maintenance activities involving fertilizers, pesticides, detergents, fuels, solvents, oils, etc.
- On-site waste disposal practices (waste piles, dumpsters, etc.)
- Concrete truck/equipment washing.
- Non-industrial waste sources that may be significant, such as worker trash and portable toilets.

It is not possible to identify all materials that will be used or stored on the construction site. It is the sole responsibility of the permit holder to identify and properly handle all materials that are potential pollutant sources prior to mobilization.

Some temporary BMP's include, but are not limited to, straw bales, silt fences, ditch checks, berms, slope drains, seeding and mulching, pipes, and sediment basins. In order to prevent mud from being transported into public right of ways, vehicle tracking pads and wheel wash areas should be utilized. Temporary BMP's should be coordinated with the site's permanent erosion control measures to assure continuous and economical erosion control. Because different BMP's are required at different stages of construction, the site should be periodically reviewed by the permit holder to verify the proper BMP's are in place.

Temporary BMP's should be inspected at a minimum once every two weeks, after each significant storm event, and at 24 hour intervals during extended storm events. Repairs or reconstruction of temporary BMP's shall occur within two working days in order to ensure continued performance. It is the responsibility of the Construction Site Operator to conduct bi-weekly inspections, maintain BMP's, and keep records of site conditions and inspections.

Areas used for material storage which are exposed to precipitation, disturbed areas, the construction site perimeter, and all applicable/installed erosion and sediment control measures shall be inspected for evidence of, or the potential for, pollutants entering the drainage system.

Preventative maintenance of all temporary BMP's shall be provided in order to ensure continued performance. Maintenance activities and actions shall be noted and recorded during inspections. All temporary erosion control measures must be kept in place and maintained until the site has been sufficiently stabilized in accordance with permit requirements.

It is recommended that a Stormwater Management Plan (SWMP) be completed prior to commencement of any land disturbing activities. Additionally, all pertinent local, state, and federal permits should be obtained prior to construction.

CONCLUSIONS

The improvements proposed for the Steamboat Basecamp Preliminary Plat include construction of an access driveway with a Duraslot Drain and 24" storm sewer system as well as intersection improvements and a public transit stop.

The project will result in an increase in imperviousness of 4% and related increases in peak flow. A combined EDB/Detention pond will provide water quality treatment for the new impervious areas as well as potential future development in Lots 1-6.

The design contained herein complies with the criteria set forth in the City's Drainage Design Manual. The storm sewer system and detention/stormwater quality pond will all require routine maintenance to maintain proper function.

LIMITATIONS

This study is intended to estimate and analyze peak stormwater runoff volumes generated by hydrologic events to evaluate existing drainage infrastructure and design new infrastructure needed to manage these flows. It does not account for groundwater, springs, or seeps and is not intended to be used for the evaluation or design of foundation drains or roof drains.

Basin delineations, areas, and soil characteristics are based on the best available information listed in the INTRODUCTION AND LOCATION section of the report. Actual conditions may vary. Landmark's assumptions, recommendations and opinions are based on this information and the

proposed site plan. If any of the data is found to be inaccurate or the proposed site plan is changed, Landmark should be contacted to review this report and make any necessary revisions.

The 100-year event is defined as the rainfall, runoff, or flooding event which has a probability of 1-percent of occurring in any given year based on available data. The 100-year event could occur in successive years or even multiple times in a single year. Events greater than the 100-year event or lesser events combined with malfunctioning drainage works can occur on rare occasion and may cause flooding damage.

The data, opinions, and recommendations of this report are applicable to the specific design elements and location that is the subject of this report. The report is not applicable to any other design elements or to any other locations. Any and subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendation without the prior written consent of Landmark Consultants, Inc.

Landmark Consultants, Inc. has no responsibility for construction means, methods, techniques, sequences, or procedures, or for safety precautions or programs in connection with the construction, for the acts or omissions of the contractor, or any other person performing any of the construction, or for the failure of any of them to carry out the construction in accordance with the Final Construction Drawings and Specifications.

The only warranty or guarantee made by Landmark Consultants, Inc. in connection with the services performed for this project is that such services are performed with the care and skill ordinarily exercised by members of the profession practicing under similar conditions, at the same time, and in the same or similar locality. No other warranty, expressed or implied, is made or intended by rendering such services or by furnishing written reports of the findings.

This study is intended to estimate and analyze peak stormwater runoff volumes generated by hydrologic events in order to evaluate existing drainage infrastructure and design new infrastructure needed to manage these flows. It does not account for groundwater, springs, or seeps and is not intended to be used for the evaluation or design of foundation drains or roof drains.

REFERENCES

1. Section 5.0 Drainage Criteria, City of Steamboat Springs Department of Public Works, September 2007.

2. Drainage Criteria Manual (Volumes 1 – 3), Urban Drainage and Flood Control District, June 2001

3. Hydraulic Design of Highway Culverts (HDS-5), Federal Highway Administration, September 2001

4. Procedures for Determining Peak Flows in Colorado, Natural Resource Conservation Service, 1984

5. Urban Hydrology for Small Watersheds (TR-55), Natural Resource Conservation Service, June 1986

6. Final Drainage Report for Steamboat Base Area Redevelopment, Drexel, Barrell & Co., December 1, 2006.

7. Citywide Stormwater Master Plan for the City of Steamboat Spring, Colorado, SEH, March 2013.

FIGURES

NORTH

40 0 40 80 120 Feet
(IN FEET)
1 inch = 40 ft.

LEGEND:

EXISTING STORM SEWER
PROPOSED STORM SEWER
PROPOSED STORM INLET (CURB & AREA)
PROPOSED MAJOR CONTOUR
PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
PROPOSED SWALE
PROPOSED CURB & GUTTER
PROPERTY BOUNDARY
PROPOSED LOT LINE
EXISTING RIGHT OF WAY
EX DRAINAGE EASEMENT
PROPOSED OVERLAND FLOW DIRECTION
PROPOSED CHANNELIZED FLOW DIRECTION
EXISTING CHANNELIZED FLOW DIRECTION

NOTES:

1. PROJECT BENCHMARK: NO. 5 REBAR WITH ALUMINUM CAP STAMPED "LANDMARK LS 29039" LOCATED ON THE SOUTH PROPERTY LINE OF LOT 1, WORLD WEST SUBDIVISION, NORTH OF CURVE COURT, ELEVATION = 6667.80 (NAVD 88)

Basin Hydrology Summary

	Historic (H)					
Basin	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
1	2.15	0.64	0.79	4.04	10.83	73%
2	2.88	0.15	0.54	1.11	8.80	14%
3	0.88	0.56	0.75	1.30	3.78	64%
4	0.48	0.26	0.59	0.28	1.43	27%
P-203R	0.50	0.81	0.87	1.56	3.65	95%
P-114R	0.89	0.77	0.85	2.65	6.39	89%

Design Point Hydrology Summary

	Historic (H)					
Design Point	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
0	6.39	0.38	0.66	6.26	23.65	42%
off	1.39	0.79	0.86	4.22	10.05	91%

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LANDMARK CONSULTANTS, INC.

REVIEW SET
NOT FOR CONSTRUCTION
XX/XX/XX

DESCRIPTION: | BY: | DATE: | NO.

PROJECT: 2387-004
DATE: 8/10/2021
DRAWN BY: DCS
CHECKED BY:

Steamboat Basecamp Preliminary Plat
Figure 2: Existing Drainage Plan

SHEET 1 Of 2 Sheets

NORTH

40 0 40 80 120 Feet

(IN FEET)
1 inch = 40 ft.

LEGEND:

- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- PROPOSED STORM INLET (CURB & AREA)
- PROPOSED MAJOR CONTOUR (6805)
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR (6805)
- EXISTING MINOR CONTOUR
- PROPOSED SWALE
- PROPOSED CURB & GUTTER
- PROPERTY BOUNDARY
- PROPOSED LOT LINE
- EXISTING RIGHT OF WAY
- PR DRAINAGE EASEMENT

- PROPOSED OVERLAND FLOW DIRECTION
- PROPOSED CHANNELIZED FLOW DIRECTION (2.0%)
- EXISTING CHANNELIZED FLOW DIRECTION

NOTES:

1. THE SIZE, TYPE AND LOCATION OF ALL KNOWN UNDERGROUND UTILITIES ARE APPROXIMATE WHEN SHOWN ON THESE DRAWINGS. IT SHALL BE THE RESPONSIBILITY OF THE DEVELOPER TO VERIFY THE EXISTENCE OF ALL UNDERGROUND UTILITIES IN THE AREA OF THE WORK. BEFORE COMMENCING NEW CONSTRUCTION, THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES AND SHALL BE RESPONSIBLE FOR FOR ALL UNKNOWN UNDERGROUND UTILITIES.
2. ALL PROJECT DATA IS ON VERTICAL DATUM; NGVD 88. SEE NOTES SHEET FOR BENCHMARK REFERENCES.
3. ELEVATIONS FOR IMPROVEMENTS THAT ARE CONTROLLED BY ADJACENT EXISTING FACILITIES (SUCH AS PROPOSED GUTTERS ALONG EXISTING ASPHALT) MAY REQUIRE ADJUSTMENT BASED ON ACTUAL CONDITIONS. COORDINATE WITH ENGINEER TO ENSURE A CONSISTENT SECTION WITH SMOOTH TRANSITIONS WHERE NECESSARY.
4. SEE SOILS REPORT FOR PAVEMENT, SUBGRADE AND MATERIAL PREPARATION, DESIGN AND RECOMMENDATIONS.
5. ALL CURB SPOTS SHOWN ARE FLOWLINE ELEVATIONS, UNLESS NOTED OTHERWISE. ALL OTHER SPOTS ARE FINISHED GRADE ELEVATIONS.

Basin Hydrology Summary

	Preliminary Plat (PP)					
Basin	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
1	2.07	0.66	0.80	3.78	9.97	76%
2.1	0.67	0.49	0.71	1.27	4.02	56%
2.2	1.94	0.11	0.52	0.56	5.84	9%
2.3	0.26	0.23	0.58	0.23	1.27	23%
2.4	0.29	0.05	0.49	0.06	1.18	2%
2	NA	NA	NA	NA	NA	NA
3	0.74	0.66	0.80	1.42	3.74	75%
4	0.24	0.49	0.71	0.42	1.32	55%
P-203R	0.70	0.71	0.82	1.90	4.82	82%
P-114R	0.89	0.77	0.85	2.65	6.39	89%

Design Point Hydrology Summary

	Preliminary Plat (PP)					
Design Point	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
0	6.20	0.42	0.68	6.59	23.14	46%
1	3.15	0.20	0.57	1.59	9.84	19%
off	1.59	0.75	0.84	4.58	11.24	86%
ud	3.05	0.65	0.79	5.00	13.30	74%

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			REVIEW SET NOT FOR CONSTRUCTION XX/XX/XX

PROJECT: 2397-004
DATE: 8/10/2021
DRAWN BY: DCS
CHECKED BY:

Steamboat Basecamp Preliminary Plat
Figure 3: Proposed Drainage Plan

SHEET 1 Of 2 Sheets

APPENDIX A

HYDROLOGIC CALCULATIONS

Hydrologic Soil Group—Routt Area, Colorado, Parts of Rio Blanco and Routt Counties
(Steamboat Base Camp)

Map Scale: 1:1,680 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
110	Elkhead clay loam, 0 to 3 percent slopes	D	7.4	100.0%
Totals for Area of Interest			**7.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential lots (lot area only)**:**	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

Table 6-5. Runoff coefficients, *c* (continued)

Total or Effective % Impervious	NRCS Hydrologic Soil Group C						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
2%	0.01	0.05	0.15	0.33	0.40	0.49	0.59
5%	0.03	0.08	0.17	0.35	0.42	0.5	0.6
10%	0.06	0.12	0.21	0.37	0.44	0.52	0.62
15%	0.1	0.16	0.24	0.4	0.47	0.55	0.64
20%	0.14	0.2	0.28	0.43	0.49	0.57	0.65
25%	0.18	0.24	0.32	0.46	0.52	0.59	0.67
30%	0.22	0.28	0.35	0.49	0.54	0.61	0.68
35%	0.26	0.32	0.39	0.51	0.57	0.63	0.7
40%	0.3	0.36	0.43	0.54	0.59	0.65	0.71
45%	0.34	0.4	0.46	0.57	0.62	0.67	0.73
50%	0.38	0.44	0.5	0.6	0.64	0.69	0.75
55%	0.43	0.48	0.54	0.63	0.66	0.71	0.76
60%	0.47	0.52	0.57	0.65	0.69	0.73	0.78
65%	0.51	0.56	0.61	0.68	0.71	0.75	0.79
70%	0.56	0.61	0.65	0.71	0.74	0.77	0.81
75%	0.6	0.65	0.68	0.74	0.76	0.79	0.82
80%	0.65	0.69	0.72	0.77	0.79	0.81	0.84
85%	0.7	0.73	0.76	0.79	0.81	0.83	0.86
90%	0.74	0.77	0.79	0.82	0.84	0.85	0.87
95%	0.79	0.81	0.83	0.85	0.86	0.87	0.89
100%	0.83	0.85	0.87	0.88	0.89	0.89	0.9

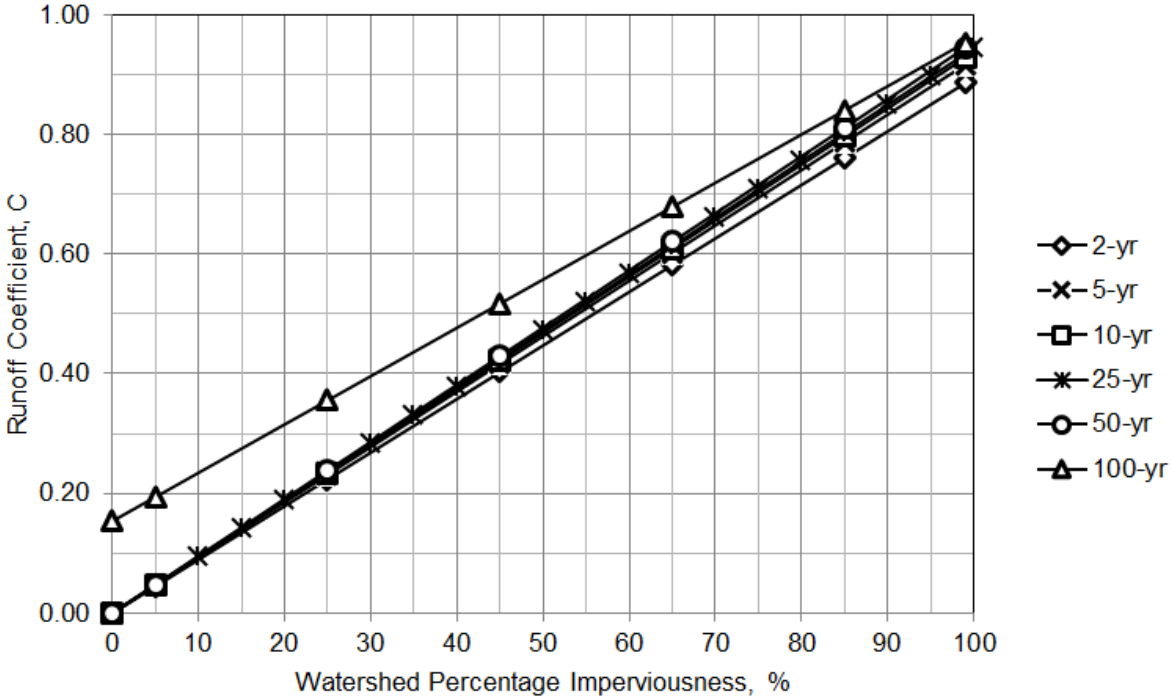

Figure 6-1. Runoff coefficient vs. watershed imperviousness NRCS HSG A

IDF Table for Steamboat Springs, CO

Table 5.5.1.P1 and Intensity-Duration-Frequency Values

Return Period	P1	Rainfall Intensity for Storm Duration				
		5-min	10-min	15-min	30-min	60-min
1.25-year	0.38	1.79	1.33	1.06	0.66	0.39
2-year	0.55	2.58	1.90	1.52	0.95	0.56
5-year	0.82	3.84	2.84	2.26	1.42	0.83
10-year	1.04	4.89	3.61	2.88	1.81	1.06
25-year	1.34	6.30	4.66	3.71	2.33	1.36
50-year	1.57	7.38	5.46	4.35	2.73	1.60
100-year	1.79	8.42	6.22	4.96	3.12	1.82
500-year	2.31	10.86	8.03	6.40	4.02	2.35

Based on 1-hour rainfall depths from NOAA Atlas 14 for Steamboat Springs (station ID-05-7936) and the equation:

$$I = P_1 \times \frac{49.1}{(T_d + 7.84)^{0.919}}$$

Where:

I = rainfall intensity (inches per hour)
P_1 = 1-hour rainfall depth (inches)
T_d = storm duration (minutes)

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COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Character of Surface	Percent Impervious
Asphalt Parking and Walkways	100%
Gravel	40%
Roof	90%
Lawns and Landscaping	2%
Future Development	85%

Existing

Basin ID	Basin Area (sq.ft.)	Basin Area (acres)	Area of Asphalt Parking and Walkways(sq. ft.)	Area of Asphalt Parking and Walkways (acres)	Area of Roof (sq.ft.)	Area of Roof (acres)	Area of Lawns and Landscaping (sq.ft.)	Area of Lawns and Landscaping (acres)	Percent Impervious	5-year Composite Runoff Coefficient	100-year Composite Runoff Coefficient
H1	**93803.58**	2.15	54694.00	1.26	14912.39	0.34	24197.19	0.56	73%	0.642	0.787
H2	**125427.33**	2.88	5064.77	0.12	10950.63	0.25	109411.93	2.51	14%	0.150	0.541
H3	**38205.96**	0.88	24041.00	0.55		0.00	14164.96	0.33	64%	0.560	0.746
H4	**20739.56**	0.48	5210.50	0.12		0.00	15529.06	0.36	27%	0.256	0.595
P-203R	**21632.04**	0.50	20493.05	0.47		0.00	1138.99	0.03	95%	0.814	0.874
P-114R	**38755.25**	0.89	34543.18	0.79		0.00	4212.07	0.10	89%	0.773	0.853
		7.77									

