DRAFT

Conceptual Drainage Study and Stormwater Quality Plan

Thunderhead Beach

Preliminary Plat

Located in the SW ¼ of Section 22, T6N, R84W, 6th P.M.

Original Date: March 15, 2024
Revised: October 3, 2024
Prepared by: Aaron Cvar, PhD, P.E.
Reviewed by: Erik Griepentrog, P.E.
Revised by: Deborah Spaustat, P.E.

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.

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CERTIFICATION

I hereby affirm that this Conceptual Drainage Study and Stormwater Quality Plan for the Preliminary Plat Application requirements was prepared by me (or under my direct supervision) for the Applicant 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.

_____

Erik Griepentrog, P.E.

State of Colorado No. 33280

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INTRODUCTION AND LOCATION

The purpose of this drainage study and stormwater quality plan is to develop an analysis of stormwater runoff and drainage structures required for the proposed Lot 1 of the Thunderhead Beach Project (formally Thunderhead Subdivision). The Preliminary Plat application intends to consolidate the Thunderhead parcels and formalize the site as a 'legal' development parcel as required by Section 713.A.4 of the Community Development Code.

Additionally, the Applicants desire to shift the southern boundary of this consolidated parcel, which requires the inclusion of Lot 2, Ski Hill Subdivision, Replat of Parcel D with the Preliminary Plat. **As there are no improvements proposed outside of Lot 1, this study excludes Lot 2 from the scope of this study for all existing facilities.**

Included in this study are all the base data, methods, assumptions, and calculations for the stormwater management system for the future development of the proposed Lot 1. This report accompanies the other submittal items in conjunction with the Preliminary Plat Application.

The facts and opinions expressed in this report are based on Landmark Consultants, Inc.'s (Landmark's) understanding of the project and data gathered from:

- Site visit (Fall, 2023)
- Steamboat Springs GIS data
- FEMA FIRM Community Panel Numbers 08107-CO879-D (February 4, 2005)
- FEMA Letter of Map Revision 13-08-0214P (July 8, 2013)
- FEMA Letter of Map Revision 18-08-0922P (July 29, 2019)
- NRCS soil maps
- Detailed field survey by Landmark Consultants, Inc.
- Citywide Stormwater Master Plan, March 2013
- Final Master Drainage Study for Ski Time Square, December 2008
- References listed at the end of this report

The subject property is located at 1965 Ski Time Square Drive and is approximately 2.48 acres in size – after the proposed consolidation and lot line adjustment. It is in the Southeast ¼, of Section 22, Township 6 North, Range 84 West of the 6th Principal Meridian, City of Steamboat Springs, Routt County, Colorado.

Specifically, the site is located on the south side of Ski Time Square Drive, just east of the intersection of Mount Werner Circle and Ski Time Square Drive. The property generally lies between 6,940 feet and 6,970 feet on the City datum. The proposed construction is expected to be limited to a disturbance area of approximately 2.7-acres below 6,975-feet in elevation.

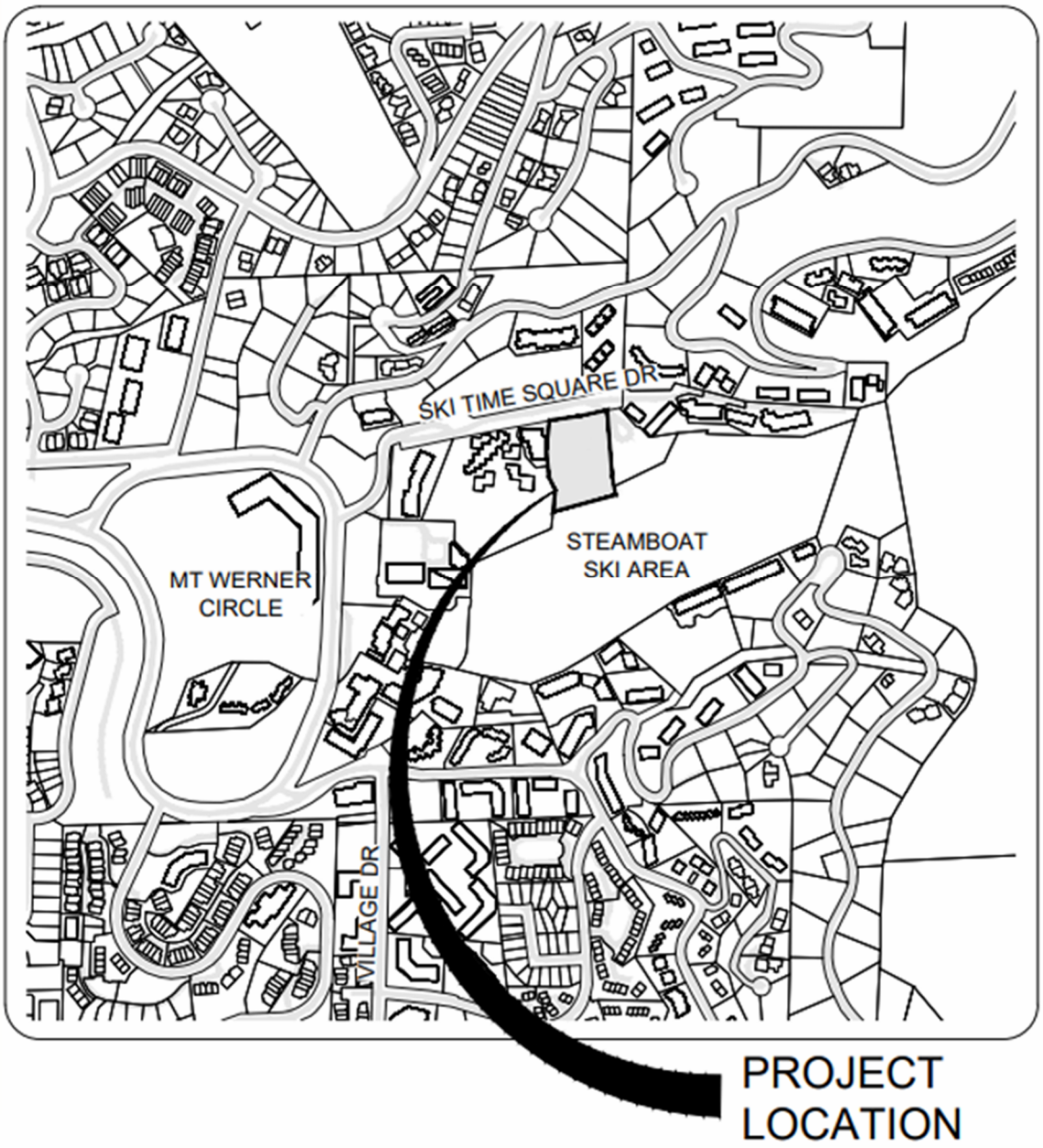

Figure 1: Vicinity Map

The existing site is adjacent to Burgess Creek, which is an existing drainage channel running along the west side of the property. Burgess Creek has an associated FEMA defined regulatory floodway. The proposed project has ensured no fill will be placed within the FEMA regulatory floodway.

The future development on Lot 1 is expected to be consistent with the underlying zoning designation Gondola-2, which is a high-density residential with a mix of commercial uses interconnected with pedestrian oriented public spaces.

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The anticipated land use and the site characteristics do not support traditional passive runoff treatment systems (extended detention, etc.). A proprietary facility (e.g. hydrodynamic separator) is proposed to provide a focused location for the future development to connect the site-specific collection system to then provide treatment prior to discharge into the Burgess Creek storm system.

DRAINAGE CRITERIA AND METHODOLOGY

Landmark prepared this report in accordance with *City of Steamboat Springs Engineering Standards, Section 5.0, Drainage Criteria* effective September 2007 and updated 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 5-year, 24-hour storm to analyze the minor storm event and the 100-year, 24-hour storm for the major storm event. 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 minimum time of concentration (t_c) used for this analysis is 5 minutes, based on the recommendations for urbanized watersheds found in Section 5.2.6.1 of the *Drainage Criteria*.

Storm Sewer Design

Storm sewers were designed and evaluated using Autodesk's Storm and Sanitary Sewer Analysis using the hydrodynamic routing method. Storm sewers were sized to convey the minor storm event so that the HGL does not exceed the ground elevation however, the storm sewers convey the major storm event as well. In general, channels and roadside ditches are designed so that the Froude number during the major storm does not exceed 0.8.

The relocation of the 48" "Tributary" storm sewer was evaluated using Autodesk's Storm and Sanitary Sewer Analysis to confirm capacity to convey the pass-through flow without flooding.

Stormwater Quality

The project uses the Constrained site TSS design standard to provide stormwater quality treatment in the form of a hydrodynamic separator. This standard was chosen due to the expected low pollutant load and its widespread applicability.

EXISTING SITE CONDITIONS

In this report the term "historic condition" refers to the conditions of the site as they are today, in 2024. This condition may also be referred to as the "pre-development condition" or "existing condition". The site is currently used as access to adjacent businesses (service drive along Burgess Creek), a beginner 'magic carpet' area for the ski resort, and a parking area that previously served the now demolished Thunderhead Lodge and Thunderhead Condominium. These were a 56-room lodge and a 75-unit condominium building, both of which were removed in the summer and fall of 2008 to prepare the property for a substantial redevelopment, which subsequently stalled with the arrival of the Great Recession. Figure 2 shows the pre-demolished conditions of the site with the Lodge, Condominium Building and paved parking.

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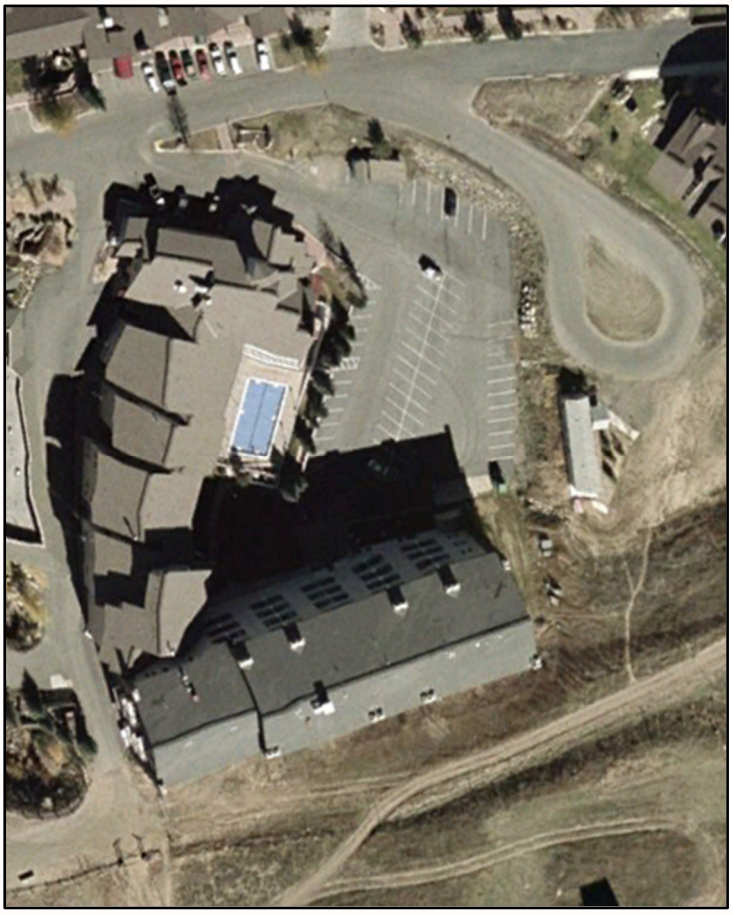

Figure 2: Thunderhead Lodge and Condominium prior to demolition.

The drainage outfall for the proposed Thunderhead Beach is the large diameter culvert that conveys the unnamed tributary to Burgess Creek (the Unnamed Culvert) to the Burgess Creek Culvert (The Burgess Creek Culvert) under the base area. The Unnamed Culvert was recently evaluated for the application for the LOMR dated March 4, 2019. The analysis included determining the 0.1% chance flood event for the unnamed tributary. In order to evaluate for future adequacy of the culvert, the study assumed the land to be in full buildout conditions based on the zoning of the contributing basin. For example, the properties in Ski Time Square are zoned G-2 so they have an assumed imperviousness of 85%.

The property historically drained directly to Burgess Creek across the access driveway. The Burgess Creek Culvert and its diversion structure was installed in 2007, prior to the demolition of buildings. The design of the culvert and its diversion structure assumed runoff from the Thunderhead Beach site to have the imperviousness of the site pre-2007, which Landmark has calculated as 81.1%.

The existing site was evaluated as two drainage basins. Basin H1 includes much of the buildable site and basin OS1-Hist consists of historic area that drains from the east onto the site. Please note that drainage basins typically do not follow property lines so areas will differ from the proposed lots.

There is an existing inlet and 48” storm sewer system that conveys pass-through flows from the unnamed tributary that follows the Right-O-Way ski run and under several properties prior to discharging into Burgess Creek and its surface and subsurface systems.

Table 1 below summarizes the existing basin hydrology:

Table 1: Existing Basin Hydrology Summary						
Basin	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
H1	2.73	0.65	0.76	4.55	11.63	81%
OS1-Hist	5.37	0.21	0.53	2.37	5.17	10%

NRCS soil data shows the site primarily as "Routt Loam". This soil falls into NRCS Hydrologic Soil Group C; soils having a slow infiltration rate when thoroughly wetted and is further described in the report provided in the Appendix.

EASEMENTS

There are no easements for the existing drainage systems. The Preliminary Plat reflects easements for the Burgess Creek system, the rerouting of the unnamed tributary storm system and the water quality feature.

FEMA FLOODPLAIN

Landmark reviewed FEMA FIRM Community Panel Numbers 08107-CO883-D (February 4, 2005) and the associated FIS Study. We have also reviewed Letter of Map Revision (LOMR) Case No. 13-08-0214P (July 8, 2013) and LOMR Case No. 18-08-0922P (July 29, 2019), which show that the western portion of the property is within the regulatory special flood hazard areas (SFHA) zones AE (1-percent annual chance flood) and X (0.2% chance annual flood). Disturbance within the regulatory floodway should be avoided and care taken to not reduce the capacity of the channel nor interfere with the subsurface storm network.

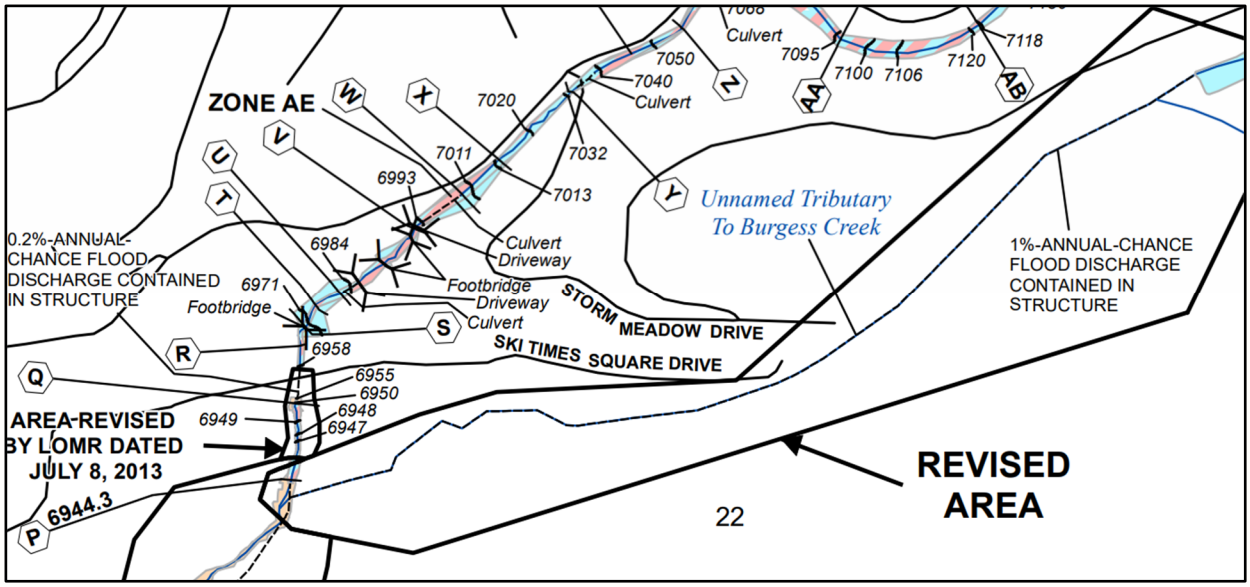

Figure 3: Current FEMA Effective Floodplain Mapping

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PROPOSED SITE CONDITIONS

The proposed site conditions were informed by the concurrent Development Plan application that proposes a 440,000 gross square foot structure with below grade parking. **The lot coverage and associated imperviousness for this proposed development should be the basis of comparison in the event the subdivision is completed yet a different development is proposed.** The total disturbed area is expected to be about 2.7-acres, although Contractor means and methods may result in a different disturbance footprint.

The site is divided into two subbasins, D1 and OS-Dev1. Basin D1 comprises the proposed interior development area. Runoff is expected to be conveyed to a hydrodynamic separator, conceptually located near the site southwest corner.

Basin OS1-Dev is the offsite area that drains onto the site from the east. Proposed grading reflected on the Preliminary Plat drawings modifies Basin OS1-Hist slightly. The unnamed tributary's pass-through storm sewer system interferes with the proposed building envelope and is proposed to be rerouted as shown on the plans. The hydraulics of the proposed storm sewer system have been evaluated for capacity to convey the pass-through flow.

The hydrological estimates for the tributary storm sewer analysis were updated using the NOAA Atlas 14 Rainfall values for the 5-year and 100-year storm events.

Table 3 summarizes and compares the hydrological characteristics of the developed site and the existing site:

Table 3: Basin Hydrology Summary

Basin	Total Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)	%Imp
H1	2.73	0.65	0.76	4.55	11.63	81%
OS1-Hist	5.37	0.21	0.53	2.71	14.73	10%
D1	2.73	0.54	0.68	3.61	10.06	71%
OS1-Dev	4.87	0.21	0.53	2.45	13.36	11%

For the purposes of future administration and review of development proposals for Lot 1, Thunderhead Beach, **Landmark recommends an upper limit value of 75% imperviousness without additional study.**

Detention

The proposed site is estimated to have an imperviousness of 70.7%, well below that used for the design of either of the Unnamed Culvert or the Burgess Creen Culvert.

Since both culverts were designed with the assumption that the Thunderhead site was more impervious than is currently being proposed, they both have the capacity for the developed flows, which will be less than the culvert design flows.

From section 5.11.1 of the City of Steamboat Springs Engineering Standards:

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"The main purpose of a detention basin is to store runoff and reduce peak discharge by allowing flow to be discharged at a slower, more controlled rate"

The Thunderhead Beach project achieves this by producing runoff at a slower rate than what the receiving infrastructure was designed to carry.

Based on the reduction of imperviousness described above and the resulting lower peak flows, detention is not required or proposed.

Storm System

Landmark evaluated the proposed realignment of the regional 48" storm sewer system and the findings have been included in the Appendix. The 100-year flow used for this evaluation was obtained from the FEMA LOMR Case No. 18-08-0922P (July 29, 2019). The "Unnamed Tributary" referenced herein is shown on the revised FIRM panel 08107-CO883-D (February 4, 2005).

It should be noted that this storm sewer system receives inflow progressively along its length. The hydraulic model uses the progressive flow rates per the LOMR to the confluence with Burgess Creek. The FEMA flow includes the runoff from the Thunderhead Lot. A Plan and Profile of the storm sewer system with hydraulic analysis is included in Figure 6: Tributary Re-Alignment Plan & Profile Analysis.

The hydrologic study used as the basis of the FEMA LOMR assumed lot imperviousness based on zoning. The zoning for this subject lot is Gondola-2 with an assumed imperviousness of 85%.

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 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.

The following are anticipated pollutant sources for this project (both during construction and long term):

1. Exposed and stored soils;
2. Vehicle tracking of sediments;
3. Significant dust particulate generating processes;
4. Vehicle and equipment maintenance and fueling;
5. Outdoor storage activities (building materials, fertilizers, and fuel);
6. Routine maintenance involving fertilizers, pesticides, detergents, fuels, solvents, oils, etc.;
7. On site waste management practices (waste piles, dumpsters, etc.);
8. Loading and unloading operations.

BMP Selection:

Stormwater quality treatment will be provided in the form of a hydrodynamic separator. Conceptual sizing of a hydrodynamic separator is provided in the Appendix, along with a concept level detail of the unit. A "Cascade Separator", by Contech Solutions, LLC (unit CS-5) has been conceptually sized for the proposed site. This sizing is subject to change based on final level site design to be detailed in the Final Drainage Study.

CONCLUSIONS

The Preliminary Plat application intends to consolidate the Thunderhead parcels and formalize the site as a 'legal' development parcel as required by Section 713.A.4 of the Community Development Code. Additionally, the Applicants desire to shift the southern boundary of this consolidated parcel, which requires the inclusion of Lot 2, Ski Hill Subdivision, Replat of Parcel D with the Preliminary Plat. As there are no improvements proposed outside of Lot 1, this study excluded Lot 2 from the scope of this study for all existing facilities located thereon.

Using information depicted on the concurrent Development Plan application for a mixed-use building in the G-2 Zone District, the proposed site plan reflected a 71% imperviousness value for Lot 1. For the purposes of future administration and review of development proposals for Lot 1, Thunderhead Beach, **Landmark recommends an upper limit value of 75% imperviousness without the need for additional study.**

A 48-inch reinforced concrete pipe (RCP) regional storm main currently traverses the site. In order to gain more developable ground, this regional storm line is proposed to be re-aligned along the southern perimeter of the site. Analysis of the re-aligned storm main is provided in this report and is based on FEMA's current graduated effective 100-year flow rates shown in LOMR Case No. 18-08-0922P (July 29, 2019). The regional storm main outfalls to Burgess Creek, just west of the site.

In the long term, permanent water quality will be provided by a hydrodynamic separator near the site's southwest corner. A "Cascade Separator", by Contech Solutions, LLC (unit CS-5) is suggested; however, this specific product as well as the product sizing is subject to change based on final level site design to be detailed in the Final Drainage Study. The hydrodynamic separator will provide treatment of onsite flows prior to outfall to the regional storm main discussed above.

LIMITATIONS

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.

Basin delineations, areas, and soil characteristics are based on those described in 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 data, opinions, and recommendations of this report are applicable to the specific design elements and location that is the subject of this report. This 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.

REFERENCES

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

2. Drainage Criteria Manual (Volumes 1 – 3), Mile High Flood District's (MHFD), 2019

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. Citywide Stormwater Master Plan, City of Steamboat Springs, Colorado, SEH, March 2013.