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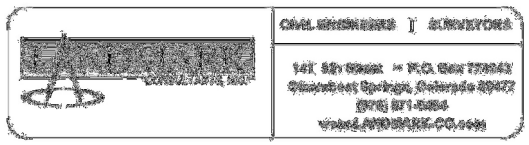
COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Character of Surface	Percent Impervious
Asphalt Parking and Walkways	100%
Gravel	40%
Roof	90%
Lawns and Landscaping	2%
Future Development	85%

Preliminary Plat

Basin ID	Basin Area (sq.ft.)	Basin Area (acres)	Area of Asphalt Parking and Walkways(sq. ft.)	Area of Asphalt Parking and Walkways (acres)	Area of Roof (sq.ft.)	Area of Roof (acres)	Area of Lawns and Landscaping (sq.ft.)	Area of Lawns and Landscaping (acres)	Percent Impervious	5-year Composite Runoff Coefficient	100-year Composite Runoff Coefficient
PP1	90038.94	2.07	54694.00	1.26	14731.67	0.34	20613.27	0.47	76%	0.658	0.796
PP2.1	29123.94	0.67	6075.32	0.14	11047.92	0.25	12000.70	0.28	56%	0.494	0.714
PP2.2	84505.75	1.94	5823.96	0.13		0.00	78681.79	1.81	9%	0.109	0.521
PP2.3	11283.90	0.26	2471.95	0.06		0.00	8811.95	0.20	23%	0.232	0.582
PP2.4	12458.69	0.29		0.00		0.00	12458.69	0.29	2%	0.051	0.492
PP3	32074.15	0.74	24041.00	0.55	0.00	0.00	8033.15	0.18	75%	0.658	0.796
PP4	10601.27	0.24	5752.47	0.13	0.00	0.00	4848.80	0.11	55%	0.494	0.714
P-203R	**30412.15**	0.70	24743.18	0.57		0.00	5668.97	0.13	82%	0.707	0.820
P-114R	**38781.34**	0.89	34569.27	0.79		0.00	4212.07	0.10	89%	0.773	0.853



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TIME OF CONCENTRATION COMPUTATIONS

Overland Flow, Time of Concentration:

$$T_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{1/3}} \quad \text{(Equation RO-3)}$$

Gutter/Swale Flow, Time of Concentration:

T_t = L / 60V

T_c = T_i + T_t (Equation RO-2)

Intensity, i From Figures 3.3.1-2 (Area II)

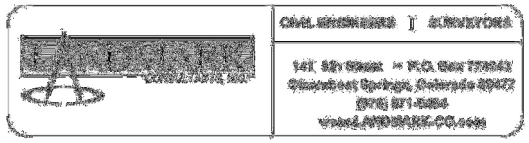
Velocity (Gutter Flow), V = 20·$S^{½}$

Velocity (Swale Flow), V = 15·$S^{½}$

Rational Equation: Q = CiA (Equation RO-1)

Existing

	Overland Flow				Conveyance		Swale Flow 1				Conveyance		Swale Flow 2				Time of Concentration		
Basin	C_5	Length, L (ft)	Slope, S (%)	T_i (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)	Comp. T_c (min)	$\frac{L}{180}+10$	Actual T_c (min)
H1	0.64	100	3.82	5.37	Heavy Meadow	2.5	63	8.37	5.79	1.45	Grassed Waterway	15	258	1.00	2.00	2.87	9.69	12.34	9.69
H2	0.15	100	3.82	11.14	Heavy Meadow	2.5	63	8.37	5.79	1.45	Grassed Waterway	15	258	1.00	2.00	2.87	15.46	12.34	12.34
H3	0.56	100	2.85	6.99	Grassed Waterway	15	445	1.00	2.00	4.95	Shallow Paved Swales	20		N/A	N/A	N/A	11.93	13.03	11.93
H4	0.26	79	3.00	9.53	Grassed Waterway	15	788	1.00	2.00	8.76	Shallow Paved Swales	20		N/A	N/A	N/A	18.29	14.82	14.82
P-203R	0.81	19	17.80	0.88	Grassed Waterway	15	235	1.63	2.55	2.05	Shallow Paved Swales	20		N/A	N/A	N/A	2.92	11.41	5.00
P-114R	0.77	19	17.80	1.00	Grassed Waterway	15	235	1.63	2.55	2.05	Shallow Paved Swales	20		N/A	N/A	N/A	3.05	11.41	5.00



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TIME OF CONCENTRATION COMPUTATIONS

Overland Flow, Time of Concentration:

$$T_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{1/3}} \quad \text{(Equation RO-3)}$$

Gutter/Swale Flow, Time of Concentration:

T_t = L / 60V

T_c = T_i + T_t (Equation RO-2)

Intensity, i From Figures 3.3.1-2 (Area II)

Velocity (Gutter Flow), V = 20·S$^{1/2}$

Velocity (Swale Flow), V = 15·S$^{1/2}$

Rational Equation: Q = CiA (Equation RO-1)

Preliminary Plat

	Overland Flow				Conveyance		Swale Flow 1				Conveyance		Swale Flow 2				Time of Concentration		
Basin	C_5	Length, L (ft)	Slope, S (%)	T_i (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)	Comp. T_c (min)	$\frac{L}{180}+10$	Actual T_c (min)
PP1	0.66	115	2.00	6.89	Grassed Waterway	15	488	2.00	2.83	3.83	Grassed Waterway	15		1.00	N/A	N/A	10.73	13.35	10.73
PP2.1	0.49		3.82	N/A	Heavy Meadow	2.5	63	8.37	5.79	1.45	Grassed Waterway	15	258	1.00	2.00	2.87	4.32	11.78	5.00
PP2.2	0.11	114	1.00	19.40	Grassed Waterway	15	184	1.00	2.00	2.04	Shallow Paved Swales	20		N/A	N/A	N/A	21.45	11.66	11.66
PP2.3	0.23		3.00	N/A	Grassed Waterway	15		1.00	N/A	N/A	Shallow Paved Swales	20		N/A	N/A	N/A	0.00	10.00	5.00
PP2.4	0.05		17.80	N/A	Grassed Waterway	15		1.63	N/A	N/A	Shallow Paved Swales	20		N/A	N/A	N/A	0.00	10.00	5.00
PP3	0.66	97	3.00	5.53	Grassed Waterway	15	399	1.00	2.00	4.43	Shallow Paved Swales	20		N/A	N/A	N/A	9.96	12.76	9.96
PP4	0.49	30	3.00	4.22	Grassed Waterway	15	236	1.00	2.00	2.62	Shallow Paved Swales	20		N/A	N/A	N/A	6.84	11.48	6.84
P-203R	0.71		17.80	N/A	Grassed Waterway	15		1.63	N/A	N/A	Shallow Paved Swales	20		N/A	N/A	N/A	0.00	10.00	5.00
P-114R	0.77		17.80	N/A	Grassed Waterway	15		1.63	N/A	N/A	Shallow Paved Swales	20		N/A	N/A	N/A	0.00	10.00	5.00

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DIRECT RUNOFF COMPUTATIONS

Overland Flow, Time of Concentration:

$$T_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{1/3}}$$ (Equation RO-3)

Gutter/Swale Flow, Time of Concentration:

T_t = L / 60V

T_c = T_i + T_t (Equation RO-2)

Intensity, I from Fig. RA-2 (Equation RO-4)

Velocity (Gutter Flow), V = 20·$S^{½}$

Velocity (Swale Flow), V = 15·$S^{½}$

Rational Equation: Q = CiA (Equation RO-1)

Existing

Basin(s)	Area, A (acres)	T_c (min)	C_5	C_{100}	Intensity, I_5 (in/hr)	Intensity, I_{100} (in/hr)	Flow, Q_5 (cfs)	Flow, Q_{100} (cfs)
H1	2.15	9.69	0.64	0.79	2.93	6.39	4.04	10.83
H2	2.88	12.34	0.15	0.54	2.58	5.64	1.11	8.80
H3	0.88	11.93	0.56	0.75	2.65	5.78	1.30	3.78
H4	0.48	14.82	0.26	0.59	2.32	5.06	0.28	1.43
P-203R	0.50	5.00	0.81	0.87	3.86	8.42	1.56	3.65
P-114R	0.89	5.00	0.77	0.85	3.86	8.42	2.65	6.39

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T_t = L / 60V

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Velocity (Gutter Flow), V = 20·$S^{½}$

Velocity (Swale Flow), V = 15·$S^{½}$

Rational Equation: Q = CiA (Equation RO-1)

Preliminary Plat

Basin(s)	Area, A (acres)	T_c (min)	C_5	C_{100}	Intensity, I_5 (in/hr)	Intensity, I_{100} (in/hr)	Flow, Q_5 (cfs)	Flow, Q_{100} (cfs)
PP1	2.07	10.73	0.66	0.80	2.78	6.07	3.78	9.97
PP2.1	0.67	5.00	0.49	0.71	3.86	8.42	1.27	4.02
PP2.2	1.94	11.66	0.11	0.52	2.65	5.78	0.56	5.84
PP2.3	0.26	5.00	0.23	0.58	3.86	8.42	0.23	1.27
PP2.4	0.29	5.00	0.05	0.49	3.86	8.42	0.06	1.18
PP3	0.74	9.96	0.66	0.80	2.93	6.39	1.42	3.74
PP4	0.24	6.84	0.49	0.71	3.48	7.60	0.42	1.32
P-203R	0.70	5.00	0.71	0.82	3.86	8.42	1.90	4.82
P-114R	0.89	5.00	0.77	0.85	3.86	8.42	2.65	6.39

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COMBINED COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Character of Surface	Percent Impervious
Asphalt Parking and Walkways	100%
Gravel	40%
Roof	90%
Lawns and Landscaping	2%
Future Development	100%

Existing

Design Point	Combined Basin IDs	Basin Area (sq.ft.)	Basin Area (acres)	Area of Asphalt Parking and Walkways(sq.ft.)	Area of Asphalt Parking and Walkways (acres)	Area of Roof (sq.ft.)	Area of Roof (acres)	Area of Lawns and Landscaping (sq.ft.)	Area of Lawns and Landscaping (acres)	Percent Impervious	5-year Composite Runoff Coefficient	100-year Composite Runoff Coefficient
0	H1+H2+H3+H4	278176.43	6.39	89010.27	2.04	25863.02	0.59	163303.14	3.75	42%	0.38	0.66
off	P-230R+P-114R	60387.29	1.39	55036.23	1.26		0.00	5351.06	0.12	91%	0.79	0.86

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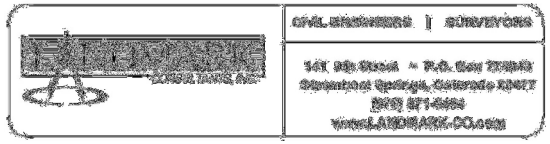
Gravel	40%
Roof	90%
Lawns and Landscaping	2%
Future Development	100%

Preliminary Plat

Design Point	Combined Basin IDs	Basin Area (sq.ft.)	Basin Area (acres)	Area of Asphalt Parking and Walkways(sq.ft.)	Area of Asphalt Parking and Walkways (acres)	Area of Roof (sq.ft.)	Area of Roof (acres)	Area of Lawns and Landscaping (sq.ft.)	Area of Lawns and Landscaping (acres)	Percent Impervious	5-year Composite Runoff Coefficient	100-year Composite Runoff Coefficient
0	D1+D2.1+D2.2+D2.3+ D2.4+D3+D4	270086.64	6.20	98858.70	2.27	25779.59	0.59	145448.35	3.34	46%	0.42	0.68
1	D2.1+D2.2+D2.3+D2.4	137372.28	3.15	14371.23	0.33	11047.92	0.25	111953.13	2.57	19%	0.20	0.57
off	P-230R+P-114R	69193.49	1.59	59312.45	1.36	0.00	0.00	9881.04	0.23	86%	0.75	0.84
ud	D1+D3+D4	132714.36	3.05	84487.47	1.94	14731.67	0.34	33495.22	0.77	74%	0.65	0.79



PROJECT:	Steamboat Basecamp/Basec
DESIGNER:	DCS
DATE:	8/10/2021

COMBINED TIME OF CONCENTRATION COMPUTATIONS

Overland Flow, Time of Concentration:

$$T_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{1/3}}$$ (Equation

Gutter/Swale Flow, Time of Concentration:

T_t = L / 60V

T_c = T_i + T_t (Equation RO-2)

Intensity, i From Figures 3.3.1-2 (Area II)

Velocity (Gutter Flow), V = 20·$S^{1/2}$

Velocity (Swale Flow), V = 15·$S^{1/2}$

Rational Equation: Q = CiA (Equation RO-1)

Existing

		Overland Flow				Conveyance		Swale Flow 1				Conveyance		Swale Flow 2				Time of Concentration		
Design Point	Basin(s)	C_5	Length, L (ft)	Slope, S (%)	T_i (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)	Comp. T_c (min)	$\frac{L}{180}+10$	Actual T_c (min)
0	H1+H2+H3+H4	0.38	100	3.82	8.45	Heavy Meadow	2.5	63	8.37	5.79	1.45	Grassed Waterway	15	258	1.00	2.00	2.87	12.77	12.34	12.34
off	P-230R+P-114R	0.79	30	3.00	2.16	Grassed Waterway	15	132	1.00	2.00	1.47	Shallow Paved Swales	20		N/A	N/A	N/A	3.63	10.90	5.00

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PROJECT:	Steamboat Basecamp/Base
DESIGNER:	DCS
DATE:	8/10/2021

COMBINED TIME OF CONCENTRATION COMPUTATIONS

Overland Flow, Time of Concentration:

$$T_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{1/3}}$$ (Equation

Gutter/Swale Flow, Time of Concentration:

T_t = L / 60V

T_c = T_i + T_t (Equation RO-2)

Intensity, i From Figures 3.3.1-2 (Area II)

Velocity (Gutter Flow), V = 20·$S^{1/2}$

Velocity (Swale Flow), V = 15·$S^{1/2}$

Rational Equation: Q = CiA (Equation RO-1)

Preliminary Plat

		Overland Flow				Conveyance		Swale Flow 1				Conveyance		Swale Flow 2				Time of Concentration		
Design Point	Basin(s)	C_5	Length, L (ft)	Slope, S (%)	T_i (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)		K	Length, L (ft)	Slope, S (%)	Velocity, V (ft/s)	T_t (min)	Comp. T_c (min)	$\frac{L}{180}+10$	Actual T_c (min)
0	D1+D2.1+D2.2+D2.3+D2.4+D3+D4	0.42	114	1.00	13.30	Heavy Meadow	2.5	184	1.00	2.00	12.27	Grassed Waterway	15	202	0.50	1.41	3.17	28.74	12.78	12.78
1	D2.1+D2.2+D2.3+D2.4	0.20	114	1.00	17.64	Grassed Waterway	15	184	1.00	2.00	2.04	Shallow Paved Swales	20	202	0.50	1.41	2.38	22.06	12.78	12.78
off	P-230R+P-114R	0.75	30	3.00	2.45	Grassed Waterway	15	132	1.00	2.00	1.47	Shallow Paved Swales	20		N/A	N/A	N/A	3.91	10.90	5.00
ud	D1+D3+D4	0.65	97	3.00	5.63	Grassed Waterway	15	399	1.00	2.00	4.43	Grassed Waterway	15	236	1.00	2.00	2.62	12.69	14.07	12.69

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PROJECT:	Steamboat Basecamp/Basecamp Sq
DESIGNER:	DCS
DATE:	8/10/2021

COMBINED DIRECT RUNOFF COMPUTATIONS

Overland Flow, Time of Concentration:

$$T_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{1/3}}$$

Gutter/Swale Flow, Time of Concentration:

T_t = L / 60V

T_c = T_i + T_t (Equation RO-2)

Intensity, I from Fig. RA-2

Velocity (Gutter Flow), V = 20·S$^{1/2}$

Velocity (Swale Flow), V = 15·S$^{1/2}$

Rational Equation: Q = CiA (Equation RO-1)

Existing

Design Point	Basin(s)	Area, A (acres)	T_c (min)	C_5	C_{100}	Intensity I_5 (in/hr)	Intensity I_{100} (in/hr)	Flow Q_5 (cfs)	Q_5 per Acre (cfs/ac)	Flow Q_{100} (cfs)	Q_{100} per Acre (cfs/ac)
0	H1+H2+H3+H4	6.39	12.34	0.38	0.66	2.58	5.64	6.26	0.98	23.65	3.70
off	P-230R+P-114R	1.39	5.00	0.79	0.86	3.86	8.42	4.22	3.04	10.05	7.25

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PROJECT:	Steamboat Basecamp/Basecamp Sq
DESIGNER:	DCS
DATE:	8/10/2021

COMBINED DIRECT RUNOFF COMPUTATIONS

Overland Flow, Time of Concentration:

$$T_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{1/3}}$$

Gutter/Swale Flow, Time of Concentration:

T_t = L / 60V

T_c = T_i + T_t (Equation RO-2)

Intensity, I from Fig. RA-2

Velocity (Gutter Flow), V = 20·S$^{1/2}$

Velocity (Swale Flow), V = 15·S$^{1/2}$

Rational Equation: Q = CiA (Equation RO-1)

Preliminary Plat

Design Point	Basin(s)	Area, A (acres)	T_c (min)	C_5	C_{100}	Intensity I_5 (in/hr)	Intensity I_{100} (in/hr)	Flow Q_5 (cfs)	Q_5 per Acre (cfs/ac)	Flow Q_{100} (cfs)	Q_{100} per Acre (cfs/ac)
0	D1+D2.1+D2.2+D2.3+D2.4+D3+D4	6.20	12.78	0.42	0.68	2.53	5.52	6.59	1.06	23.14	3.73
1	D2.1+D2.2+D2.3+D2.4	3.15	12.78	0.20	0.57	2.53	5.52	1.59	0.50	9.84	3.12
off	P-230R+P-114R	1.59	5.00	0.75	0.84	3.86	8.42	4.58	2.89	11.24	7.08
ud	D1+D3+D4	3.05	12.69	0.65	0.79	2.53	5.52	5.00	1.64	13.30	4.37

APPENDIX B

HYDRAULIC CALCULATIONS

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow
Minimum Flow: 5 cfs
Design Flow: 7.65 cfs
Maximum Flow: 27.25 cfs

Table 1 - Summary of Culvert Flows at Crossing: EX ARCH CMP

Headwater Elevatio	Total Discharge (c	Culvert 1 Dischar (cfs)	Roadway Dischar (cfs)	Iterations
6661.75	5.00	5.00	0.00	1
6662.15	7.65	7.65	0.00	1
6662.48	9.45	9.45	0.00	1
6663.14	11.68	11.68	0.00	1
6663.87	13.90	13.90	0.00	1
6664.37	16.13	15.01	1.00	24
6664.41	18.35	14.27	4.00	5
6664.43	20.58	13.45	7.03	4
6664.46	22.80	12.58	10.18	4
6664.48	25.03	11.63	13.24	3
6664.50	27.25	10.61	16.54	3
6664.35	15.26	15.26	0.00	Overtopping