7. Flood Insurance Study (FIS), FEMA, February 2019

8. Final Master Drainage Study for Ski Time Square, Landmark Consultants, December 10, 2008 NWCC, July 13, 2022.

APPENDIX A

HYDROLOGIC CALCULATIONS

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*

Total or Effective % Impervious	NRCS Hydrologic Soil Group A						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
2%	0.01	0.01	0.01	0.01	0.04	0.13	0.27
5%	0.02	0.02	0.02	0.03	0.07	0.15	0.29
10%	0.04	0.05	0.05	0.07	0.11	0.19	0.32
15%	0.07	0.08	0.08	0.1	0.15	0.23	0.35
20%	0.1	0.11	0.12	0.14	0.2	0.27	0.38
25%	0.14	0.15	0.16	0.19	0.24	0.3	0.42
30%	0.18	0.19	0.2	0.23	0.28	0.34	0.45
35%	0.21	0.23	0.24	0.27	0.32	0.38	0.48
40%	0.25	0.27	0.28	0.32	0.37	0.42	0.51
45%	0.3	0.31	0.33	0.36	0.41	0.46	0.54
50%	0.34	0.36	0.37	0.41	0.45	0.5	0.58
55%	0.39	0.4	0.42	0.45	0.49	0.54	0.61
60%	0.43	0.45	0.47	0.5	0.54	0.58	0.64
65%	0.48	0.5	0.51	0.54	0.58	0.62	0.67
70%	0.53	0.55	0.56	0.59	0.62	0.65	0.71
75%	0.58	0.6	0.61	0.64	0.66	0.69	0.74
80%	0.63	0.65	0.66	0.69	0.71	0.73	0.77
85%	0.68	0.7	0.71	0.74	0.75	0.77	0.8
90%	0.73	0.75	0.77	0.79	0.79	0.81	0.84
95%	0.79	0.81	0.82	0.83	0.84	0.85	0.87
100%	0.84	0.86	0.87	0.88	0.88	0.89	0.9
Total or Effective % Impervious	**NRCS Hydrologic Soil Group B**						
	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**500-Year**
2%	0.01	0.01	0.07	0.26	0.34	0.44	0.54
5%	0.03	0.03	0.1	0.28	0.36	0.45	0.55
10%	0.06	0.07	0.14	0.31	0.38	0.47	0.57
15%	0.09	0.11	0.18	0.34	0.41	0.5	0.59
20%	0.13	0.15	0.22	0.38	0.44	0.52	0.61
25%	0.17	0.19	0.26	0.41	0.47	0.54	0.63
30%	0.2	0.23	0.3	0.44	0.49	0.57	0.65
35%	0.24	0.27	0.34	0.47	0.52	0.59	0.66
40%	0.29	0.32	0.38	0.5	0.55	0.61	0.68
45%	0.33	0.36	0.42	0.53	0.58	0.64	0.7
50%	0.37	0.4	0.46	0.56	0.61	0.66	0.72
55%	0.42	0.45	0.5	0.6	0.63	0.68	0.74
60%	0.46	0.49	0.54	0.63	0.66	0.71	0.76
65%	0.5	0.54	0.58	0.66	0.69	0.73	0.77
70%	0.55	0.58	0.62	0.69	0.72	0.75	0.79
75%	0.6	0.63	0.66	0.72	0.75	0.78	0.81
80%	0.64	0.67	0.7	0.75	0.77	0.8	0.83
85%	0.69	0.72	0.74	0.78	0.8	0.82	0.85
90%	0.74	0.76	0.78	0.81	0.83	0.84	0.87
95%	0.79	0.81	0.82	0.85	0.86	0.87	0.88
100%	0.84	0.86	0.86	0.88	0.89	0.89	0.9

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

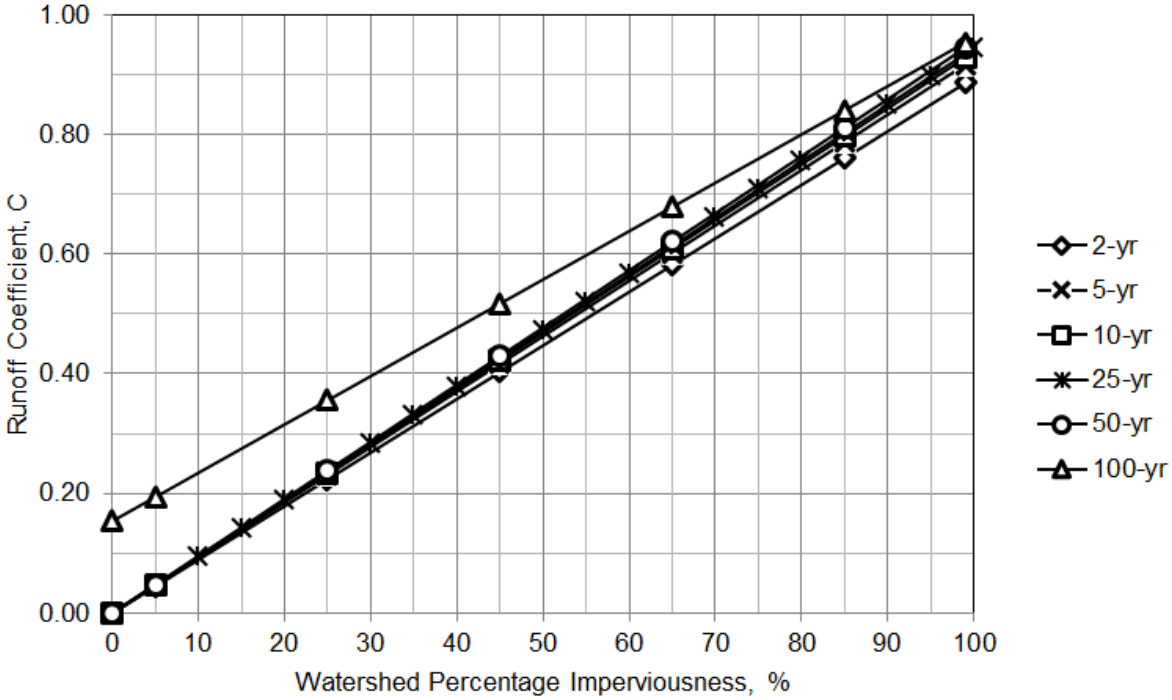

Figure 6-1. Runoff coefficient vs. watershed imperviousness NRCS HSG A

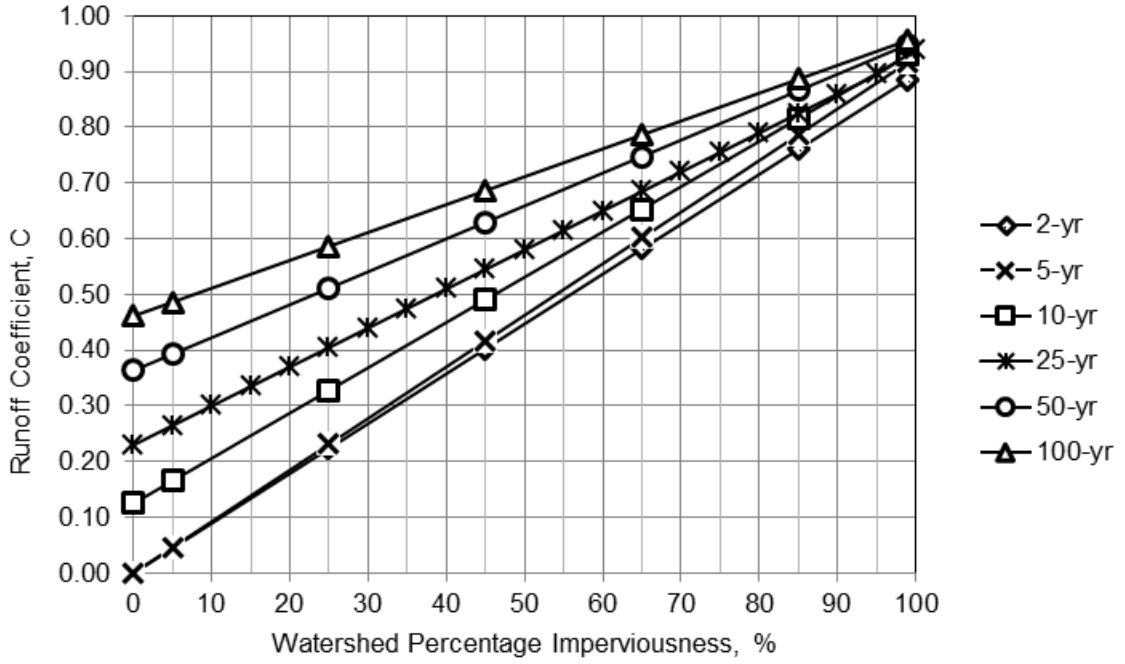

Figure 6-2. Runoff coefficient vs. watershed imperviousness NRCS HSG B

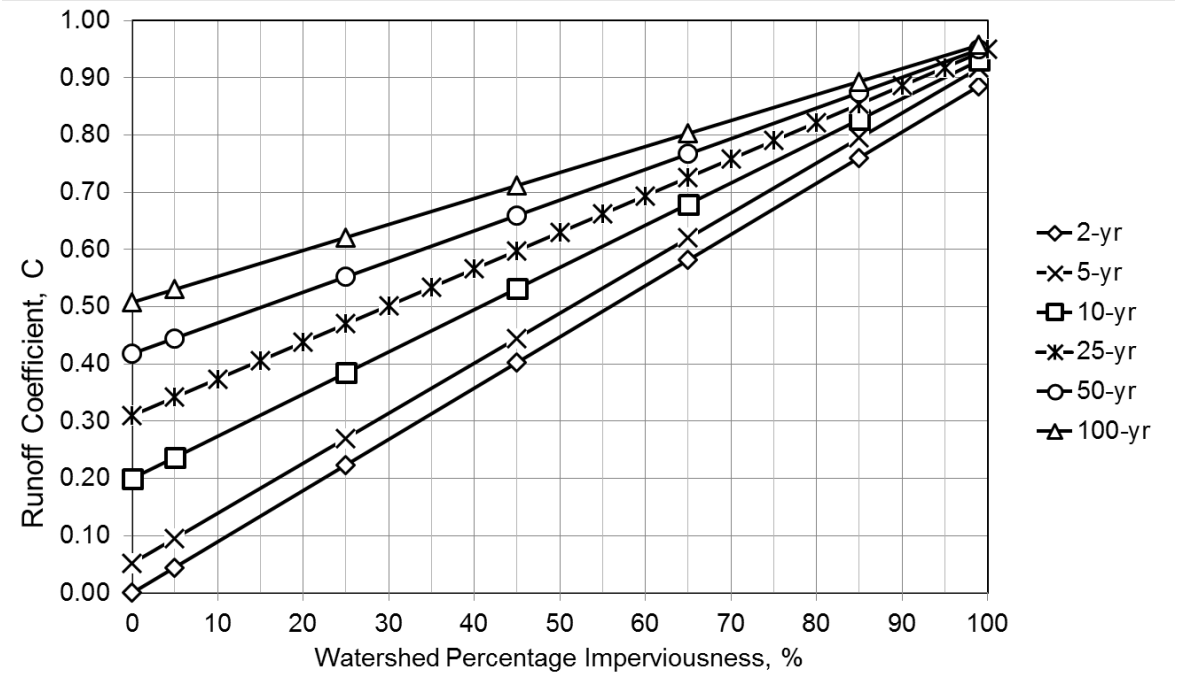

Figure 6-3. Runoff coefficient vs. watershed imperviousness NRCS HSG C and D

5.5.1 INTRODUCTION

Presented in this Section are design rainfall data for the minor and major storm events. These data are used to determine storm runoff peak flows and volumes in conjunction with the runoff models described in Section 5.6, Storm Runoff. All hydrologic analyses for Steamboat Springs shall utilize the rainfall data presented in this Section for calculating storm runoff.