Rating Curve Plot for Crossing: EX ARCH CMP

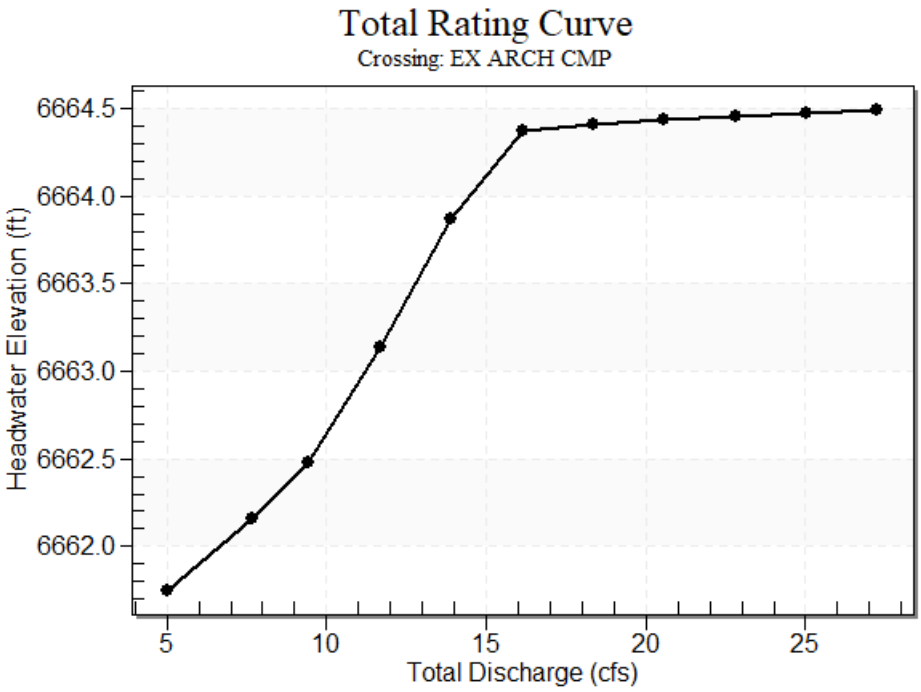
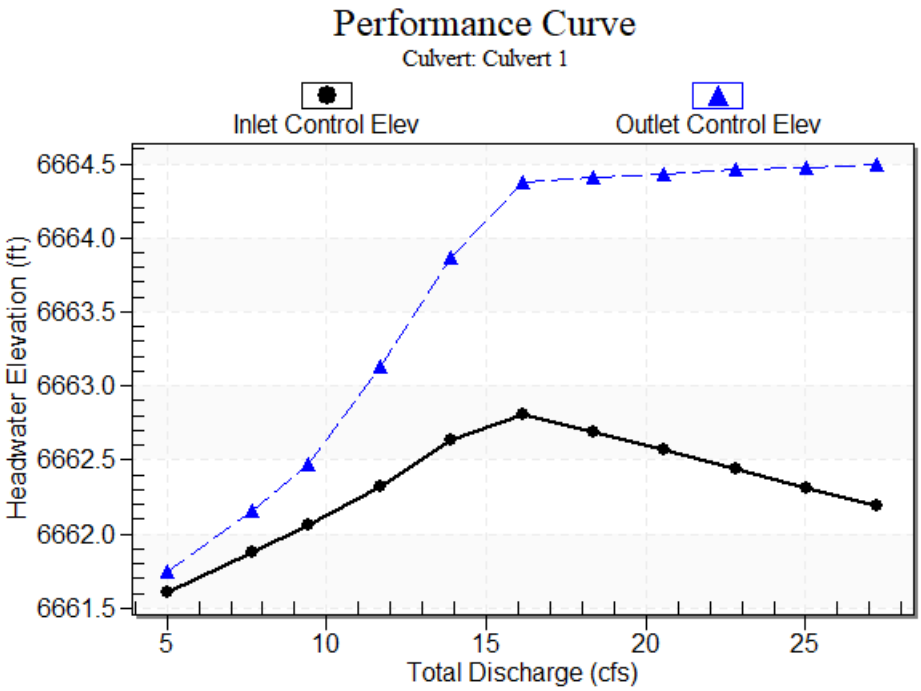


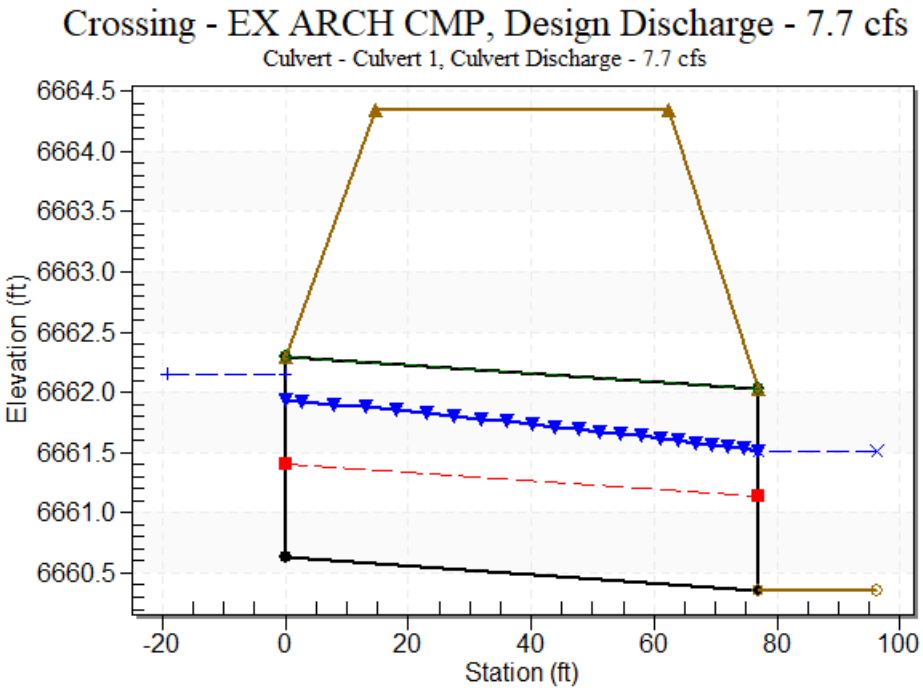
Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (f	Outlet Control Depth (f	Flow Type	Normal Depth (f	Critical Depth (f	Outlet Depth (f	Tailwater Depth (f	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	6661.7	0.976	1.121	3-M2	1.007	0.608	0.849	0.849	2.828	2.357
7.65	7.65	6662.1	1.244	1.525	3-M2	1.667	0.775	1.157	1.157	3.169	2.645
9.45	9.45	6662.4	1.429	1.846	3-M2	1.667	0.876	1.356	1.356	3.417	2.789
11.68	11.68	6663.1	1.691	2.506	7-M2	1.667	0.991	1.594	1.594	3.809	2.930
13.90	13.90	6663.8	2.002	3.236	4-FF	1.667	1.095	1.667	1.826	4.477	3.045
16.13	15.01	6664.3	2.177	3.744	4-FF	1.667	1.144	1.667	2.054	4.835	3.140
18.35	14.27	6664.4	2.058	3.778	4-FF	1.667	1.111	1.667	2.279	4.595	3.221
20.58	13.45	6664.4	1.935	3.804	4-FF	1.667	1.075	1.667	2.501	4.332	3.290
22.80	12.58	6664.4	1.811	3.827	4-FF	1.667	1.034	1.667	2.722	4.051	3.351
25.03	11.63	6664.4	1.685	3.846	4-FF	1.667	0.988	1.667	2.941	3.746	3.404
27.25	10.61	6664.5	1.559	3.866	4-FF	1.667	0.937	1.667	3.158	3.416	3.452

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 ft
Inlet Elevation: 6660.63 ft
Outlet Station: 77.09 ft
Outlet Elevation: 6660.36 ft
Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Pipe Arch
Barrel Span: 28.00 in
Barrel Rise: 20.00 in
Barrel Material: Steel or Aluminum
Embedment: 0.00 in
Barrel Manning's n: 0.0250
Culvert Type: Straight
Inlet Configuration: Mitered
Inlet Depression: None

Tailwater Channel Data - EX ARCH CMP

Tailwater Channel Option: Rectangular Channel
Bottom Width: 2.50 ft
Channel Slope: 0.0100
Channel Manning's n: 0.0400
Channel Invert Elevation: 6660.36 ft

Roadway Data for Crossing: EX ARCH CMP

Roadway Profile Shape: Constant Roadway Elevation
Crest Length: 100.00 ft
Crest Elevation: 6664.35 ft
Roadway Surface: Paved
Roadway Top Width: 47.59 ft

HY-8 Culvert Analysis Report

PR STORM 02

Water Surface Profile Plot for Culvert: Culvert 1

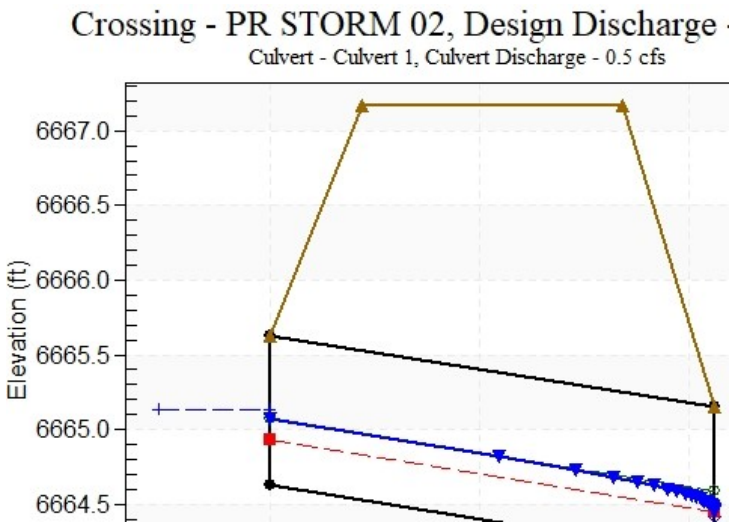


Table 1 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.20	0.20	6664.93	0.260	0.304	2-M2c	0.265	0.183	0.183	0.124	2.027	0.806
0.31	0.31	6665.01	0.326	0.381	2-M2c	0.332	0.229	0.229	0.163	2.280	0.946
0.42	0.42	6665.08	0.381	0.447	2-M2c	0.390	0.267	0.267	0.198	2.478	1.055
0.52	0.52	6665.13	0.428	0.503	2-M2c	0.440	0.299	0.299	0.228	2.635	1.140
0.64	0.64	6665.20	0.477	0.565	2-M2c	0.494	0.332	0.332	0.260	2.792	1.223
0.75	0.75	6665.25	0.520	0.620	2-M2c	0.543	0.360	0.360	0.288	2.924	1.292
0.85	0.85	6665.30	0.562	0.674	2-M2c	0.592	0.387	0.387	0.316	3.045	1.352
0.96	0.96	6665.35	0.602	0.724	2-M2c	0.641	0.412	0.412	0.342	3.159	1.408
1.07	1.07	6665.41	0.639	0.776	2-M2c	0.692	0.435	0.435	0.367	3.266	1.459
1.18	1.18	6665.46	0.675	0.829	2-M2c	0.748	0.458	0.458	0.392	3.367	1.505
1.29	1.29	6665.51	0.709	0.883	2-M2c	0.814	0.480	0.480	0.416	3.464	1.549

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****
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Straight Culvert

Inlet Elevation (invert): 6664.63 ft, Outlet Elevation (invert): 6664.15 ft

Culvert Length: 106.40 ft, Culvert Slope: 0.0045

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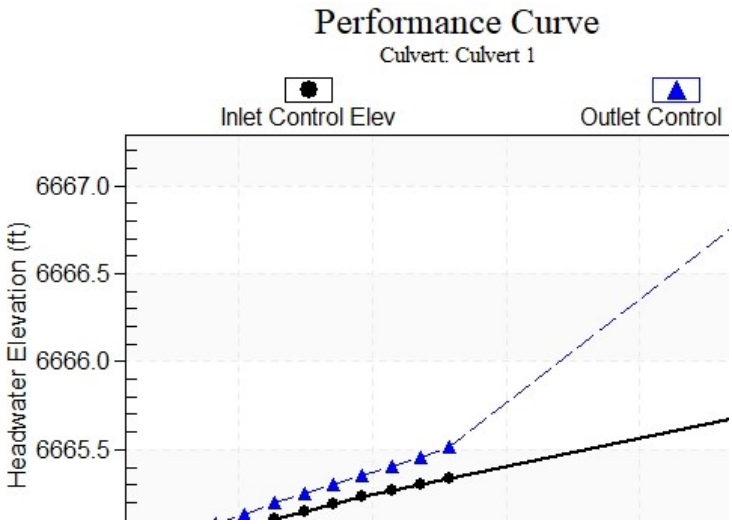
****
****

Culvert Performance Curve Plot: Culvert 1



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Inlet Station: 0.00 ft
Inlet Elevation: 6664.63 ft
Outlet Station: 106.40 ft
Outlet Elevation: 6664.15 ft
Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular
Barrel Diameter: 1.00 ft
Barrel Material: Corrugated PE
Embedment: 0.00 in
Barrel Manning's n: 0.0240
Culvert Type: Straight
Inlet Configuration: Mitered to Conform to Slope
Inlet Depression: None

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.2 cfs

Design Flow: 0.52 cfs

Maximum Flow: 1.29 cfs

Table 2 - Summary of Culvert Flows at Crossing: PR STORM 02

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6664.93	0.20	0.20	0.00	1
6665.01	0.31	0.31	0.00	1
6665.08	0.42	0.42	0.00	1
6665.13	0.52	0.52	0.00	1
6665.20	0.64	0.64	0.00	1
6665.25	0.75	0.75	0.00	1
6665.30	0.85	0.85	0.00	1
6665.35	0.96	0.96	0.00	1
6665.41	1.07	1.07	0.00	1
6665.46	1.18	1.18	0.00	1
6665.51	1.29	1.29	0.00	1
6667.17	2.60	2.60	0.00	Overtopping

Rating Curve Plot for Crossing: PR STORM 02

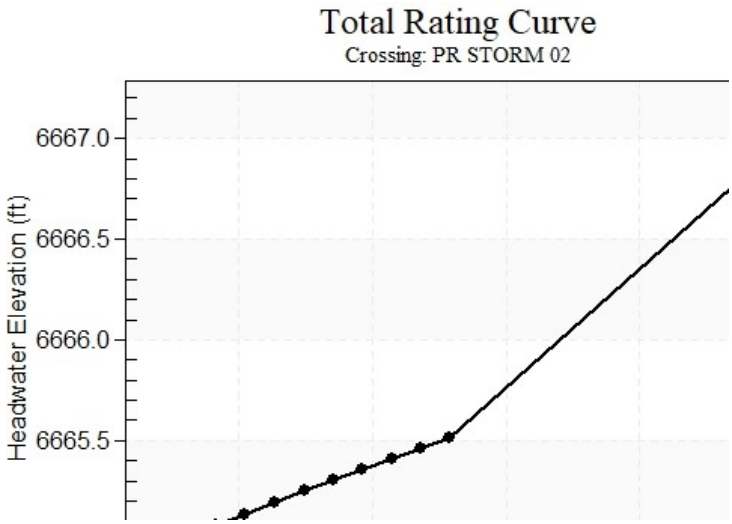


Table 3 - Downstream Channel Rating Curve (Crossing: PR STORM 02)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.20	6664.27	0.12	0.81	0.04	0.40
0.31	6664.31	0.16	0.95	0.05	0.41
0.42	6664.35	0.20	1.06	0.06	0.42
0.52	6664.38	0.23	1.14	0.07	0.42
0.64	6664.41	0.26	1.22	0.08	0.42
0.75	6664.44	0.29	1.29	0.09	0.42
0.85	6664.47	0.32	1.35	0.10	0.42
0.96	6664.49	0.34	1.41	0.11	0.42
1.07	6664.52	0.37	1.46	0.11	0.42
1.18	6664.54	0.39	1.51	0.12	0.42
1.29	6664.57	0.42	1.55	0.13	0.42

Tailwater Channel Data - PR STORM 02

Tailwater Channel Option: Rectangular Channel

Bottom Width: 2.00 ft

Channel Slope: 0.0050

Channel Manning's n: 0.0300

Channel Invert Elevation: 6664.15 ft

Roadway Data for Crossing: PR STORM 02

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 6667.17 ft

Roadway Surface: Paved

Roadway Top Width: 62.00 ft

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 10 2021

PR Swale

Triangular

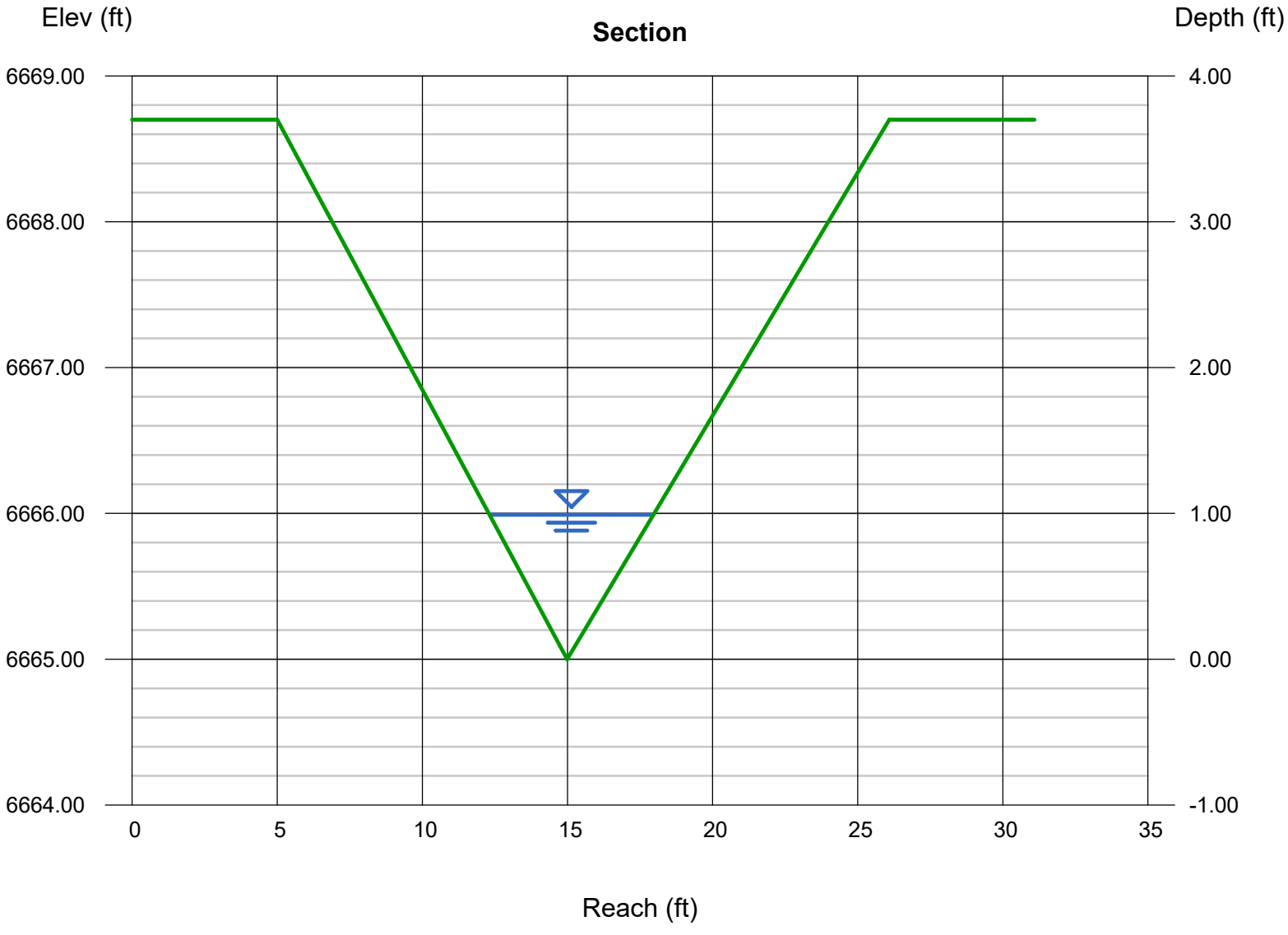
Side Slopes (z:1)	= 2.70, 3.00
Total Depth (ft)	= 3.70
Invert Elev (ft)	= 6665.00
Slope (%)	= 0.50
N-Value	= 0.030

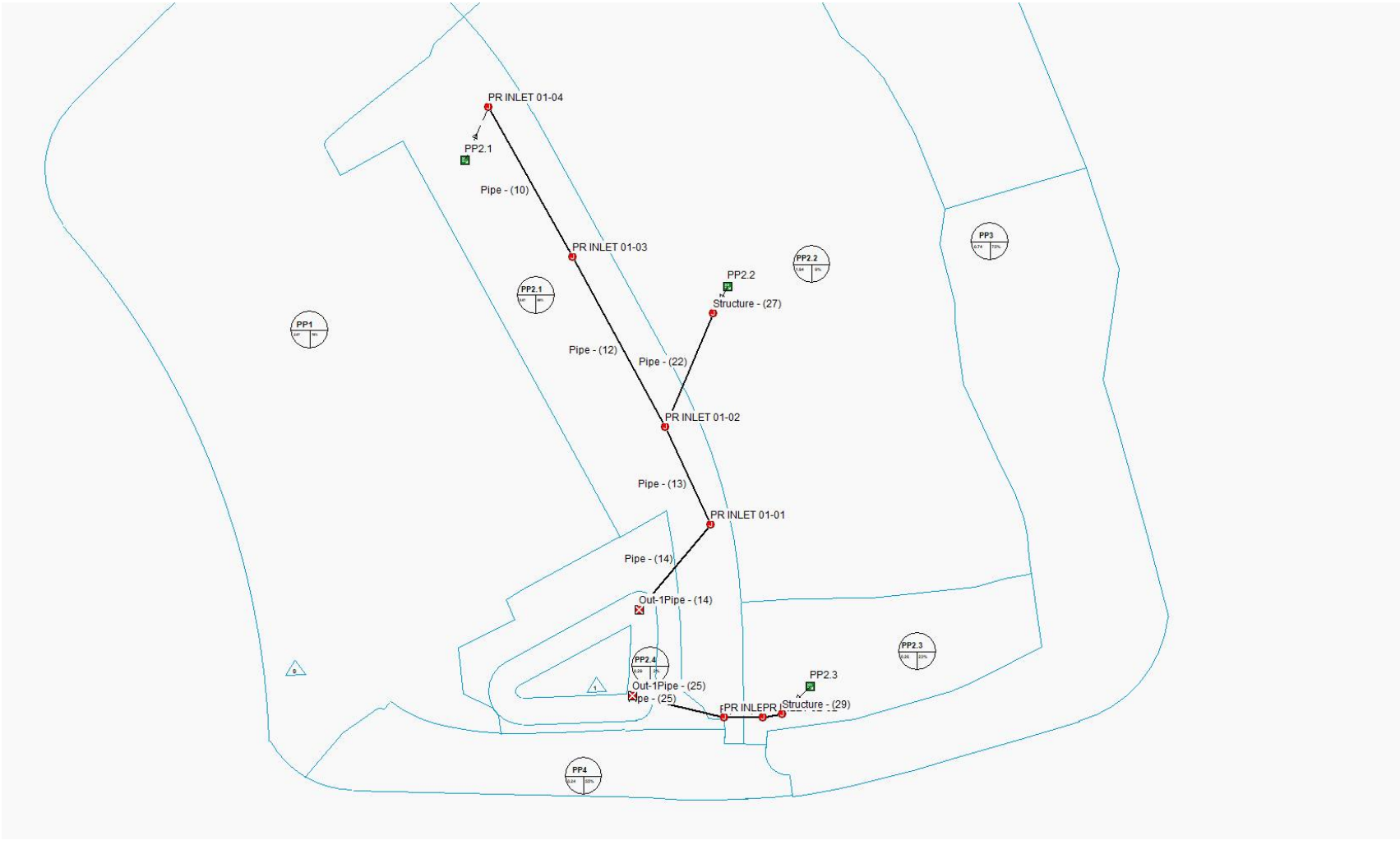
Calculations

Compute by:	Known Q
Known Q (cfs)	= 5.84

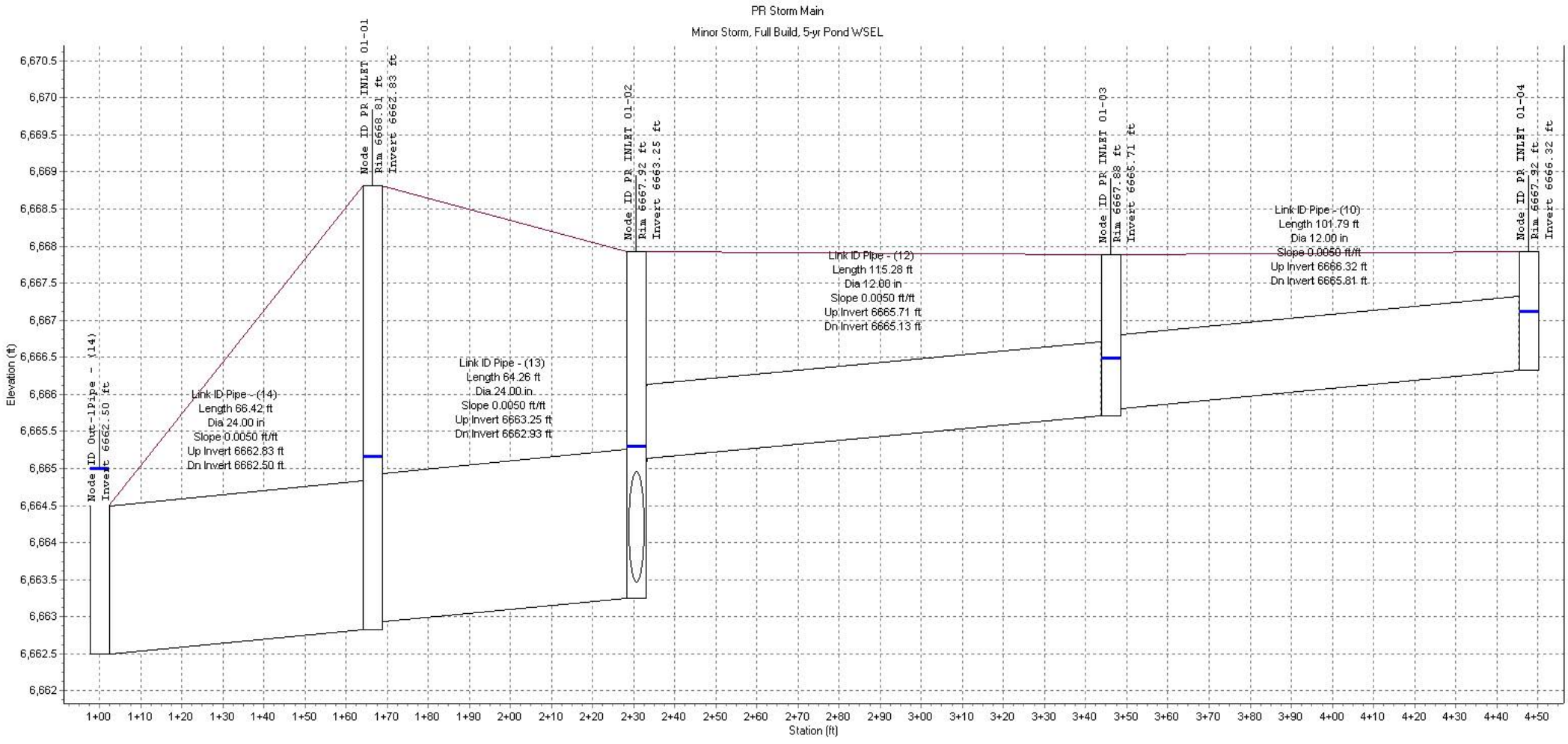
Highlighted

Depth (ft)	= 0.99
Q (cfs)	= 5.840
Area (sqft)	= 2.79
Velocity (ft/s)	= 2.09
Wetted Perim (ft)	= 5.98
Crit Depth, Yc (ft)	= 0.77
Top Width (ft)	= 5.64
EGL (ft)	= 1.06





Autodesk Storm and Sanitary Analysis



Node ID:		PR INLET 01-01	PR INLET 01-02	PR INLET 01-03	
Rim (ft):		6668.81	6667.92	6667.88	6667.92
Invert (ft):	6662.50	6662.83	6663.25	6665.71	6666.32
Min Pipe Cover (ft):		3.88	1.79	1.07	0.60
Max HGL (ft):	6665.00	6668.81	6665.32	6666.48	6667.12

Link ID:	Pipe - (14)	Pipe - (13)	Pipe - (12)	Pipe - (10)
Length (ft):	66.42	64.26	115.28	101.79
Dia (in):	24.00	24.00	12.00	12.00
Slope (ft/ft):	0.0050	0.0050	0.0050	0.0050
Up Invert (ft):	6662.83	6663.25	6665.71	6666.32
Dn Invert (ft):	6662.50	6662.93	6665.13	6665.81
Max Q (cfs):	14.61	10.20	2.15	2.25
Max Vel (ft/s):	4.99	4.47	3.70	3.70
Max Depth (ft):	2.00	2.00	0.69	0.72

Project Description

File Name	PR Storm PH1.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	User-Defined
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Aug 10, 2021	00:00:00
End Analysis On	Aug 11, 2021	00:00:00
Start Reporting On	Aug 10, 2021	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins	3
Nodes	10
Junctions	8
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	8
Channels	0
Pipes	8
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	5 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	PP2.1	0.85	0.7300	0.32	0.23	0.20	2.38	0 00:05:00
2	PP2.2	1.94	0.7300	0.43	0.31	0.61	4.37	0 00:08:16
3	PP2.3	0.26	0.7300	0.32	0.23	0.06	0.73	0 00:05:00

Node Summary

SN	Element ID	Elem Type	Invert Elevation (ft)	und/Rim (Max) Elevation (ft)	Initial Water evation (ft)	urcharge levation (ft)	onded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence ys hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	PR INLET	Junct	6662.83	######	#####	######	0.00	14.61	6668.81	0.00	0.00	0 00:00	0.00	0.00
2	PR INLET	Junct	6663.25	######	#####	######	0.00	10.20	6665.32	0.00	2.60	0 00:00	0.00	0.00
3	PR INLET	Junct	6665.71	######	#####	######	0.00	2.25	6666.48	0.00	1.41	0 00:00	0.00	0.00
4	PR INLET	Junct	6666.32	######	#####	######	0.00	2.38	6667.12	0.00	0.80	0 00:00	0.00	0.00
5	PR INLET	Junct	6663.56	######	#####	######	0.00	5.89	6667.17	0.00	0.84	0 00:00	0.00	0.00
6	PR INLET	Junct	6663.88	######	#####	######	0.00	4.90	6666.16	0.00	1.93	0 00:00	0.00	0.00
7	Structure -	Junct	6663.82	######	#####	######	0.00	5.94	6665.54	0.00	0.00	0 00:01	0.01	0.00
8	Structure -	Junct	6665.54	######	#####	######	0.00	1.00	6665.89	0.00	1.37	0 00:00	0.00	0.00
9	Out-1	Pipe Outfa	6662.50					14.61	6665.00					
10	Out-1	Pipe Outfa	6663.00					5.89	6665.00					

Link Summary

SN	Element ID	Elem Type	From (Inlet) Node	To (Outl Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert evation (ft)	Average Slope (%)	iameter or Height (in)	Manning's oughness	Peak Flow (cfs)	esign Flow Capacity (cfs)	eak Flow/ esign Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time urcharged (min)	Reported Condition
1	Pipe - (10)	Pipe	PR INLET (	PR INLE	#####	######	#####	0.5000	12.000	0.0120	2.25	2.73	0.82	3.70	0.72	0.72	0.00	Calculated
2	Pipe - (12)	Pipe	PR INLET (	PR INLE	#####	######	#####	0.5000	12.000	0.0120	2.15	2.73	0.79	3.70	0.69	0.69	0.00	Calculated
3	Pipe - (13)	Pipe	PR INLET (	PR INLE	64.26	######	#####	0.5000	24.000	0.0120	10.20	17.33	0.59	4.47	2.00	1.00	0.00	SURCHARGED
4	Pipe - (14)	Pipe	PR INLET (	Out-1Pi	66.42	######	#####	0.5000	24.000	0.0120	14.61	17.33	0.84	4.99	2.00	1.00	1439.00	SURCHARGED
5	Pipe - (22)	Pipe	Structure -	PR INLE	73.59	######	#####	0.5000	18.000	0.0120	5.51	8.05	0.68	3.24	1.50	1.00	2.00	SURCHARGED
6	Pipe - (23)	Pipe	Structure -	PR INLE	11.87	######	#####	12.3600	18.000	0.0120	0.92	40.01	0.02	1.20	0.77	0.56	0.00	Calculated
7	Pipe - (24)	Pipe	PR INLET (	PR INLE	23.09	######	#####	0.5000	18.000	0.0120	4.89	8.05	0.61	3.48	1.50	1.00	0.00	SURCHARGED
8	Pipe - (25)	Pipe	PR INLET (	Out-1Pi	56.18	######	#####	1.0000	18.000	0.0120	5.89	11.38	0.52	3.69	1.50	1.00	2.00	SURCHARGED

Subbasin Hydrology

Subbasin : PP2.1

Input Data

Area (ac) 0.85
Weighted Runoff Coefficient 0.7300

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.85	-	0.73
Composite Area & Weighted Runoff Coeff.	0.85		0.73

Subbasin Runoff Results

Total Rainfall (in) 0.32
Total Runoff (in) 0.23
Peak Runoff (cfs) 2.38
Rainfall Intensity 3.840
Weighted Runoff Coefficient 0.7300
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : PP2.2

Input Data

Area (ac) 1.94
Weighted Runoff Coefficient 0.7300

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	1.94	-	0.73
Composite Area & Weighted Runoff Coeff.	1.94		0.73

Subbasin Runoff Results

Total Rainfall (in) 0.43
Total Runoff (in) 0.31
Peak Runoff (cfs) 4.37
Rainfall Intensity 3.083
Weighted Runoff Coefficient 0.7300
Time of Concentration (days hh:mm:ss) 0 00:08:17

Subbasin : PP2.3

Input Data

Area (ac) 0.26
Weighted Runoff Coefficient 0.7300

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.26	-	0.73
Composite Area & Weighted Runoff Coeff.	0.26		0.73

Subbasin Runoff Results

Total Rainfall (in) 0.32
Total Runoff (in) 0.23
Peak Runoff (cfs) 0.73
Rainfall Intensity 3.840
Weighted Runoff Coefficient 0.7300
Time of Concentration (days hh:mm:ss) 0 00:05:00

Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	PR INLET 01-01	6662.83	6668.81	5.98	6662.83	0.00	6668.81	0.00	0.00	46.51
2	PR INLET 01-02	6663.25	6667.92	4.67	6663.25	0.00	6667.92	0.00	0.00	21.44
3	PR INLET 01-03	6665.71	6667.88	2.17	6665.71	0.00	6667.88	0.00	0.00	12.87
4	PR INLET 01-04	6666.32	6667.92	1.60	6666.32	0.00	6667.92	0.00	0.00	7.22
5	PR INLET 02-01	6663.56	6668.01	4.45	6663.56	0.00	6668.01	0.00	0.00	32.98
6	PR INLET 02-02	6663.88	6668.09	4.21	6663.88	0.00	6668.09	0.00	0.00	30.12
7	Structure - (27)	6663.82	6665.54	1.72	6663.82	0.00	6665.54	0.00	0.00	2.66
8	Structure - (29)	6665.54	6667.27	1.72	6665.54	0.00	6667.27	0.00	0.00	2.66