5.5.2 RAINFALL ANALYSIS

For the City of Steamboat Springs, rainfall analysis shall be completed by using Equation 1 in this Section or by using the Colorado Urban Hydrograph Procedure (CUHP) developed by the Urban Drainage and Flood Control District. Rainfall data is generally based on NOAA Atlas 14, Volume 8. A detailed memo regarding the evaluation of NOAA Atlas 14 is available from the City upon request. To develop design flow rates, Equation 1 is used with the Rational Method and CUHP is used with SWMM or PCSWMM and HEC-1 or HEC-HMS. These runoff methodologies are discussed in Section 5.6, Storm Runoff.

5.5.3 INTENSITY-DURATION-FREQUENCY CURVES

Equation 1 shall be used to calculate rainfall intensity for a given time of concentration or to develop intensity-duration-frequency curves for the Rational Method for runoff analysis. The 1-hour rainfall depths from NOAA Atlas 14 for Steamboat Springs (station ID 05-7936) are used in Equation 1 for the durations and return periods of interest. Equation 1 was developed using data from NOAA Atlas 14. A detailed memo on the development of the equation is available from the City upon request.

$$I = P_1 \times \frac{49.1}{(T_d + 7.84)^{0.919}} \quad (1)$$

Where:

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

Rainfall intensities as a function of various storm durations and recurrence intervals are provided in Table 5.5.1 for reference. These values were calculated using Equation 1. Table 5.5.1 includes a 1-hour rainfall depth and intensities as a function of storm duration for the 80th percentile storm event (the event having a 1.25-year return period) to be used to design permanent stormwater treatment facilities using the TSS design standard. The values in Table 5.5.1 are subject to revision and users of these Engineering Standards are encouraged to check for updates.

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

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Routt Area, Colorado, Parts of Rio Blanco and Routt Counties

December 13, 2023

Map Scale: 1:806 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 35 70 140 210

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Routt Area, Colorado, Parts of Rio Blanco and Routt Counties
Survey Area Data: Version 13, Aug 23, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 2, 2021—Aug 25, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
50F	Routt loam, 25 to 65 percent slopes, very stony	2.7	100.0%
Totals for Area of Interest		**2.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Routt Area, Colorado, Parts of Rio Blanco and Routt Counties

50F—Routt loam, 25 to 65 percent slopes, very stony

Map Unit Setting

National map unit symbol: k0gc
Elevation: 6,890 to 8,200 feet
Mean annual precipitation: 20 to 24 inches
Mean annual air temperature: 38 to 41 degrees F
Frost-free period: 30 to 70 days
Farmland classification: Not prime farmland

Map Unit Composition

Routt, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Routt, Very Stony

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from sandstone and shale

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A1 - 1 to 12 inches: loam
A2 - 12 to 22 inches: loam
A3 - 22 to 27 inches: loam
B/E - 27 to 29 inches: clay loam
B/E - 29 to 31 inches: loam
Bt1 - 31 to 46 inches: clay
Bt2 - 46 to 65 inches: clay

Properties and qualities

Slope: 25 to 65 percent
Surface area covered with cobbles, stones or boulders: 1.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.07 to 0.21 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): 7e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C

Ecological site: F048AY449CO - Aspen Woodland
Hydric soil rating: No

Minor Components

Impass

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R048BY296CO - Claypan
Hydric soil rating: No

Venable

Percent of map unit: 5 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R048AY241CO - Mountain Meadow
Hydric soil rating: Yes

Slater

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: F048AY449CO - Aspen Woodland
Other vegetative classification: ASPEN (null_3)
Hydric soil rating: No

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PROJECT: 2633-003
DESIGNER: Aaron Cvar
DATE: 12/1/2023
POND ID:

BASIN RUNOFF COEFFICIENT CALCULATIONS

Character of Surface	Percent Impervious
Asphalt Parking and Walkways	100%
Pavers/Gravel	40%
Roof	90%
Lawns and Landscaping	2%
Hard Pack Gravel	80%
Residential Lots	85%

IDF	Soil Type
Steamboat Springs NOAA	C

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 Pavers/ Gravel Surfaces (sq.ft)	Area of Pavers/ Gravel Surfaces (acres)	Area of Roof (sq.ft.)	Area of Roof (acres)	Area of Lawns and Landscaping (sq.ft.)	Area of Lawns and Landscaping (acres)	Area of Hard Pack Gravel (sq.ft.)	Area of Hard Pack Gravel (acres)	Area of Residential (sq.ft.)	Area of Residential (acres)	Percent Impervious	5-year Composite Runoff Coefficient	100-year Composite Runoff Coefficient
H1	118918.80	2.73	60299.33	1.38	0.00	0.00	39727.68	0.91	18891.79	0.43	0.00	0.00	0.00	0.00	81.1%	0.65	0.76
OS1-Hist	233917.20	5.37	13330.41	0.31	0.00	0.00	11189.36	0.26	209397.00	4.81	0.00	0.00	0.00	0.00	11.8%	0.22	0.53
D1	118918.80	2.73	30122.00	0.69	0.00	0.00	59331.07	1.36	29465.73	0.68	0.00	0.00	0.00	0.00	70.7%	0.54	0.68
OS1-Dev	212137.20	4.87	12608.41	0.29	0.00	0.00	11189.36	0.26	188339.00	4.32	0.00	0.00	0.00	0.00	12.5%	0.23	0.54

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POND ID:

BASIN TIME OF CONCENTRATION CALCULATIONS

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 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)

	Overland Flow 1				Overland Flow 2				Conveyance		Swale Flow 1				Conveyance		Swale Flow 2				Time of Concentration		
Basin(s)	C_5*	Length, L (ft)	Slope, S (%)	T_i (min)	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	0.15	304	6.48	16.29				N/A	Grassed Waterway	15	98	4.80	4.38	0.50	Grassed Waterway	15			N/A	N/A	16.79	12.23	12.23
OS1-Hist	0.15	396	18.60	13.08				N/A	Grassed Waterway	15	413	7.03	5.30	1.73	Grassed Waterway	15			N/A	N/A	14.81	14.49	14.49
D1	0.15	115	2.10	14.59				N/A	Grassed Waterway	15	457	3.40	3.69	2.75	Grassed Waterway	15			N/A	N/A	17.34	13.18	13.18
OS1-Dev	0.15	396	18.60	13.08				N/A	Grassed Waterway	15	413	7.03	5.30	1.73	Grassed Waterway	15			N/A	N/A	14.81	14.49	14.49

Note: C_5 for overland flow is C value for that segment of flow, not overall basin C_5

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PROJECT: 2633-003
DESIGNER: Aaron Cvar
DATE: 12/1/2023
POND ID:

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)

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)
H1	2.73	12.23	0.65	0.76	2.58	5.64	4.55	1.67	11.63	4.26
OS1-Hist	5.37	14.49	0.22	0.53	2.37	5.17	2.78	0.52	14.79	2.75
D1	2.73	13.18	0.54	0.68	2.47	5.39	3.61	1.32	10.06	3.68
OS1-Dev	4.87	14.49	0.23	0.54	2.37	5.17	2.59	0.53	13.46	2.76

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PROJECT:	2633-003
DESIGNER:	Aaron Cvar
DATE:	12/1/2023
POND ID:	

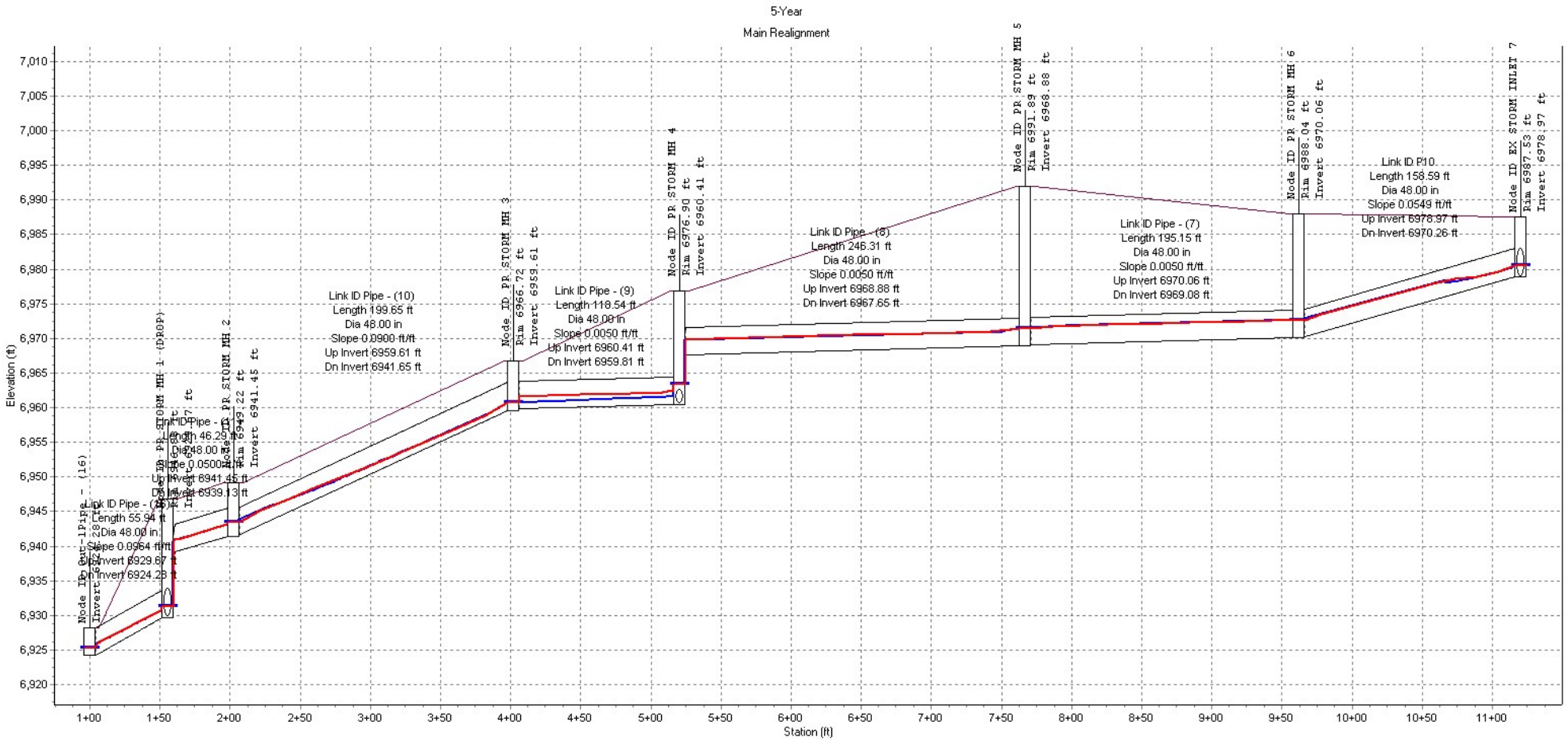
TABLES

Table 1: Basin Hydrology Summary

Basin	Pre-Development							Post-Development						
	Total Area (acres)	%Imp	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)	Total Area (acres)	%Imp	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	2.73	81.09%	0.65	0.76	12.23	4.55	11.63	2.73	70.73%	0.54	0.68	13.18	3.61	10.06