Junction Results

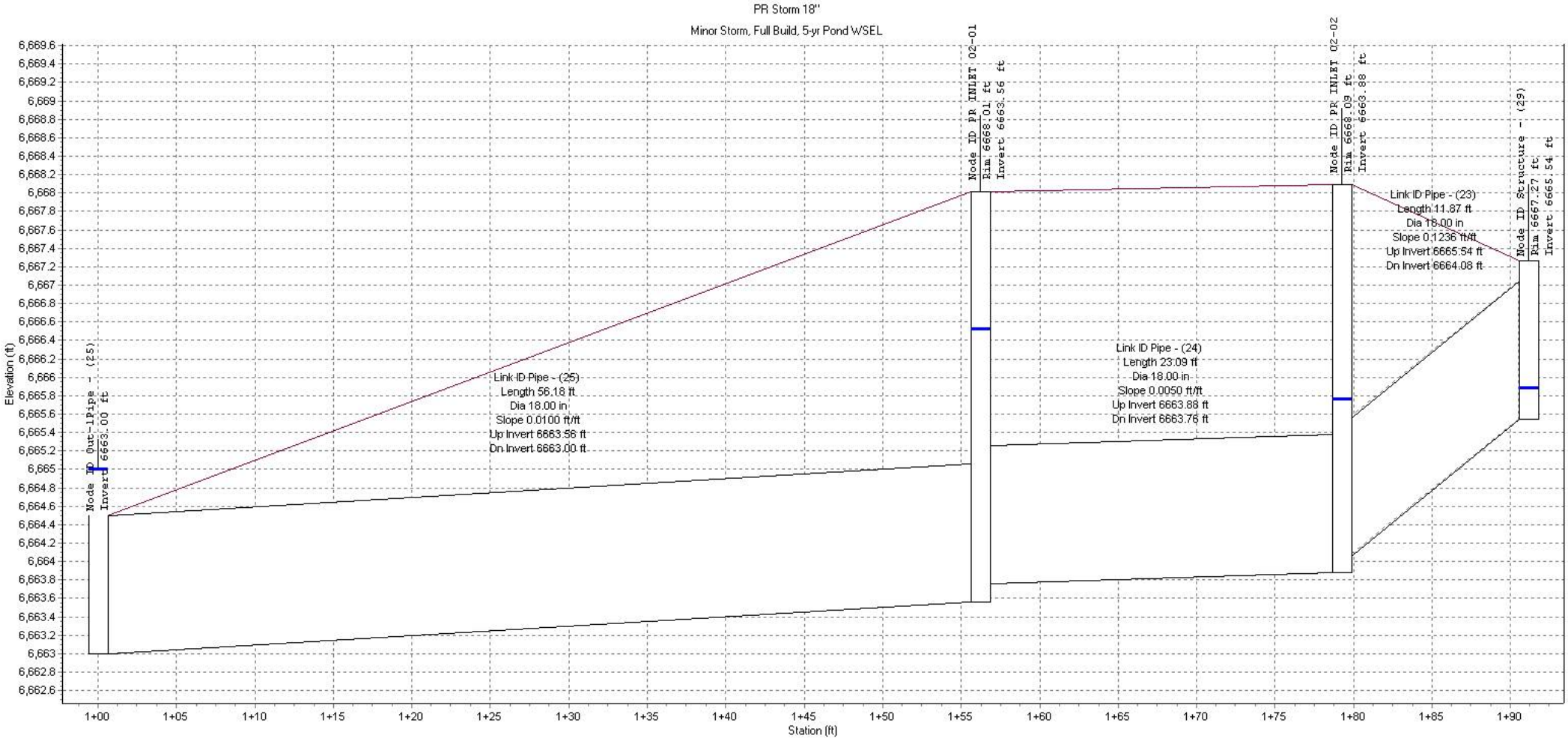
SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max charge Depth Attained (ft)	Min Freeboard Attained (ft)	erage HGL Elevation Attained (ft)	age HGL Depth Attained (ft)	Time of Max HGL ccurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	PR INLET 01-01	14.61	0.00	6668.81	5.98	0.00	0.00	6665.00	2.17	0 00:00	0 00:00	0.00	0.00
2	PR INLET 01-02	10.20	0.00	6665.32	2.07	0.00	2.60	6665.00	1.75	0 00:01	0 00:00	0.00	0.00
3	PR INLET 01-03	2.25	0.00	6666.48	0.77	0.00	1.41	6665.72	0.01	0 00:05	0 00:00	0.00	0.00
4	PR INLET 01-04	2.38	2.38	6667.12	0.80	0.00	0.80	6666.33	0.01	0 00:05	0 00:00	0.00	0.00
5	PR INLET 02-01	5.89	0.00	6667.17	3.61	0.00	0.84	6665.00	1.44	0 00:00	0 00:00	0.00	0.00
6	PR INLET 02-02	4.90	0.00	6666.16	2.28	0.00	1.93	6665.00	1.12	0 00:00	0 00:00	0.00	0.00
7	Structure - (27)	5.94	4.37	6665.54	1.72	0.00	0.00	6665.00	1.18	0 00:01	0 00:01	0.01	0.00
8	Structure - (29)	1.00	0.73	6665.89	0.35	0.00	1.37	6665.55	0.01	0 00:05	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe iameter or Height (in)	Pipe Width (in)	Manning's oughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Pipe - (10)	101.79	6666.32	0.00	6665.81	0.10	0.51	0.5000	CIRCUL.	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
2	Pipe - (12)	115.28	6665.71	0.00	6665.13	1.88	0.58	0.5000	CIRCUL.	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
3	Pipe - (13)	64.26	6663.25	0.00	6662.93	0.10	0.32	0.5000	CIRCUL.	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
4	Pipe - (14)	66.42	6662.83	0.00	6662.50	0.00	0.33	0.5000	CIRCUL.	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
5	Pipe - (22)	73.59	6663.82	0.00	6663.45	0.20	0.37	0.5000	CIRCUL.	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
6	Pipe - (23)	11.87	6665.54	0.00	6664.08	0.20	1.47	12.3600	CIRCUL.	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
7	Pipe - (24)	23.09	6663.88	0.00	6663.76	0.20	0.12	0.5000	CIRCUL.	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
8	Pipe - (25)	56.18	6663.56	0.00	6663.00	0.00	0.56	1.0000	CIRCUL.	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity	eak Flow/ sign Flow Ratio	k Flow /elocity (ft/sec)	Travel Time (min)	Peak Flow Depth Total (ft)	eak Flow Depth/ Depth Ratio	Total Time urcharged (min)	Froude Number	Reported Condition
1	Pipe - (10)	2.25	0 00:05	2.73	0.82	3.70	0.46	0.72	0.72	0.00		Calculated
2	Pipe - (12)	2.15	0 00:06	2.73	0.79	3.70	0.52	0.69	0.69	0.00		Calculated
3	Pipe - (13)	10.20	0 00:00	17.33	0.59	4.47	0.24	2.00	1.00	0.00		SURCHARGED
4	Pipe - (14)	14.61	0 00:00	17.33	0.84	4.99	0.22	2.00	1.00	1439.00		SURCHARGED
5	Pipe - (22)	5.51	0 00:00	8.05	0.68	3.24	0.38	1.50	1.00	2.00		SURCHARGED
6	Pipe - (23)	0.92	0 00:00	40.01	0.02	1.20	0.16	0.77	0.56	0.00		Calculated
7	Pipe - (24)	4.89	0 00:00	8.05	0.61	3.48	0.11	1.50	1.00	0.00		SURCHARGED
8	Pipe - (25)	5.89	0 00:00	11.38	0.52	3.69	0.25	1.50	1.00	2.00		SURCHARGED



Node ID:		PR INLET 02-01	PR INLET 02-02	Structure - (29
Rim (ft):		6668.01	6668.09	6667.27
Invert (ft):	6663.00	6663.56	6663.88	6665.54
Min Pipe Cover (ft):		2.75	2.51	0.22
Max HGL (ft):	6665.00	6667.17	6666.16	6665.89

Link ID:	Pipe - (25)	Pipe - (24)	Pipe - (23)
Length (ft):	56.18	23.09	11.87
Dia (in):	18.00	18.00	18.00
Slope (ft/ft):	0.0100	0.0050	0.1236
Up Invert (ft):	6663.56	6663.88	6665.54
Dn Invert (ft):	6663.00	6663.76	6664.08
Max Q (cfs):	5.89	4.89	0.92
Max Vel (ft/s):	3.69	3.48	1.20
Max Depth (ft):	1.50	1.50	0.77

Project Description

File Name	PR Storm PH1-100yr.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	User-Defined
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Aug 10, 2021	00:00:00
End Analysis On	Aug 11, 2021	00:00:00
Start Reporting On	Aug 10, 2021	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins	3
Nodes	10
Junctions	8
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	8
Channels	0
Pipes	8
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	100 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	PP2.1	0.85	0.8300	0.70	0.58	0.49	5.94	0 00:05:00
2	PP2.2	1.94	0.8300	0.94	0.78	1.51	10.88	0 00:08:16
3	PP2.3	0.26	0.8300	0.70	0.58	0.15	1.82	0 00:05:00

Node Summary

SN	Element ID	Elem Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	PR INLET	Junct	6662.83	6668.81	6662.83	6668.81	0.00	20.63	6668.81	0.00	0.00	0 00:00	0.00	0.00
2	PR INLET	Junct	6663.25	6667.92	6663.25	6667.92	0.00	13.39	6665.81	0.00	2.11	0 00:00	0.00	0.00
3	PR INLET	Junct	6665.71	6667.88	6665.71	6667.88	0.00	3.69	6667.88	0.00	0.00	0 00:03	0.00	0.00
4	PR INLET	Junct	6666.32	6667.92	6666.32	6667.92	0.00	5.93	6667.92	0.00	0.00	0 00:05	0.10	4.00
5	PR INLET	Junct	6663.56	6668.01	6663.56	6668.01	0.00	9.24	6668.01	0.00	0.00	0 00:00	0.00	0.00
6	PR INLET	Junct	6663.88	6668.09	6663.88	6668.09	0.00	7.94	6667.53	0.00	0.56	0 00:00	0.00	0.00
7	Structure -	Junct	6663.82	6665.54	6663.82	6665.54	0.00	14.59	6665.54	0.00	0.00	0 00:08	76.27	1439.00
8	Structure -	Junct	6665.54	6667.27	6665.54	6667.27	0.00	3.98	6666.62	0.00	0.64	0 00:00	0.00	0.00
9	Out-1	Pipe Outfa	6662.50					20.63	6665.70					
10	Out-1	Pipe Outfa	6663.00					9.24	6665.70					

Link Summary

SN	Element ID	Elem Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Pipe - (10)	Pipe	PR INLET (	PR INLET 01-03	101.79	6666.32	6665.81	0.5000	12.000	0.0120	3.69	2.73	1.35	4.77	1.00	1.00	4.00	SURCHARGED
2	Pipe - (12)	Pipe	PR INLET (	PR INLET 01-02	115.28	6665.71	6665.13	0.5000	12.000	0.0120	3.21	2.73	1.18	4.37	0.88	0.88	0.00	> CAPACITY
3	Pipe - (13)	Pipe	PR INLET (	PR INLET 01-01	64.26	6663.25	6662.93	0.5000	24.000	0.0120	13.39	17.33	0.77	5.44	2.00	1.00	1439.00	SURCHARGED
4	Pipe - (14)	Pipe	PR INLET (	Out-1Pipe - (14)	66.42	6662.83	6662.50	0.5000	24.000	0.0120	20.63	17.33	1.19	6.59	2.00	1.00	1440.00	SURCHARGED
5	Pipe - (22)	Pipe	Structure -	PR INLET 01-02	73.59	6663.82	6663.45	0.5000	18.000	0.0120	7.52	8.05	0.93	4.26	1.50	1.00	1439.00	SURCHARGED
6	Pipe - (23)	Pipe	Structure -	PR INLET 02-02	11.87	6665.54	6664.08	12.3600	18.000	0.0120	3.88	40.01	0.10	3.63	1.17	0.86	0.00	Calculated
7	Pipe - (24)	Pipe	PR INLET (	PR INLET 02-01	23.09	6663.88	6663.76	0.5000	18.000	0.0120	7.93	8.05	0.99	5.85	1.50	1.00	1440.00	SURCHARGED
8	Pipe - (25)	Pipe	PR INLET (	Out-1Pipe - (25)	56.18	6663.56	6663.00	1.0000	18.000	0.0120	9.24	11.38	0.81	5.32	1.50	1.00	1440.00	SURCHARGED

Subbasin Hydrology

Subbasin : PP2.1

Input Data

Area (ac) 0.85
Weighted Runoff Coefficient 0.8300

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.85	-	0.83
Composite Area & Weighted Runoff Coeff.	0.85		0.83

Subbasin Runoff Results

Total Rainfall (in) 0.70
Total Runoff (in) 0.58
Peak Runoff (cfs) 5.94
Rainfall Intensity 8.420
Weighted Runoff Coefficient 0.8300
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : PP2.2

Input Data

Area (ac) 1.94
Weighted Runoff Coefficient 0.8300

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	1.94	-	0.83
Composite Area & Weighted Runoff Coeff.	1.94		0.83

Subbasin Runoff Results

Total Rainfall (in) 0.94
Total Runoff (in) 0.78
Peak Runoff (cfs) 10.88
Rainfall Intensity 6.755
Weighted Runoff Coefficient 0.8300
Time of Concentration (days hh:mm:ss) 0 00:08:17

Subbasin : PP2.3

Input Data

Area (ac) 0.26
Weighted Runoff Coefficient 0.8300

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.26	-	0.83
Composite Area & Weighted Runoff Coeff.	0.26		0.83

Subbasin Runoff Results

Total Rainfall (in) 0.70
Total Runoff (in) 0.58
Peak Runoff (cfs) 1.82
Rainfall Intensity 8.420
Weighted Runoff Coefficient 0.8300
Time of Concentration (days hh:mm:ss) 0 00:05:00

Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	PR INLET 01-01	6662.83	6668.81	5.98	6662.83	0.00	6668.81	0.00	0.00	46.51
2	PR INLET 01-02	6663.25	6667.92	4.67	6663.25	0.00	6667.92	0.00	0.00	21.44
3	PR INLET 01-03	6665.71	6667.88	2.17	6665.71	0.00	6667.88	0.00	0.00	12.87
4	PR INLET 01-04	6666.32	6667.92	1.60	6666.32	0.00	6667.92	0.00	0.00	7.22
5	PR INLET 02-01	6663.56	6668.01	4.45	6663.56	0.00	6668.01	0.00	0.00	32.98
6	PR INLET 02-02	6663.88	6668.09	4.21	6663.88	0.00	6668.09	0.00	0.00	30.12
7	Structure - (27)	6663.82	6665.54	1.72	6663.82	0.00	6665.54	0.00	0.00	2.66
8	Structure - (29)	6665.54	6667.27	1.72	6665.54	0.00	6667.27	0.00	0.00	2.66

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max charge Depth Attained (ft)	Min erage HGL Freeboard Attained (ft)	age HGL Elevation Attained (ft)	age HGL Depth Attained (ft)	Time of Max HGL ccurrence ys hh:mm)	Time of Peak Flooding Occurrence ys hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	PR INLET 01-01	20.63	0.00	6668.81	5.98	0.00	0.00	6665.67	2.84	0 00:00	0 00:00	0.00	0.00
2	PR INLET 01-02	13.39	0.00	6665.81	2.56	0.00	2.11	6665.65	2.40	0 00:00	0 00:00	0.00	0.00
3	PR INLET 01-03	3.69	0.00	6667.88	2.17	0.00	0.00	6665.72	0.01	0 00:03	0 00:03	0.00	0.00
4	PR INLET 01-04	5.93	5.93	6667.92	1.60	0.00	0.00	6666.33	0.01	0 00:02	0 00:05	0.10	4.00
5	PR INLET 02-01	9.24	0.00	6668.01	4.45	0.00	0.00	6665.70	2.14	0 00:00	0 00:00	0.00	0.00
6	PR INLET 02-02	7.94	0.00	6667.53	3.65	0.00	0.56	6665.70	1.82	0 00:00	0 00:00	0.00	0.00
7	Structure - (27)	14.59	10.87	6665.54	1.72	0.00	0.00	6665.54	1.72	0 00:00	0 00:08	76.27	1439.00
8	Structure - (29)	3.98	1.81	6666.62	1.08	0.00	0.64	6665.70	0.16	0 00:00	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	iameter or Height (in)	Pipe Width (in)	Manning's oughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Pipe - (10)	101.79	6666.32	0.00	6665.81	0.10	0.51	0.5000	CIRCUL	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
2	Pipe - (12)	115.28	6665.71	0.00	6665.13	1.88	0.58	0.5000	CIRCUL	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
3	Pipe - (13)	64.26	6663.25	0.00	6662.93	0.10	0.32	0.5000	CIRCUL	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
4	Pipe - (14)	66.42	6662.83	0.00	6662.50	0.00	0.33	0.5000	CIRCUL	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
5	Pipe - (22)	73.59	6663.82	0.00	6663.45	0.20	0.37	0.5000	CIRCUL	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
6	Pipe - (23)	11.87	6665.54	0.00	6664.08	0.20	1.47	12.3600	CIRCUL	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
7	Pipe - (24)	23.09	6663.88	0.00	6663.76	0.20	0.12	0.5000	CIRCUL	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
8	Pipe - (25)	56.18	6663.56	0.00	6663.00	0.00	0.56	1.0000	CIRCUL	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence days hh:mm)	Design Flow Capacity	eak Flow/ sign Flow Ratio	k Flow /elocity (ft/sec)	Travel Time (min)	Peak Flow Depth Total (ft)	eak Flow Depth/ Depth Ratio	Total Time urcharged (min)	Froude Number	Reported Condition
1	Pipe - (10)	3.69	0 00:03	2.73	1.35	4.77	0.36	1.00	1.00	4.00		SURCHARGED
2	Pipe - (12)	3.21	0 00:03	2.73	1.18	4.37	0.44	0.88	0.88	0.00		> CAPACITY
3	Pipe - (13)	13.39	0 00:00	17.33	0.77	5.44	0.20	2.00	1.00	1439.00		SURCHARGED
4	Pipe - (14)	20.63	0 00:00	17.33	1.19	6.59	0.17	2.00	1.00	1440.00		SURCHARGED
5	Pipe - (22)	7.52	0 00:00	8.05	0.93	4.26	0.29	1.50	1.00	1439.00		SURCHARGED
6	Pipe - (23)	3.88	0 00:00	40.01	0.10	3.63	0.05	1.17	0.86	0.00		Calculated
7	Pipe - (24)	7.93	0 00:00	8.05	0.99	5.85	0.07	1.50	1.00	1440.00		SURCHARGED
8	Pipe - (25)	9.24	0 00:00	11.38	0.81	5.32	0.18	1.50	1.00	1440.00		SURCHARGED

APPENDIX C

DETENTION/WATER QUALITY CALCULATIONS

LANDMARK CONSULTANTS, INC.