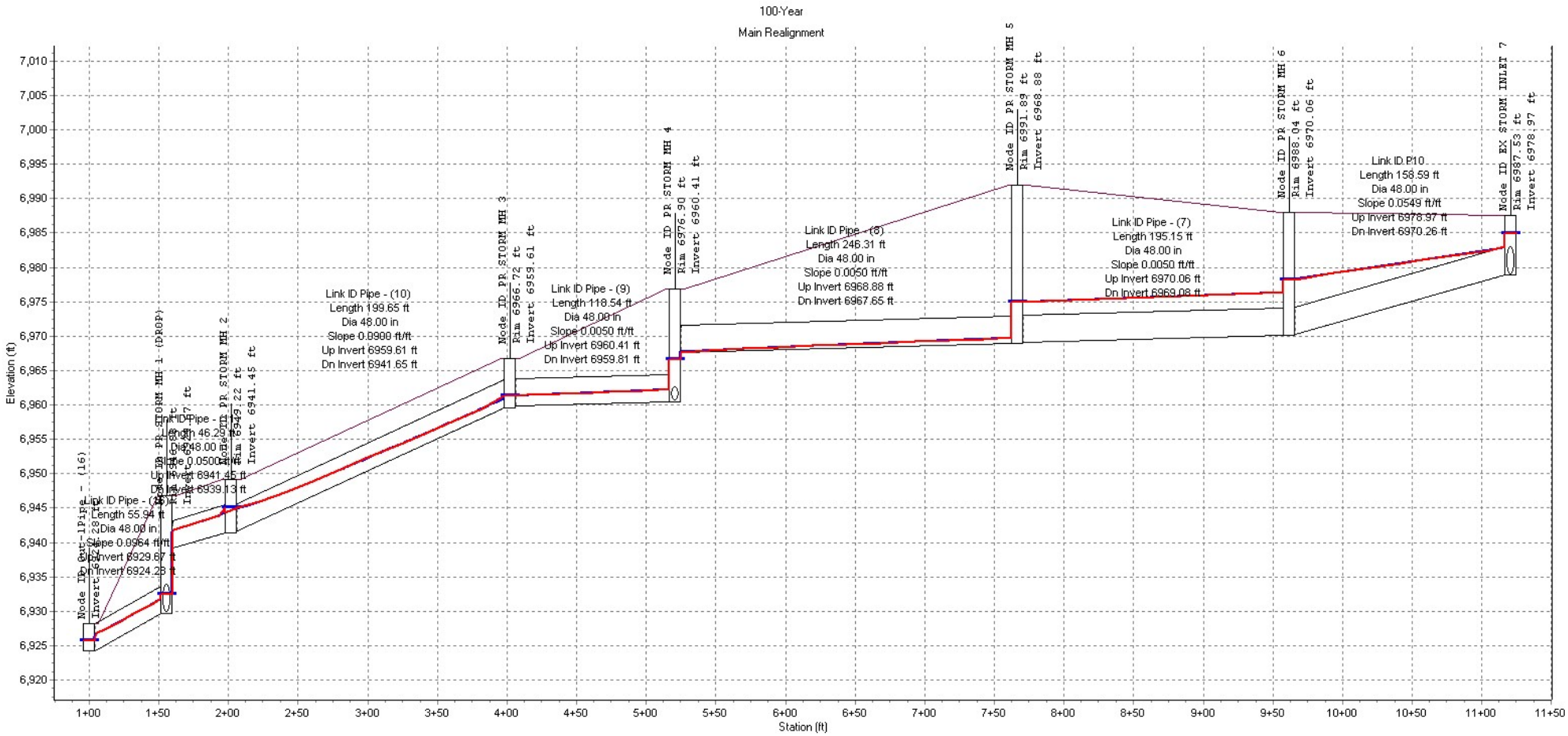
APPENDIX B

HYDRAULIC CALCULATIONS



Node ID:	PR STORM MH 1 (DROP)	PR STORM MH 2	PR STORM MH 3	PR STORM MH 4	PR STORM MH 5	PR STORM MH 6	
Rim (ft):	6946.88	6949.22	6966.72	6976.90	6991.89	6988.04	6987.53
Invert (ft):	6924.28	6929.67	6941.45	6959.61	6960.41	6968.88	6970.06	6978.97
Min Pipe Cover (ft):		3.75	3.58	2.91	5.25	18.80	13.78	
Max HGL (ft):	6925.33	6931.35	6943.56	6960.73	6963.55	6971.54	6972.91	6980.53

Link ID:	Pipe - (16)	Pipe - (11)	Pipe - (10)	Pipe - (9)	Pipe - (8)	Pipe - (7)	P10
Length (ft):	55.94	46.29	199.65	118.54	246.31	195.15	158.59
Dia (in):	48.00	48.00	48.00	48.00	48.00	48.00	48.00
Slope (ft/ft):	0.0964	0.0500	0.0900	0.0050	0.0050	0.0050	0.0549
Up Invert (ft):	6929.67	6941.45	6959.61	6960.41	6968.88	6970.06	6978.97
Dn Invert (ft):	6924.28	6939.13	6941.65	6959.81	6967.65	6969.08	6970.26
Max Q (cfs):	72.91	72.73	72.68	72.63	63.94	64.17	64.28
Max Vel (ft/s):	19.35	14.57	16.63	7.87	8.06	7.28	9.30
Max Depth (ft):	1.33	1.63	1.46	2.63	2.29	2.45	1.99



Node ID:	PR STORM MH 1 (DROP)	PR STORM MH 2	PR STORM MH 3	PR STORM MH 4	PR STORM MH 5	PR STORM MH 6	
Rim (ft):	6946.88	6949.22	6966.72	6976.90	6991.89	6988.04	6987.53
Invert (ft):	6924.28	6929.67	6941.45	6959.61	6960.41	6968.88	6970.06	6978.97
Min Pipe Cover (ft):		3.75	3.58	2.91	5.25	18.80	13.78	
Max HGL (ft):	6925.79	6932.53	6945.07	6961.33	6966.57	6975.03	6978.39	6984.96

Link ID:	Pipe - (16)	Pipe - (11)	Pipe - (10)	Pipe - (9)	Pipe - (8)	Pipe - (7)	P10
Length (ft):	55.94	46.29	199.65	118.54	246.31	195.15	158.59
Dia (in):	48.00	48.00	48.00	48.00	48.00	48.00	48.00
Slope (ft/ft):	0.0964	0.0500	0.0900	0.0050	0.0050	0.0050	0.0549
Up Invert (ft):	6929.67	6941.45	6959.61	6960.41	6968.88	6970.06	6978.97
Dn Invert (ft):	6924.28	6939.13	6941.65	6959.81	6967.65	6969.08	6970.26
Max Q (cfs):	146.40	145.25	144.79	144.15	135.22	135.22	135.34
Max Vel (ft/s):	21.00	16.19	17.38	11.74	11.08	10.76	10.77
Max Depth (ft):	2.16	2.68	2.54	3.77	3.73	4.00	4.00

APPENDIX C

WATER QUALITY CALCULATIONS

Hydrodynamic Separation Product Calculator

Thunderhead Beach

Thunderhead Beach

CASCADE SEPARATOR CS-5

Project Information					
Project Name	Thunderhead Beach			**Option #**	A
Country	UNITED_STATES	**State**	Colorado	**City**	Steamboat Springs

Contact Information			
First Name	Aaron	**Last Name**	Cvar
Company	Landmark Consulting, Inc.	**Phone #**	970-690-0493
Email	storm-flood@live.com		

Design Criteria					
Site Designation	Thunderhead Beach			**Sizing Method**	Treatment Flow Rate
Screening Required?	No	**Treatment Flow Rate**	1.80	**Peak Flow (cfs)**	10.10
Groundwater Depth (ft)	>15	**Pipe Invert Depth (ft)**	5 - 10	**Bedrock Depth (ft)**	>15
Multiple Inlets?	No	**Grate Inlet Required?**	No	**Pipe Size (in)**	24.00
Required Particle Size Distribution?	No	**90° between two inlets?**	N/A		

Treatment Selection				
Treatment Unit	CASCADE SEPARATOR	**System Model**	CS-5	
Target Removal	80%	**Particle Size Distribution (PSD)**	250	

Hydrodynamic Separation Product Calculator

Thunderhead Beach

Thunderhead Beach

CASCADE SEPARATOR CS-5

CASCADE SEPARATOR ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD								
Rainfall Intensity[1] (in/hr)	**% Rainfall Volume[1]**	**Cumulative Rainfall Volume**	**Rainfall Volume Treated**	**Total Flowrate (cfs)**	**Treated Flowrate (cfs)**	**Hydraulic Loading Rate (%)**	**Removal Efficiency (%)**	**Incremental Removal (%)**
							Removal Efficiency Adjustment[2] =	
							Predicted % Annual Rainfall Treated =	
							Predicted Net Annual Load Removal Efficiency =	
1 -								
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.								

SECTION (_____)
STORM WATER TREATMENT DEVICE

1.0 GENERAL

1.1 This item shall govern the furnishing and installation of the Cascade Separator™ by Contech Engineered Solutions LLC, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.

1.2 The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

1.3 The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a Cascade Separator™ device manufactured by:

Contech Engineered Solutions LLC
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

1.4 Related Sections

1.4.1 Section 02240: Dewatering
1.4.2 Section 02260: Excavation Support and Protection
1.4.3 Section 02315: Excavation and Fill
1.4.4 Section 02340: Soil Stabilization

1.5 All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.

1.6 The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

1.7 The SWTD manufacturer shall submit to the Engineer of Record a “Manufacturer’s Performance Certification” certifying that each SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research

1.8 No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

2.0 MATERIALS

2.1 Housing unit of stormwater treatment device shall be constructed of pre-cast or cast-in-place concrete, no exceptions. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

- 2.1.1 Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
- 2.1.2 Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
- 2.1.3 Cement shall be Type III Portland Cement conforming to ASTM C 150;
- 2.1.4 Aggregates shall conform to ASTM C 33;
- 2.1.5 Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
- 2.1.6 Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
- 2.1.7 Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

2.2 Internal Components and appurtenances shall conform to the following:

- 2.2.1 Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
- 2.2.2 Support brackets shall be manufactured of 5052 Aluminum
- 2.2.3 Fiberglass components shall conform to applicable sections of ASTM D-4097
- 2.2.4 Access system(s) conform to the following:
- 2.2.5 Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

3.0 PERFORMANCE

3.1 The SWTD shall be capable of achieving an annualized weighted reduction of at least 80% of the OK-110 particle distribution having particles ranging from 53 microns to 212 microns with a d_{50} of approximately 110 microns unless otherwise stated.

3.2 The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the

SWTD's treatment efficiency as captured pollutants accumulate. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.

3.3 The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.

3.4 The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

4.0 EXECUTION

4.1 The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.

4.2 The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.

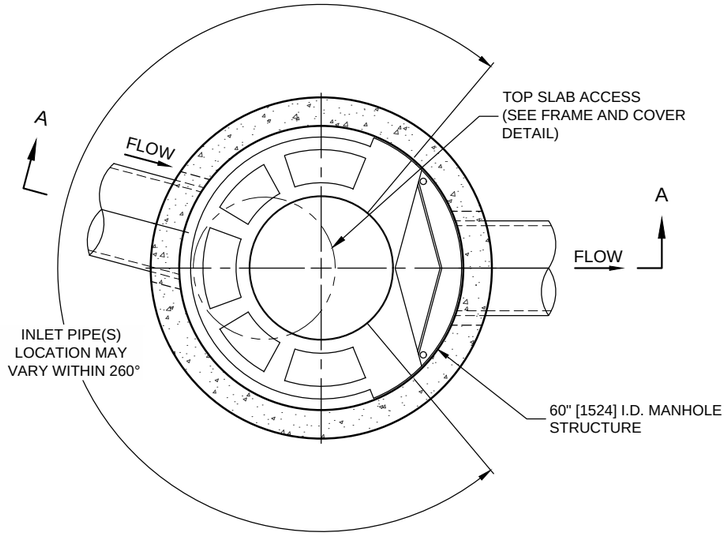
4.3 The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.