CIVIL ENGINEERS | SURVEYORS

141 9th Street ~ P.O. Box 774943
Steamboat Springs, Colorado 80477
(970) 871-9494
www.LANDMARK-CO.com

PROJECT:	Steamboat Base Camp Phase 1
DESIGNER:	DCS
DATE:	8/9/2021
POND ID:	EDB/Detention Pond

WQCV DESIGN CALCULATION - 40 HOUR DRAIN TIME

Extended Detention Basin - Preliminary Plat

REQUIRED STORAGE:

BASIN AREA (AC) =	3.15	<-- INPUT from impervious calcs
BASIN IMPERVIOUSNESS PERCENT =	19%	<-- INPUT from impervious calcs
BASIN IMPERVIOUSNESS RATIO =	0.1933	<-- CALCULATED
d6 (in) =	0.34	<-- INPUT depth of average runoff producing storm
WQCV (watershed inches) =	0.09	<-- CALCULATED from USDCM Vol.3, Equation 3-1
V (ft^3) =	1,226	<-- CALCULATED from USDCM Vol.3, Equation B-1

FOREBAY:

100-YEAR PEAK DISCHARGE (cfs) =	14.49	<-- INPUT from runoff calcs
RELEASE RATE (cfs) =	0.29	<-- CALCULATED from MHFD Vol. 3, Table EDB-4
MIN VOLUME (ft3) =	25	<-- CALCULATED from MHFD Vol. 3, Table EDB-4

TRICKLE CHANNEL

CAPACITY (cfs) =	0.29	<-- INPUT forebay release rate

INITIAL SURCHARGE VOLUME

MIN VOLUME (ft3) =	3.68	<-- CALCULATED from MHFD Vol. 3, Table EDB-4

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(970) 871-9494
www.LANDMARK-CO.com

PROJECT:	Steamboat Base Camp Phase 1
DESIGNER:	DCS
DATE:	8/9/2021
POND ID:	EDB/Detention Pond

FAA Method Detention Estimate - Preliminary Plat

Per section 5.11.7.2 of the City of Steamboat Springs Drainage Criteria

$$V_i = (CiA)(T_c)(60\,\text{sec/min}) \qquad (5.11.1)$$

Where:

V_i = inflow volume (ft³)
C = Rational Method runoff coefficient for the major or minor storm
A = watershed area draining to the detention pond (acres)
T_c = Rational Method time of concentration (min)
i = design rainfall intensity (in/hr)

$$V_o = (Allowable\,Release Rate)(T_c)(60\,\text{sec/min}) \qquad (5.11.2)$$

Where:

V_o = outflow volume (ft³)
T_c = Rational Method time of concentration (min)
Allowable release rate shall be determined per this Section (cfs).

A (acres) =	3.15	<-- INPUT from impervious calcs
Tc (min) =	12.78	<-- INPUT from Tc calcs

Minor Storm (5-Year) Use Minor Storm for Detention only pond (No WQ)

C_5 =	0.20	<-- INPUT from impervious calcs
i (in/hr) =	2.53	<-- INPUT from runoff calcs
V_i (ft^3) =	1216	
Q_{A5} =	1.26	<-- INPUT from historic runoff calcs
V_o (ft^3) =	966	
V_{req} (ft^3) =	250	

Major Storm (100-Year)

C_{100}	0.57	<-- INPUT from impervious calcs
i (in/hr)	5.52	<-- INPUT from runoff calcs
V_i (ft^3)	7,547	
Q_{A100}	10.35	<-- INPUT from historic runoff calcs
V_o (ft^3)	7,932	
V_{req} (ft^3)	-385	

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PROJECT: Steamboat Base Camp Phase 1
DESIGNER: DCS
DATE: 8/9/2021
POND ID: EDB/Detention Pond

POND VOLUME PROVIDED - Basecamp Square

$$V = \frac{D^*\left(A_1 + A_2 + \sqrt{A_1 * A_2}\right)}{3}$$

D = Depth between contours (ft.)
A_1 = Surface Area lower contour (ft^2)
A_2 = Surface Area upper contour (ft^2)

Elevation	Surface Area	Incremental Depth	Incremental Vol.	Total Vol.	Total Vol.	Stage
(ft)	(ft^2)	(ft)	(ft^3)	(ft^3)	(ac-ft)	
6662.10	5	0.00	0	0.0	0.00	
6662.20	19	0.10	1	1.1	0.00	
6662.30	43	0.10	3	4.2	0.00	
6662.40	72	0.10	6	9.9	0.00	
6662.50	102	0.10	9	18.6	0.00	
6662.60	134	0.10	12	30.4	0.00	
6662.70	167	0.10	15	45.4	0.00	
6662.80	202	0.10	18	63.9	0.00	
6662.90	238	0.10	22	85.9	0.00	
6663.00	1625	0.10	83	168.7	0.00	
6663.10	1702	0.10	166	335.0	0.01	5-Year Detention
6663.20	1780	0.10	174	509.1	0.01	
6663.30	1860	0.10	182	691.1	0.02	
6663.40	1940	0.10	190	881.0	0.02	
6663.50	2022	0.10	198	1079.1	0.02	
6663.60	2104	0.10	206	1285.4	0.03	WQCV
6663.70	2188	0.10	215	1499.9	0.03	
6663.80	2272	0.10	223	1722.9	0.04	
6663.90	2358	0.10	231	1954.4	0.04	
6664.00	2444	0.10	240	2194.5	0.05	
6665.00	3381	0.10	333	5100.5	0.12	
6666.00	4417	0.10	436	8995.9	0.21	
6666.10	4530	0.10	447	9443.2	0.22	
6666.20	4643	0.10	459	9901.8	0.23	
6666.30	4756	0.10	470	10371.7	0.24	
6666.40	4869	0.10	481	10853.0	0.25	
6666.50	4982	0.10	493	11345.5	0.26	
6666.60	5096	0.10	504	11849.4	0.27	
6666.70	5210	0.10	515	12364.7	0.28	
6666.80	5324	0.10	527	12891.4	0.30	
6666.90	5439	0.10	538	13429.6	0.31	

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141 9th Street ~ P.O. Box 774943
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www.LANDMARK-CO.com

PROJECT:	Steamboat Base Camp Phase 1
DESIGNER:	DCS
DATE:	7/26/2021
POND ID:	EDB/Detention Pond

FAA Method Detention Estimate - Future

Per section 5.11.7.2 of the City of Steamboat Springs Drainage Criteria

$$V_i = (CiA)(T_c)(60\,\text{sec/min}) \qquad (5.11.1)$$

Where:

V_i = inflow volume (ft³)
C = Rational Method runoff coefficient for the major or minor storm
A = watershed area draining to the detention pond (acres)
T_c = Rational Method time of concentration (min)
i = design rainfall intensity (in/hr)

$$V_o = (Allowable\,Release Rate)(T_c)(60\,\text{sec/min}) \qquad (5.11.2)$$

Where:

V_o = outflow volume (ft³)
T_c = Rational Method time of concentration (min)
Allowable release rate shall be determined per this Section (cfs).

A (acres) =	3.34	<-- INPUT from impervious calcs
Tc (min) =	10.34	<-- INPUT from Tc calcs

Minor Storm (5-Year) Use Minor Storm for Detention only pond (No WQ)

C_5 =	0.73	<-- INPUT from impervious calcs
i (in/hr) =	3.86	<-- INPUT from runoff calcs
V_i (ft^3) =	5845	
Q_{A5} =	1.33	<-- INPUT from historic runoff calcs
V_o (ft^3) =	825	
V_{req} (ft^3) =	5020	

Major Storm (100-Year)

C_{100}	0.83	<-- INPUT from impervious calcs
i (in/hr)	8.42	<-- INPUT from runoff calcs
V_i (ft^3)	14,512	
Q_{A100}	10.72	<-- INPUT from historic runoff calcs
V_o (ft^3)	6,656	
V_{req} (ft^3)	7856	

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PROJECT:	Steamboat Base Camp Phase 1
DESIGNER:	DCS
DATE:	4/16/2021
POND ID:	EDB/Detention Pond

WQCV DESIGN CALCULATION - 40 HOUR DRAIN TIME

Extended Detention Basin - Future

REQUIRED STORAGE:

BASIN AREA (AC) =	3.34	<-- INPUT from impervious calcs
BASIN IMPERVIOUSNESS PERCENT =	85%	<-- INPUT from impervious calcs
BASIN IMPERVIOUSNESS RATIO =	0.8500	<-- CALCULATED
d6 (in) =	0.34	<-- INPUT depth of average runoff producing storm
WQCV (watershed inches) =	0.29	<-- CALCULATED from USDCM Vol.3, Equation 3-1
V (ft^3) =	4,161	<-- CALCULATED from USDCM Vol.3, Equation B-1

FOREBAY:

100-YEAR PEAK DISCHARGE (cfs) =	17.28	<-- INPUT from runoff calcs
RELEASE RATE (cfs) =	0.35	<-- CALCULATED from MHFD Vol. 3, Table EDB-4
MIN VOLUME (ft3) =	83	<-- CALCULATED from MHFD Vol. 3, Table EDB-4

TRICKLE CHANNEL

CAPACITY (cfs) =	0.35	<-- INPUT forebay release rate

INITIAL SURCHARGE VOLUME

MIN VOLUME (ft3) =	12.48	<-- CALCULATED from MHFD Vol. 3, Table EDB-4

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PROJECT: Steamboat Base Camp Phase 1
DESIGNER: DCS
DATE: 7/26/2021
POND ID: EDB/Detention Pond

POND VOLUME PROVIDED - Future

$$V = \frac{D * \left(A_1 + A_2 + \sqrt{A_1 * A_2}\right)}{3}$$

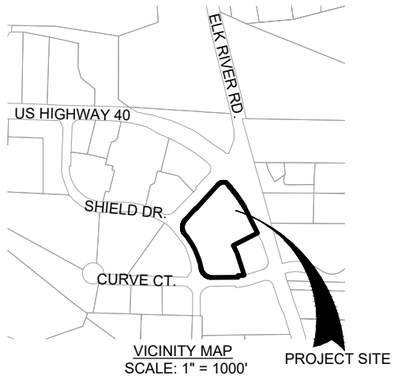
D = Depth between contours (ft.)
A_1 = Surface Area lower contour (ft^2)
A_2 = Surface Area upper contour (ft^2)

Elevation	Surface Area	Incremental Depth	Incremental Vol.	Total Vol.	Total Vol.	Stage
(ft)	(ft^2)	(ft)	(ft^3)	(ft^3)	(ac-ft)	
6662.10	5	0.00	0	0.0	0.00	
6663.00	1625	0.10	83	168.7	0.00	
6663.10	1702	0.10	166	335.0	0.01	
6663.20	1780	0.10	174	509.1	0.01	
6663.30	1860	0.10	182	691.1	0.02	
6663.40	1940	0.10	190	881.0	0.02	
6663.50	2022	0.10	198	1079.1	0.02	
6663.60	2104	0.10	206	1285.4	0.03	
6663.70	2188	0.10	215	1499.9	0.03	
6663.80	2272	0.10	223	1722.9	0.04	
6663.90	2358	0.10	231	1954.4	0.04	
6664.00	2444	0.10	240	2194.5	0.05	
6664.10	2535	0.10	249	2443.4	0.06	
6664.20	2625	0.10	258	2701.4	0.06	
6664.30	2717	0.10	267	2968.5	0.07	
6664.40	2810	0.10	276	3244.9	0.07	
6664.50	2903	0.10	286	3530.5	0.08	
6664.60	2997	0.10	295	3825.4	0.09	
6664.70	3092	0.10	304	4129.9	0.09	WQCV
6664.80	3187	0.10	314	4443.8	0.10	
6664.90	3284	0.10	324	4767.3	0.11	
6665.00	3381	0.10	333	5100.5	0.12	5-Year Detention
6665.10	3482	0.10	343	5443.7	0.12	
6665.20	3585	0.10	353	5797.0	0.13	
6665.30	3687	0.10	364	6160.6	0.14	
6665.40	3790	0.10	374	6534.4	0.15	
6665.50	3894	0.10	384	6918.6	0.16	
6665.60	3997	0.10	395	7313.1	0.17	
6665.70	4102	0.10	405	7718.1	0.18	100-Year Detention
6665.80	4207	0.10	415	8133.5	0.19	
6665.90	4312	0.10	426	8559.4	0.20	
6666.00	4417	0.10	436	8995.9	0.21	
6666.50	4982	0.10	493	11345.5	0.26	
6666.90	5439	0.10	538	13429.6	0.31	

APPENDIX D

BMP MAINTENANCE PLAN

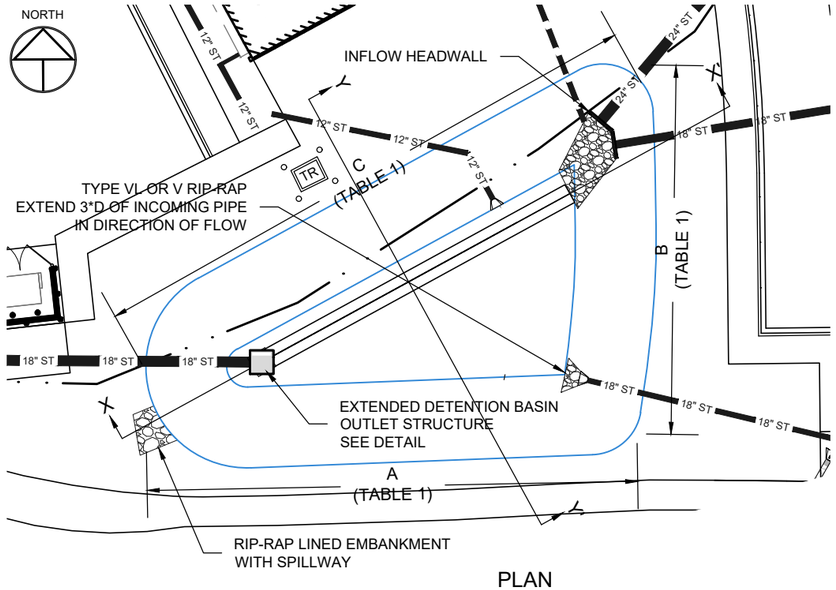
STEAMBOAT BASECAMP
OWNERSHIP AND MAINTENANCE PLAN
FOR
EXTENDED DETENTION BASIN



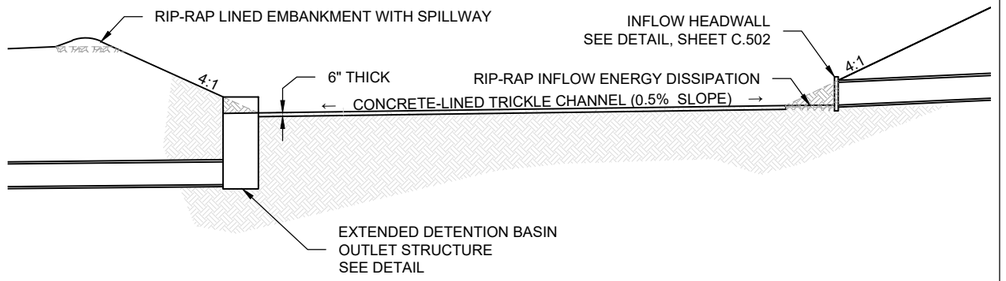
VICINITY MAP
SCALE: 1" = 1000'

NOTES:

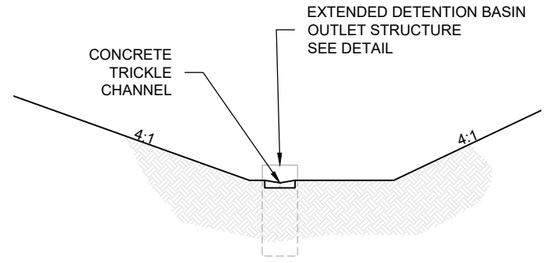
1. FOR ADDITIONAL DESIGN INFORMATION REFER TO THE CONSTRUCTION DRAWINGS FOR THIS PROJECT.
2. DISTURBANCE OF WETLAND AREAS SHALL BE AVOIDED DURING MAINTENANCE OPERATIONS.
3. SEE DETAILED NOTES ON THE SECOND SHEET OF THIS PLAN FOR ALL MAINTENANCE REQUIREMENTS.



PLAN
SCALE: 1" = 30'

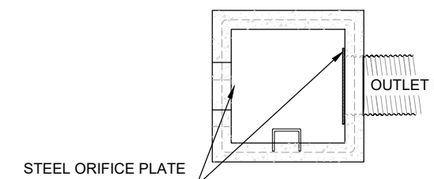


SECTION X-X'

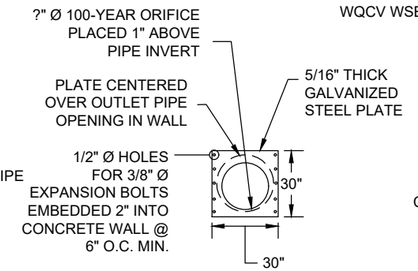


SECTION Y-Y'

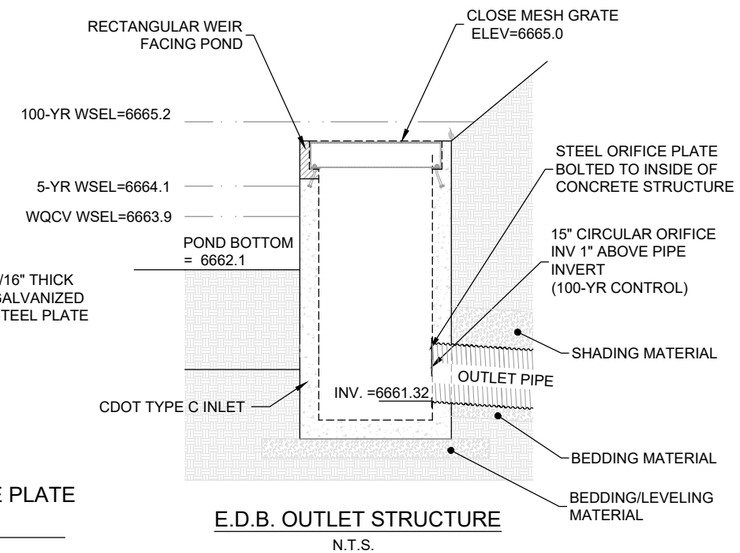
TABLE 1: POND DIMENSIONS	
DIM A (ft)	97
DIM B (ft)	73
DIM C (ft)	113



E.D.B. OUTLET STRUCTURE
PLAN VIEW
N.T.S.



100-YEAR ORIFICE PLATE
DETAIL
N.T.S.



E.D.B. OUTLET STRUCTURE
N.T.S.

PROJECT: 2387-004	NO.	DATE:	BY:	DESCRIPTION:
DATE: 7/27/2021				
DRAWN BY: DCS				
CHECKED BY: LCI				

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Steamboat Basecamp
Ownership & Maintenance Plan
Extended Detention Basin

SHEET 1 Of 2 Sheets

OWNERSHIP AND MAINTENANCE PLAN FOR STEAMBOAT BASECAMP EXTENDED DETENTION BASIN

1. GENERAL PROJECT INFORMATION

A. STEAMBOAT BASECAMP. LOT 1, WORLDWEST SUBDIVISION

B. RECEIVING WATER: ROADSIDE DITCH ON CURVE COURT. ULTIMATE OUTFALL YAMPA RIVER.

PROPERTY OWNER: MAY RIEGLER PROPERTIES
2201 WISCONSIN AVE NW
SUITE 200
WASHINGTON DC 20007
gaby@mayriegler.com

C. AGENCY RESPONSIBLE FOR MAINTENANCE: SAME AS OWNER

D. DESIGN ENGINEER: LANDMARK CONSULTANTS, INC.
141 9TH STREET
STEAMBOAT SPRINGS, CO 80487
970-871-9494
ATTN: ERIK GRIEPENTROG, P.E.
ERIKG@LANDMARK-CO.COM

2. GENERAL FACILITY DESCRIPTION

THIS FACILITY IS AN EXTENDED DETENTION BASIN THAT WILL RELEASE THE WATER QUALITY CAPTURE VOLUME OVER 40-HOURS. THE FACILITY HAS BEEN ADOPTED AND APPROVED BY THE MAY RIEGLER PROPERTIES AS A PART OF THE STEAMBOAT BASECAMP PROJECT. IT WILL RECEIVE RUNOFF FROM 3.17-ACRES AND WILL OCCUPY A PARCEL OF 0.12-ACRES THAT WILL BE USED TO TREAT RUNOFF VIA SETTLING AND PROVIDE ACCESS FOR MAINTENANCE ACTIVITIES.

3. INSPECTION & MAINTENANCE FREQUENCY & PROCEDURE

A. MAINTENANCE ACTIVITIES SHALL OCCUR ACCORDING TO TABLE 3:

TABLE 3: MAINTENANCE ACTIVITY/FREQUENCY

ACTIVITY	REQUIRED FREQUENCY
LAWN MOWING AND LAWN CARE	ROUTINE - DEPENDING ON AESTHETIC REQUIREMENTS
DEBRIS AND LITTER REMOVAL	ROUTINE - TWICE ANNUALLY UPON INSPECTION AND AS NEEDED FOLLOWING SIGNIFICANT RAINFALL EVENTS
SEDIMENT REMOVAL FROM FOREBAY AND MICROPOOL	ROUTINE - ONCE ANNUALLY AFTER COMPLETION OF SNOWMELT FROM CONTRIBUTING BASIN
NUISANCE CONTROL	NON-ROUTINE - HANDLE AS NECESSARY PER INSPECTION OR LOCAL COMPLAINTS
EROSION AND SEDIMENT CONTROL	NON-ROUTINE - PERIODIC REPAIR AS NECESSARY BASIN ON INSPECTION
STRUCTURAL	NON-ROUTINEREPAIR AS NEEDED BASED ON INSPECTIONS
INSPECTIONS	ROUTINE - TWO TIMES ANNUALLY, ONCE AFTER COMPLETION OF SNOWMELT AND ONCE AFTER SIGNIFICANT RAINFALL EVENT
SEDIMENT REMOVAL	NON ROUTINE - PERFORMED WHEN SEDIMENT ACCUMULATION OCCUPIES 20% OF WQCV (1,091-CF OR 1.4-FT DEEP). THIS MAY VARY CONSIDERABLY, BUT EXPECT TO DO THIS EVERY 15 TO 20 YEARS

B. REVISIONS TO MAINTENANCE FREQUENCY:

DATES/REASONS FOR CHANGES:

C. TRAFFIC CONTROL: N/A

D. THE FACILITY DOES NOT REQUIRE CONFINED SPACE ENTRY PROCEDURES.

E. DEWATERING AND WATER CONTROL: DEWATERING OF THE MICRO-POOL BY PUMPING ONTO THE EDB'S BOTTOM GRASSES WILL BE NEEDED TO REMOVE ACCUMULATED SEDIMENT FROM THE MICRO-POOL'S BOTTOM.

F. DEBRIS, & TRASH REMOVAL & DISPOSAL

REMOVAL SHALL BE CONDUCTED IF THERE IS PRESENCE OF TRASH OR DEBRIS AT INSPECTION. SEDIMENT AND DEBRIS SHALL BE REMOVED MANUALLY USING A SHOVEL OR RAKE AND DISPOSED OF AT A LICENSED FACILITY. THE LONGEST DISTANCE BETWEEN THE EDGE OF AN ACCESS ROAD AND THE FAR CORNER OF A STRUCTURE REQUIRING SEDIMENT REMOVAL IS 35 FEET.

G. VEGETATION MANAGEMENT

SEE SECTION 4 OF THE NOTES ON THIS SHEET

H. WETLAND AREAS: NA.

I. DESCRIBE ADDITIONAL REQUIRED MAINTENANCE PROCEDURES AND FREQUENCIES - N/A

J. MATERIALS TESTING OF SEDIMENT REMOVED FROM SITE IS NOT REQUIRED.

K. ALL MAINTENANCE MATERIALS AND TOOLS SHALL BE REMOVED FROM THE SITE FOLLOWING MAINTENANCE COMPLETION.

3. EQUIPMENT, STAFFING, AND VEGETATION MANAGEMENT

A. EQUIPMENT REQUIRED: SHOVEL, RAKE, BACKHOE, CAMERA, DATA LOG / INSPECTION REPORT

B. STAFFING: ONE PERSON WHO IS QUALIFIED TO RUN THE REQUIRED EQUIPMENT IS REQUIRED FOR MAINTENANCE.

C. MOWING: MOWING MAY BE REQUIRED DEPENDING ON THE TYPE OF PLANTINGS. IF GRASS IS STARTED FROM SEED, ALLOW TIME FOR GERMINATION AND ESTABLISHMENT OF GRASS PRIOR TO MOWING . IF MOWING IS REQUIRED DURING THIS PERIOD FOR WEED CONTROL, IT SHOULD BE ACCOMPLISHED WITH HAND-HELD STRING TRIMMERS TO MINIMIZE DISTURBANCE TO THE SEEDBED. AFTER ESTABLISHED, MOW AS DESIRED OR AS NEEDED FOR WEED CONTROL. MOWING OF NATIVE/DROUGHT TOLERANT GRASSES MAY STOP OR BE REDUCED TO MAINTAIN A LENGTH OF NO LESS THAN 6 INCHES. .

D. WEEDS & UNDESIRABLE VEGETATION: MAINTAIN HEALTHY, WEED FREE VEGETATION. WEEDS SHOULD BE REMOVED BY HAND TOOLS, MOWING, WEED WHACKING OR OTHER MEANS AS APPROPRIATE BEFORE THEY FLOWER. THE FREQUENCY OF WEEDING WILL DEPEND ON THE PLANTING SCHEME AND COVER.

4. SNOW AND ICE CONTROL

FACILITY IS LOCATED WITHIN A SNOW STORAGE AREA. FACILITY SHALL BE INSPECTED AFTER SNOWMELT AND DEBRIS AND LITTER REMOVED.

5. RIGHT-OF-WAY, ADJACENT OWNERSHIP, & ACCESS

A. RIGHT-OF-WAY DESCRIPTION: CURVE COURT, ROW VARIES. SHIELD DRIVE, ROW VARIES.

B. ADJACENT OWNERSHIP: NA

C. ACCESS INFORMATION AND DETAILS: MAINTENANCE ACCESS TO THE FACILITY IS VIA THE DRIVEWAY OFF OF SHIELD DRIVE. PROCEED TO THE SOUTH SIDE OF THE MAIN PARKING AREA.

D. MAINTENANCE OPERATIONS WILL NOT IMPACT OR OBSTRUCT RIGHT-OF-WAY AND A RIGHT-OF-WAY PERMIT IS NOT REQUIRED.

7. HYDRAULIC DESIGN

A. FLOW RATES (CFS):

	INFLOW	OUTFLOW
BASE FLOW:	0 CFS	0 CFS
WQ EVENT:	NA	NA
5-YEAR:	10.26 CFS	0.31 CFS
100-YEAR:	31.01 CFS	7.90 CFS

B. VOLUMES, DEPTHS, & WSELS:

ITEM	VOLUME		WSEL	DEPTH	INVERT
EXTENDED DETENTION BASIN	213,429.6	CF		4.8'	6662.1
WQCV	1,907 CF		6663.9	1.8'	
5-YEAR	1,918 CF		6663.9	1.8'	
100-YEAR	2,675 CF		6664.2	2.1'	

C. WQCV DRAIN TIME = 40 HOURS

8. SENSITIVE AREAS, WETLANDS, & PERMITS

THE SITE INCLUDES 0.24-ACRES OF WETLANDS LOCATED NORTH OF THE DEVELOPMENT. MAINTENANCE ACTIVITIES WILL NOT IMPACT THE WETLANDS.

8. MISCELLANEOUS INFORMATION

A. PROJECT SURVEY:

TOPOGRAPHIC AND EXISTING CONDITIONS PER LANDMARK GROUND SURVEY 10-30-2020. SOME OFFSITE AND ADJACENT PROPERTY INFROMATION WAS DIGITIZED FROM AERIAL IMAGERY. LANDMARK IS NOT RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF THE EXISTING CONDITIONS AND/OR PROPERTY INFORMATION INCLUDING EASEMENTS AND ENCUMBRANCES AND THE OWNER ASSUMES ALL RISK WITH COMPLYING WITH THE LEGAL REQUIREMENTS OF THIS PROJECT.

PROJECT BENCHMARKS IS RECOVERED NO. 5 REBAR W/ 1 $\frac{1}{2}$" ALUMINUM CAP STAMPED LANDMARK LS 29039, ELEV=6667.80 NAVD 88. THE COORDINATE SYSTEM IS COLORADO COORDINATE SYSTEM, NORTH ZONE, NAD83 (2011), NAVD88, COMBINED SCALE FACTOR: (N)1415866.11 (E)2636677.13, 1.000368966.

B. [ADDITIONAL INFORMATION]

PROJECT: 2387-004	NO.	DATE:	BY:	DESCRIPTION:
DATE: 7/27/2021				
DRAWN BY: DCS				
CHECKED BY: LCI				

LANDMARK CONSULTANTS, INC.
CIVIL ENGINEERS | SURVEYORS
141 9th Street ~ P.O. Box 774943
Steamboat Springs, Colorado 80477
(970) 871-9494 www.LANDMARK-CO.com

Steamboat Basecamp
Ownership & Maintenance Plan
Bioretention Pond East

SHEET 2 Of 2 Sheets

APPENDIX E

CITY CHECKLISTS

Standard Form No. 3 Final Drainage Study Checklist

Instructions:

1. The applicant shall identify with a "check mark" if information is provided with letter. If applicant believes information is not required, indicate with "N/A" and attach separate sheet with explanation.
2. The reviewer will determine if information labeled "N/A" is required and whether additional information must be submitted.

I. General

✓ A. Report typed and legible in 8½" x 11" format.
✓ B. Report bound (comb, spiral, or staple – no notebook).
✓ C. Drawings that are 8½ x 11 or 11 x 17 bound within report, larger drawings (up to 24 x 36) included in a pocket attached to the report. Drawings shall be at an appropriate size and scale to be legible and include project area.

II. Cover

✓ A. Report Type – Final Drainage Study.
✓ B. Project Name, Subdivision, Original Date, Revision Date.
✓ C. Preparer's name, firm, address, phone number.
✓ D. "DRAFT" for 1st submittal and revisions; "FINAL" once approved.

III. Title Sheet

✓ A. Table of Contents.
✓ B. Certification, PE Stamp, signature, and date from licensed Colorado PE.
✓ C. Note: City of Steamboat Springs plan review and approval is only for general conformance with City design criteria and the City code. The City is not responsible for the accuracy and adequacy of the design, dimensions, and elevations that shall be confirmed and correlated at the job site. The City of Steamboat Springs assumes no responsibility for the completeness or accuracy of this document.

IV. Introduction

✓ A. Description of site location, size in acres, existing and proposed land use, and any pertinent background info.
✓ B. Reference planning application type and plan set date and preparer.
✓ C. Identify drainage reports for adjacent development.

V. Drainage Criteria and Methodology Used

✓ A. Identify design rainfall and storm frequency.
✓ B. Identify the runoff calculation method used.
✓ C. Identify culvert and storm sewer design methodology.
✓ D. Identify detention discharge and storage methodology.
NA E. Discuss HEC-HMS methodologies and parameters, if HEC-HMS is used.

VI. Existing Conditions (Pre-Development/Historic)

✓ A. Indicate ground cover, imperviousness, topography, and size of site (acres).
✓ B. Describe existing stormwater system (sizes, materials, etc.).
✓ C. Describe other notable features (canals, major utilities, etc.).
✓ D. Note site outfall locations and ultimate outfall location (typically Yampa River).
✓ E. Note capacity of existing system and identify any constraints.
✓ F. Identify NRCS soil type.
✓ G. Discuss any existing easements.
✓ H. Identify the FEMA Map reviewed, if site is in floodplain/way, and zone designation.

VII. Proposed Conditions

✓ A. Indicate ground cover, imperviousness, topography, and disturbed area (acres).
✓ B. Describe proposed stormwater system (sizes, materials, etc.).
✓ C. Describe proposed outlets and indicate historic and proposed flow for each.
✓ D. Include calculations for all culverts, ditches, ponds, etc. in appendix.
✓ E. Include a summary table for the 5- and 100-year events showing historic flow and proposed flow for total site and each basin.
✓ F. Discuss proposed easements.
✓ G. Describe off-site flows to be passed thru site.
✓ H. Summarize any impacts to downstream properties or indicate none. Reference CLOMR/LOMR and impacts.

I. Detention Ponds.
✓ 1. Indicate pond volume and area (size and depth) requirement.
✓ 2. Indicate release rates.
✓ 3. Discuss outfall design, location, and overflow location.
✓ 4. Discuss maintenance requirements.

J. Curb and Gutter
NA 1. Indicate gutter capacity.
NA 2. Indicate curb capacity.
NA 3. Indicate design velocity
NA 4. Indicate design depth of flow in street.

K. Culverts
✓ 1. Indicate whether each culvert is under inlet or outlet control.
✓ 2. Show that headwater is less than the maximum allowable.
✓ 3. Indicate design velocity.
✓ 4. Indicate required and provided flow rates.
✓ 5. Discuss whether outlet protection is required and what will be used.

L. Inlets
✓ 1. Indicate inlet capacity.
✓ 2. Indicate the type of inlet(s) used.

M. Channels
✓ 1. Indicate design velocity (and type of dissipation if required).
✓ 2. Indicate required and provided flow capacity.
✓ 3. Show critical cross-section(s) including water surface.

N. Site Discharge
✓ 1. Discuss use and design of detention to ensure discharge is less than or equal to historic flow.
NA 2. Provide documentation that downstream facilities are adequate and no adverse impacts to downstream property owners (i.e. no rise certification)

VIII. Post Construction Stormwater Management

✓ A. Discuss in general terms which permanent BMP practices will be used to control pollutant and sediment discharge after construction is complete. Exhibit A, Storm Water Quality Plan shall be attached that will give details (see separate checklist)

IX. Conclusions

✓ A. Provide general summary.
✓ B. Note if site complies with criteria and any variances to criteria.
✓ C. Indicate if peak proposed flow is less than, equal to, or greater than peak historic flow for each outfall, design point, and for the total site.
✓ D. List proposed new stormwater system requirements.

X. References

✓ A. Provide a reference list of all criteria, master plans, drainage reports and technical information used.

XI. Tables

✓ A. Include a copy of all tables prepared for the study.

XII. Figures

✓ A. Vicinity Map.
NA B. Site Plan (include the horizontal and vertical datum used and all benchmarks).
C. Existing conditions.
✓ 1. Delineate existing basin boundaries.
✓ 2. Delineate offsite basins impacting the site.
✓ 3. Show existing and proposed topography at an interval of at least 2-ft.
✓ 4. Show existing runoff flow arrows.
✓ 5. Show existing stormwater features (structures, sizes, materials, etc.).
NA 6. Show floodplain limits and information.
✓ 7. For each basin show bubble with basin number, acreage and % impervious.
✓ 8. For each outlet show bubble with acreage and historic flow and proposed flow or provide information in summary table on figure.
D. Proposed Conditions
✓ 1. Delineate proposed basin boundaries.
✓ 2. Show proposed runoff flow arrows.
✓ 3. Show existing and proposed topography at an interval of at least 2-ft.
✓ 4. For each basin show bubble with basin number, acreage and percent impervious or provide a summary table or figure.
✓ 5. For each outlet show bubble with acreage, historic flow, and proposed flow or provide a summary table or figure.
NA 6. Show floodplain limits and information.
NA 7. Show proposed building footprints and FFE for commercial and multi-family
✓ 8. Show property lines and easements (existing and proposed).
✓ 9. Label public and private facilities. A general note can be placed on the plans in lieu of labeling all facilities, if applicable.

XIII. Appendices

- ✓ A. Runoff Calculations.
- ✓ B. Culvert Calculations.
- ✓ C. Pond Calculations.
- ✓ D. Other Calculations.

Acknowledgements

Standard Form No. 3 was prepared by: _____ 8/10/2021
Date

Include Attachment A – Scope Approval Form (see Standard Form No. 5)
Include Attachment B – Storm Water Quality Plan (see Standard Form No. 4)

Standard Form No. 4 Stormwater Quality Plan Checklist

This list is not an exhaustive list of every possible item that may be required or requested in a Stormwater Quality Plan but provides a general guideline for preparation of the Stormwater Quality Plan.

Instructions:

1. The applicant shall identify with a "check mark" if information is provided within the Stormwater Quality Plan. If applicant believes information is not required, indicate with "N/A" and attach separate sheet with explanation. If information is included with the associated drainage letter or study, indicated with a "D."
2. The reviewer will determine if information labeled "N/A" is required and whether additional information must be submitted.