4.4 The contractor shall removal all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Owner.

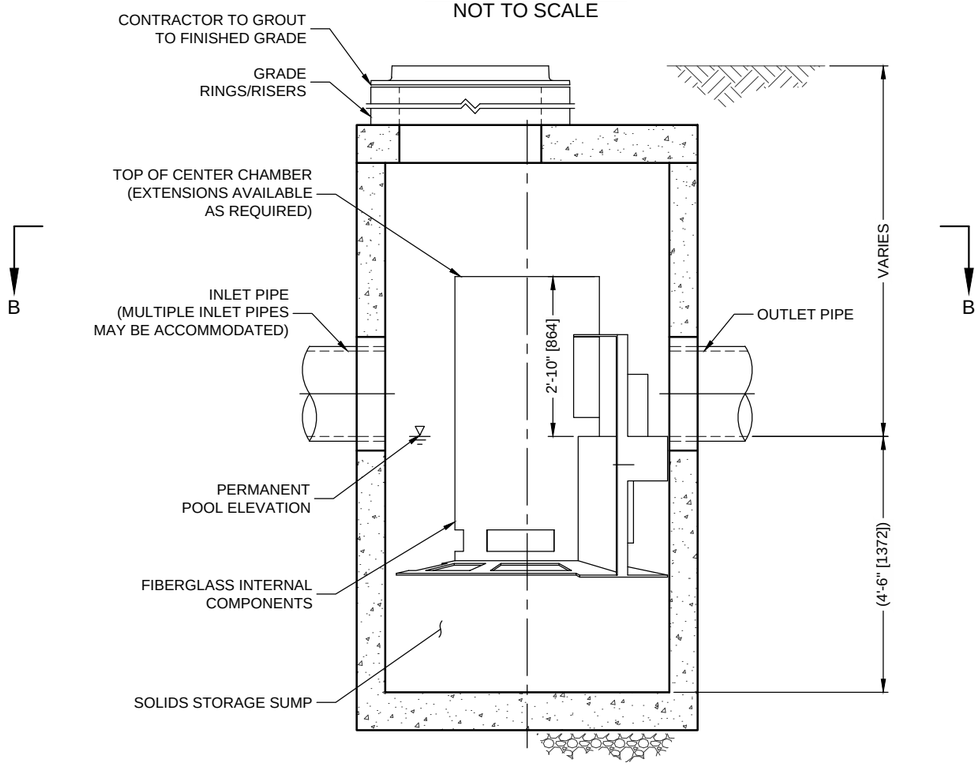
TABLE 1: Storm Water Treatment Device Storage Capacities

Cascade Model	Minimum Sump Storage Capacity (yd^3)	Minimum Oil Storage Capacity (gal)
CS-4	0.70	141.0
CS-5	1.09	269.3
CS-6	1.57	475.9
CS-8	2.79	1128.0
CS-10	4.36	2203.2
CS-12	6.28	3807.1

END OF SECTION



PLAN VIEW B-B
NOT TO SCALE



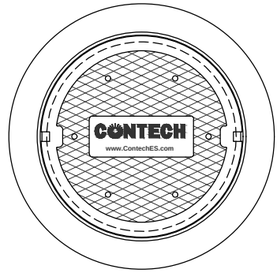
ELEVATION A-A
NOT TO SCALE

CASCADE separator™

CASCADE SEPARATOR DESIGN NOTES

THE STANDARD CS-5 CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES



FRAME AND COVER
(DIAMETER VARIES)
NOT TO SCALE

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	
WATER QUALITY FLOW RATE (cfs [L/s])	
PEAK FLOW RATE (cfs [L/s])	
RETURN PERIOD OF PEAK FLOW (yrs)	
RIM ELEVATION	

PIPE DATA:	INVERT	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			

NOTES / SPECIAL REQUIREMENTS:

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CASCADE SEPARATOR WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. CASCADE SEPARATOR STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2' [610], AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
5. CASCADE SEPARATOR STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C478 AND AASHTO LOAD FACTOR DESIGN METHOD.
6. ALTERNATE UNITS ARE SHOWN IN MILLIMETERS [mm].

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CASCADE SEPARATOR MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CS-5
CASCADE SEPARATOR
STANDARD DETAIL

APPENDIX D

With CDs

OWNERSHIP AND MAINTENANCE PLAN

APPENDIX E

CITY FORMS & CHECKLISTS

Standard Form No. 2 Conceptual 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

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

II. Cover

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

III. Title Sheet

X A. Table of Contents
X B. Certification, PE Stamp, signature, and date from licensed Colorado PE.
X 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

X A. Description of site location, size in acres, existing and proposed land use, and any pertinent background info.
X B. Identify drainage reports for adjacent development.

V. Drainage Criteria and Methodology Used

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

VI. Existing Conditions (Pre-Development/Historic)

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

VII. Proposed Conditions

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

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

J. Curb and Gutter
N/A 1. Indicate gutter capacity.
N/A 2. Indicate curb capacity.
N/A 3. Indicate design depth of flow in street.

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

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

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

N. Site Discharge
X 1. Discuss use and design of detention to ensure discharge is less than or equal to historic flow.
X 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

X 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

X A. Provide general summary.
X B. Note if site complies with criteria and any variances to criteria.
X 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.
X D. List proposed new stormwater system requirements.

X. References

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

XI. Tables

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

XII. Figures

X A. Vicinity Map.
X B. Site Plan (include the horizontal and vertical datum used and all benchmarks).
C. Existing conditions.
X 1. Delineate existing basin boundaries.
X 2. Delineate offsite basins impacting the site.
X 3. Show existing and proposed topography at an interval of at least 5-ft.
X 4. Show existing runoff flow arrows.
X 5. Show existing stormwater features (structures, sizes, materials, etc.).
X 6. Show floodplain limits and information.
X 7. For each basin show bubble with basin number, acreage and % impervious.
X 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
X 1. Delineate proposed basin boundaries.
X 2. Show proposed runoff flow arrows.
X 3. Show existing and proposed topography at an interval of at least 5-ft.
X 4. For each basin show bubble with basin number, acreage and percent impervious or provide a summary table or figure.
X 5. For each outlet show bubble with acreage, historic flow, and proposed flow or provide a summary table or figure.
X 6. Show floodplain limits and information.
X 7. Show proposed stormwater system (components, sizes, materials, & slopes).
X 8. Show property lines and easements (existing and proposed).

XIII. Appendices

X A. Runoff Calculations.
X B. Culvert Calculations.
N/A C. Pond Calculations.
X D. Other Calculations.

Acknowledgements:

Standard Form No. 2 was prepared by: Aaron Cvar 12/13/2023
Date

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

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:	Thunderhead Beach		
Project Location:	Steamboat Springs, CO		
Submitted Date:	12/22/2023	Submitted By:	Landmark Consultants, Inc.
Acreage Disturbed:	2.73		
Existing Impervious:	81.1%	New Net Impervious:	70.7%
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: Primary BMP will be hydrodynamic separator near site southeast corner. Maintain existing drainage pattern.

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			
Pollutant Removal		2.73-acres	D1
Runoff Reduction			

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

X A. Report typed and legible in 8½" x 11" format.
X B. Report bound (comb, spiral, or staple – no notebook) and in digital PDF format.
X 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

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

III. Title Sheet

X A. Table of Contents.
X B. Certification, PE Stamp, signature and date from licensed Colorado PE (for Final).
X 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

X 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.
X B. State purpose and goal of Stormwater Quality Plan and report along with any special requirements of the desired outcome.
X C. List any project stakeholders and/or requestors.
X D. Describe the background of the flooding source and any previous studies.

V. Design Criteria and Methodology Used

X A. Identify design rainfall and storm frequency used to design permanent stormwater treatment facilities.

X B Identify the runoff calculation method used to design permanent stormwater treatment facilities.

X C. Identify the standard the design will meet and the means and methodologies by which it will use to meet the standard.

X D. Provide all details supporting the use of the selected design standard.

VI. Proposed Conditions

X 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.

X B. Describe potential site contaminant sources including sediment.

X C. Identify source and quantity of on-site and off-site stormwater flows that need to be managed and how they will be managed.

X 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.

N/A 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).

X 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.

N/A 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

TO BE SUBMITTED WITH CD'S

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: Aaron Cvar 12/13/2023
Date

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

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:	Thunderhead Beach
Project location:	1965 Ski Time Square Drive
Developer name/contact info:	Majestic Realty c/o: Landmark Consultants, Inc.
Drainage engineer name/contact info:	Landmark Consultants, Inc., 141 9th St., Steamboat Springs, CO 80477
Application Type:	Preliminary Plat
Proposed Land Use:	Commercial (Hotel/Restaurant/Spa/Retail)

Project Site Parameters	
Total parcel area (acres):	2.24 Acre
Disturbed area (acres):	2.24 Acre
Existing impervious area (acres, if applicable):	Per Final Drainage Study for Ski Time Square 2.18 Ac
Proposed new impervious area (acres):	-0- Acre
Proposed total impervious area (acres):	2.16 Acre
Proposed number of project outfalls:	1
Number of additional parking spaces:	N/A - All parking in garage below proposed building.
Description and site percentage of existing cover/land use(s):	Per Final Drainage Study for Ski Time Square, lanscaped areas, paved parking and drives, rooftop areas.
Description and site percentage of proposed cover/land use(s):	Lanscaped areas, paved parking and drives, rooftop areas.
Expected maximum proposed conveyance gradient (%):	8%
Description of size (acres) and cover/land use(s) of offsite areas draining to the site	0.04 Ac. undeveloped area directly west of site; land cover: undeveloped/native grasses 0.13 Ac. Right of Way directly north of site; land cover: asphalt, landscaped area, concrete drive

Type of Study Required:

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

Hydrologic Evaluation:

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

Project Drainage	
Number of subbasins to be evaluated:	4
Presence of pass through flow (circle):	YES (NO)
Description of proposed stormwater conveyance on site:	
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:	
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:	Storm and Sanitary Analysis, Autodesk Civil 3D

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.:	TSS design standard applies to this site and has been used extensively in the area.
Concept-level permanent stormwater treatment facility design details (type, location of facilities, proprietary structure selection, treatment train concept, etc.):	Hydrodynamic separator will be utilized for water quality treatment in order to meet Municipal Separate Storm Sewer System (MS4) requirements. One unit is anticipated near the southwest corner of the site, providing treatment prior to entry to Burgess Creek.
Proposed LID measures to reduce runoff volume:	Hydrodynamic separator only, runoff reduction not necessary since no change from historic peak flow or volume per Final Drainage Study for Ski Time Square.
Will treatment evaluation include off-site, pass through flow (circle):	YES (NO)

Approvals

Aaron Cvar, Landmark Consultants, Inc.	12/5/2023	970-690-0493
Prepared By: (Insert drainage engineer name & firm)	Date	Phone number

Approved By:

Printed Name: City Engineer	Date

SKI TIME SQUARE DRIVE
KUTUK SIGN
BOX CULVERT HEADWALL
YVEA DUCT BANK
FH M82
SHED FFE @ DOOR ELEV. = 6965.05'
SHED FFE @ DOOR ELEV. = 6965.01'
N79°34'20"E 277.99'
TRACT F-1 PORTION OF VACATED MT. WERNER RD. ORDINANCE 730 RECEPTION NO. 307100
VACATED PORTION OF SKI TIME SQUARE DRIVE ORDINANCE NO. 730 RECEPTION NO. 307100 [TC 12]
TRACT D-1 PORTION OF VACATED MT. WERNER RD. ORDINANCE 730 RECEPTION NO. 307100
EXHIBIT A EASEMENT LANDS RECEPTION NO. 543178 [TC 15]
SITE BENCHMARK #5 REBAR W/ ORANGE PLASTIC CAP STAMPED "LANDMARK REF MARK" NAVD88 ELEV. = 6963.78
CONCRETE WALL
TRACT D (THUNDERHEAD PARKING LOT) RECEPTION NO. 816590
H1 2.73 81.1%
OS1-Hist 5.37 11.8%
RIPRAP
TRACT F (THUNDERHEAD LODGE) RECEPTION NO. 816590
CONCRETE WALL W/ WOOD RAILING
MAGIC CARPET
LIFT SHACK FFE @ DOOR ELEV. = 6954.76'
TRACT E (THUNDERHEAD CONDOMINIUMS) RECEPTION NO. 816590
STORM VAULT W/ SCREENED OPENING IN EASTERLY WALL RIM ELEV. = 6958.26 48" RCP INV IN (E) = 6949.88 48" RCP INV OUT (SW) = 6947.36
TURNAROUND LICENSE AREA REC. NO. 539136 EXHIBIT A TO EXHIBIT C REC. NO. 539651 FROM PREVIOUS
WOOD MODULAR BUILDING
PARCEL B SKI HILL SUBDIVISION REC. NO. 307130 FILE NO. 8823
STORM SEWER EASEMENT REC. NO. 539534 FROM PREVIOUS
SPILLWAY BOX INV. ELEV. = 6956.06
WOOD SHED
RECOVERED REBAR W/ ALUMINUM CAP STAMPED "LCI 29039"
INGRESS-EGRESS, UTILITY & SKI EASEMENT REC. NO. 524547 FROM PREVIOUS
S86°49'50"W 0.25'
S74°56'59"W 284.61'
ENTRYWAY EASEMENT BK. 412, PG. 341 FROM PREVIOUS
1-PERCENT ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN STRUCTURE PER LOMR 18-08-0922P (SEE NOTE 5)
48" RCP PIPE NOT FIELD LOCATED AND IS APPROXIMATE IN LOCATION
STORM PIPE FILE NO. 7552 [TC 11]
N26°48'51"W 70.00'
N05°04'52"W 136.82'
TRENCH DRAIN
6" ROUND AREA DRAIN GRATE ELEV. = 6946.46
ACCESS EASEMENT BK. 412, PG. 343 FROM PREVIOUS
SKI EASEMENT REC. NO. 692162 FROM PREVIOUS
INLET NOT VISIBLE
LOT 2 SKI HILL SUBDIVISION, REPLAT OF PARCEL D REC. NO. 817319 FILE NO. 14469
ELECTRIC EASEMENT REC. NO. 817314 FROM PREVIOUS
10' PEDESTRIAN AND BICYCLE PATH EASEMENT BK. 634, PG. 49 FROM PREVIOUS
TORIAN PLUM CONDOMINIUMS PHASE II REC. NO. 522146 FILE NO. 12826
TORIAN PLUM CONDOMINIUMS PHASE I REC. NO. 333249 FILE NO. 9561
BURGESS CREEK EASEMENT REC. NO. 522146 FILE NO. 12826 FROM PREVIOUS
MUTUAL GRANT OF EASEMENT BOOK 554, PAGE 616 [TC 14]
ZONE AE FLOODWAY (SEE NOTE 5)
ADJACENT BUILDING
SLOPE LINED W/ ROCK & BOULDER
CONCRETE DRAINAGE STRUCTURE
10' ELECTRIC EASEMENT FILE NO. 8823 (E11) BK 532 PG 788 FROM PREVIOUS
SUMP
10' SEWER EASEMENT BK 560, PG 396 FROM PREVIOUS
30' STORM SEWER EASEMENT BK 560, PG 396 FROM PREVIOUS
ROCK LANDSCAPING
SLOPESIDE
WOOD DUMPSTER ENCLOSURE
CULVERT OPENING BELOW PLAZA
8" PVC POND OUTLET
ENDS NOT FOUND
12X18 REDUCER PER MWW RECORDS LOCATION NOT KNOWN
SEWER EASEMENT REC. NO. 543179 FROM PREVIOUS

SEE SHEET C.004 FOR OVERALL EXISTING CONDITIONS EXHIBIT

NORTH

30 0 30 60 90 Feet

(IN FEET)
1 inch = 30 ft.

EXISTING CONDITIONS LEGEND:

- PROPERTY BOUNDARY
- ADJACENT PROPERTY BOUNDARY
- EASEMENT
- PROPERTY MONUMENT AS NOTED
- [TC15] = REFERENCE TO TITLE COMMITMENT. SEE NOTE 2 — [TC15]
- EASEMENT SHOWN BASED ON PREVIOUS SURVEY INFORMATION (SEE NOTE 2) — FROM PREVIOUS
- LIMITS OF FLOOD ZONE AE (SEE NOTE 5)
- BUILDING
- WALL
- FENCE
- MAJOR CONTOUR — 6800
- MINOR CONTOUR
- ASPHALT
- CONCRETE
- CONCRETE CURB W/ PAN
- BRICK PAVERS
- GRAVEL
- ROCK/ BOULDERS/ RIP RAP
- WETLANDS (SEE NOTE 13)
- SIGN
- SANITARY SEWER LINE MARKER MANHOLE AND CLEANOUT
- SEPTIC TANK LID AND VENT PIPE
- WATER LINE MAKER, FIRE HYDRANT GATE VALVE, CURB STOP & METER
- FIRE DEPT. CONNECTION, YARD HYDRANT, VENT PIPE, WATER MANHOLE AND WELL
- GAS LINE MARKER, VALVE, MANHOLE/VAULT, METER AND SHUTOFF
- CABLE LINE MARKER, VAULT AND PEDESTAL
- FIBER OPTIC LINE MARKER, VAULT & PEDESTAL
- TELEPHONE LINE MARKER, VAULT, PEDESTAL AND MANHOLE
- ELECTRIC LINE MARKER, TRANSFORMER, METER AND SECONDARY PEDESTAL
- ELECTRIC MANHOLE, OUTLET, GENERATOR AND JUNCTION BOX
- LIGHT POLE, STREET LIGHT, TRAFFIC SIGNAL TRAFFIC CONTROL VAULT AND CABINET
- OVERHEAD UTILITY LINE GUY POLE, UTILITY POLE & GUY WIRE
- EDGE OF WATER
- ORDINARY HIGH WATER MARK (SEE NOTE 13)
- DITCH/SWALE
- STORM SEWER SCALED TO PIPE DIMENSION LOCATION FOR INFORMATION ONLY
- STORM MANHOLE, MANHOLE INLET, GRATE INLET AND CURB INLET
- STUMP, BOULDER AND IRRIGATION VALVE BOX
- CONIFEROUS AND DECIDUOUS TREE (SCALED TO APPROXIMATE DRIPLINE)
- CONIFEROUS AND DECIDUOUS SHRUB (SCALED TO APPROXIMATE DRIPLINE)
- PROPOSED DRAINAGE BASIN
- PROPOSED DRAINAGE BASIN LABEL — BASIN ID; D1; 2.73 70.7%; BASIN AREA (ACRES); PERCENT IMPERVIOUSNESS

NOTES:

1. THIS MAP DOES NOT REPRESENT A MONUMENTED LAND SURVEY. IT IS INTENDED ONLY TO DEPICT THAT INFORMATION REQUESTED BY OUR CLIENT.
2. LAND TITLE GUARANTEE COMPANY TITLE COMMITMENT ORDER NO. ABC30031079, COMMITMENT DATE: 07/21/2023 WAS RELIED UPON TO DETERMINE OWNERSHIP AND EASEMENTS OF RECORD SHOWN ON THIS EXISTING CONDITIONS MAP UNLESS NOTED OTHERWISE. EASEMENTS NOTED "FROM PREVIOUS" ARE SHOWN BASED ON PREVIOUS SURVEYING PERFORMED IN THE AREA BY LANDMARK CONSULTANTS, INC. NO REPRESENTATION IS MADE BY LANDMARK CONSULTANTS, INC. OR THE SURVEYOR OF RECORD THAT ALL EASEMENTS SHOWN HEREON ARE STILL EXTANT, OR THAT ALL EASEMENTS OF RECORD WITHIN THE MAPPING AREA ARE SHOWN OR NOTED HEREON.
3. BASIS OF HORIZONTAL CONTROL: THE 2011 ITERATION OF THE COLORADO COORDINATE SYSTEM OF 1983 NORTH ZONE, NAD83(2011) COLORADO NORTH, SCALED TO GROUND ABOUT A POINT HAVING COORDINATES OF 1412535.68 ,2636559.05 AND A SCALE FACTOR OF 1.0003690183.
4. UNITS SHOWN HEREON ARE IN US SURVEY FEET AND THE STANDARD OF DISTANCE ACCURACY FOR THIS MAP HAS BEEN DETERMINED TO BE GREATER THAN 1:10,000.
5. FLOOD ZONE INFORMATION IS SHOWN HEREON PER LETTER OF MAP REVISION 13-08-0214P, EFFECTIVE JULY 8, 2013, AND LETTER OF MAP REVISION LOMR 18-08-0922P, EFFECTIVE JULY 29, 2019.
6. SITE BENCHMARK: A SET #5 REBAR WITH ORANGE PLASTIC CAP HAVING AN ELEVATION OF 6963.78 BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AS SHOWN HEREON.
7. CONTOUR INTERVAL = 1 FEET
8. UNDERGROUND IMPROVEMENTS: LOCATIONS FOR UNDERGROUND IMPROVEMENTS ARE SHOWN HEREON PER ONE OR MORE OF THE FOLLOWING; VISIBLE AND APPARENT SURFACE EVIDENCE, AS-BUILT DRAWINGS PROVIDED BY OTHERS, MARKINGS PROVIDED BY COLORADO 811 ONE CALL SERVICES, PRIVATE UNDERGROUND LOCATING SERVICES, OR GIS INFORMATION. ANY METHOD OF SHOWING UNDERGROUND IMPROVEMENTS, OR ANY COMBINATION THEREOF, MAY NOT PROVIDE COMPLETE AND ACCURATE LOCATIONS FOR ALL UNDERGROUND IMPROVEMENTS. IF ACCURATE LOCATIONS FOR UNDERGROUND IMPROVEMENTS ARE REQUIRED, THEY WILL HAVE TO BE VERIFIED BY FIELD POTHOLING OF THE IMPROVEMENTS. LANDMARK CONSULTANTS, INC. AND THE SURVEYOR OR ENGINEER OF RECORD SHALL NOT BE LIABLE FOR THE FAILURE TO ACCURATELY AND COMPLETELY DEPICT THE LOCATIONS OF UNDERGROUND IMPROVEMENTS.
9. ALL REFERENCES HEREON TO BOOKS, PAGES, FILES AND RECEPTION NUMBERS ARE TO PUBLIC DOCUMENTS FILED IN THE RECORDS OF ROUTT COUNTY, COLORADO.
10. THE LAST FIELD INSPECTION OF THE SITE WAS ON 8/17/2023.
11. DRAWING PLOTS TO SCALE ON 24"x36" PAPER.
12. WATER AND SEWER INFORMATION SUPPLEMENTED USING MOUNT WERNER WATER RECORD INFORMATION. SOME DISCREPANCIES MAY EXIST.
13. ORDINARY HIGH WATER MARK AND WETLANDS ARE SHOWN HEREON PER MARKINGS PROVIDED BY A WETLANDS SUBCONSULTANT.

PROPERTY DESCRIPTION: THAT PARCEL OF LAND DESCRIBED IN RECEPTION NO. 816590 IN THE ROUTT COUNTY RECORDS; COUNTY OF ROUTT, STATE OF COLORADO.