I. General

- ✓ A. Report typed and legible in 8½" x 11" format.
- ✓ B. Report bound (comb, spiral, or staple – no notebook) and in digital PDF format.
- ✓ C. Drawings that are 11" x 17" bound within letter, larger drawings (up to 24" x 36") included in a pocket attached to the letter, and a digital PDF copy. Drawings shall be at an appropriate size and scale to be legible and include project area.

II. Cover

- ✓ A. Report Type – Stormwater Quality Plan.
- ✓ B. Project Name, Subdivision or Development, Original Date, Revision Date.
- ✓ C. Preparer's name, firm, address, and phone number.
- ✓ D. "DRAFT" for 1st submittal and revisions; "FINAL" once approved.

III. Title Sheet

- ✓ A. Table of Contents.
- ✓ B. Certification, PE Stamp, signature and date from licensed Colorado PE (for Final).
- ✓ C. Note: City of Steamboat Springs plan review and approval is only for general conformance with City design criteria and City code. The City is not responsible for the accuracy and adequacy of the design, dimensions, and elevations that shall be confirmed and correlated at the job site. The City of Steamboat Springs assumes no responsibility for the completeness or accuracy of this document.

IV. Introduction and Background

- ✓ A. Description of site location, study limits, size in acres, existing and proposed land use, soil data, permeability of the site, drainage patterns, and any pertinent background info.
- ✓ B. State purpose and goal of Stormwater Quality Plan and report along with any special requirements of the desired outcome.
- ✓ C. List any project stakeholders and/or requestors.
- ✓ D. Describe the background of the flooding source and any previous studies.

V. Design Criteria and Methodology Used

- ✓ A. Identify design rainfall and storm frequency used to design permanent stormwater treatment facilities.
- ✓ B Identify the runoff calculation method used to design permanent stormwater treatment facilities.
- ✓ C. Identify the standard the design will meet and the means and methodologies by which it will use to meet the standard.
- ✓ D. Provide all details supporting the use of the selected design standard.

VI. Proposed Conditions

- ✓ A. Identify total site area, total site imperviousness, area to be treated, and impervious area to be treated. Include justification for treating less than the total site area.
- ✓ B. Describe potential site contaminant sources including sediment.
- ✓ C. Identify source and quantity of on-site and off-site stormwater flows that need to be managed and how they will be managed.
- ✓ D. For each permanent treatment facility, identify the design standard, MDCIA level (if applicable), area treated (& percentage of total), imperviousness of area treated, C values of area treated, soil types, and all pertinent data for design.
- ✓ E. Volume based facilities: Provide total storage pond volume, WQCV, drain time, release rate, sediment storage, outlet & overflow structures, area and depth of pond, micropool, forebays, etc. (include all calculations in the appendix).
- NA F. Flow based facilities: Provide design flow rate and all treatment calculations and how flows larger than the water quality design flow rate will be handled. If proprietary facilities are proposed, provide the justification and sizing requirements from manufacturer.
- ✓ G. If stormwater detention is provided, discuss how water quality is provided within the detention facility. No underground detention is allowed.

VII. Operation and Maintenance Plan Requirements

See template O&M plan and guidance document.

- ✓ A. Describe general project information, facility description, ROW and access information, vegetation management, hydraulic design parameters, environmental permitting, snow and ice control, and additional pertinent information in the notes.
- ✓ B. Indicate, describe, and detail the permanent stormwater treatment facilities.
- ✓ C Include section details where necessary of the permanent treatment facilities.
- ✓ D. Provide an inspection and maintenance schedule and procedure of permanent treatment facilities and who is responsible for them.
- ✓ E. Identify design specifications for construction.

Acknowledgements

Standard Form No. 4 prepared by: _____ 8/10/2021
Date

Include appropriate Project Sheet(s) and Design Checklist(s) (See Section 5.12)
Include this form as part of the Stormwater Quality Plan.

DESIGN CHECKLIST – Water Quality Capture Volume (WQCV) Standard

WQCV STANDARD Criteria

Treatment facilities must be designed to provide treatment and/or infiltration of the WQCV for 100% of the site. Under certain conditions, up to 20% of the site may be excluded, not to exceed 1 acre. This may apply if it is not practicable to capture runoff from portions of the site and where it is not practicable to construct a separate treatment facility for those same portions of the site.

Complete checklist if using the WQCV Standard to meet Design Standard requirements.

Project Name:			
Preparer	**City**	**Requirements**	
NO		Facilities provide treatment and/or infiltration of the WQCV for 100% of the site	
		% of site treated: 84%	
		Facility Type: Extended Detention Basin	Facility Location: Lot 1 Worldwest Subdivision
		See Drainage Report section: Stormwater Quality	

If less than 100% of the site is treated, complete the following:

Preparer	**City**	**Requirements**	
		% of site not treated by control measures (not to exceed 20% or 1 acre):	
		16% %	0.20-acres Size (acres)
		Provide explanation of why the excluded area is impractical to treat: Existing horizontal constraints prevent areas from draining to facility	
		Provide explanation of why another facility is not practicable for the untreated area: Areas are too small to practically treat with another facility.	

PROJECT SHEET – BASE DESIGN STANDARDS (Site is not constrained)

Complete a Project Sheet for each project that includes Permanent Stormwater Treatment Facilities.

SITE INFORMATION

Project Name: Basecamp Preliminary Plat	
Project Location: Lot1 and Lot2 Worldwest Subdivision	
Submitted Date: August 11, 2021	Submitted By:
Acreage Disturbed: 1.24-acres	
Existing Impervious: 42%	New Net Impervious: 46%
Review Date:	Reviewed By:

Preparer	City	Requirements
		Design Details are included for all Treatment Facilities
		List or include a description of any source controls or other non-structural practices: none

DESIGN STANDARDS

Multiple Design Standards may be used on a site, as necessary, to meet the requirements, but only one Design Standard may be used for each treatment facility's tributary area. Evaluation of suitability of permanent stormwater treatment facilities is based on meeting the specified Design Standard and ease of long-term maintenance. Facilities must be designed in accordance with the most current versions of the City's Engineering Standards and Volume 3 of the USDCM and meet the specific requirements for each Design Standard used.

1. Indicate below, which Design Standard(s) will be used for the project, and
2. Complete a separate, corresponding Design Standards checklist for each facility (e.g., WQCV)

Design Standard	*Quantity*	*Tributary Area*	*Location/Identifying information*
WQCV	1,226-CF	3.15-acres	Lot 1 Worldwest Subdivision
Pollutant Removal			
Runoff Reduction			

Standard Form No. 5 Drainage and Stormwater Treatment Scope Approval Form

Prior to starting a development plan and before the first drainage submittal, a Drainage and Stormwater Treatment Scope Approval Form must be submitted for review and signed by the City Engineer. A signed form shall also be included in every drainage submittal as Attachment A. This Scope Approval Form is for City requirements only. Values may be approximate. The City encourages supporting calculations and figures to be attached.

Project Information	
Project name:	Steamboat Basecamp
Project location:	1901 Curve Plaza, Steamboat Springs, CO 80487
Developer name/contact info:	May Reigler Properties
Drainage engineer name/contact info:	Deb Spaustat, debs@landmark-co.com, (970) 871-9494
Application Type:	Preliminary Plat
Proposed Land Use:	Commercial / Mixed-Use

Project Site Parameters	
Total parcel area (acres):	5.12 acres; total basin area = 7.18 acres
Disturbed area (acres):	0.69 acres
Existing impervious area (acres, if applicable):	3.06 acres
Proposed new impervious area (acres):	0.56-acres
Proposed total impervious area (acres):	3.63-acres
Proposed number of project outfalls:	1
Number of additional parking spaces:	0
Description and site percentage of existing cover/land use(s):	35% asphalt parking lot & conc. walks 8% office building 57% grass & undeveloped lot
Description and site percentage of proposed cover/land use(s): (Denotes TOTAL post-project land uses, including existing totals)	42% asphalt parking lot & conc. walk 8% office building 49% landscaping and undeveloped
Expected maximum proposed conveyance gradient (%):	2%
Description of size (acres) and cover/land use(s) of offsite areas draining to the site	N/A

CITY OF STEAMBOAT SPRINGS ENGINEERING STANDARDS

Type of Study Required:

☐ Drainage Letter
☒ Final Drainage Study
☐ Conceptual Drainage Study
☒ Stormwater Quality Plan — REQUIRED

Hydrologic Evaluation:

☒ Rational Method ☐ CUHP/SWMM ☐ HEC-HMS ☐ Other_____

Project Drainage	
Number of subbasins to be evaluated:	7
Presence of pass through flow (circle):	YES (NO)
Description of proposed stormwater conveyance on site:	Runoff to be collected in curb & gutter/inlets and conveyed through site to EDB. Stubouts will collect runoff from undeveloped portions of site and provide connections for future development
Project includes roadway conveyance as part of design evaluation (circle):	YES (NO)
Description of conveyance of site runoff downstream of site, identify any infrastructure noted in Stormwater Master Plan noted as lacking capacity for minor or major storm event:	Runoff leaves the site via an ex. 21"x27" CMP arch culvert. It makes its way via roadside ditches and culverts to a large wetlands area west of the CLEF and eventually to the Yampa River. None of the existing culverts are lacking capacity per the Citywide Stormwater Masterplan.
Detention expected onsite (circle):	(YES) NO
Presence of Floodway or Floodplain on site (circle):	YES (NO)
Anticipated modification of Floodway or Floodplain proposed (circle):	YES (NO)
Describe culvert or storm sewer conveyance evaluative method:	HY-8, SSA

Permanent Stormwater Treatment Facility Design Standard (check all that apply with only one standard per tributary basin):

☒ WQCV Standard ☐ TSS Standard ☐ Infiltration Standard
☐ Constrained Redevelopment WQCV Standard
☐ Constrained Redevelopment TSS Standard
☐ Constrained Redevelopment Infiltration Standard
☐ Does not Require Permanent Stormwater Treatment (attach Exclusion Tracking Form)

Project Permanent Stormwater Treatment	
Justification of choice of proposed design standard, including how the site meets the constrained redevelopment standard, infiltration test results, etc.:	Proposed improvements require detention to maintain historic discharge rates. Water quality treatment is needed due to the increased impervious surface area. Both standards are met by the proposed extended detention basin
Concept-level permanent stormwater treatment facility design details (type, location of facilities, proprietary structure selection, treatment train concept, etc.):	One EDB will treat the WQCV and also provide attenuation for the minor and major storm event. The EDB will be designed to accommodate the current proposed improvements as well as potential future development.
Proposed LID measures to reduce runoff volume:	N/A
Will treatment evaluation include off-site, pass through flow (circle):	YES (NO)

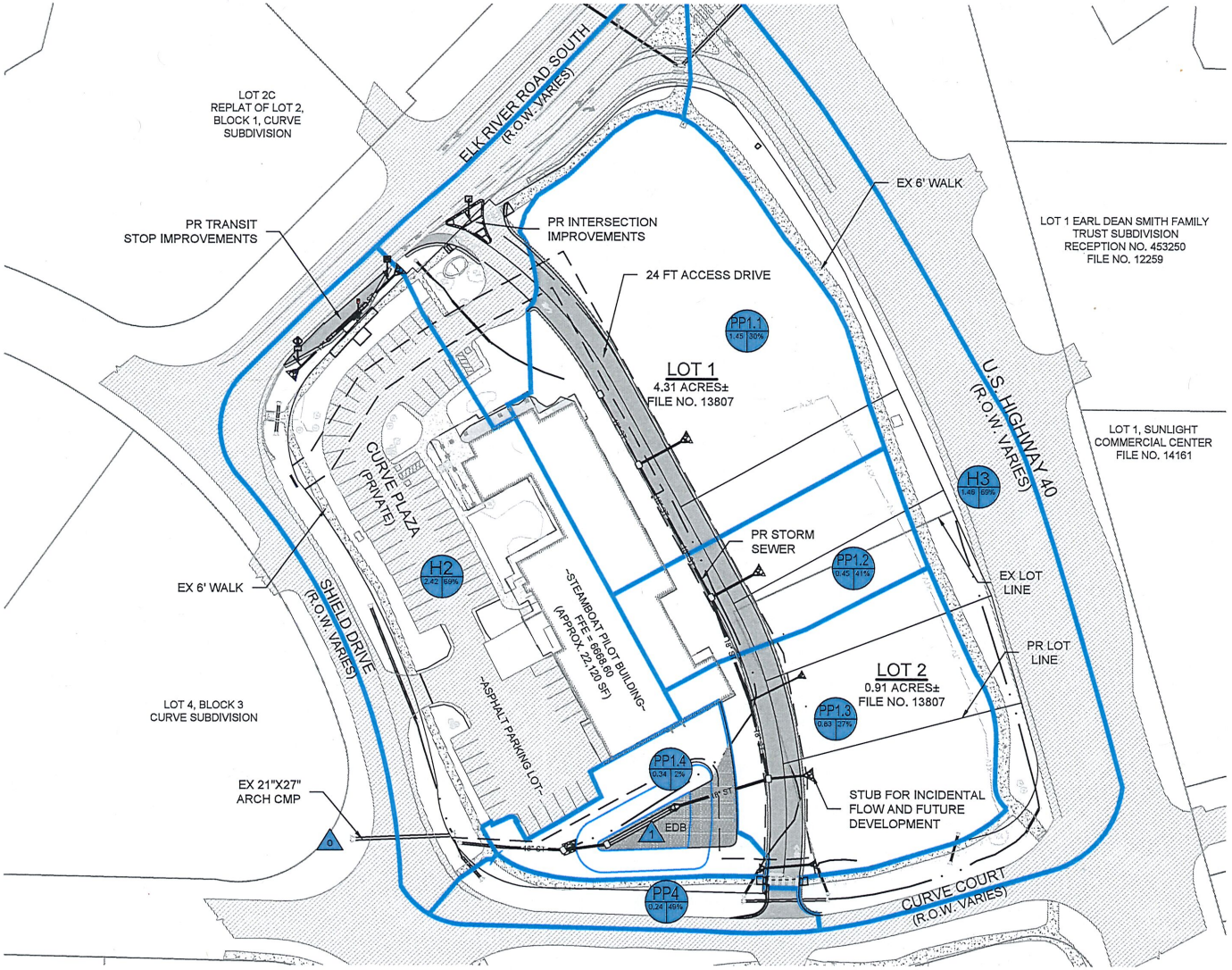
Approvals

Deb Spaustat	6/1/2021	(970) 871-9494
Prepared By: (Insert drainage engineer name & firm)	Date	Phone number

Approved By: Tamara King for

Printed Name: City Engineer

Date 6/9/2021



NORTH

40 0 40 80

1" = 80'

LEGEND:

- PROPERTY BOUNDARY
- ADJ. PROPERTY BOUNDARY
- EASEMENT
- CENTERLINE
- FOUND MONUMENT
- FOUND SECTION CORNER
- BUILDING
- ROOF LINE/OVERHANG
- FENCE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX ASPHALT
- CONCRETE
- GRAVEL
- CONIF. AND DECID. TREE
- DEV DRAINAGE BASIN
- PR ASPHALT

Basin Hydrology Summary - Preliminary Plat

	Historic (H)		Preliminary Plat (PP)	
Basin	Total Area (acres)	%Imp	Total Area (acres)	%Imp
1.1			1.45	30%
1.2			0.45	41%
1.3			0.83	27%
1.4			0.34	2%
1	3.05	9%		
2	2.42	69%	2.42	69%
3	1.46	69%	1.46	69%
4	0.25	50%	0.24	49%

Design Point Hydrology Summary - Preliminary Plat

	Historic (H)		Preliminary Plat (PP)	
Design Point	Total Area (acres)	%Imp	Total Area (acres)	%Imp
o	7.18	43%	7.18	51%
1	3.05	9%	3.39	25%

PROJECT:	2387-004	NO.	DATE:	BY:	DESCRIPTION:
DATE:	5/28/2021				NOT FOR CONSTRUCTION REVIEW SET 3/19/2021
DRAWN BY:	DCS				
CHECKED BY:	EG				

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LANDMARK CONSULTANTS, INC.

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STEAMBOAT BASECAMP
PRELIMINARY PLAT
DRAINAGE SCOPE EXHIBIT

SHEET 2 Of 2 Sheets

TABLES

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SUMMARY TABLES

EDB/Detention Pond Summary

	WQCV (ft3)	Q_{A5}[1] (cfs)	Q_{A100}[1] (cfs)	V_5 (ft^3)	V_{100} (ft^3)	$V_{provided}$ (ft^3)
Future	4,161	1.50	11.08	5,643	8,831	13,430
Preliminary Plat	1,226	1.26	10.35	250	-385	13,430

1. Allowable Flow (Q_A) = Historic Flow (h1) - Undetained Flow (ud)

Basin Hydrology Summary

	Historic (H)						Preliminary Plat (PP)					
Basin	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
1	2.15	0.64	0.79	4.04	10.83	73%	2.07	0.66	0.80	3.78	9.97	76%
2.1	NA	NA	NA	NA	NA	NA	0.67	0.49	0.71	1.27	4.02	56%
2.2	NA	NA	NA	NA	NA	NA	1.94	0.11	0.52	0.56	5.84	9%
2.3	NA	NA	NA	NA	NA	NA	0.26	0.23	0.58	0.23	1.27	23%
2.4	NA	NA	NA	NA	NA	NA	0.29	0.05	0.49	0.06	1.18	2%
2	2.88	0.15	0.54	1.11	8.80	14%	NA	NA	NA	NA	NA	NA
3	0.88	0.56	0.75	1.30	3.78	64%	0.74	0.66	0.80	1.42	3.74	75%
4	0.48	0.26	0.59	0.28	1.43	27%	0.24	0.49	0.71	0.42	1.32	55%
P-203R	0.50	0.81	0.87	1.56	3.65	95%	0.70	0.71	0.82	1.90	4.82	82%
P-114R	0.89	0.77	0.85	2.65	6.39	89%	0.89	0.77	0.85	2.65	6.39	89%

Design Point Hydrology Summary

	Historic (H)						Preliminary Plat (PP)					
Design Point	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
0	6.39	0.38	0.66	6.26	23.65	42%	6.20	0.42	0.68	6.59	23.14	46%
1	NA	NA	NA	NA	NA	NA	3.15	0.20	0.57	1.59	9.84	19%
off	1.39	0.79	0.86	4.22	10.05	91%	1.59	0.75	0.84	4.58	11.24	86%
ud	NA	NA	NA	NA	NA	NA	3.05	0.65	0.79	5.00	13.30	74%