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

PROJECT:	2633-003
DATE:	3/15/2024
CONTACT:	Erik Griepentrog
EMAIL:	erikg@landmark-co.com
DRAWN BY:	AC
CHECKED BY:	EG

NO.	DATE:	BY:	DESCRIPTION:

THUNDERHEAD SUBDIVISION
EXISTING DRAINAGE PLAN
SW ¼ SECTION 22,
TOWNSHIP 6 NORTH, RANGE 84 WEST OF THE 6TH P.M.
CITY OF STEAMBOAT SPRINGS, COUNTY OF ROUTT
STATE OF COLORADO

SHEET
FIGURE 4

GRADING PLAN LEGEND:

- PROPOSED STORM SEWER W/ FLARED END SECTION
- PROPOSED STORM INLET (CURB & AREA)
- PROPOSED STORM MANHOLE & CLEANOUT
- EXISTING MAJOR CONTOUR (6805)
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR 6805
- PROPOSED MINOR CONTOUR
- PROPOSED SWALE
- PROPOSED CURB & GUTTER
- PROPERTY BOUNDARY
- PROPOSED LOT LINE
- FLOOD HAZARD LIMITS
- SPOT ELEVATION 6790.50
- PROPOSED OVERLAND FLOW DIRECTION W/ SLOPE 2.0%
- STORM SEWER FLOW DIRECTION
- PROPOSED DRAINAGE BASIN
- PROPOSED DRAINAGE BASIN LABEL (BASIN ID, BASIN AREA (ACRES), PERCENT IMPERVIOUSNESS)

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. PROJECT BENCHMARK: RECOVERED NO.5 REBAR W/ YELLOW PLASTIC CAP STAMPED "LS 13221" 0.1' BELOW GRAND, NAVD88 ELEV. = 6784.29
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.
6. PROPOSED GRADING INFORMATION IS NOT PART OF LANDMARK'S SCOPE AND HAS BEEN PROVIDED BY OTHERS.

REVISIONS:

NO	DATE	DESCRIPTION

PROJECT NUMBER:
123134.00

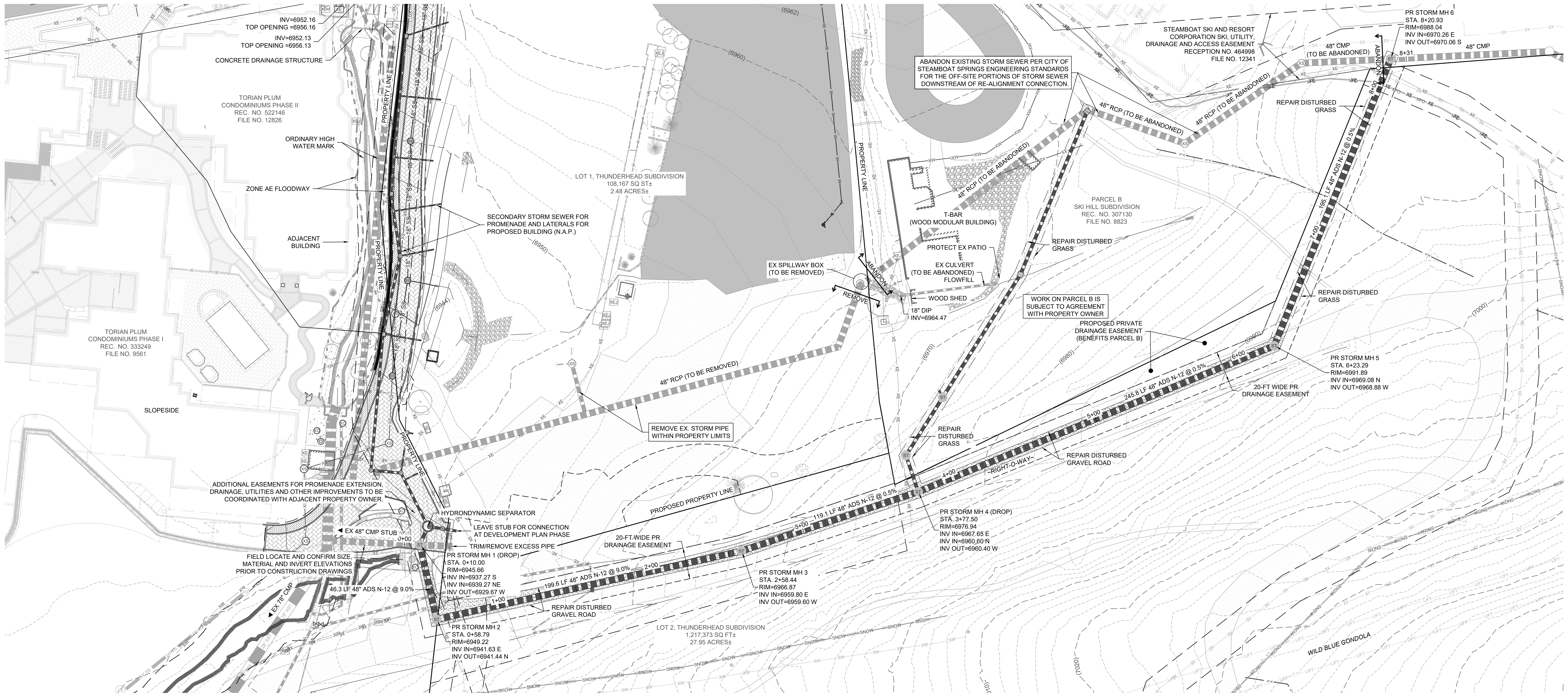
DATE:
7/18/2024

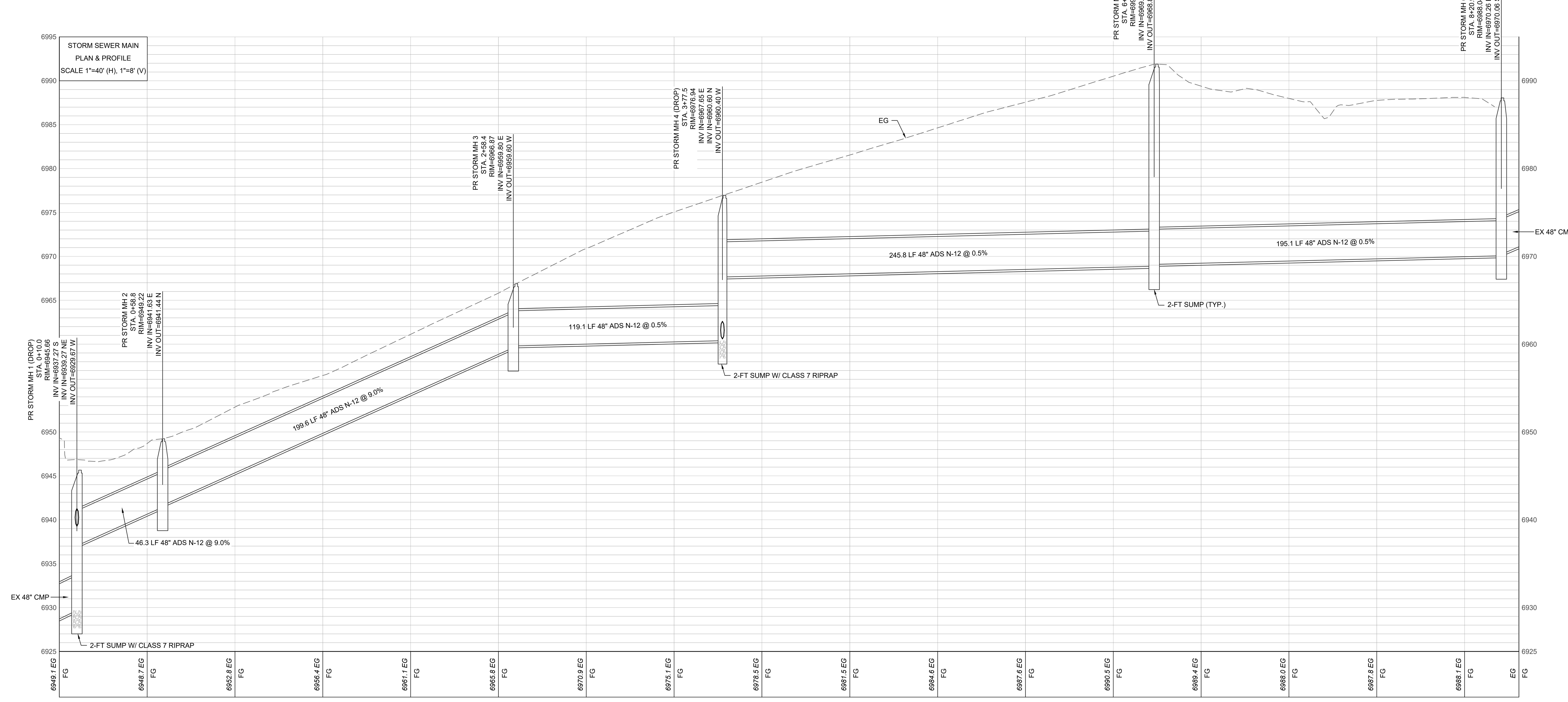
ISSUED FOR:
DP RE-SUBMITTAL

SHEET TITLE:
PR DRAINAGE PLAN

SHEET NUMBER
1

STORM SEWER MAIN RE-ALIGNMENT (STA. 0+00 - 4+40)





NORTH

40 0 40 80 120 Feet

(IN FEET)
1 inch = 40 ft.

GRADING PLAN LEGEND:

- PROPERTY BOUNDARY
- HIGHWATER MARK
- FEMA FLOODWAY
- EDGE OF WATER
- WATER BODY SETBACK
- PROPOSED STORM SEWER W/ FLARED END SECTION
- PROPOSED STORM INLET (CURB & AREA)
- PROPOSED STORM MANHOLE & CLEANOUT
- EXISTING MAJOR CONTOUR (6805)
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR 6805
- PROPOSED MINOR CONTOUR
- PROPOSED SWALE
- FLOOD HAZARD LIMITS
- SPOT ELEVATION 6790.50
- PROPOSED OVERLAND FLOW DIRECTION W/ SLOPE 2.0%
- FLOW CONVEYANCE DIRECTION

ADJACENT AND OFF-SITE IMPROVEMENTS NOTE:

THERE ARE IMPROVEMENTS SHOWN THAT EXTEND BEYOND THE PROPERTY LIMITS OF THIS APPLICATION. EASEMENTS AND/OR AGREEMENTS WILL BE REQUIRED TO CONSTRUCT, OPERATE AND MAINTAIN SUCH IMPROVEMENTS. CHANGES MAY BE REQUIRED BASED ON THE FINAL TERMS AND CONDITIONS. NOTIFY LANDMARK OF ANY AND ALL REQUIREMENTS NECESSARY FOR DESIGN AND CONSTRUCTION OF THE SCOPES OF WORK.

*THE IMPROVEMENTS SHOWN WITHIN THE SKI TIME SQUARE DRIVE RIGHT-OF-WAY REFLECT THE PROPOSED WORK DESCRIBED IN THE SKI TIME SQUARE DRIVE TURNAROUND & COMPLETE STREET IMPROVEMENTS (BY OTHERS). FINAL CONDITIONS MAY DIFFER AND ARE SUBJECT TO CHANGE.

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.
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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.

CALL UTILITY NOTIFICATION CENTER OF COLORADO

811 Know what's below. Call before you dig.

CALL 2 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

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CIVIL ENGINEERS | SURVEYORS
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(970) 871-9494 • www.LANDMARK-CO.com

REVIEW SET
NOT FOR CONSTRUCTION

NO.	DATE:	BY:	DESCRIPTION:
1	7/24/2024	Erik	DRT Responses and Plan Updates
2	10-4-24	Matt	DRT #2 Responses and Plan Updates

PROJECT:	2633-003
DATE:	3-15-24
CONTACT:	Erik Griepentrog
EMAIL:	erikg@landmark-co.com

Preliminary Plat - Thunderhead Beach

STORM SEWER RE-ALIGNMENT

SHEET
C.310